Supplemental Feasibility Study
Radiological-Impacted Material Excavation Alternatives Analysis West Lake Landfill Operable Unit-1

Prepared for

The United States Environmental Protection Agency Region VII

Prepared on behalf of

The West Lake Landfill OU-1 Respondents

Prepared by

Engineering Management Support, Inc.
7220 West Jefferson Avenue, Suite 406
Lakewood, Colorado 80235

In association with

Feezor Engineering, Inc.
406 E. Walnut Street
Chatham, Illinois 62629

and

Auxier & Associates, Inc.
9821 Cogdill Road, Suite 1
Knoxville, Tennessee 37932

September 30, 2011

Revised December 16, 2011

Final December 28, 2011

ENGINEERING MANAGEMENT SUPPORT INC.

7220 West Jefferson Avenue, Suite 406
Lakewood, CO 80235

Telephone (303) 940-3426
Telecopier (303) 940-3422

December 16, 2011

Daniel R. Gravatt
Remedial Project Manager
Missouri/Kansas Remedial Branch
Superfund Division
U.S. Environmental Protection Agency – Region 7
901 N. 5th Street
Kansas City, KS 66101-2907

**SUBJECT: Revised Supplemental Feasibility Study Report
Radiological-Impacted Material Excavation Alternatives Analysis
West Lake Landfill Operable Unit 1, Bridgeton, Missouri**

Dear Mr. Gravatt,

On behalf of Cotter Corporation (N.S.L.), Laidlaw Waste Systems (Bridgeton), Inc., and Rock Road Industries, Inc., and funding provided the United Sates Department of Energy (the "Respondents"), enclosed please find two printed copies of changed pages for the Supplement Feasibility Study (SFS) Report of Operable Unit 1 of the West Lake Landfill. Also enclosed is one completed electronic copy of the Revised SFS report for your use and three additional electronic copies for you to distribute to the Region VII personnel listed below. We have also transmitted two printed copies of the changed pages and eight electronic copies of the entire revised report to Doug Ammon at EPA Headquarters for distribution to Headquarters personnel. We have also transmitted two printed copies of the changed pages and one electronic copy of the entire revised report to Shawn Muenks of MDNR.

If you have any questions or need additional copies, please do not hesitate to contact me.

Sincerely,
ENGINEERING MANAGEMENT SUPPORT, Inc.

Paul V. Rosasco, P.E.

Enclosure

Distribution:

Rich Kapuscinski – USEPA OSRTI (2 printed and 1 electronic copy)
Shawn Muenks - Missouri Dept of Natural Resources (2 printed and 1 electronic copy)
Victoria Warren - Allied Waste Industries, Inc. (1 printed and 1 electronic copy)
Bill Beck – Lathrop & Gage, LLP (1 printed and 1 electronic copy)
Jessica Merrigan – Lathrop & Gage, LLP (1 printed and 1 electronic copy)
Kate Whitby - Spencer Fane Britt & Browne (1 printed and 1 electronic copy)
Charlotte Neitzel - Holme Roberts & Owen (4 printed and 1 electronic copy)
Audrey Asher – USEPA Region VII (electronic copy)
Cecilia Tapia – USEPA Region VII (electronic copy)
Deandre Singletary – USEPA Region VII (electronic copy)
Elizabeth Southerland – USEPA (electronic copy)
Doug Ammon – USEPA (electronic copy)
Stuart Walker – USEPA (electronic copy)
Ron Wilhelm – USEPA (electronic copy)
David Bartenfelder – USEPA (electronic copy)
Charles Openchowski – USEPA (electronic copy)
John Michaud – USEPA (electronic copy)
Daniel Feezor – Feezor Engineering, Inc. (1 printed and 1 electronic copy)
Michael Bollenbacher – Auxier & Associates (1 printed and 1 electronic copy)

Table of Contents

Table of Contents (continued)

Table of Contents (continued)

Table of Contents (continued)

Table of Contents (continued)

Table of Contents (continued)

Table of Contents (continued)

Table of Contents (continued)

Appendices

List of Tables

List of Figures

Table of Contents (continued)

List of Figures (cont.)

List of Acronyms

AC	Advisory Circular
ACM	asbestos containing materials
AEC	Atomic Energy Commission
amsl	above mean sea level
AOA	air operations area
AOC	Administrative Order on Consent
ARAR	Applicable or Relevant and Appropriate Requirements
ARRA	American Recovery and Reinvestment Act
ASTM	American Society of Testing Materials
bcy	bank cubic yard
BDAT	Best Demonstrated Available Technology
bgs	below ground surface
Bi	Bismuth
BMP	Best Management Practices
BRA	Baseline Risk Assessment
C&D	Construction and demolition
CERCLA	Comprehensive Environmental Recovery, Compensation, and Liability Act
cf	cubic feet
CFR	Code of Federal Regulations
cm	centimeter
CM	Construction Manager
cm/sec	centimeter per second
COCs	Chemicals of concern
COD	Chemical Oxygen Demand
CoPC	constituent of potential concern
CQA	construction quality assurance
CSR	Code of State Regulations
cy, or cu yd	cubic yard
DAF	Dilution-Attenuation Factor
DCGL	Derived concentration guideline
DOD	Department of Defense
DOE	United States Department of Energy
DOT	United States Department of Transportation
DQO	data quality objective
dtrs	daughters
ea	each
ecy	embankment cubic yards
EDTA	ethylenediaminetetraacetic acid
EMSI	Engineering Management Support, Inc.
ENR CCI	Engineering News Record Construction Cost Index
EPA	United States Environmental Protection Agency
EPC	Exposure point concentration
ERA	Ecological Risk Assessment

List of Acronyms (continued)

FAA	Federal Aviation Administration
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FRTR	Federal Remediation Technologies Roundtable
FS	Feasibility Study
FUSRAP	Formerly Utilized Sites Remedial Action Program
ft	feet
gm, or g	gram
GM	Geiger Mueller
gpm	gallons per minute
GRA	General Response Action
HAZMAT	hazardous materials
HDPE	high density polyethylene
HHRA	Human Health Risk Assessment
HI	Hazard Index
HP	health physics
hr	hour
IC	Institutional Control
IP	industrial packaging
IRIS	Integrated Risk Information System
K	Potassium
kg	kilogram
L	liter
LAACC	Large Area Activated Charcoal Canisters
lbs	pounds
lcy	loose cubic yard
LDPE	low density polyethylene
LDR	Land disposal restrictions
LEL	lower explosive limit
lf	linear foot
LFMR	Landfill mining and reclamation
Li	Lithium
LLRW	Low level radioactive waste
LoMR	Letter of Map Revision
LPGAC	Liquid Phase Granular Activated Carbon
LSA	low specific activity
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MCA	Multi-channel analyzer
MCL	Maximum contaminant level
MCLG	Maximum contaminant level goal
MDA	Minimum detectable activity
MDOT	Missouri Department of Transportation
MDNR	Missouri Department of Natural Resources
MECA	Missouri Environmental Covenants Act

List of Acronyms (continued)

m	meter
MeV	Million electron volts
mg	milligram
mm	millimeter
mo `	month
MOU	Memorandum of Understanding
mrem	millirem
msf	thousand square feet
MSD	Metropolitan St. Louis Sewer District
MSWLF	Municipal Solid Waste Landfill
MTG	Migration to Groundwater
Na	Sodium
NARM	Naturally-Occurring and Accelerator-Produced Radioactive Material
NCP	National Oil and Hazardous Substance Pollution Contingency Plan
NEPA	National Environmental Policy Act
NESHAPs	National Emissions Standards for Hazardous Air Pollutants
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NRC	Nuclear Regulatory Commission
NORM	Naturally occurring radioactive material
NPL	National Priorities List
O	Oxygen
O&M	operation and maintenance
OM&M	operation, maintenance, and monitoring
OMB	Office of Management and Budget
OSHA	Occupational Safety and Health Administration
OSR	Off-site Rule
OSTRI	Office of Superfund Technology Research and Innovation
OSWER	Office of Solid Waste and Emergency Response
OU	Operable Unit
Pa	Protactinium
PAH	Poly-nuclear aromatic hydrocarbon
Pb	Lead
PCB	Poly-chlorinated biphenyl
pCi	pico Curie
PFLT	Paint filter liquids test
Po	Polonium
POTW	Publicly-Owned Treatment Works
PPE	personal protective equipment
ppm	Parts per million
PRG	Preliminary Remediation Goal
PUF	Poly-urethane foam
R	Roentgen
RD	Remedial design

List of Acronyms (continued)

RA	Remedial action
Ra	Radium
RACM	Regulated asbestos-containing material
RAECOM	Radiation Attenuation Effectiveness and Cover Optimization with Moisture Effects computer program
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RDWP	Remedial Design Work Plan
rem	roentgen equivalent in man
RESRAD	RESRAD – CHEM: A computer code for chemical risk assessment
RI	Remedial Investigation
RIM	Radiologically Impacted Material
RMC	Radiation Management Corporation
RML	radioactive material license
ROD	Record of Decision
RSMo	Revised Statutes of Missouri
SAP	Sampling and Analysis Plan
sec, or s	second
sf or sq ft	square feet
SFS	Supplemental Feasibility Study
Si	Silocon
SLAPS	St. Louis Airport Site
SLDS	St. Louis Downtown Site
STLAA	St. Louis Airport Authority
SOW	Statement of Work
SVOC	Semi-Volatile Organic Compound
SWMP	Solid Waste Management Program
SWPP	Stormwater Pollution Prevention Plan
t	ton
TBC	To Be Considered
TCLP	Toxicity Characteristic Leaching Procedure
TENORM	Technologically Enhanced Naturally Occurring Radioactive Materials
Th	Thorium
TS	Transfer Station
TSDF	Treatment, storage, and disposal facility
TSS	Total Dissolved Solids
U	Uranium
ug	microgram
UMTRCA	Uranium Mill Tailings Radiation Control Act
uR	microRoentgen
U.S.C.	United States Code
USACOE	United States Army Corps of Engineers
USCS	Unified Soil Classification System

List of Acronyms (continued)

USDA	United States Department of Agriculture
USEI	US Ecology Idaho
UTS	Universal treatment standards
VOCs	Volatile Organic Compounds
VCA	Verification of current acceptability
WAC	Waste Acceptance Criteria
WL	Working Level
yr	Year

1 INTRODUCTION

As a result of internal deliberations by the United States Environmental Protection Agency (EPA) and its further consideration of certain comments provided by interested community members, EPA determined that a Supplemental Feasibility Study (SFS) is warranted. This SFS will be added to the Administrative Record for this Site.

1.1 Scope of the SFS

This SFS has been performed to provide additional evaluation of a select group of potential remedial alternatives for Operable Unit 1 (OU-1) at the West Lake Landfill Site. EPA determined that additional work was necessary to accomplish the objectives of the RI/FS for OU-1. Specifically, EPA requested the OU-1 Respondents to perform an SFS consisting of an engineering and cost analysis of the ROD-selected remedy, and two remedial alternatives that would remove all material containing radionuclides at levels greater than those that would allow for unrestricted use (relative to the presence of radionuclides) of the radiologically-contaminated areas (Areas 1 and 2 and the Buffer Zone/Crossroad properties) in OU-1; referred to by EPA as "complete rad removal".

The ROD-selected containment remedy for OU-1 would protect human health and the environment by providing source control and institutional controls for the landfilled waste materials. A description of and reasons for selection of this remedy are presented in EPA's Record of Decision (ROD) for OU-1 (EPA, 2008a). The source control and institutional control methods prevent human receptors from contacting the waste material. The source control method mitigates contaminant migration to air and restricts infiltration of precipitation into the landfill, which contributes to protection of groundwater quality. The description and basis for the selected remedy was documented in the ROD. The components of the ROD-selected remedy include the following:

1. Install landfill cover meeting the Missouri closure and post-closure care requirements for sanitary landfills, including enhancements consistent with the standards for uranium mill tailing sites, i.e., armoring layer and radon barrier;
2. Consolidation of radiologically contaminated surface soil from the Buffer Zone/Crossroad Property to the containment area;.
3. Apply groundwater monitoring and protection standards consistent with requirements for uranium mill tailing sites and sanitary landfills;.
4. Surface water runoff control;
5. Gas monitoring and control including radon and decomposition gas as necessary;
6. Institutional controls to prevent land and resource uses that are inconsistent with a closed sanitary landfill site containing long-lived redionuclides; and
7. Long-term surveillance and maintenance of the remedy.

Performance standards for each of the remedy components are specified in the ROD. As a result of subsequent discussions between EPA Region 7 and EPA's Office of Superfund Remediation and Technology Innovation (OSRTI), the following additional performance standards were identified for the ROD-selected remedy:

- The proposed cap should meet UMTRCA guidance for a 1,000-year design period including an additional thickness to prevent radiation emissions.

- Air monitoring stations for radioactive materials should be installed at both on-site and off-site locations.

- Groundwater monitoring should be implemented at the waste management unit boundary and also at off-site locations. The groundwater monitoring program needs to be designed so that it can be determined whether contaminants from the landfill have migrated across the waste management unit boundary in concentrations that exceed drinking water Maximum Contaminant Levels. The groundwater monitoring program needs to measure for both contaminants that have historically been detected in concentrations above MCLs (e.g., benzene, chlorobenzene, dissolved lead, total lead, dissolved arsenic, total arsenic, dissolved radium and total radium) and broader indicators of contamination (e.g., redox potential, alkalinity, carbonates, pH and sulfates/sulfides).

- Flood control measures at the site should meet or exceed design standards for a 500-year storm event under the assumption that the existing levee system is breached.

This SFS analysis incorporates those additional performance standards and refines the description and evaluation of the containment remedy that was selected in the ROD.

In a January 11, 2010, letter (EPA, 2010a) and Statement of Work (SOW) (EPA, 2010b) requesting that the Respondents perform this SFS, EPA identified the two "complete rad removal" alternatives that EPA directed be developed and evaluated in addition to the ROD-selected remedy:

1. Excavation of radioactive materials with off-site commercial disposal of the excavated materials (referred to as "complete rad removal" with off-site disposal alternative in this SFS); and

2. Excavation of radioactive materials with on-site disposal of the excavated materials in an on-site engineered disposal cell with a liner and cap if a suitable location outside the geomorphic flood plain can be identified (referred to as "complete rad removal" with on-site disposal alternative in this SFS).

EPA indicated (EPA, 2010a) that "complete rad removal" was defined to mean attainment of risk-based radiological cleanup levels specified in OSWER Directives 9200.4-25 and 9200.4-18. Although these new alternatives have been termed "complete rad removal," it must be recognized that implementation of either of these alternatives would not result in complete removal of all radionuclides from the landfill, but instead would remove radionuclides from Areas 1 and 2 to the degree feasible such that additional engineering and institutional controls would not be required based on the radiological content of these areas. Because these areas would still contain solid wastes after removal of the radiologically-impacted materials, regrading, capping and establishment of institutional controls related to the presence of solid wastes would still be required.

As described in the SOW (EPA, 2010b), EPA required the two "complete rad removal" alternatives to be evaluated along with the ROD-selected remedy. The two "complete rad removal" alternatives along with the ROD-selected remedy were evaluated using the threshold and primary balancing criteria set forth in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 CFR § 300.430 (EPA, 2009a). These criteria include the following:

- Threshold Criteria:
  - Overall Protection of Human Health and the Environment;
  - Compliance with applicable or relevant and appropriate requirements of other regulations (ARARs).

- Primary Balancing Criteria:
  - Long-term Effectiveness and Permanence;
  - Reduction of Toxicity, Mobility, or Volume through Treatment;
  - Short-term Effectiveness;
  - Implementability; and
  - Cost.

Additional descriptions of these criteria are presented in Section 6 of this SFS.

The NCP also requires remedial alternatives to be evaluated in terms of Modifying Criteria which include State and community acceptance. State and community acceptance will be evaluated by EPA as part of any decision process that may be undertaken by EPA after completion of the SFS and are not considered in this document.

1.2 SFS Approach

This SFS has been developed pursuant to a January 11, 2010, letter from EPA to the OU-1 Respondents (EPA, 2010a), an EPA-developed Statement of Work (SOW) (EPA SOW, 2010b) attached to the January 11 letter, and the EPA-approved Work Plan for the Supplemental Feasibility Study (SFS Work Plan) (EMSI, 2010a).

The engineering and cost analyses of the "complete rad removal" alternatives and the ROD-selected remedy performed for this SFS are based primarily on existing information provided in the Remedial Investigation (RI) (EMSI, 2000), Baseline Risk Assessment (BRA) (Auxier, 2000), Feasibility Study (FS) (EMSI, 2006), and the ROD for OU-1. These analyses also consider the results of a supplemental evaluation prepared by EPA subsequent to the ROD (TetraTech, 2009). Additionally, information was obtained from representatives of the United States Army Corps of Engineers (USACE), the United States Department of Energy (DOE), and various vendors of equipment, materials and services as necessary to develop and evaluate the potential effectiveness, implementability and cost of the "complete rad removal" alternatives. Additional field investigations or laboratory testing were not included in the scope of this effort and were not performed.

This report has been prepared to address the requirements of the SOW, EPA-approved Work Plan, and the NCP, in accordance with EPA's Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (EPA, 1988a) and other EPA FS-related guidance documents (e.g., EPA, 1991a; EPA, 2000). This SFS:

- provides a summary discussion of site conditions and other information presented in the RI for OU-1 (EMSI, 2000);
- addresses findings in United States Nuclear Regulatory Commission (NRC) reports that evaluated the radiological disposal areas at the West Lake Landfill site;
- provides additional characterization of the dimensions of radiologically impacted materials in the two radiological disposal areas;
- summarizes the characterization of potential site risks presented in the BRA for OU-1 (Auxier, 2000);
- provides further information and evaluation pertaining to a negative easement on the property held by the City of St. Louis, and its potential impacts on remedy implementation for OU-1;
- provides additional information about environmental monitoring during remedy implementation and long-term maintenance and operations;
- evaluates potential treatment technologies for the radiologically impacted materials; and
- evaluates potential ARARs and remedial technologies, and descriptions of the remedial alternatives previously presented and evaluated in the site FS (EMSI, 2006).

Where necessary for the evaluation of the "complete rad removal" alternatives, or as otherwise appropriate for completion of the SFS, brief summaries or tabulations of the results of prior site evaluations are provided; however, the prior reports should be reviewed or consulted for additional details and specific information relative to those evaluations.

1.3 Report Organization

This report is organized as follows:

Section 1: Introduction – Presents information regarding the scope and approach used to complete the SFS.

Section 2: Site Conditions – Summarizes information regarding site conditions as they relate to the alternatives evaluated in the SFS. Detailed information about site conditions was presented in the RI report for OU-1 (EMSI, 2000) and a summary discussion of site conditions related to the development and evaluation of remedial alternatives was presented in the FS report for OU-1 (EMSI, 2006). This section provides a description of occurrences of radionuclides in soil/waste, air and groundwater at the site. In addition, this section describes the nature, general locations, and overall lateral and vertical extent of Radiologically-Impacted Materials (RIM). This section also provides a summary of the occurrences of chemical constituents in soil/waste and groundwater. Lastly, this section provides a brief summary of the results of the Baseline Risk Assessment (Auxier, 2000).

Section 3: ARARs – Summarizes information regarding potential ARARs and remedial action objectives (RAOs) as they relate to the additional alternatives evaluated in the SFS. Additional, detailed information about potential ARARs and RAOs was presented in the FS report for OU-1 (EMSI, 2006).

Section 4: Remedial Technologies – Summarizes information regarding additional remedial technologies that may be potentially applicable to the "Complete Rad Removal" alternatives evaluated in the SFS. Additional, detailed information about potentially applicable technologies was presented in the FS report for OU-1 (EMSI, 2006).

Section 5: Remedial Alternatives – Provides descriptions of the ROD-selected remedy and the "complete rad removal" alternatives that are the subject of the detailed evaluations presented in Sections 6 and 7. Descriptions of other remedial alternatives previously developed and evaluated for OU-1 were presented in the FS report for OU-1 (EMSI, 2006) and are not repeated in this SFS report.

Section 6: Detailed Analysis of Alternatives – Presents a detailed analysis of the ROD-selected remedy and the "complete rad removal" alternatives relative to the threshold and balancing criteria defined by the NCP.

Section 7: Comparative Analysis of Alternatives – Presents a summary comparison of the ROD-selected remedy and the two "complete rad removal" alternatives in terms of the threshold and balancing criteria defined by the NCP.

Section 8: References – Provides a list of references cited in this report.

This SFS also includes the following appendices:

Appendix A: Existing Institutional Controls affecting the Site, the City of St. Louis Negative Easement and Restrictive Covenant on West Lake Landfill, and FAA ROD, MOU and Advisory Circulars
Appendix B: Identification and Quantification of the Volume of RIM above Cleanup Levels
Appendix C: Off-site Disposal Facilities – Waste Acceptance Criteria
Appendix D: Evaluation of Potential Application of Shoring Technology
Appendix E: Evaluation of Area 1 and 2 Regrading Options
Appendix F: Required Cover Thicknesses Calculations
Appendix G: Conceptual Environmental Monitoring Plan
Appendix H: Evaluation of Potential Risks Associated with the Proposed Remedial Alternatives
Appendix I: Estimated Greenhouse Gas Emissions Associated with the Alternatives
Appendix J: Estimated Project Schedules for the Remedial Alternatives
Appendix K: Estimated Costs for the Remedial Alternatives.

2 SITE CONDITIONS

The purpose of this Section 2 is to provide information necessary to support the evaluation of remedial technologies and alternatives presented in Sections 4, 6, and 7. Therefore, this section summarizes certain site-specific information from the existing Administrative Record in order to present a summary of the site conditions at the West Lake Landfill.

This Section 2 is divided into five subsections:

- Section 2.1 provides information regarding the West Lake landfill and the surrounding area including discussions and/or descriptions of historical landfill operations and disposal areas; Superfund Operable Units (OUs) on the site; current site uses; site zoning, use restrictions and easements; surrounding land uses; and potential impacts or consequences from the landfill's proximity to the Missouri River floodplain.

- The nature and extent of radionuclide occurrences in OU-1 are discussed in Section 2.2 including the source of the radionuclides; general locations and lateral extent of radiologically-impacted materials (RIM); vertical extent of RIM occurrences in Areas 1 and 2; estimated volume of RIM; radiological occurrences on the Buffer Zone and Crossroad Property; radiological characterization of the RIM in Areas 1 and 2; projected radionuclide decay and ingrowth of the RIM; and the evaluation of principal threat wastes. Section 2.2 also includes information regarding the occurrence of non-radiological hazardous substances (trace metals, petroleum hydrocarbons, volatile and semi-volatile organics, pesticides and PCBs) in soil samples collected from Areas 1 and 2 as well as discussions regarding the potential for occurrences of hazardous wastes and asbestos-containing materials in the landfill matrix.

- The presence of radionuclides in air is discussed in Section 2.3.

- Brief descriptions of the site geology and hydrogeology and the nature and extent of radionuclide and chemical occurrences in groundwater near Areas 1 and 2 are provided in Section 2.4.

- Finally, Section 2.5 includes summaries and conclusions from the baseline human health and screening-level ecological risk assessments.

2.1 Site Location and Surrounding Area

The West Lake Landfill is located within the western portion of the St. Louis metropolitan area on the east side of the Missouri River floodplain approximately two miles east of the river (Figure 1). The landfill is located approximately one mile north of the intersection of Interstate 70 and Interstate 270 within the city limits of the City of Bridgeton in northwestern St. Louis County.

The site is bounded to the east and northeast by St. Charles Rock Road (State Highway 115) (Figure 2). Commercial and industrial properties bound the site immediately to the north, across St. Charles Rock Road to the north and east, and to the south. The site is bounded on the west by Old St. Charles Rock Road (vacated) and the Earth City Industrial Park (Earth City) stormwater/flood control pond. The Earth City commercial and industrial complex continues to the west and north of the stormwater/flood control pond and extends from the site to the Missouri River. Earth City is separated from the river by an engineered levee system owned and maintained by the Earth City Flood Control District.

2.1.1 Historic Landfill Operations and Disposal Areas

The West Lake Landfill is an approximately 200-acre parcel containing multiple areas of past operations. The site was used agriculturally until a limestone quarrying and crushing operation began in 1939. The quarrying operation continued until 1988 and resulted in two quarry pits, the North Quarry Pit and the South Quarry Pit (Figure 3), which were excavated to maximum depth of 240 feet below ground surface (bgs) (Herst & Associates, 2005).

The West Lake Landfill is the site of several areas where solid wastes have been disposed. Beginning in the early 1950s or perhaps the later 1940s, portions of the quarried areas and adjacent areas were used for landfilling municipal refuse, industrial solid wastes, and construction/demolition debris. These operations predated state laws and regulations governing such operations. Landfill activities conducted after 1974 within the quarry areas were subject to permits obtained from the Missouri Department of Natural Resources (MDNR). In 1974 landfilling began in the portion of the site described as the North Quarry Pit. Landfilling continued in this area until 1985 when the landfill underwent expansion to the southwest into the area described as the South Quarry Pit (Herst & Associates, 2005). In August 2005, the Bridgeton Sanitary Landfill stopped receiving waste pursuant to an agreement with the City of St. Louis to reduce the potential for birds to interfere with airport operations. The Bridgeton Sanitary Landfill is inactive and closure and post-closure activities are proceeding under MDNR supervision.

In addition to the Bridgeton Sanitary Landfill north and south quarry pits currently in the process of closure/post-closure, the West Lake Landfill property contains four other areas where solid wastes were disposed (Figure 3):

- Area 1 where solid wastes and radiologically-impacted materials were disposed;
- Area 2 where solid wastes and radiologically-impacted materials were disposed;
- A closed demolition landfill; and
- An inactive sanitary landfill.

2.1.2 Superfund Operable Units

Superfund-program remedial action at the site is divided into two operable units (OUs). OU-1 is comprised of the solid wastes and RIM disposed in Areas 1 and 2 and portions of an adjacent property, formerly described as the Ford Property and now called the Buffer Zone/Crossroad Property. OU-2 consists of the other landfill areas that are not impacted by radionuclides and includes the inactive sanitary landfill located adjacent to Area 2, the closed demolition landfill, and the Bridgeton Sanitary Landfill located in the North and South Quarry Pits. The closed demolition landfill and the Bridgeton Sanitary Landfill, while designated as part of OU-2, are regulated by the MDNR pursuant to State of Missouri solid waste regulations and are not being actively addressed by the Superfund program. To the extent that the presence of or activities associated with these OU-2 areas potentially impact OU-1 and the remedial alternatives considered by this SFS, those impacts are discussed in the appropriate SFS section.

OU-1 Area 1 is situated on the northern and western slopes of a topographic high within the overall West Lake landfill property. Ground surface elevation in Area 1 varies from 490 feet above mean sea level (AMSL) on the south to 452 feet AMSL at the roadway near the transfer station entrance (Figure 4). OU-1 Area 2 is situated between a topographic high of landfilled materials on the south and east, and the Buffer Zone/Crossroad Property on the west. The highest topographic level in Area 2 is about 500 feet AMSL on the southwest side of Area 2, sloping to approximately 470 feet AMSL near the top of the landfill berm (Figure 4). The upper surface of the berm along the western edge of Area 2 is located approximately 20 to 30 feet above the adjacent Buffer Zone/Crossroad Property and approximately 30 to 40 feet higher than the water surface in the flood control channel located to the south-west of Area 2. A berm on the northern portions of Area 2 controls runoff to the adjacent properties.

No contemporaneous reports, drawings or other records from the former site operators exist regarding the construction of the disposal units or the overall types and amounts of wastes that were disposed in the Area 1 and Area 2 landfills during their operation. Based on the RI investigations, it appears that these areas were filled using an "area-fill" approach whereby waste materials consisting primarily of municipal solid wastes, construction and demolition debris, and quarry spoil material were deposited onto the existing land surface.

Municipal solid waste, construction and demolition debris, quarry spoil material and possibly other wastes were disposed of in Areas 1 and 2. Reportedly, 38,000 to 39,000 tons of soil were mixed with approximately 8,700 tons of leached barium-sulfate residue, and of this amount, 43,000 tons were sent to West Lake Landfill over the period from July through October 1973 (Nuclear Regulatory Commission (NRC), 1976 and 1988 and RMC, 1982). Post-disposal investigations by NRC (NRC, 1976 and RMC, 1982) suggest that the 43,000 tons of soil mixed with leached barium-sulfate residue were spread and used as cover material for the landfill operations. Per the NRC (1976 at page 2), "This material was hauled to the landfill area and used as cover for part of the several hundred truckloads of garbage and refuse that are shipped to the landfill area site every week." Landfilling of waste materials continued to be performed both during and after disposal of the radiologically-impacted soil mixture (NRC, 1976). Information regarding the configuration of radiologically-impacted materials that were placed in Areas 1 and

2 was developed by investigations and evaluations performed by the NRC and/or its contractors (NRC, 1976 and 1988 and RMC, 1981 and 1982), and by the investigations performed pursuant to the RI (McLaren Hart, 1996 and EMSI, 2000). A summary of the results of these investigations appears in Section 2.2 of this report.

On the north side of Area 2 is the property referred to in the RI as the Ford Property because it was previously owned by Ford Motor Credit, Inc. Prior to 1998, Ford subdivided and sold all of its property in this area. The majority of the Ford property was sold to Crossroad Properties LLC and has been developed into the Crossroads Industrial Park. Crossroad has developed all of their property with the exception of Lot 2A2, a 3.58 acre parcel located immediately north of the Buffer Zone. Crossroad's predecessor Ford retained the 1.78 acres immediately adjacent to the western portion of the northern boundary of Area 2, referred to as the Buffer Zone, and subsequently transferred ownership of this strip to Rock Road Industries, Inc. (Rock Road). Sampling conducted in conjunction with preparation of the RI/FS (EMSI, 2000 and 2006) identified the presence of radionuclides in surface soil on the Buffer Zone and Crossroad Property. Based on communications with a representative of Rock Road Industries (Whitacker, personal communication) and the overall distribution and surficial nature of the occurrences of radiologically impacted soil on Buffer Zone and the Crossroad property, the source of the radionuclide occurrences on these former Ford properties was stormwater erosion of the Area 2 landfill berm prior to establishment of vegetative cover. Additional discussion regarding the nature and extent of soil contamination at the former Ford properties and subsequent activities that resulted in relocation and redistribution of this material are provided in Section 2.2.4 of this report.

2.1.3 Current Site Uses

The West Lake Landfill is located in a predominantly industrial area. The entire landfill area, including the areas investigated under OU-1 and OU-2, has been the site of historic quarry operations to remove limestone, and landfill operations. Other activities on the OU-2 portion of the property include a solid waste transfer facility, concrete and asphalt batch plant operations, and an auto repair facility (Figure 3).

The 1.8 acre Buffer Zone property (Figure 3) was purchased by Rock Road Industries to support implementation of the selected remedial action and/or to provide a buffer between the landfill and adjacent properties and businesses. With the exception of the Buffer Zone, all of the site area has previously been developed and was used for or in conjunction with disposal of solid wastes at the site or is currently being used in conjunction with the various industrial operations conducted at the Site. Areas 1 and 2, the closed demolition landfill, the inactive sanitary landfill, and the former Bridgeton Sanitary Landfill located in the North and South Quarry pits (Figure 3) were all used for disposal of solid wastes. Current activities in these areas consist of maintenance of the landfill covers and environmental monitoring. Extraction of groundwater/leachate continues to be performed on an ongoing basis from the North and South Quarry Pits.

In addition to the area containing the transfer station entrance road and site office trailer/weigh station, there are two areas located outside of the solid waste disposal units in which industrial activities are conducted at the site. These include the area in the central portion of the site where the solid waste transfer station and the concrete and asphalt batch plants are located, and a small area near the southwestern portion of the site in which an automobile repair facility is located (Figure 3). The concrete and asphalt batch plants and automobile repair facility operate at the site pursuant to long-term (99-year) leases. In addition to these areas, the Allied Waste Services district office and refuse collection vehicle parking and repair lots are located outside of but adjacent to the site. The landfill stormwater retention pond and OU-2 on-site soil borrow and stockpile area are also located on property outside of but adjacent to the site (Figure 3).

2.1.4 Site Zoning, Use Restrictions, and Easements

Current owners of the land encompassed by the West Lake Landfill and owners of adjacent properties are shown on Figure 5. The land use zoning for the West Lake Landfill and adjacent properties is shown on Figure 6. The southern portion of the West Lake Landfill is zoned M-1 (manufacturing district, limited). Although the northern portion of the West Lake Landfill is zoned R-1 (one family dwelling district), this area has never been used for residential purposes, is bounded on all sides by industrial and commercial uses, and has been used for industrial purposes for more than fifty years. In addition, in 1988 the Missouri Court of Appeals affirmed in a trial court's finding that the "residential" zoning of the West Lake Quarry property directly south of the West Lake Landfill was unconstitutional, unreasonable and arbitrary. *West Lake Quarry and Material Company v. City of Bridgeton, 761 S.W. 2d 749 (Mo App 1988).* The court specifically considered the commercial-industrial land uses of the surrounding property, the high development costs for residential use, noise from airplanes, and other evidence and concluded that property in this area is "totally inappropriate for residential development" and ordered the City to rezone the property M-2 (commercial-industrial) *Id.* at 752. Consequently, even though a portion of the site is zoned residential, as a practical matter, the only reasonable future use of the site is commercial-industrial, not residential.

Various restrictions on land use have been implemented at the site (Figure 7). These restrictions were developed and implemented to reflect: (1) use of the site as a solid waste disposal facility; (2) the presence of radiologically-impacted materials in Areas 1 and 2; and (3) the proximity of the site to the Lambert-St. Louis International Airport. Residential land use has been precluded at the West Lake Landfill (including Areas 1 and 2) by restrictive covenants recorded in May 1997 by each of the fee owners against their respective parcels. These restrictive covenants also prohibit use of groundwater from beneath the site. Construction activities and commercial and industrial uses have also been precluded on Areas 1 and 2 by a Supplemental Declaration of Covenants and Restrictions recorded by Rock Road Industries, Inc. in January 1998, prohibiting the placement of buildings and restricting the installation of underground utilities, pipes, and/or excavation upon its property. These covenants automatically renew fifty (50) years from the date first recorded and every twenty five (25) years thereafter. The covenants grant EPA, the MDNR, and the owners the right to enforce the covenants' restrictions and these land-use restrictions cannot be terminated without written approval of the then owners, MDNR and EPA. Copies of these land use covenants are included in Appendix A to this report.

Finally, the site is located northwest of the Lambert-St. Louis International Airport. Much of the site, including more than half of Area 1, is located within 10,000 feet of the start of Runway 11 (end of Runway 29) for which construction was completed in 2006 (Figure 8). Numerous flight tracks pass over the West Lake site (Figure 8). An agreement was reached between the St. Louis Airport Authority (STLAA) and Bridgeton Landfill, LLC, whereby the Bridgeton Sanitary Landfill ceased disposal of municipal waste, organic waste, and putrescible waste in 2005 in order to reduce potential bird impacts to aircraft operations. As part of this cessation agreement with the STLAA, a Negative Easement and Declaration of Restrictive Covenants Agreement (restrictive covenant) (Appendix A) was recorded against the majority of the West Lake Landfill site, including the OU-2 soil stockpile/borrow area south of the landfill stormwater detention pond, all of OU-1 Area 1, and the southwestern portion of OU-1 Area 2 (Figure 7).

2.1.5 Surrounding Land Uses

Land use in the area surrounding the landfill is commercial and industrial. The property to the north of the landfill, across St. Charles Rock Road, is moderately developed with commercial, retail and manufacturing operations. The Earth City Industrial Park is located adjacent to the landfill on the south and west, across Old St. Charles Rock Road. The Lambert St. Louis International Airport is located within two miles to the southeast of the site.

Two residential communities are present within approximately one mile of the site. A trailer park is located on the other side of St. Charles Rock Road approximately one-half mile to the southeast of Area 1 and nearly one mile to the southeast of Area 2 (near the intersection of St. Charles Rock Road and Interstate 270) (Figure 2). In addition, the "Spanish Village" neighborhood, which contains mixed single and multi-family residential units as well as commercial and industrial facilities, is located to the south of the landfill near the intersection of St. Charles Rock Road and I-270, approximately one mile from Areas 1 and Area 2 (Figure 2).

2.1.6 Missouri River Floodplain

Portions of the West Lake Landfill, including all of Area 2 and much of Area 1, are located within the geomorphic floodplain of the Missouri River. The topography of the West Lake Landfill area has been significantly altered by quarry activities and by placement of quarry spoils and landfill materials. Consequently, although portions of the landfill were built over the historic (geomorphic) floodplain, development of the landfill property has significantly increased the topographic elevation of much of the landfill (Figure 4) such that the majority of the landfill surface is now located above and outside of the 500-year floodplain of the Missouri River.

The Earth City Flood Control and Levee District has constructed and operates and maintains a levee and stormwater management system in order to protect the Earth City development from

Missouri River floods with a recurrence interval greater than 500-years (commonly referred to as a 500-year flood). As the Earth City levee system is located between the Missouri River and the West Lake Landfill, this levee system also acts to protect the landfill from a 500-year flood.

The limits of the geomorphic floodplain were delineated based on information obtained from the MDNR web site (http://www.dnr.mo.gov/geology/statemap/stlouis/sl8615.htm). Specifically, available documentation and mapping pertaining to the West Lake Landfill site and the underlying bedrock and associated geomorphological setting were reviewed to evaluate the potential limits of the historical Missouri River floodplain in the area of the site.

Identification of the geomorphic floodplain was performed by reviewing a 1954 aerial photograph and an unpublished Missouri Department of Natural Resources – Division of Geology and Land Survey geologic map of the St. Charles Missouri quadrangle which includes the site and surrounding area. MDNR – Division of Geology and Land Survey publication Order Number SL8615 (Figure 9) is a 1986 publication that used a 1954 USGS 7.5 minute topographic quadrangle for a base map in order to portray the bedrock geology in the area. These documents were reviewed to identify the location of the bluffs and terrace alluvium deposits that defined the pre-development, geomorphic floodplain prior to the time the topography of site and surrounding area were modified by quarrying, landfilling, and commercial/industrial development. From this information, the Missouri River alluvial valley deposits (Qal), terrace deposits (Qt), and consolidated bedrock formations were located and used to delineate the historical extent of the floodplain.

The results of this evaluation are presented on Figure 10. Review of this figure indicates that the historic geomorphic floodplain originally included portions of the north-western portion of the West Lake Landfill property. As a result of prior site development and grading and filling, much of the West Lake Landfill property (including all of Area 1 and most of Area 2) now is located at elevations above the current 500-year floodplain. In addition, the site is protected by the Earth City engineered levee and flood control system.

The Federal Emergency Management Agency (FEMA) prepares Flood Insurance Rate Maps (FIRM) for many portions of the country. These maps are available online through FEMA's Map Service Center site: http://msc.fema.gov. The area of the West Lake Landfill is on FIRM Number 29189C0039 H dated August 2, 1995 (FEMA, 1995). This map incorrectly indicates that Area 2 and the northern portion of Area 1 are in the Zone X flood area. This inaccuracy was acknowledged by FEMA through a Letter of Map Revisions (LoMR) dated March 5, 1996. According to the LoMR, the levee that protects the Earth City area, including the West Lake Landfill, is protective of a 500-year flood, not just a 100-year flood. FEMA's LoMR acknowledged the error and proposed changes to the affected FIRMs, but the FIRMs themselves have not yet been formally updated. The LoMR indicates that the proposed FIRM revisions reflect the 500-year flood protection afforded by the Earth City Levee. The Zone X Flood Area that includes the West Lake Landfill is annotated on the proposed revisions with the following text: "This area protected from the 0.2-percent annual chance (500-year) flood by levee, dike, or other structures subject to possible failure or overtopping during larger floods."

Finally, the surface of the Area 2 berm is approximately 20 feet above the projected 100-year flood elevations within the levees. Flooding of areas adjacent to the landfill (i.e., areas outside of the levees) would only occur as a result of a failure of the levees. Spreading of floodwaters into areas outside of the levees would produce lower flood elevations than those projected to occur within the levees because water height decreases as it spreads out. Therefore, the actual elevations of any floodwaters that may extend into areas adjacent to the landfill are expected to be less than the height of the Area 2 berm – 453 feet (Figure 4). No flooding of the landfill or the adjacent Crossroad property occurred in 1993 or 1995 during the 500- and 300-year flood events that occurred in those years, respectively.

2.2 Nature and Extent of Radionuclide and Chemical Occurrences in OU-1

This section summarizes the origin and general nature and extent of occurrences of radiologically-impacted materials (RIM) in waste materials in Areas 1 and 2. This information is taken from several sources and was originally summarized in the RI report (EMSI, 2000). It is presented again in the SFS to provide the basis for evaluating the extent of the areas to be capped and covered under the ROD-selected remedy and to estimate the extent and volume of waste material that would be excavated and disposed of offsite or on-site under the two "complete rad removal" alternatives. Information regarding the nature and extent of non-radionuclide hazardous material occurrences in soil/waste material in OU-1 is also presented again in the SFS to assess the potential for occurrences of hazardous waste within the landfill materials.

Radiological constituents in OU-1 Areas 1 and 2 occur in soil materials that are intermixed with and interspersed within the overall matrix of landfilled refuse, debris and fill materials and unimpacted soil and quarry spoils in Area 1 and Area 2. In some portions of Areas 1 and 2, radiologically-impacted materials are present at the surface; however, the majority of the radiological occurrences are present in the subsurface beneath these two areas. At the Buffer Zone/Crossroads properties the radiologically-impacted materials are found in soils believed to have been carried by erosion from the Area 2 berm prior to growth of the current on-site vegetation.

In general, the primary radionuclides detected at levels above background concentrations at the West Lake Landfill are part of the uranium-238 and uranium-235 decay series. Thorium-232 and radium-224 isotopes from the thorium-232 decay series are also present above background levels but at a lesser frequency.

The characterization of the RIM occurrences is based primarily on:

1. The results of the sampling performed during the RI for OU-1 (McLaren/Hart 1996, EMSI, 1997 and 2000), which entailed extensive testing of site conditions and generated laboratory analytical data that met EPA's data quality requirements; and

2. The overall findings and conclusions about the location and nature of the radioactivity at West Lake Landfill reported by the NRC and its contractors (NRC, 1976 and 1988 and RMC, 1981 and 1982).

Both sets of investigators (the NRC and the Respondents) identified approximately the same two areas (Areas 1 and 2) where radiologically-impacted materials (RIM) are present at the site. Both investigations found that the radioactivity at the site results from occurrences of uranium and its decay products and is dominated by thorium-230 and radium-226, and that the levels of radium-226 at the Site are not in radioactive equilibrium with the levels of thorium-230. Consequently, the levels of radium-226 are anticipated to increase during the next thousand years as a result of decay of thorium-230. Both sets of studies determined that the then-existing and expected future concentrations of radionuclides are significantly elevated, relative to levels that would allow for unrestricted use of the site (although the presence of the landfill wastes results in unrestricted use not being realistic for the site regardless of the presence of the radiological materials). Finally, both sets of investigators concluded that the majority of the RIM is located near (i.e., within approximately 7 to 12 feet of) the ground surface, but with deeper occurrences at varying depths in both Areas 1 and 2.

2.2.1 Source of the Radionuclides

An NRC investigation conducted in 1976 concluded that approximately 8,700 tons of leached barium-sulfate had been mixed with approximately 39,000 tons of soil and, of this amount, about 43,000 tons were transported to the West Lake Landfill over a three month period from July 16 through October 9, 1973 (EPA, 2008a and NRC, 1976 and 1988 and RMC, 1982). Leached barium-sulfate residues were reportedly derived from uranium ore processing and prior to 1966 were initially stored by the Atomic Energy Commission (AEC) on a 21.7-acre tract of land in a then-undeveloped area of north St. Louis County now known as the St. Louis Airport Site (SLAPS) (EPA, 2008a, NRC, 1988 and RMC, 1982). Leached barium-sulfate residues reportedly were moved from the airport site to nearby 9200 Latty Avenue in Hazelwood, Missouri in 1966 (NRC, 1988). Most of the uranium and radium had been removed from the leached barium sulfate in previous precipitation steps (EPA, 2008a, NRC, 1988) and the leached barium sulfate residues reportedly contained only approximately 0.05% to 0.1 % or approximately 7 tons of uranium (NRC, 1976 at page 2).

According to the NRC (1976, at page 2), “This material was hauled to the landfill area and used as cover for part of the several hundred truckloads of garbage and refuse that are shipped to the landfill area site every week.” The NRC further reports that this material was spread as cover over the existing fill material (RMC, 1982 at page 16). The NRC reported that the radiologically-impacted material was buried and covered with about 3 feet of soil (NRC, 1988 at page 1).

2.2.2 General Locations and Lateral Extent of RIM Occurrences in Areas 1 and 2

Radionuclides (specifically, thorium-230, radium-226, and uranium-238) have been identified as primarily present in soils at two distinct and separate areas at the landfill. These two areas have been designated as Radiological Area 1 (Area 1) and Radiological Area 2 (Area 2) (Figure 11). Prior investigations of radionuclide occurrences in soils at West Lake Landfill (RMC, 1982, NRC, 1988, McLaren Hart, 1996, and EMSI, 2000 and 2006) identified these same two areas as locations where radionuclides are present at the site. Figure 12 presents and compares the extent of RIM identified in the 1982 RMC report, the 1988 NRC report, the 2000 RI report, and the results of additional engineering evaluations performed in conjunction with preparation of this SFS report. All four reports identified similar general areas of RIM occurrences at the site.

Area 1 encompasses an approximately 10-acre portion of the site located immediately to the southeast of the main entrance road to the West Lake Landfill property. Area 2 encompasses an approximately 30-acre portion of the site along the northern boundary of the West Lake Landfill property (Figure 11).

Radionuclides are present in surface soil (0-6 inches in depth) over approximately 50,700 square feet (1.16 acres) of Area 1. Approximately 194,000 square feet (4.45 acres) of Area 1 have radionuclides present in the subsurface at depths ranging up to 7 feet, with localized intervals present to depths of 15 feet.

Radionuclides are present in surface soil covering approximately 468,700 square feet (10.76 acres) of Area 2. An additional 17,200 square feet in the northeastern portion of Area 2 contains soil/sediment eroded from the surface of Area 2 . Radionuclide impacted materials are present in the subsurface beneath approximately 817,000 square feet (18.76 acres) of Area 2 at depths of up to approximately 12 feet, with some localized deeper intervals at depths up to 50 feet bgs.

The extent of subsurface occurrences of radionuclides exceeds and encompasses the extent of surficial occurrences of radionuclides in both Areas 1 and 2. Subsurface occurrences of radionuclides are present in soil material that is intermixed with the overall landfill matrix of refuse, debris and fill materials (EMSI, 2000).

Based on the results of sampling performed during the RI, radionuclide occurrences were identified to be present within surface soil (approximately 6- to at most 12-inches deep) beneath that portion of the former Ford property that later became the Buffer Zone and Crossroad Lot 2A2. Radionuclide occurrences were estimated to be present in an area of approximately 196,000 square feet (4.5 acres). As discussed later in Section 2.2.5 of this report, subsequent grading and site development activities by third parties have modified the surface condition and occurrences of radionuclides on these properties.

During preparation of this SFS, the extent of occurrences of thorium-230, radium-226, and uranium-238 in Areas 1 and 2 was rigorously examined to provide a basis for estimating the volume of material that would need to be excavated pursuant to the "complete rad removal" alternatives. The data collected during both the NRC and the RI investigations were used in this evaluation. The specific procedures and data used to identify the volume encompassing the RIM are discussed briefly in Section 2.2.4 and are fully described and presented in Appendix B to the SFS. Based upon these analyses, this SFS identified the horizontal (lateral) extent of radiological occurrences as approximately four acres (approximately 40% of the total area) within Area 1 and as approximately 22 acres (approximately 70% of the total area) within Area 2.

2.2.3 Vertical Extent of RIM Occurrences in Areas 1 and 2

RMC (1982) found radionuclides "to extend from the surface ... to a depth of about 20 feet below surface, in two cases" but generally "ranging from two to fifteen feet thick, located between elevations of 455 feet and 480 feet."

With respect to the depth of RIM in Area 1, the RI found that radiologically-impacted materials were generally present at depths ranging between 0 and 17 feet bgs, which corresponds to elevations of approximately 438.5 to 461 feet AMSL.

With respect to Area 2, the RI found that, based upon the results of the downhole gamma logging and laboratory analysis of soil samples, radiologically-impacted materials were generally found at depths ranging between 0 to approximately 31 feet bgs. These depths correspond to elevations of approximately 448 to 478.5 feet AMSL. Deeper occurrences of radiologically-impacted materials were identified to be present at three locations in Area 2. In the northern part of Area 2 (area of borings WL-209, PVC-4, PVC-5, PVC-6 and PVC-7, see Figure 13) radiologically-impacted materials were identified at depths up to 26 ft corresponding to an elevation of 440 ft. Soil samples obtained from Boring WL-214 indicated that radiologically-impacted materials were present at a depth of 26 ft (elevation 442 ft amsl) at this location. In the southern part of Area 2 (borings WL-210, WL-218 and WL-235), radiologically-impacted materials were identified at depths up to 49.5 ft which corresponds to an elevation of approximately 427 feet AMSL.

These RI findings regarding the vertical extent of the RIM are generally consistent with those reported by the NRC. Therefore, the RI data on vertical extent of the RIM, supplemented by the NRC data, were used to estimate the three-dimensional extent of RIM presented in Appendix B.

2.2.4 Estimated Volume of RIM

The RI (EMSI, 2000) and pre-RI (RMC, 1982 and NRC, 1988) data were reviewed to identify those soil borings and depth intervals that contain radium, thorium, and/or total uranium activity levels greater than those that would allow for unrestricted use (see discussion of levels that would allow for unrestricted use in Section 3). The results of the downhole gamma logging were also used to define areas and depth intervals that likely contain soil with radionuclide levels above those that would allow for unrestricted use. The downhole gamma logs were visually reviewed and qualitatively evaluated to identify locations and depth intervals where soil containing radionuclides above levels that would allow for unrestricted use are expected to be present. The results of these evaluations were tabulated to identify the locations and depth intervals that contain, or are likely to contain, radionuclide occurrences in soil and refuse above levels that would allow for unrestricted use. Details of these evaluations are presented in Appendix B-1. The results of these evaluations were used along with the results of the overland gamma survey to define the lateral and vertical extent of radionuclide occurrences in the waste materials above levels that would allow for unrestricted use (Appendix B-2).

The soil boring locations where RIM materials are known or suspected to exist, as well as the soil boring locations where RIM materials are not present, were plotted and used to define the horizontal (lateral) extent of RIM (Figures 12 and 13). Intervals containing or suspected to contain radionuclide activities above those that would allow for unrestricted use were then plotted in three dimensions and located within the overall waste mass. It should be noted that in Area 2, RIM are located at varying depth intervals, including: a) an extensive upper layer in which RIM is located at or near the ground surface and extends to depths of approximately 10 ft to as much as 31 ft below ground surface (bgs); and b) a few discrete locations where RIM is located at deeper intervals at depths of approximately 10 to as much as 49.5 ft bgs (Figure 13). Volumes of solid waste materials containing radionuclides above levels that would allow for unrestricted use were calculated using computer-assisted volumetric calculating software (AutoCAD Civil 3D 2010 software). The volume of waste materials that overlay the RIM (overburden waste) and which would need to be removed in order to excavate the underlying RIM were also calculated using the same approach.

Based on these evaluations, the total volumes of RIM contained in Areas 1 and 2 were estimated to be as follows:

Area 1 RIM	33,500 bank cubic yards (bcy)
Area 2 RIM	302,000 bcy
Total RIM	335,500 bcy

The volume of non-radiological overburden soil and waste materials that would have to be removed to allow for excavation of the RIM was estimated to be as follows:

Area 1 overburden	49,000 bcy
Area 2 overburden	310,000 bcy
Total overburden	359,000 bcy

A "bank cubic yard" refers to the volume of an in-place, undisturbed material such as soil or refuse. Conversely, a "loose cubic yard" refers to a volumetric measurement of material when it is in a loose state after it has been excavated. When material is excavated, it typically swells relative to its in-place volume. For example, a "bank cubic yard" of soil will typically occupy 20 to 30 percent less volume than a "loose cubic yard" of soil, and a "bank cubic yard" of refuse may occupy up to 60 percent less volume than a "loose cubic yard" of refuse. For purposes of estimating quantities in the SFS, it was assumed that a "bank cubic yard" of combined overburden and RIM (matrix of soil and refuse) in Areas 1 and 2 would occupy 50 percent less volume than a “loose cubic yard. Additional information and supporting calculations used to define the extent and volumes of RIM above levels that would allow for unrestricted use are presented in Appendix B.

2.2.5 Radiological Occurrences on the Buffer Zone and Crossroad Property

During the RI (EMSI, 2000), radionuclide occurrences in surface soil were identified in the southern portion of what at that time was property owned by Ford Motor Credit (referred to in the RI as the Ford property), located immediately to the north and west of Area 2 (Figure 14). Ford sold a portion of the property to Crossroad Properties, LLC (Crossroad), and sold the remaining portion (the Buffer Zone) to Rock Road Industries to provide a buffer between the landfill and the adjacent properties.

Reportedly, after completion of landfilling activities in Area 2 but prior to establishment of a vegetative cover over the landfill berm, erosion of soil from the landfill berm resulted in the transport of radiologically-impacted materials from Area 2 onto the adjacent Buffer Zone and Crossroad properties (EMSI, 2000). The landfill berm and the adjacent properties were subsequently revegetated by natural processes such that no evidence of subsequent erosion or other failures were present. Occurrences of radionuclides were found in surficial (6 to 12 inches or less) soil at the toe and immediately adjacent to the landfill berm as a result of this historic erosion from Area 2.

Based on an estimated areal extent of 196,000 square feet and a presumed 6-inch thickness, the volume of radiologically-impacted materials located on the former Ford property was estimated to be 3,600 cubic yards.

In November 1999, third parties scraped the vegetation and surface soil on Crossroad Lot 2A2 and the Buffer Zone to a depth of approximately 2 to 6 inches. These activities were unauthorized and reportedly conducted by AAA Trailer, the current tenant of the Crossroad property. The removed materials were piled in a berm along the southern boundary of the Buffer Zone, adjacent to the northwestern boundary of the West Lake Landfill. A small amount of removed materials was also placed in a small pile on the Crossroad property near the base of the landfill berm along the east side of Lot 2A1.

In February 2000, additional surface soil samples were collected from the disturbed area and submitted for laboratory testing. Only one sample (RC-02) obtained from the Buffer Zone, below and adjacent to the area of the former landfill berm slope failure, contained radionuclides (thorium-230) above levels that would allow for unrestricted use. The remainder of the samples contained either background levels of radionuclides or levels above background but within levels that would allow for unrestricted use. The results of the additional soil sampling indicated that most of the radiologically impacted soil that had previously been present on the Buffer Zone and Lot 2A2 of the Crossroad property had been removed and placed in the stockpiles. Evaluation of the soil sampling results obtained prior to and after the 1999 disturbance indicates that approximately one acre of the Buffer Zone may still contain some radionuclides above reference levels. Inspection of the area in May 2000 indicated that native vegetation had been re-established over both the disturbed area and the stockpiled materials. The presence of native vegetation over these materials was determined to be sufficient to prevent windblown or rainwater runoff of these materials.

A 2004 inspection of this area indicated that additional soil removal/regrading had been performed on the remaining portion of the Crossroad property and the adjacent Buffer Zone property by, or on the behalf of, AAA Trailer. These activities appear to have resulted in removal of the soil stockpiles created during the previous regrading activity reportedly conducted by AAA Trailer, removal of any remaining soil on Lot 2A2 and the Buffer Zone not scraped up during the 1999 event, and placement of gravel over the entirety of Lot 2A2 and the Buffer Zone. According to AAA Trailer, all of the soil removed during the July 1999 grading work and the May 2003 gravel layer installation was placed in the northeastern corner of the Buffer Zone (terra technologies, 2004). Trailers associated with AAA Trailer's operations were then parked in this area without authorization from the Respondents regarding use of the Buffer Zone. At Respondent's request, AAA Trailer subsequently removed the trailers from the Buffer Zone, and the Respondents installed a fence between the Buffer Zone and Crossroad property to prevent any future disruption of the Buffer Zone by AAA Trailer or any other party.

Because no sampling has been performed since the most recent (May 2003) grading work conducted by AAA Trailer, the levels and extent of radionuclides, if any that may remain in the soil at the Buffer Zone and Crossroad Property are unknown. Additional soil sampling to determine current conditions with respect to radionuclide occurrences in the Buffer Zone and Crossroad Property soil will be conducted as part of implementation of the selected remedy for this area.

2.2.6 Radiological Characterization of the RIM

The primary radionuclides detected in Areas 1 and 2 at levels above background concentrations are part of the uranium-238 and uranium-235 decay series. The uranium-238 and uranium-235 decay series include thorium-230 and radium -226, which is consistent with the reported source of the radioactivity. Thorium-232 and radium-224 isotopes from the thorium-232 decay series were also present above background levels but at a lesser frequency.

During the OU-1 RI, a total of 134 soil samples, including 12 duplicate samples, were collected from Areas 1 and 2 (including the areas identified by the NRC investigations) and the Buffer Zone/Crossroad Property and submitted to an offsite laboratory for radionuclide analyses. This included 54 total samples (including 6 duplicate samples) from Area 1 and 80 total samples (including 6 duplicate samples) from Area 2 (including the Buffer Zone/Crossroad Property). The maximum detected values for radium-226, thorium-230 and uranium-238 reported for the RI samples obtained from Area 1 were, respectively: 906; 9,700; and 147 picocuries per gram (pCi/g). The maximum detected values for radium-226, thorium-230 and uranium-238 reported for the RI samples obtained from Area 2 were, respectively: 3,060 (duplicate result of 1,260);

57,300 (duplicate result of 12,000); and 294 pCi/g. A complete listing of the RI analytical results is presented in the RI report.

The following table summarizes the maximum reported activity levels found in the RI and NRC samples.

Comparison of Radionuclides and Maximum Concentrations Detected During the RI and NRC Investigations						
Radionuclide	Maximum Concentration Detected During the Stated Investigation (pCi/g)					
	Area 1		Area 2		Buffer Zone/Crossroad Property	
	RI	NRC	RI	NRC*	RI	NRC
Uranium-238	147	No samples	294	2,900	4.17	No samples
Thorium-230	9,700	No samples	57,300	6,095	429	No samples
Radium-226	906	No samples	3,060	15,000	17.2	No samples

* Note that the values provided in this table do not include the reported value of 4.4 E9 (4.4×10^9 or 4,400,000,000) pCi/g for radium-226 for the 18 foot depth interval in NRC borehole 21, as this value appears to have been an error. Based on the text and the other results for this depth interval the reported value appears to be a typographical error and the likely value should have been reported as 4.4 E0. The values listed above also do not include any of the results for NRC borehole 1 as the location of this borehole is not provided in the NRC report (RMC, 1982).

Table 1 presents a full comparison of the downhole logging and soil sample results obtained from the fifteen NRC and RI soil borings which were located in approximately the same locations (proximately located borings). The locations of the various borings are shown on Figure 13. Of the fifteen co-located soil borings, radionuclide activity levels, specifically radium-226 values, were only obtained from five of the NRC borings. The level of radium-226 (2,500 pCi/g) reported for NRC boring No. 4 (PVC-4) is similar to the radium-226 level (3,720 pCi/g) found in the co-located RI boring WL-209. The levels of radium-226 reported by the NRC for the other four proximately located borings were higher by factors of 4 to 240 compared to the levels for soil samples collected from the same general areas during the RI.

Although both the NRC and the RI studies identified the same radionuclides, the maximum activity levels identified by both studies and, in most instances, the results for soil samples obtained from the same general locations, were substantially different. These differences are likely due to the fact that the NRC site investigation was based on field measurements rather than analytical laboratory results.

2.2.7 Radionuclide Decay and Ingrowth

Radionuclides present in Area 1 and 2 (including the Buffer Zone/Crossroad Property) are derived from uranium-238 and uranium-235 and its decay products. The primary decay products of concern are thorium-230 and radium-226 owing to the higher activity (concentration) levels, higher radiation levels, and/or longer half lives of these isotopes.

Results of all of the investigations at the site indicates that the activity level of thorium-230 exceeds and is not in equilibrium with the activity level of the other radionuclides, notably, radium-226. Consequently, as a result of decay of thorium-230, the levels of radium-226 are expected to increase over time as noted in the NRC reports (RMC, 1982 and NRC, 1988). Projected future values for radium-226 as a result of decay of thorium-230 are presented on Table 2 and graphically displayed on Figure 15.

The projected increase in radium-226 levels over time will be expected to result in both increased radiation levels and increased radon gas generation over time. The projected increase in radiation and radon levels over time was addressed as part of the risk characterization included in the Baseline Risk Assessment (Auxier & Associates, 2000), and was considered as part of the conceptual design of the remedial alternatives and potential long-term risks evaluated in this SFS, as described further in Sections 5 and 6.

2.2.8 Principal Threat Wastes

In accordance with the National Contingency Plan (NCP), EPA expects that treatment will be the preferred means by which to address the principal threats posed by a site, wherever practicable. Because the purpose of the SFS is to provide a thorough evaluation of the potential "complete rad removal" alternatives relative to the ROD-selected remedy, it is conservatively assumed that principal threat wastes may be present within OU-1. Therefore, potential treatment technologies are evaluated in Section 4 of this SFS under the assumption that principal threat wastes are present. As discussed in Section 4, the evaluation of potential treatment technologies takes into account both the presence of the RIM and the expected further in-growth of radionuclides in the RIM due to radioactive decay and disequilibrium.

2.2.9 Occurrences of Non-Radiological Chemical Constituents in Soil/Waste

As part of the investigation of radiological occurrences in Areas 1 and 2, investigations of occurrences of non-radiological, chemical constituents were also performed during the RI. Occurrences of chemical constituents in Areas 1 and 2 are associated with the presence of solid waste materials disposed in the landfill and are not related to the presence of radiologically-impacted materials within the landfill.

A complete summary of the results of the non-radiological analyses (both organic and inorganic) obtained from the surface and subsurface soil samples from Areas 1 and 2 is presented in the RI

(EMSI, 2000). Additional detailed information is contained in the "Soil Boring/Surface Soil Investigation Report" (McLaren/Hart, 1996). The discussions below present a brief summary of the results of these investigations. The results are used at the end of this section as the basis for an assessment of the potential for occurrences of RCRA hazardous wastes in Areas 1 and 2.

2.2.9.1.1 Trace Metal Occurrences in Soil

The most commonly detected trace metals were arsenic, chromium, copper, lead, nickel and zinc, which were detected in all or nearly all of the 37 samples analyzed for trace metals. Beryllium was detected in approximately one-half of the samples while cadmium and selenium were each detected in ten samples and mercury was detected in only four samples. Antimony was only detected in two samples and thallium was only detected in one sample. In addition, cyanide was only detected in two samples.

The highest trace metal levels were found in the following samples: WL-114 at 0-ft, WL-115 at 5-ft, WL-208 at 20-ft, WL-209 at 0-ft, and WL-210 at 0 ft. These samples contained two or three metals with concentrations greater than ten times the background levels. The results included lead with four samples greater than ten times background, copper and nickel with three samples each greater than ten times background, chromium with two samples and arsenic and zinc with one sample each greater than ten times background.

2.2.9.1.2 Total Petroleum Hydrocarbons in Soil

Total petroleum hydrocarbon (TPH) analyses were performed on 43 soil samples for gasoline, diesel and motor oil range hydrocarbon compounds. Gasoline range hydrocarbons were detected in six, diesel range hydrocarbons in four, and motor oil range hydrocarbons in twenty of the 43 samples. The highest levels of petroleum hydrocarbons detected in any of the soil samples were found in the sample obtained from the 20-foot depth in boring WL-208 and the soil sample obtained from the 15-foot depth in boring WL-210.

2.2.9.1.3 Volatile Organic Compounds in Soil

Volatile organic compounds (VOCs) were detected in approximately three-quarters of the 43 soil samples analyzed for VOCs. The primary VOCs detected were aromatic hydrocarbons (toluene, xylenes, etc.), ketones (acetone and 4-methyl 2-pentanone), and isolated occurrences of methylene chloride. With the exception of a few samples, the concentrations of the individual VOCs detected were less than one part per million (ppm).

The highest levels of VOCs in a soil sample were found in the sample obtained from boring WL-210 at 15 feet which contained toluene (140 ppm) and xylenes (166 ppm) along with lesser amounts of ethylbenzene (32 ppm) and 2-butanone (50 ppm). All of these results were estimated values because the results of laboratory's analysis of the surrogate samples associated with these investigative samples were diluted beyond the laboratory's detection limits. A high level of 1,4-dichlorobenzene was detected in the soil sample obtained from the 16-ft depth from boring WL-230. In general, the samples with the highest detected levels of VOCs (WL-115, WL-208, WL-

210, WL-218, and WL-230) corresponded with samples that also contained high levels of petroleum hydrocarbons.

One sample (WL-208 at 20 feet) was of the contents of a severely damaged 5-gallon container. This sample displayed high levels of VOCs compared to the results obtained from all of the other samples. In addition to gasoline and motor oil range hydrocarbons, this sample contained stained soil with benzene at an estimated concentration of 120 ppm, toluene at an estimated concentration of 8,300 ppm, ethylbenzene at an estimated concentration of 300 ppm, xylenes at an estimated concentration of 2,300 ppm, acetone at an estimated concentration of 1,400 ppm, methylene chloride at an estimated concentration of 240 ppm, and 1,1-dichloroethane at an estimated concentration of 270 ppm. These results were reported as estimated concentrations as the samples were diluted as part of the laboratory analytical process yielding analytical results that were below the laboratory reporting limit and/or surrogate sample results that were diluted beyond detection limits.

2.2.9.1.4 Semi-Volatile Organic Compounds in Soil

Polynuclear aromatic hydrocarbons (PAHs) including naphthalene, 2-methylnaphthalene, pyrene, fluoranthene and phenanthrene were detected in some of the soil samples. The naphthalene compounds are often associated with occurrences of fuel, oil or other petroleum products, while the other PAH compounds detected may be associated with oil and fuel products but are also commonly found in conjunction with fires or fire debris as they can be a product of incomplete combustion.

Two phenol compounds (phenol and 4-methyl phenol) were also detected in a few of the soil samples, with the highest levels (estimated values of 9.0 and 5.8 milligrams per kilogram [mg/kg], respectively) found in the sample from the 15-foot depth of boring WL-210. In addition, benzoic acid was detected in three samples from Area 2 at levels from 0.15 to 0.79 ppm.

The compound 1,4-dichlorobenzene was detected in semi-volatile organic compound (SVOC) analysis of several of the soil samples. With the exception of the sample obtained from the 16-foot depth from boring WL-230, which contained approximately 530 ppm, only very low levels of 1,4-dichlorobenzene (estimated results due to sample dilution effects ranging from 0.062 to 0.14 ppm) were detected in the soil samples.

2.2.9.1.5 Pesticides and Polychlorinated Biphenyls in Soil

Pesticide compounds including 4,4’-DDD, 4,4’-DDE, 4,4’-DDT, aldrin, dieldrin, endrin, beta-BHC, and Endosulfan I were detected at low levels, generally less than 0.01 ppm to less than 0.001 ppm (or one part per billion) in many of the soil samples. Three polychlorinated biphenyls (PCBs) (Aroclors 1242, 1248, and 1254) were detected in Areas 1 and 2. In Area 1, three borings (WL-113, WL-114, and WL-115) detected PCBs at concentrations ranging from 0.033 to 2.6 ppm. In Area 2, PCBs were detected in eight of the sixteen borings (eight of 24 total samples) that were sampled and analyzed for PCBs. Some of the samples obtained from borings

WL-208, WL-209, WL-210, WL-214, WL-226, WL-227, and WL-230 reportedly contained PCBs at concentrations ranging from 0.017 to 1.6 ppm. PCBs were detected in one of the samples obtained from boring WL-218 at a concentration of 18 ppm.

2.2.9.1.6 Potential for Occurrences of Hazardous Wastes

Disposal operations at the West Lake Landfill date back to the 1950's or earlier and predate the adoption of federal or state regulations prohibiting the disposal of hazardous wastes in solid waste landfills. Accordingly, there is a potential that some of the waste materials at the landfill could display the characteristics of hazardous wastes.

The potential for occurrences of hazardous wastes within Areas 1 and 2 was evaluated by comparing the maximum levels of the chemical constituents detected in any of the RI soil samples to the maximum concentration of contaminants using the Toxicity Characteristic Leaching Procedure (TCLP) under the Resource Conservation and Recovery Act (RCRA) (40 CFR Part 261.24) and the Missouri state hazardous waste regulations (10 CSR 25-4.261). Because the constituents are present in soil and the hazardous characteristic determinations address possible leaching to liquids or groundwater, a dilution-attenuation factor (DAF) of 100 was applied to the maximum concentration of contaminants for each toxicity characteristic and the resultant value was compared to the maximum detected concentrations found in the RI soil samples. The results of these comparisons are presented on Table 3.

Based on these comparisons, the possibility exists that some of the waste materials contained in Areas 1 and 2 could be classified as hazardous wastes. This potential is considered remote. Although the maximum detected concentrations of some of the constituents could exceed levels that qualify as hazardous wastes, generally only a single sample contained such high chemical concentrations. The majority, or in most cases all, of the other samples displayed chemical levels sufficiently low that they would likely not be classified as a hazardous waste. This conclusion is supported by the general lack of occurrences of RCRA characteristic waste chemical compounds in groundwater (see discussion of groundwater conditions presented below). Regardless, the potential impacts on the feasibility and cost of implementation of the remedial alternatives in the event that hazardous wastes are encountered is addressed as part of the detailed analysis of the remedial alternatives provided in Section 6 of this SFS.

2.2.9.1.7 Asbestos Containing Materials in Soil/Waste

Identification of, or testing for, regulated asbestos containing materials (RACM) was not included in the scope of the RI field investigations. Review of the soil boring logs does not indicate that pipe insulation, transite panels or other materials that may represent RACM were encountered during drilling; however, as stated above, identification of such materials was not part of the scope of the RI field investigations. Therefore, although previous investigations did not note the presence of RACM, no definitive information exists regarding the presence of, or locations where, RACM, if any, may be present in Areas 1 and 2.

2.3 Radionuclide Occurrences in Air

Because the scope and design of the landfill covers included in the ROD-selected remedy and in the “complete rad removal” with on-site disposal alternative are based in part on control of radon emissions and fugitive dust, this subsection describes the results of the prior radon emissions and fugitive dust monitoring performed in Areas 1 and 2.

Radon flux measurements obtained during the RI indicated that the combined radon flux level from Areas 1 and 2 slightly exceeded (21.8 pCi/m^2s) the standard of 20 pCi/m^2s (which is applied as an average to the entire area of interest) established pursuant to UMTRCA for radon emissions from residual radioactive materials from inactive uranium processing sites (40 CFR 192.02(b)). The presence of radon emissions from OU-1 indicates that these emissions may be a migration pathway of concern; however, testing performed during the RI indicated that the overall radon emissions from OU-1 are below the standard.

Fugitive dust monitoring was conducted at one location in Area 1 and one location in Area 2. Sampling for fugitive dust was performed at locations that contained some of the highest radionuclide concentrations in surface soil samples. Results of the fugitive dust monitoring indicated that, although fugitive dust emissions may be a potential pathway, the levels of radionuclides detected in the fugitive dust samples indicated that it is not a significant pathway for radionuclide migration from Areas 1 and 2 (EMSI, 2000). Fugitive dust is not considered a significant pathway for radionuclide migration under current conditions because the surfaces of Areas 1 and 2 are well vegetated, thereby reducing or preventing release of significant amounts fugitive dust.

2.4 Groundwater Conditions

This section describes groundwater conditions and the nature and extent of radionuclide and chemical occurrences in groundwater near Areas 1 and 2. This information was originally presented in the RI and FS reports (EMSI, 2000 and 2006) and is repeated in this SFS because it was used to estimate the scope of the groundwater monitoring programs included in each of the three remedial alternatives evaluated in Section 6.

Brief descriptions of the geology and hydrogeology of the site are provided in subsections 2.4.1 and 2.4.2. More detailed information on the geology and hydrogeology is set out in the OU-1 and OU-2 RI reports (EMSI, 2000 and Herst & Associates, 2005). The nature and extent of radiological and chemical constituent occurrences in groundwater near Areas 1 and 2 are described in Sections 2.4.3 and 2.4.4 below. Additional information regarding the nature and extent of contamination associated with Areas 1 and 2 is presented in the OU-1 RI report (EMSI, 2000).

2.4.1 Geology

The geology of the landfill area consists of Paleozoic-age sedimentary rocks overlying Pre-Cambrian age igneous and metamorphic rocks (EMSI, 2000). The Paleozoic bedrock is overlain by unconsolidated alluvial and loess deposits of recent (Holocene) age (EMSI, 2000).

The uppermost bedrock units near the landfill consist of Mississippian age limestone and dolomite with inter-bedded shale and siltstone layers of the Meramecian Series. The Meramecian Series consists of several formations, including the Warsaw Formation, the Salem Formation, and the St. Louis Formation, that are present in the area of the West Lake Landfill.

The bedrock formations are overlain by Holocene-age alluvial deposits associated with the Missouri River and upland loess and glacial till deposits of Pleistocene age. The alluvial deposits range in thickness from 0 to 150 feet (Herst & Associates, 2005). Loessial deposits are up to 100 feet thick (Herst & Associates, 2005). Glacial till deposits occur less frequently in the area of the site, but where present occur in layers up to 55 feet thick (Herst & Associates, 2005). The loess is an aeolian (windblown) deposit consisting primarily of silt and clay. Relatively thin loess deposits were reported to be present near the eastern portion of the site (Herst & Associates, 2005). The alluvial deposits typically consist of fine-grained (clay and silt) overbank deposits overlying poorly sorted, coarse-grained (sand and gravel) channel deposits associated with historic flooding and river meanders of the Missouri River. The depth to bedrock and the thickness of the alluvial deposits increases to the west of the site where the thickness of alluvium (depth to bedrock) was reported to be 120 feet (Herst & Associates, 2005).

The St. Louis area is part of the New Madrid Seismic Impact zone. There is no indication that any Holocene-age faults are present at the site. Extensive geologic mapping of the quarry walls in the area of the inactive Bridgeton Sanitary Landfill performed as part of the OU-2 RI did not identify the presence of any faults in the bedrock units in that area (Golder Associates, 1996).

2.4.2 Hydrogeology

Continuous groundwater is present in the unconsolidated alluvial deposits beneath and outside of Areas 1 and 2 and in the bedrock formations located beneath the site. Detailed discussions of the hydrogeology of the alluvial groundwater and bedrock groundwater are presented in the OU-1 and OU-2 RI reports (EMSI, 2000 and Herst & Associates, 2005). A summary of pertinent information regarding the hydrogeology of the alluvial deposits in the vicinity of the landfill is presented below.

Alluvial deposits of varying thickness are present beneath Areas 1 and 2. The landfill debris varies in thickness from 5 to 56 feet in Areas 1 and 2, with an average thickness of approximately 36 feet in Area 1 and approximately 30 feet in Area 2. The underlying alluvium increases in thickness from east to west beneath Area 1. The alluvial thickness beneath the southeastern portion of Area 1 is less than 5 feet (bottom elevation of 420 feet AMSL), while the thickness along the northwestern edge of Area 1 is approximately 80 feet (bottom elevation of

370 feet AMSL). The thickness of the alluvial deposits beneath Area 2 is fairly uniform at approximately 100 feet (bottom elevation of 335 feet AMSL).

Water level measurements performed during the RI indicated that the water level elevations beneath and adjacent to Areas 1 and 2 were consistent with only approximately one-half foot of variability in the water levels beneath these areas during any given set of measurements. Seasonally, the water levels varied by approximately 5 feet beneath and adjacent to Areas 1 and 2 from approximately 429 feet AMSL in April 1995 to 434 feet AMSL in July 1995. These water level elevations corresponded to depth-to-groundwater in these areas of at least 35-40 feet bgs and generally nearer to 50 feet bgs beneath Areas 1 and 2. Consequently, groundwater was generally encountered beneath Areas 1 and 2 in the underlying alluvium near or below the base of the landfill debris. The depth to groundwater in areas adjacent to Areas 1 and 2 ranged from 10 to 20 feet bgs, or in some instances along St. Charles Rock Road and near the Earth City Flood Control basin to depths of 5 to 10 feet bgs. As the measured elevations of groundwater occurrences in these areas are similar to the elevation of groundwater beneath Areas 1 and 2 (*i.e.*, on the order of 429 to 434 feet AMSL), the variations in depths-to-groundwater between Areas 1 and 2 and adjacent properties result from the greater height of the surface of Areas 1 and 2 as compared to the elevation of the adjacent properties.

Monthly groundwater levels measured in various landfill wells during the RI indicated that groundwater generally occurs only in the underlying alluvium at or below the base of the landfill materials, with the exception of the localized perched water conditions encountered in isolated areas within the landfill. Groundwater elevations varied seasonally and were generally lowest during the fall and winter months (September through March) and highest during the spring and summer months (April through August).

The regional direction of groundwater flow is generally northerly within the Missouri River alluvial valley, parallel or sub-parallel to the river alignment. The RI data indicate that only a very small amount of difference (less than one foot) exists in the water table surface beneath the landfill, making interpretations of the directions of groundwater flow based only on water level data difficult. Based on the water level data, the direction of groundwater flow beneath Area 1 appears to be generally to the south toward the formerly active sanitary landfill. This southerly direction of groundwater flow is due to ongoing leachate extraction from the formerly active sanitary landfill that removes approximately 200,000 gallons per day (Herst & Associates, 2005), resulting in convergent directional flow. Water level elevations beneath Area 2 displayed areal differences of less than one foot indicating the presence of a very flat water table beneath this area. Based on the slight differences in groundwater levels, the direction of groundwater flow beneath Area 2 would be to the west/northwest toward the Missouri River.

No public water supply wells are present near the landfill. An inventory of private wells in the area of the landfill is presented in the RI report (EMSI, 2000). The results of this inventory indicated that the nearest private well reportedly used as a drinking water source is located one mile to the north of the landfill (Foth & Van Dyke, 1989). An updated well inventory was prepared as part of the RI for OU-2 (Herst & Associates, 2005). This evaluation included an inventory of both registered and unregistered wells located within approximately five miles of the West Lake Landfill. The closest registered well is located approximately one mile northeast of the landfill. This well was reportedly drilled to a depth of 245 feet, which indicates a bedrock completion. Regional groundwater flow in the vicinity of the landfill is to the northwest, towards the Missouri River. Accordingly, the nearest registered well is not downgradient of the landfill. The closest registered well that appears to be completed in alluvium is approximately 2.5 miles south (upgradient) of the landfill.

2.4.3 Occurrences of Radionuclides in Groundwater

Groundwater monitoring was performed during 1995, 1996 and 1997 as part of the RI and during 2004 in conjunction with the FS. The levels of radionuclides detected in groundwater beneath and adjacent to Areas 1 and 2 generally were below both background levels and the State of Missouri Maximum Contaminant Levels (MCLs) for drinking water systems. Dissolved radium was detected in only one well D-6 (Figure 16) at a concentration (5.4 pCi/l) that was slightly above the MCL of 5 picocuries per liter (pCi/l) for the total of radium-226 and -228 isotopes. Total radium was detected in two OU-1 alluvial wells: well D-3 which is located adjacent to Area 1; and well D-6 which is located adjacent to Area 2 (Figure 17), both at levels slightly greater than the MCL (7.75 and 5.98 pCi/l, respectively). Total radium was also detected at levels slightly above the MCL in three OU-2 bedrock monitoring wells..

Well D-6 is located in the Buffer Zone immediately adjacent to the west side of Area 2. Neither total nor dissolved radium have ever been detected in shallow wells co-located with well D-6 or in wells located upgradient of well D-6. Based on all available data, the RI concluded that the source of the radium levels in well D-6 was possibly the result of cross-contamination: drag-down of shallow impacted soil during drilling activities.

Well D-3 is located in the western portion of Area 1. Radium was not detected in well D-3 at levels above the MCL during sampling performed for the RI; however, it was detected above the MCL during sampling performed in March and May of 2004 in conjunction with the FS. Radium was not detected at levels above or even close to the MCL in wells S-5 and I-4, completed at shallower depths at the same location as D-3, nor in any other wells in and around Area 1. This suggests that the occurrences of radium in well D-3 are isolated and not extensive.

Groundwater sampling performed for OU-2 detected total radium at levels above the MCL in three St. Louis Limestone bedrock monitoring wells (PZ-113-SS, PZ-106-SS, and PZ-1201-SS). PZ-113-SS is located to the southwest of the landfill scale/office trailer (Figure 17) and is completed at a depth of 148 to 158 feet below ground surface. This well reportedly contained 5.8 pCi/l of total radium. Total radium levels in the shallow and deep alluvial wells located adjacent to this bedrock wells did not exceed the MCL. Bedrock wells PZ-106-SS located in the southwestern portion of the site, and PZ-1201-SS located in the southern portion of the site (Figure 17) reportedly contained total radium levels of 6.33 and 5.74 pCi/l, respectively. These wells are also completed in the St. Louis Limestone at depths of approximately 155 to 165 and 138 to 147 feet below ground surface, respectively. These wells are located between 2,000 and 2,500 feet to the south of Area 1 and neither dissolved nor total radium was detected in any of the monitoring wells located between Area 1 and these two OU-2 monitoring wells. These wells are located on the margins of the South Quarry Pit landfill and as such are hydraulically isolated from Areas 1 and 2 by the groundwater/leachate extraction from the Quarry Pits.

Groundwater monitoring performed during the RI and FS did not identify any wells containing uranium at levels close to or above the MCL. Uranium possesses a greater solubility than that of other radionuclides. Uranium isotopes (U-238 and U-234) have been detected in groundwater samples obtained from monitoring wells at the site at levels of approximately 5 pCi/l or less. Uranium has also been detected in upgradient background wells at levels up to approximately 2 pCi/l. The levels of uranium detected at the site are below the 30 micrograms per liter (ug/l) federal and state MCLs for uranium (which is equivalent to approximately 10 pCi/l for U-238 and approximately 191,000 pCi/l for U-234) (40 CFR Part 141.66 and 10 CSR 60-4.060).

Based on the monitoring data obtained during the RI, potential leaching of radionuclides into groundwater and subsequent transport in groundwater to offsite areas was not considered to be a significant migration pathway. Although slightly elevated levels of radionuclides have been detected in a few isolated wells completed within or adjacent to the OU-1 portions of the landfill, there is no plume or continuous area of radionuclide occurrences in groundwater at concentrations above regulatory standards or risk-based levels at the West Lake Landfill. The lack of a plume of radionuclide contamination in groundwater at the site is consistent with the relatively low solubility of most radionuclides in water and their affinity to adsorb onto the soil matrix.

2.4.4 Occurrences of Chemical Constituents in Groundwater

With the exception of the naturally occurring trace metals, only isolated detections of non-radiological constituents were found at low concentrations in wells sampled in or near Areas 1 and 2 (*i.e.*, these constituents were only detected in samples obtained from a single well or in a some instances in only a few wells). Being naturally occurring, trace metals were detected in a greater number of wells, particularly in the unfiltered samples which contained suspended sediment.

Arsenic was the most frequently detected trace metal and was found in approximately one-half of the wells sampled. Arsenic was detected at concentrations ranging from 10 to 420 ug/l. Occurrences of dissolved and total arsenic concentrations greater than its MCL (10 ug/l) were identified near Area 1 and Area 2 as well as near the closed demolition landfill and the inactive sanitary landfill (Figures 18 and 19).

Lead was not detected in any of the filtered water samples at concentrations above its MCL (Figure 20). Lead was detected in almost all unfiltered samples at concentrations ranging from 3.1 to 70 ppb. Lead occurrences above its MCL of 0.015 mg/l (15 ug/l) were found in wells located near both Area 1 and Area 2 (Figure 21).

Benzene was detected at concentrations greater than its MCL (5 ug/l) in several wells located along the west side of the inactive sanitary landfill and near the southwest corner of Area 2. Benzene was either not detected or not detected at concentrations greater than its MCL at other portions of Area 2, near Area 1, or anywhere else at the site (Figure 22).

Chlorobenzene was detected in well D-14 (170 ug/l) during the RI and in well D-85 (120 ug/l) during the additional sampling performed during the FS at levels above its MCL (100 ug/l) (Figure 23). Chlorobenzene was detected in a few other wells near Area 1 and in single wells near the closed demolition landfill and the inactive sanitary landfill at concentrations below its MCL.

Due to the limited number of detections and the widespread locations where non-radiological contaminants have been detected, no discernable pattern of non-radiological occurrences in groundwater could be identified. The discontinuous nature of the occurrences of non-radiological contaminants in groundwater indicates that a plume or continuous area of non-radiological groundwater contamination does not exist beneath the landfill.

2.5 Baseline Risk Assessment

A Baseline Risk Assessment (BRA) was performed for Areas 1 and 2 and the adjacent Buffer Zone/Crossroad Property (Auxier & Associates, 2000). The BRA included both a quantitative human health risk assessment and a screening level ecological risk assessment. Because the SFS evaluation of remedial alternatives are based in part on evaluations of potential risk, a brief summary of the conclusions from the BRA regarding the baseline risks for potential current and future exposures are presented below.

2.5.1 Human Health Risk Assessment

The BRA identified three radionuclides (U-238, U-235, and Th-232) and their associated daughter products (U-234, Th-230, Ra-226, Pb-210, and Pa-231) for a total of eight radiological Chemicals of Potential Concern (CoPCs) based on their relatively long half-lives. Based on a review of the site data and a toxicity characteristics screening, three trace metals (arsenic, lead, and uranium as a metal) and one polychlorinated biphenyl (Aroclor 1254) were also selected as CoPCs for the human health risk assessment. Using a comparison to EPA screening values, other trace metals and organic compounds detected in the soil samples obtained from Areas 1 and 2 were not selected as CoPCs because the maximum detected values of these constituents at the site did not exceed their respective risk-based screening levels.

Several potential human receptors were identified and evaluated in the BRA, including a groundskeeper currently working adjacent to Areas 1 and 2, a groundskeeper who may work on Areas 1 and 2 in the future, and a current or future groundskeeper working offsite on the Buffer Zone/Crossroad Property. Potential receptors associated with possible parking, open storage or other uses of Areas 1 and 2 ancillary to potential future commercial/industrial uses in areas adjacent to Areas 1 and 2 were also evaluated. The potential pathways by which these receptors could potentially be exposed to contaminants present in Areas 1 and 2 included exposure to external radiation, inhalation of radon gas or dust containing radionuclides or other constituents, dermal contact with impacted materials, or incidental ingestion of soil containing radionuclides or other chemicals.

Although groundwater within the alluvial aquifer in the area of the site may be potentially usable, potential exposure to radionuclides through consumption of groundwater is not considered to be viable pathway of concern. Groundwater use from beneath the entirety of the 200 acre West Lake Landfill site is prohibited by deed restrictions and environmental covenants. The nearest drinking water well is a bedrock well located one mile to the northeast of the site. All of the local businesses and residences in the area use municipal drinking water supplies. Therefore, there currently is no use of shallow groundwater in the area of the site and none is expected to occur in the future. In addition, as discussed above, groundwater monitoring to date has shown only isolated occurrences of chemical and radiological constituents at levels slightly above MCLs.

Table 4 presents a summary of the results of the risk assessment evaluations. Based upon an assessment of the carcinogenic potential and systemic toxic effects associated with each of the CoPCs, combined with the exposure assessment scenarios, potential risks were calculated for each potential receptor. These calculations indicated that the potential exposure to external radiation for the hypothetical groundskeeper who currently could work adjacent to Areas 1 and 2 resulted in a carcinogenic risk of 1×10^{-5} for Area 1 and 4×10^{-5} for Area 2. These calculated risks were within the generally acceptable risk range used by EPA of 10^{-4} to 10^{-6}. No adverse systemic (non-carcinogenic) effects to this hypothetical groundskeeper were identified. The potential risks to a hypothetical groundskeeper working on the Buffer Zone/Crossroad Property adjacent to Area 2 resulted in a carcinogenic risk of 6×10^{-7}, which is also within the generally acceptable risk range used by EPA of 10^{-4} to 10^{-6}.

The potential risks to a future onsite groundskeeper working in Areas 1 and 2 were calculated at 6×10^{-5} for Area 1 and 2×10^{-4} for Area 2. This calculated risk for a future onsite groundskeeper working in Area 2 is at the upper end of or slightly exceeds the generally acceptable risk range used by EPA of 10^{-4} to 10^{-6}. As with the current exposure scenario, the calculated risk for a possible future exposure for a hypothetical offsite groundskeeper receptor (2×10^{-6}) was within EPA's accepted risk range.

Possible future uses of Areas 1 and 2 for parking lots, open storage, or employee recreation ancillary to potential future commercial or industrial uses of portions of the landfill adjacent to Areas 1 and 2 were also addressed. The potential risks to a future user of a building that might be constructed adjacent to Area 1 or 2 (land use covenants prevent construction of a building on Area 1 or 2) were calculated at 1×10^{-5} for Area 1 and 4×10^{-5} for Area 2, both of which are within the accepted risk range of 10^{-4} to 10^{-6} used by EPA. The potential risks to a future worker who may be involved in outdoor storage uses on Area 1 or 2 were calculated to be 1×10^{-4} for Area 1 and 4×10^{-4} for Area 2. This calculated risk for a future worker involved in outdoor storage in Area 2 is at the upper end of or slightly exceeds the generally acceptable risk range used by EPA of 10^{-4} to 10^{-6}.

Non-radiological CoPCs are not projected to cause unacceptable risks under either the current or future exposure scenarios.

Uncertainties associated with the human health risk assessment were addressed through the use of conservative assumptions likely resulting in an overestimate of the actual risks that may occur. Although the calculated potential risk levels, for the most part, are within the accepted risk range of 10^{-4} to 10^{-6} used by EPA, the calculated risks from radiological CoPCs for some of the potential future exposure scenarios are at the upper end of, or slightly exceed the generally acceptable risk range used by EPA.

Consistent with the current and reasonably expected future uses of the property, industrial, commercial and recreational future uses were considered in the BRA. The calculated estimates of the potential risks were also based on exposure scenarios that were limited in part by existing restrictions on current and potential future land uses (institutional controls) at the Site. These evaluations of potential current and future risks were based on the assumption that the existing land use restrictions remain in place because these restrictions cannot be revoked or modified without the consent of EPA, MDNR and future site owners. Consequently, the risk assessment incorporates a No Further Action scenario (land use controls previously instituted) rather than a No Action scenario. Unrestricted use of the site, including possible future residential use, was not evaluated as part of the BRA due to the prior industrial and landfill uses of the site, the presence of land use covenants limiting future use, and requirements associated with post-closure regulations for solid waste landfills. The BRA included only those reasonably anticipated future uses.

The overall conclusion of the BRA is that the presence of radionuclides and non-radiological contaminants in OU-1 would pose an unacceptable risk to public health if institutional controls and the physical integrity of the disposal areas were not maintained or if future site uses change.

2.5.2 Ecological Risk Assessment

The BRA included a screening level ecological risk assessment (ERA). There is a significant amount of uncertainty associated with the actual potential for ecological impacts. A screening level risk assessment deals with such uncertainty by using highly conservative assumptions when estimating potential risks, thus intentionally overestimating the potential risks significantly, sometimes by several orders of magnitude. Thus, while the screening level ERA indicates that a potential ecological risk may exist, the ERA also cautions that this does not mean that site-related chemicals are actually impacting ecological receptors.

After assessing these uncertainties, the ERA notes that Areas 1 and 2 currently support vegetative and animal communities with no observable impact to the plant communities. Vegetation in Areas 1 and 2 consists primarily of old field community (primarily grasses and herbaceous species with woody species present along the landfill berm in Area 2), interspersed with small areas of hydrophilic (herbaceous) vegetation within small depressions. Indications of the presence of deer, rabbits, coyotes and/or red foxes as well as various bird species were observed during the RI investigations. The ERA notes that the existing plant and animal communities are located within areas of landfill operations, and concludes that the ecosystems present at the landfill are the result of existing institutional controls and other limitations on land use within or adjacent to OU-1 that have allowed field succession to take place.

The screening level risk assessment concluded that ecological receptors may be at risk from exposure to chemical contaminants, especially metals, in Areas 1 and 2. Small burrowing animals may be at risk from exposure to radioactive materials in Area 2. Metals present in soils may adversely affect plants and soil invertebrates. However, both Areas 1 and 2 currently support vegetative and animal communities and there is no observable impact to the health of the plant communities.

3 POTENTIAL ARARS AND REMEDIAL ACTION OBJECTIVES

This section of the SFS describes other environmental laws which may be potentially applicable or relevant and appropriate (ARARs) to a remedy. This section also describes additional requirements associated with off-site disposal. Remedial action objectives to be addressed by the remedial alternatives are also presented in this section. Cleanup levels that would allow for unrestricted use of the site relative to radionuclide occurrences are developed in this section based on chemical-specific ARARs and site-specific risk-related factors.

3.1 Potential Applicable or Relevant and Appropriate Requirements

CERCLA remedial actions must be analyzed for compliance with ARARs. ARARs are divided into three categories:

- Chemical-specific ARARs;
- Location-specific ARARs; and
- Action-specific ARARs.

Compliance with ARARs is one of the criteria used to evaluate potential remedial alternatives during the FS. Descriptions of ARARs, the criteria used to identify whether a regulation is potentially applicable or relevant and appropriate, and identification of potential ARARs for OU-1 are provided in the FS report (EMSI, 2006). The following sections provide additional evaluation of ARARs as they relate to the "complete rad removal" alternatives.

3.1.1 Potential Chemical-Specific ARARs

Chemical-specific ARARs include those laws and requirements that regulate the release to the environment of materials possessing certain chemical or physical characteristics, or containing specified chemical compounds. Evaluations of potential chemical-specific ARARs for West Lake Landfill OU-1 are presented in the FS report (EMSI, 2006). The results of these evaluations are summarized on Table 5 and are discussed below. No additional chemical-specific ARARs have been identified as a result of work performed for this SFS or relative to the additional evaluations of the "complete rad removal" alternatives.

3.1.1.1 Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings

The FS report (EMSI, 2006) includes an evaluation of the health and environmental protection standards promulgated under the Uranium Mill Tailings Radiation Control Act (UMTRCA) (40 CFR 192) for potential chemical- and action-specific requirements. Specifically, the FS addresses requirements relative to standards for cleanup of contaminated land and buildings (40

CFR 192 Subpart B), the standards for radon emissions from closed tailing impoundments (40 CFR 192 Subpart A), and the groundwater protection standards (40 CFR 192 Subparts A and B) promulgated under these regulations. Additional discussion of these standards as they relate to the "complete rad removal" alternatives is presented below.

3.1.1.2 Standards for Cleanup of Contaminated Land – 40 CFR 192.12(a)

Requirements relative to standards for cleanup of land contaminated with residual radioactive materials from an inactive uranium processing site (40 CFR 192.12(a)) are evaluated as potential chemical-specific ARARs in the FS (EMSI, 2006). The FS determined that these standards are not applicable to West Lake Landfill because the landfill is not an UMTRCA designated uranium processing facility. The evaluation also determined that these requirements are not relevant and appropriate to OU-1 Areas 1 and 2 because the waste materials in Areas 1 and 2 are not similar to uranium mill tailings or to the situations addressed by the uranium mill tailings standards. The FS did conclude that the portion of these regulations addressing clean up levels for off-site impacted soil may be potentially relevant and appropriate criteria for remedial action, if any, involving excavation of radiologically impacted soil on the Buffer Zone/Crossroad properties.

As previously discussed, EPA has defined "complete rad removal" to mean attainment of the risk-based radiological cleanup levels specified in OSWER directives 9200.4-25 and 9200.4-18 (EPA, 1998a and 1997a). OSWER Directive 9200.4-25, titled "Use of Soil Cleanup Criteria in 40 CFR Part 192 as Remediation Goals for CERCLA Sites" (EPA, 1998a) (the CERCLA UMTRCA guidance) discusses the potential applicability, relevance and appropriateness, and use of the soil cleanup standards established pursuant to UMTRCA at CERCLA sites.

Pursuant to the CERCLA UMTRCA guidance, EPA has determined that the surface soil standard for cleanup of soil at UMTRCA sites (5 pCi/g plus background for combined Ra-226 plus Ra-228 or combined Th-230 plus Th-232) would only be applicable to cleanup of uranium mill tailings at the 24 uranium mill tailing sites designated under Section 102(a)(1) of UMTRCA (Title I sites). West Lake Landfill is not a Title I site and therefore these standards are not applicable to any remedial actions for the West Lake Landfill.

The CERCLA UMTRCA guidance further indicates that for CERCLA sites where subsurface contamination exists at a level between 5 pCi/g and 15 pCi/g averaged over areas of 100 square meters, conditions are not considered to be sufficiently similar to an UMTRCA site to warrant use of the UMTRCA subsurface soil standard of 15 pCi/g over background as a relevant and appropriate requirement. Instead, EPA recommends 5 pCi/g as a suitable subsurface cleanup level so long as a site-specific risk assessment demonstrates that 5 pCi/g is protective. EPA further notes that when the UMTRCA subsurface cleanup standards are found to be relevant and appropriate requirements for a CERCLA site, the 5 pCi/g standard should be applied to both the combined levels of radium-226 and radium-228, and to the combined level of thorium-230 and thorium-232, in order to provide reasonable assurance that the preceding radionuclides in the series would not be left behind at levels that would permit the combined radium activity to build-up to levels exceeding 5 pCi/g after completion of the response action.

The CERCLA UMTRCA guidance indicates that the UMTRCA standards may be relevant and appropriate to CERCLA sites which contain soil contaminated with radium-226, radium-228 and/or thorium isotopes. Although the radiologically-impacted materials at OU-1 contain radium-226, radium-228 and thorium, the UMTRCA standards are not relevant and appropriate because they do not address specific conditions which are sufficiently similar to the West Lake Landfill circumstances.

The UMTRCA mine tailings standards established pursuant to 40 CFR 192.12(a) were not developed or intended to address conditions at solid waste disposal units. Furthermore, as indicated in the CERCLA UMTRCA guidance, "The purpose of these standards was to limit the risk from inhalation of radon decay products in houses built on land contaminated with tailings, and to limit gamma radiation exposure of people using contaminated land." The West Lake Landfill is a solid waste landfill that is subject to controls on future land use which will prevent the construction of houses over the waste materials, regardless of whether radiologically-impacted materials are present or not. Institutional controls to restrict residential use of the property have previously been developed and implemented by the owners of the West Lake Landfill properties, including OU-1, OU-2 and other portions of the landfill properties. In addition, implementation of institutional controls to restrict future use of solid waste disposal sites is required by the Missouri Solid Waste Regulations (10 CSR 80-3.010(20)(C)2.C.II). Furthermore, even if a "complete rad removal" alternative were to be implemented, non-radiological waste materials would still remain on site, thereby requiring institutional controls as required for Subtitle D landfills which would prevent construction of houses on the landfill (EPA SOW, 2010b). Therefore, the standards established pursuant to 40 CFR 192.12(a) do not address situations sufficiently similar to those present within the solid waste management units at the West Lake Landfill and so the standards are neither relevant nor appropriate.

Although the standards established under 40 CFR 192.12(a) are neither applicable nor relevant and appropriate to the landfill Areas 1 and 2 at the West Lake site, they do represent standards that have been established by EPA for use in the SFS to evaluate the "complete rad removal" alternatives. For purposes of the SFS, the UMTRCA criteria are used to develop cleanup levels for the evaluation of the "complete rad removal" alternatives (see prior discussion in Section 2.2.2).

Finally, and as stated in the CERCLA UMTRCA guidance, the standards established pursuant to 40 CFR 192.12(a) do address cleanup of so-called "vicinity" sites at which cleanup to unrestricted use is authorized for specified off-site properties. Because these "vicinity" sites are related solely to the 24 UMTRCA Title I sites, they are not applicable to any remedial actions at the West Lake Landfill. Overland gamma surveys and surface soil sampling at Areas 1 and 2 indicated that soil containing radionuclides eroded from the surface of Area 2 and was deposited on the surface of the adjacent Buffer Zone and a portion of the Crossroad Property. Subsequent site development at the Crossroad Property resulted in regrading and placement of surface soil previously located on the Crossroad Property onto the Buffer Zone. Current conditions relative to occurrences of radionuclides at the Buffer Zone and Crossroad Property are unknown but are to be the subject of additional investigation and sampling as part of the ROD-selected remedy for OU-1. Remaining occurrences of radionuclides, if present, on these properties would represent a condition that may be sufficiently similar to the conditions associated with the "vicinity" sites addressed by the UMTRCA regulations. As such, the standards established pursuant to 40 CFR 192.12(a) may be relevant and appropriate to any remedial actions taken to address radionuclides in soil at the Buffer Zone/Crossroad Property.

3.1.1.3 Radon Emissions Standards – 40 CFR 192.02(b)

The UMTRCA regulations which establish standards of performance (radon emissions standards) for cover systems installed over radiologically impacted materials (40 CFR 192.02(b)) may potentially be relevant and appropriate chemical-specific criteria for the design of a cover system for Areas 1 and 2 pursuant to the ROD remedy, and for design of a cover system for the engineered on-site disposal cell included in the scope of the "complete rad removal" with on-site disposal alternative.

The UMTRCA regulations state that engineered controls of residual radioactive materials and their listed constituents shall be designed to provide reasonable assurance that release of radon-222 from residual radioactive material to the atmosphere will not exceed an average release rate of 20 pCi/m^2s (40 C.F.R. § 192.02 (b)(1)). For inactive sites, this standard can be satisfied alternatively by providing reasonable assurance that releases of radon-222 from residual radioactive material to the atmosphere will not increase the annual average concentration of radon-222 in air at or above any location outside the disposal site by more than 0.5pCi/L (40 C.F.R. § 192.02(b)(2)).

Radon monitoring was performed as part of the RI for OU-1. These results indicate that the overall radon emission from Areas 1 and 2 (21.8 pCi/m^2s based on the average of 50 test locations) slightly exceed the 20 pCi/m^2s radon emission flux standard as a result of the presence of three high value samples. The presence of radon at levels in the range of the UMTRCA radon standard indicates that this standard may potentially be relevant and appropriate for OU-1. Remedial actions involving placement of an engineered cover pursuant to the ROD remedy or construction of a new, engineered on-site disposal cell under the "complete rad removal" with on-site disposal alternative should meet the radon emission standard promulgated under UMTRCA. Demonstration of compliance with this standard would be based on a single monitoring event performed upon completion of construction of the new landfill cover pursuant to the ROD remedy, or upon closure of the new on-site disposal cell pursuant to the "complete rad removal" with on-site disposal alternative evaluated in this SFS.

The UMTRCA standards for radon emissions (40 CFR 192.02(b)(2) and 40 CFR 192.12(b)(1)) represent potentially relevant and appropriate requirements for radon monitoring relative to occupied buildings. Specifically, radon emissions from the site should not increase the annual average concentration of radon-222 in air at or above any location outside of the disposal site by more than 0.5pCi/L (40 CFR 192.02(b)(2)). In addition, the objective of the remedial action shall be, and reasonable effort shall be made to achieve, an annual average (or equivalent) radon decay product concentration (including background) not to exceed a 0.02 Working Level (WL) (40 CFR 192.12(b)(1)). In any case, the radon decay product concentration (including background) shall not exceed a 0.03 WL (40 CFR 192.12(b)(1)). A Working Level is a unit of measure for documenting exposure to radon decay products, which are termed "daughter products" or simply "daughters." One Working Level is defined as any combination of short lived daughters in one liter of air which will ultimately release 1.3E5 MeV (million electron volts) of alpha by decay through polonium 214. One Working Level is equal to approximately 200 picocuries per liter.

Radon monitoring results from the landfill gas probes around Area 1 and 2 under the ROD-selected remedy or around the new on-site disposal cell under the "complete rad removal" with on-site disposal alternative would be compared to the EPA guidance level of 4 pCi/l for residential structures (EPA, 2009b), which is equivalent to the 0.02 WL remedial action objective established by UMTRCA (40 CFR 192.12(b)(1)). Use of this value is protective and conservative because existing institutional controls prohibit residential use on the landfill property and the current and reasonably anticipated future uses of properties adjacent to the landfill are commercial and industrial. Because monitoring would be performed along the margins of Areas 1 and 2 so as to ensure that the levels of radon did not exceed levels protective for use of habitable or occupied buildings, there would be no need to perform indoor air monitoring in buildings located offsite.

3.1.1.4 Groundwater Protection Standards – 40 CFR 192 Subparts A and B

The concentration limits established under the groundwater protection standard of the UMTRCA regulations (40 CFR 192.02(c)(3)) present potentially relevant and appropriate standards for groundwater quality at the site. The uranium concentrations observed in groundwater during the RI did not approach the UMTRCA standard of 30 pCi/L for uranium. As for radium, with the exception of the total radium concentration in wells D-3 and D-6 (see discussion in section 2.3.3 of the FS (EMSI, 2006)), which slightly exceeded the standard of 5 pCi/L, the radium concentrations observed during the RI were also less than the standard established by these regulations. UMTRCA also regulates trace metals at mill tailing sites. For trace metals, there were some instances where the total (unfiltered) samples exceeded the UMTRCA standards; however, with the exception of the arsenic levels in two wells (MW-F3 and S-84), analyses of the dissolved (filtered) fraction of these samples did not exceed the standards for the trace metals.

Based on the presence of radioactive materials at OU-1 and the potential for leaching trace metals to groundwater, the groundwater protection standards (40 CFR 192.02(c)(3) and (4)) and monitoring requirements (40 CFR 192.03) of the UMTRCA regulations are potentially relevant and appropriate to the ROD remedy. These standards would also be potentially relevant and appropriate to the engineered on-site disposal cell included in the scope of the "complete rad removal" with on-site disposal alternative.

3.1.1.5 Other Potential Chemical-Specific ARARs

Other potential chemical-specific ARARs are identified and evaluated in the FS (EMSI, 2006) and are summarized on Table 5. Some of these ARARs were determined to be potentially applicable or relevant and appropriate to OU-1, and in particular to the ROD remedy. These include the following:

- The National Emissions Standards for Hazardous Air Pollutants (NESHAPs) standards for radon-222 emissions (40 CFR 61 Subpart T);
- The Missouri Radiation Regulations for Protection Against Ionizing Radiation (19 CSR 20-10.040); and
- Missouri Maximum Contaminant Levels (10 CSR Division 60 Chapter 4)

3.1.1.6 National Emissions Standards for Hazardous Air Pollutants

The NESHAPs include standards for radon-222 emissions to ambient air from designated uranium mill tailings piles that are no longer operational. Specifically, radon-222 emissions from inactive uranium mill tailings piles should not exceed 20 pCi/m^2s (40 CFR 61 Subpart T). Because West Lake Landfill OU-1 is not a designated uranium mill tailings site, this requirement is not applicable. Insofar as a portion of the waste materials in West Lake Landfill OU-1 do emit radon, however, the radon-222 NESHAP is considered to be potentially relevant and appropriate. These NESHAP standards are relevant and appropriate to the ROD remedy and for the engineered on-site disposal cell pursuant to the "complete rad removal" with on-site disposal alternative.

The "complete rad removal" with off-site disposal alternative includes removal of all RIM above the cleanup standards from Areas 1 and 2 and from the Buffer Zone/Crossroad Property, if necessary, such that additional engineering and institutional controls would not be required due to the radiological content of Areas 1 and 2. As the RIM would be disposed off-site, there would be no RIM left at the site above the cleanup standards. Therefore, the radon NESHAP is not considered to be a relevant and appropriate requirement for this offsite alternative.

3.1.1.7 Missouri Radiation Regulations for Protection Against Ionizing Radiation

The Missouri Radiation Regulations for Protection Against Ionizing Radiation (19 CSR 20-10.040) contain chemical-specific standards that under certain circumstances may be applicable or relevant and appropriate requirements for OU-1. The maximum permissible exposure limits standards for ionizing radiation are applicable to machines and materials that are sources of ionizing radiation; they are not applicable to waste materials such as those found in OU-1. These regulations establish a maximum permissible dose for ionizing radiation of 5 millirem (mrem) per year or 3 mrem per quarter to the entire body. As these regulations do provide standards for protection from radiation, they are potentially relevant and appropriate to the waste materials in OU-1.

Specifically, those portions of the regulations that address protection from radiation for persons inside of a controlled area may be relevant and appropriate to the protection of workers inside of Areas 1 and 2 during a remedial action. Similarly, those portions of the regulations that address protection from radiation for persons outside of a controlled area may be relevant and appropriate to the protection of other workers at the site outside of Areas 1 and 2 and for the general public during a remedial action.

The regulations also define maximum permissible exposure limits for occurrences of specific radionuclides in air at levels above background outside of controlled areas. These requirements are considered to be potentially applicable for protection of the public during implementation of a remedial action. Specifically, these regulations would require perimeter air monitoring during implementation of a remedial action.

3.1.1.8 Missouri Maximum Contaminant Levels

EPA has established Maximum Contaminant Levels (MCLs) and Maximum Contaminant Level Goals (MCLGs) pursuant to the Safe Drinking Water Act (40 CFR Part 141, Subparts F and G). Implementation of the requirements of the Safe Drinking Water Act in Missouri has been delegated to the State of Missouri and is the subject of regulations promulgated by the MDNR.

These regulations (10 CSR Division 60 Chapter 4) establish MCLs for public drinking water systems. As the West Lake Landfill does not operate a public drinking water system, these regulations are not applicable to the remedial actions under consideration for OU-1. Because groundwater beneath the West Lake Landfill is part of a larger alluvial aquifer which could potentially be used for drinking water by private and/or public wells outside of the West Lake Landfill, these regulations are potentially relevant to the remedial actions evaluated under this SFS. These regulations are potentially appropriate for remedial actions for OU-1 insofar as they identify MCLs for certain chemicals in drinking water, and some of the chemical constituents that are the subject of these regulations have been detected in one or more groundwater monitoring wells located within or adjacent to Areas 1 and 2. The MCLs provide numerical standards against which the groundwater monitoring results obtained as part of the remedial action can be evaluated to assess the overall protectiveness of the remedy and the effectiveness of the various remedy components.

3.1.2 Potential Location-Specific ARARs

Location-specific ARARs are those requirements that relate to the geographical or physical location of the site or remedial action rather than the nature of the contaminants or the actions being taken. The FS (EMSI, 2006) includes evaluations of potential location-specific ARARs.

The results of these evaluations are summarized on Table 6. The significant location-specific ARARs identified in the FS are those related to floodplain management and the site selection standards of the Missouri Solid Waste Management regulations regarding proximity to airport runways and floodplains. In addition, the site selection standards of the Missouri Solid Waste Management regulations would also potentially be applicable to locating and operating the engineered disposal cell pursuant to the "complete rad removal" with on-site disposal alternative evaluated in this SFS. The requirements of these regulations are discussed below.

3.1.2.1 Floodplain Management

Executive Order 11988, 40 CFR 6.302(b) and the Missouri Governor's Order 82-19 relative to floodplain management are identified in the FS (EMSI, 2006) as potential location-specific ARARs relative to floodplain management (Table 3-2 in the FS). The Buffer Zone and Crossroad Property are located within the historic floodplain of the Missouri River. These areas are currently protected by the engineered Earth City levee and flood control system.

Areas 1 and 2, the Buffer Zone and the Crossroad Property are located within the extent of the floodplain identified by the Federal Emergency Management Agency (FEMA). Specifically, Flood Insurance Rate Map (FIRM) 29189C0039H (uncorrected) indicates that Areas 1 and 2 are located within the extent of the 500 year floodplain, portions of the 100 year floodplain that are expected to flood to depths of less than one foot, or portions of the 100 year floodplain that are protected by levees.

A letter of map revision was issued in 1996 that corrected FIRM 29189C0039H to indicate that Areas 1 and 2, the Buffer Zone and the Crossroad Property are all actually within an area that is protected by levees from 500-year floods. Nonetheless, to the extent that any regrading or excavation of soil or wastes containing radionuclides are performed in these areas, mitigative measures may need to be taken to minimize any adverse impacts in a flood situation.

The goal of floodplain mitigation is to lessen the potential impact floods have on people, property and the environment. Impacts can occur due to forces of water causing damage to location-specific or project-specific structures and/or to the overall functions of the floodplain which may include the flood-holding capacity of the floodplain, fish and wildlife habitat values of the floodplain, water quality functions of the floodplain or other hydrological processes (e.g., groundwater recharge). The nature of potential mitigative measures depends on the nature of the potential impacts that could occur. For example, with respect to location- or project-specific structures, flood-protection techniques such as elevation of critical structures, application of rip-rap armoring, or other measures to reduce impacts of flooding on project structures may be appropriate mitigation measures. Mitigation of potential impacts to the overall functions of a floodplain could also include construction and operation of stormwater detention basins to offset reductions in flood-holding capacity or water quality functions of a floodplain, or designation of open/natural areas to offset habitat loss from construction in a floodplain.

Because the West Lake Landfill site is located outside of the base (100-year) floodplain, no mitigative actions would be required to comply with the Executive Order unless the remedial action (1) impacts the base floodplain, (2) indirectly supports floodplain development, or (3) is a critical action. Critical actions are those for which even a slight chance of flooding would be too great. Remedial actions for OU-1 are not expected to impact the base floodplain or indirectly support floodplain development. In the event of a failure of the Earth City Levee system (which provides protection from flood events with a recurrence interval greater than 500 years), floodwaters could reach the toe of the Area 2 portion of OU-1. Due to the distance from the river, such floodwaters would not be expected to be high energy, but instead would be nearly stagnant and without the velocity and energy capable of resulting in significant erosion of the landfill cover or releasing the contained waste materials. However, as the intent of an engineered landfill cover is to contain the waste materials, the function of the landfill could be impacted if floodwaters were to erode the cover and the underlying waste materials. Therefore, mitigation measures such as placement of engineered rip-rap armoring along the toe of the Area 2 portion of the landfill and creation of stormwater detention basins are planned to provide an added measure of protection.

3.1.2.2 Missouri Solid Waste Management Regulations – Site Selection

The Missouri Solid Waste Regulations contain site selection standards that apply to new or operating landfills (10 CSR 80.3.010(4)). Some of the site-selection standards also apply to horizontal expansions of existing landfills. The solid waste site-selection standards address landfills located in proximity to airports, within 100-year floodplains, within wetlands, within seismic impact zones, and within unstable areas. The site selection criteria also specify site condition information required for design and operation plan submittals and requirements relative to the base elevation of a landfill liner to the depth of groundwater.

Because Areas 1 and 2 are neither new nor operating landfills, these requirements are not considered applicable to remediation of Areas 1 and 2. Although these standards are not applicable to Areas 1 and 2, they are considered to be potentially relevant and appropriate to Areas 1 and 2 because portions of Area 1 are located within 10,000 feet of the end of the runways at St. Louis-Lambert International Airport, and a portion of Area 1 and all of Area 2 are located within the 500-year floodplain that is protected by the Earth City levee system. Regrading or excavation of wastes within Areas 1 and 2 is included within the scope of ROD-selected remedy as well as both “complete rad removal” alternatives, and the “complete rad removal” alternatives potentially need to address the regulatory requirements relative to airport safety and floodplains. These requirements are described below.

The Missouri solid waste regulatory site selection criteria are potentially applicable to the “complete rad removal” with on-site disposal alternative evaluated in this SFS. The on-site disposal cell would meet the definition of a new landfill, new landfill cell, or a horizontal expansion of an existing landfill cell. Selection and evaluation of a location for the engineered disposal cell would need to address all of the criteria in the regulations.

Missouri's "Guidance for Conducting and Reporting Detailed Geologic and Hydrogeologic Investigations at Proposed Solid-Waste-Disposal Area" is not a promulgated regulation, but is a "To Be Considered" (TBC) for characterization of the subsurface conditions for potential locations of a new on-site disposal cell. The substantive requirements of this guidance are potential TBC's relative to characterization of a new on-site disposal cell location.

3.1.2.3 Missouri Solid Waste Regulations – Airport Safety

The Missouri Solid Waste Regulation requirements for airport safety apply to new or existing municipal solid waste landfills or lateral expansions that are located within 10,000 feet of the end of any airport runway used by turbojet aircraft or within 5,000 feet of any airport runway end used by only piston-type aircraft (10 CSR 80-3.010(4)(B)1). Landfills or landfill expansions located within these areas must demonstrate that the units are designed and operated so as to pose no bird hazards to aircraft.

Portions of the West Lake Landfill property, including a portion of Area 1, are located within 10,000 feet of the end of Lambert-St. Louis International Airport's Runway 11-29 (formerly known as 12W/30W) completed in 2006 (Figure 8). Because Area 1 is located in an inactive/closed portion of the landfill, these requirements are not applicable. Insofar as the intent of the regulations is to control bird hazards, however, these requirements may potentially be relevant to remedial activities that could result in the exposure of previously placed refuse which could attract birds and therefore present a potential hazard to aircraft. Consequently, these regulations may be potentially relevant and appropriate to excavation and regrading activities that may be performed in Area 1 under the ROD-selected remedy, and for the excavation and regrading activities required for both of the "complete rad removal" alternatives.

Additionally, the "complete rad removal" with on-site disposal alternative includes construction of a new on-site engineered disposal cell that would contain the RIM excavated from Areas 1 and 2. Due to the requirement to locate any new engineered disposal cell outside of the geomorphic floodplain (EPA, 2010e), there is only one area of the site (the soil borrow and stockpile area) that potentially could be suitable for locating and constructing a new on-site engineered disposal cell. This area is located within approximately 8,000 feet of the end of Airport's Runway 11-29. Therefore, the requirements of the Missouri Solid Waste Regulations relative to airport safety (10 CSR 80-3.010(4)(B)1) would be applicable to the design and operation of the new engineered disposal cell pursuant to the "complete rad removal" with on-site disposal alternative.

Missouri siting regulations require landfill units operating within 10,000 feet of a commercial airport to demonstrate that "they are designed and operated" so as not "to pose a bird hazard to aircraft." 10 CSR 80-3.010(4)(B)1.A. These regulations require any new landfill unit proposed to be located within 10,000 feet of an airport that has jet traffic to demonstrate to the MDNR that the landfill operations will not pose a bird hazard to air traffic. In addition, owners or operators proposing to site a new MSWLF "within five (5) miles of any airport runway end used by turbojet aircraft or piston-type aircraft shall notify the affected airport and the Federal Aviation Administration (FAA)." 10 CSR 80-3.010(4)(B)1.B.

3.1.2.4 Missouri Solid Waste Management Regulations – Floodplains

The Missouri Solid Waste Regulations contain requirements relative to landfills located within floodplains (10 CSR 80-3.010(4)(B)2). Specifically, owners/operators of sanitary landfills located in 100-year floodplains shall demonstrate to MDNR that the sanitary landfill would not restrict the flow of the 100-year flood, reduce temporary water storage capacity of the floodplain, or result in washout of solid waste so as to pose a hazard to public health or the environment.

Areas 1 and 2 do not appear to be located within the 100-year floodplain and therefore this standard is not relevant and appropriate to actions taken in Areas 1 and 2. Likewise, the area identified for a possible new engineered, on-site disposal cell for the "complete rad removal" with on-site disposal alternative is located outside of both the 100-year and the 500-year floodplains.

3.1.2.5 Missouri Solid Waste Management Regulations – Wetlands

The area identified as a potentially suitable location for the new, engineered disposal cell under the "complete rad removal" with on-site disposal alternative is the current location of the on-site soil borrow and soil stockpile areas. There are no wetlands present in this area and this location was previously disturbed as part of prior activities at the site. Therefore, although the wetlands criteria may potentially be applicable requirements, there are no wetlands in this area. No wetlands were identified in Areas 1 and 2 during performance of the RI work.

3.1.2.6 Missouri Solid Waste Management Regulations – Seismic Impact Zones

The solid waste regulations require that sanitary landfills located in seismic impact zones shall generally not be located within 200 feet of a fault that has had displacement in Holocene time (10 CSR 80-3.010(4)B.4). Landfills located within seismic impact zones must demonstrate that all containment structures (e.g., liners, final covers, leachate collection systems and surface water control systems) are designed to resist permanent cumulative earthquake displacements greater than 6 inches resulting from the maximum credible Holocene time earthquake event's acceleration versus time history (10 CSR 80-3.010(4)B.5).

The St. Louis area is part of the New Madrid Seismic Impact Zone and therefore these requirements are applicable to the design of the final cover system for Areas 1 and 2 under all of the alternatives and are also applicable to the site selection and design of the new engineered disposal cell included in the scope of the "complete rad removal" with on-site disposal alternative. There is no indication that any Holocene-age faults are present at the site. Extensive geologic mapping of the quarry walls in the area of the inactive Bridgeton Sanitary Landfill did not identify the presence of any faults in that area.

Additional geologic investigation would need to be performed to verify that a fault that has had displacement in Holocene time is not present beneath or within 200 feet of the location being considered for the new engineered disposal cell. The design of the new engineered on-site disposal cell would need to be developed in a manner that demonstrates that the containment structures would not be subject to displacements greater than 6 inches as required by 10 CSR 80-3.010(4)B.5.

3.1.2.7 Missouri Solid Waste Management Regulations – Unstable Areas

The solid waste regulations require that sanitary landfills located in unstable areas demonstrate that the landfill design ensures that the integrity of the structural components of the sanitary landfill will not be disrupted (10 CSR 80-3.010(4)B.6). Minimum factors to be considered in determining whether an area is unstable include the following:

- areas where on-site or local rock or soil conditions may result in failure or significant differential settlement;
- on-site or local geologic or geomorphologic features; and
- on-site or local human-made features or events (both surface and subsurface).

None of these features are currently expected to be present in the area; however, additional geologic investigation would need to be performed as part of the design of a new on-site engineered disposal cell included in the “complete rad removal” with on-site disposal alternative.

3.1.2.8 Missouri Solid Waste Management Regulations – Plans

The solid waste regulations require that design and operations plans for new sanitary landfills include maps showing initial and proposed topographies at specified scales and contour intervals, and maps showing land use and zoning within one quarter mile including specific features listed in the regulations (10 CSR 80-3.010(4)B.7). The regulations also require a description of project post-closure land use and evaluations of the characteristics and quantity of available on-site soil with respect to its suitability for sanitary landfill operations. Because these regulations address new sanitary landfills, they are not applicable to the existing Areas 1 and 2.

These items would need to be addressed as part of the remedial design of the new engineered disposal cell that is evaluated in this SFS as part of the “complete rad removal” with on-site disposal alternative.

3.1.2.9 Missouri Solid Waste Management Regulations – Base of Landfill

For sanitary landfills with a landfill liner that will be in contact with groundwater, the solid waste regulations require a demonstration that groundwater will not adversely impact the liner (10 CSR 80-3.010(4)B.8). The Missouri Solid Waste Management Program has identified a one foot minimum separation between the base of the soil liner and the groundwater elevation as a means of making this demonstration. This demonstration would be addressed during the design of a new engineered disposal cell evaluated in this SFS as part of the "complete rad removal" with on-site disposal alternative.

3.1.2.10 FAA Guidance

The Federal Aviation Administration (FAA) has developed guidance to address safety issues associated with aircraft bird strikes (Appendix A). The FAA also issued a Record of Decision (the Lambert Airport ROD) (FAA, 1998) (Appendix A) for federal actions related to improvements at Lambert-St. Louis International Airport (Lambert), including construction and operation of a new air carrier length runway (then designated 12W/30W, now known as Runway 11/29). That ROD included requirements relative to proximity of the proposed new runway to the existing Bridgeton Sanitary Landfill. In 2003, the FAA, EPA and other agencies also entered into a Memorandum of Understanding (the FAA MOU) (Appendix A) addressing aircraft-wildlife strikes. These advisories, decision document, and memorandum are not cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or State law and therefore are not ARARs. Likewise, because the FAA advisories, Lambert Airport ROD, and FAA MOU are non-promulgated advisories or guidance issued by Federal government, these documents are not legally binding and therefore do not have the status of potential ARARs. They do, however, represent TBC criteria relative to the potential remedial actions at the West Lake Landfill.

In its Lambert Airport ROD (Appendix A), the FAA noted that the end of the proposed runway would be located within 10,000 feet of an existing active landfill (the Bridgeton Landfill) and therefore would not be consistent with FAA's current runway siting guidelines without mitigation. The decision document indicated that at its closest point, the Bridgeton Landfill is located approximately 9,166 feet west of the northwest end of proposed Runway 12W/30W. This is not consistent with FAA's runway siting guideline of 10,000 feet, which was developed to protect aircraft from potential bird strikes.

The FAA decision document states:

> "STLAA will attempt to develop an agreement with the operator of the landfill to implement one of the following options:
>
> - Re-prioritize the landfill utilization plan so that the subject portion (i.e., that portion within the FAA's 10,000-foot radius of incompatibility) of the landfill is utilized first;

- Require that STLAA be able to direct available fill that cannot be reasonably recycled from the construction projects to the subject portions of the landfill;

- Require that organic waste be capped in the landfill before the new runway is opened and that only clean fill (such as construction materials) be placed in the subject portions of the landfill once the runway is operational.

Should it not be practical to completely fill the subject landfill through the above measures, the STLAA will purchase an easement from the landfill operator which will provide the operator compensation for any lost revenue associated with the unused excess capacity. Any plan to convert or close the landfill must provide for a one-year bird-repelling program. Repelling efforts will begin 6 months before opening of the new runway and continue for a minimum of 6 months thereafter. The program will be in effect from dawn until dusk." (FAA ROD, September 30, 1998, pp 42 – 43)

Pursuant to an agreement between the Bridgeton Landfill and the City of St. Louis on behalf of the STLAA, the Bridgeton Sanitary Landfill ceased accepting waste materials prior to the opening of Runway 11/29.

FAA Advisory Circular AC 150/5200-34A dated January 26, 2006, "Construction or Establishment of Landfills Near Public Airports" contains guidance on complying with Federal statutory requirements regarding the construction or establishment of a new municipal solid waste landfill (MSWLF) near public airports (Appendix A). This advisory only applies to a new MSWLF constructed or established after April 5, 2000, near an airport that received Federal grants (under the Airport and Airway Improvement Act of 1982 as amended, 49 U.S.C. § 47101, et seq.) and primarily serves general aviation aircraft and scheduled air carrier operations using aircraft with less than 60 passenger seats. This advisory requires a minimum separation distances of six statute miles between a new MSWLF and a public airport as measured from the closest point of the airport property boundary to the closest point of the MSWLF property boundary. This Circular is a TBC as it relates to the "complete rad removal" alternative with on-site disposal, because that remedial option requires construction and establishment of a new MSWLF near a public airport – i.e., Lambert International.

FAA Advisory Circular AC 150/5200-33B, dated August 28, 2007, "Hazardous Wildlife Attractants On or Near Airports," provides guidance on certain land uses that have the potential to attract hazardous wildlife on or near public-use airports (Appendix A). This circular recommends against locating a MSWLF within the separation distances identified below:

1. Airports serving piston-powered aircraft – 5,000 feet
2. Airports serving turbine-powered (jet) aircraft – 10,000 feet
3. Protection of approach, departure and circling airspace – 5 statute miles

These separation distances are to be maintained between the Air Operations Area (AOA) and the nearest point to the hazardous wildlife attractant. The AOA is defined as any area of an airport used or intended to be used for landing, takeoff, or surface maneuvering of aircraft which includes such paved or unpaved areas that are used or intended to be used for the unobstructed movement of aircraft in addition to its associated runway, taxiways, or apron. With respect to landfills, the separation distances should be measured from the closest point of the AOA to the closest planned MSWLF cell (AC 150/5200-33B, p. 4). The FAA strongly recommends against allowing a waste disposal operation to be located within 10,000 feet of a jet aircraft runway if the material contains putrescible waste or has the potential to attract wildlife that could threaten air traffic.

The FAA, EPA, and other agencies developed and signed the FAA MOA to address risks that aircraft-wildlife strikes pose to safe aviation (Appendix A). Specific aspects of this MOA that could be relevant to potential remedial actions at West Lake Landfill include the following:

Paragraph M – Agree to cooperate with the airport operator to develop a specific, wildlife hazard management plan for a given location, when a potential wildlife hazard is identified.

Paragraph O - Agree that information and analyses relating to mitigation that could cause or contribute to aircraft-wildlife strikes should, whenever possible, be included in documents prepared to satisfy the National Environmental Policy Act (NEPA).

EPA and representatives of Bridgeton Landfill, LLC previously met with the STLAA to discuss the remedial actions at the West Lake Landfill and to obtain STLAA input on the remedial alternatives included in the SFS. The STLAA sent a letter to EPA regarding the potential remedial actions under consideration for West Lake (included in Appendix A). It is anticipated that additional meetings with the STLAA will occur as the project progresses. It is also anticipated that any plan developed to mitigate hazards to aircraft operations that may be posed by bird populations at the landfill during implementation of remedial actions will be provided to the STLAA for review and input. These actions should meet the objectives of Paragraph M of the FAA MOA. Evaluation of potential risks associated with bird hazards to aircraft and evaluation of potential mitigation measures for aircraft-bird hazards as part of the detailed analysis of alternatives in the SFS addresses the objectives of Paragraph O of the FAA MOA.

3.1.2.11 Airport Negative Easement and Restrictive Covenants

Although not part of a promulgated Federal or State standard and therefore by definition not an ARAR or a TBC standard or criteria, use of the West Lake Landfill is subject to additional constraints relative to airport safety. As previously discussed, in August 2005, the Bridgeton Sanitary Landfill stopped receiving waste pursuant to an agreement with the airport owner, the City of St. Louis, to reduce the potential for birds to interfere with airport operations. As part of this closure plan, a Negative Easement and Declaration of Restrictive Covenants Agreement (Restrictive Covenant) (Appendix A) was recorded against the majority of the West Lake

Landfill site, including all of Area 1, most of Area 2, and all of the soil borrow/stockpile area which is the only viable location for an on-site engineered disposal cell (Appendix A). The Restrictive Covenant states:

> The negative easement granted herein and described below shall constitute a binding servitude upon the Property. To that end, Grantors do hereby covenant on behalf of themselves and their heirs, successors in interest and assigns with St. Louis, its successors in interest and assigns, such covenants and provisions being deemed to run with the land as a binding servitude in perpetuity, as provided for below, to do and to refrain from doing upon the Property the following stipulations, which contribute to the public purpose in that they aid in the reduction or mitigation of said potential wildlife or bird hazards on or from the Property, and hereby declare and impose the following restrictions upon the use and enjoyment of the Property:
>
> > 1. There shall be no new or additional depositing or dumping of municipal waste, organic waste, and/or putrescible waste (municipal waste, organic waste and putrescible waste hereinafter collectively referred to as "Putrescible Waste") above, upon, on, or under the Property beginning as of August 1, 2005 and continuing in perpetuity, unless and until such time as this Agreement is terminated or canceled by St. Louis in accordance with the terms set out in paragraph 3 below. For purposes of this Agreement, "Putrescible Waste" shall mean solid waste that contains organic matter capable of being decomposed by micro-organisms and of such a character and proportion as to be capable of attracting or providing food for birds. For purposes of this Agreement, "Putrescible Waste" shall not include construction waste or demolition waste.

Section 4 of the Restrictive Covenant states that the agreement shall end only if and when the City of St. Louis chooses in its sole and absolute discretion to abandon its negative easement. Consequently, although the Restrictive Covenant is not an ARAR, construction and operation of a new engineered disposal cell would violate the terms of this recorded land use covenant.

On September 7, 2010, representatives of Bridgeton Landfill, LLC, and the EPA met with representatives of the St. Louis Airport Authority and the U.S. Department of Agriculture to follow up on concerns raised that the Restrictive Covenant entered into between landfill owners and STLAA would prohibit construction of the "on-site cell" evaluated as part of the SFS. The EPA provided a summary of the alternatives considered in the SFS. STLAA and USDA stated that an excavation remedy would create risks that they could not even calculate, and that monitoring and management of risks created by wildlife would be impossible. STLAA noted that under the ROD-selected remedy, the site will present no risk to human health or the environment and said that creating new risks by implementing an excavation remedy did not seem advisable.

STLAA further stated that an excavation remedy would necessitate FAA review and likely result in objections from airlines as well as the FAA. STLAA was particularly concerned that either excavation alternative would take years to perform.

The EPA asked whether the airport's concerns would be alleviated by excavation of only Area 2 (outside the 10,000-foot range). The response was no, the entire area is within the Restrictive Covenant and subject to FAA review if "new landfilling operations" were to occur. In particular, STLAA explained that construction of an on-site disposal cell would not qualify as an expansion or change to an existing landfill because the Bridgeton Sanitary Landfill was already in closure mode, but would instead constitute "new operations" at the site and therefore would trigger FAA review. STLAA could not predict the changes that any excavation activities would cause to the migratory patterns of birds and could not take the risk that such changes would increase the local bird population.

STLAA stated that its 2006 letter, submitted during the public comment period on the ROD for Operable Unit I, still reflected its position.

Notes of this 2010 meeting were provided to the EPA and are included in Appendix A.

By letter dated September 20, 2010, (Appendix A), the city of St. Louis Airport Authority provided written comments on the SFS Work Plan. The letter identified the West Lake Landfill as a hazardous wildlife attractant for the airport. The city stated that the excavation ("complete rad removal") alternatives would adversely affect wildlife mitigation measures taken by the airport to protect aircraft from bird strikes, thereby placing the city in violation of the FAA ROD requiring that such mitigation efforts be undertaken and maintained. The city also stated that implementation of the excavation alternatives would violate the Restrictive Covenant. The city specifically identified creation of an on-site engineered disposal cell as a direct violation of paragraph 1 of the Restrictive Covenant. The city further indicated that the proposed location for the on-site engineered disposal cell would be approximately 8,000 feet from the airport and is incompatible with state and federal regulations that prohibit placement of a new solid waste disposal site within a 10,000-foot radius of an active runway.

3.1.3 Potential Action-Specific ARARs

Action-specific ARARs are technology-based requirements that define handling, treatment, disposal, and other procedures triggered by the type of remedial action under consideration. These requirements generally set performance or design standards for specific activities related to the management of wastes. Evaluations of potential action-specific ARARs are presented in the FS report (EMSI, 2006) and are summarized on Table 7. Table 7 also lists additional potential action-specific ARARs related to the “complete rad removal” alternatives. The potential action-specific ARARs associated with the ROD remedy and the “complete rad removal” alternatives are discussed below.

3.1.3.1 Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings

Part 192 of Title 40 of the Code of Federal Regulations provides for Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings. Subpart A of these UMTRCA regulations contain standards for the control of residual radioactive materials from inactive uranium processing sites. Those portions of these regulations that provide for closure performance standards may potentially be relevant and appropriate to remedial actions for OU-1. Specifically, to address longevity considerations, 40 CFR 192.02(d) requires that each disposal site "shall be designed and stabilized in a manner that minimizes the need for future maintenance."

In developing this requirement, EPA was concerned with long-term hazards relating to misuse by man or disruption by natural phenomena. While large volumes of uniform sand-like tailings from uranium mining activities piled on the ground or in impoundments may be of concern due to misuse by man (for example, use of tailings as construction or fill material), Areas 1 and 2 contain radiological contamination mixed with solid waste, construction and demolition debris and other wastes, and it is highly unlikely that old garbage and debris of these types would be misused by man.

For UMTRCA tailings piles, the longevity consideration is typically addressed through placement of a rock armoring layer over the upper surface of the tailings pile capping system. Placement of a rock armoring layer over the top of a solid waste landfill cover system is inconsistent with the solid waste landfill cover design criteria contained in the Resource Conservation and Recovery Act (RCRA) Subtitle D regulations and Missouri DNR Solid Waste regulations. Solid waste landfill closure requirements are generally more appropriate than the UMTRCA requirements for the conditions associated with OU-1.

To address longevity considerations for OU-1 and long-term hazards relating to disruption of the disposal site by natural phenomena, the ROD-selected remedy incorporates a concrete debris or gravel layer to restrict bio-intrusion and erosion into the underlying landfilled materials and to increase the longevity of the landfill cover. The conceptual design of a new on-site disposal cell included as part of the "complete rad removal" with on-site disposal alternative would also need to include a concrete debris/rock layer or other measure to increase the longevity of the landfill cover to address this requirement.

3.1.3.2 Missouri Solid Waste Management Regulations

The ROD-selected remedy was developed and selected to provide engineered containment of the solid wastes and RIM contained in Areas 1 and 2. Because these areas contain solid wastes, the RCRA Subtitle D regulations and the MDNR Solid Waste Management Regulations represent the primary standards for design and implementation of a containment remedy. Specifically, the landfill cover design, gas control measures, maintenance, groundwater monitoring, and corrective action criteria of these regulations are potentially relevant and appropriate. These regulations would also provide minimum standards for design of a new engineered on-site disposal cell included as part of the "complete rad removal" with on-site disposal alternative.

Evaluation of these solid waste management criteria as potential ARARs relative to the evaluation of remedial alternatives for OU-1, including the remedial alternative that ultimately became the ROD remedy, is presented in the FS report (EMSI, 2006). In particular, the FS report presents an extensive discussion of the final grading and cover requirements for solid waste landfills as potentially relevant and appropriate requirements for construction of new landfill covers over Areas 1 and 2. In the ROD (EPA, 2008a), EPA provided an evaluation of solid waste regulations as potential ARARs, including how they would apply to the ROD-selected remedy. These evaluations will not be repeated in this SFS.

The final grading and final cover requirements of the Missouri Solid Waste regulations would be relevant and appropriate to regrading and design and construction of final cover over Areas 1 and 2 as part of the ROD remedy. Specifically, for the ROD remedy the final grading and cover requirements mandate final grades of at least 2% and less than 25% (unless a stability analysis is performed to support inclusion of steeper slopes but in no event shall the final slopes exceed 33 1/3%) and final cover of at least two feet (2') of compacted clay with a coefficient of permeability of 1×10^{-5} cm/sec or less overlaid by at least one foot (1') of soil capable of sustaining vegetative growth (10 CSR 80-3.010(17)(C)(4)). Analysis of these requirements and the basis for use of a minimum slope of 2% for the ROD-selected remedy is provided in the ROD (EPA, 2008a) and the FS (EMSI, 2006). For the two "complete rad removal" alternatives the final grading and cover requirements mandate final grades of at least 5% and less than 25% (unless a stability analysis is performed to support inclusion of steeper slopes but in no event shall the final slopes exceed 33 1/3%) and final cover of at least two feet (2') of compacted clay with a coefficient of permeability of 1×10^{-5} cm/sec or less overlaid by at least one foot (1') of soil capable of sustaining vegetative growth (10 CSR 80-3.010(17)(C)(4)).

Relative to the "complete rad removal" alternatives, the site selection (10 CSR 80-3.010(4)), design (10 CSR 80-3.010(5)), quality assurance/quality control (10 CSR 80-3.010(6)), survey control (10 CSR 80-3.010(7)), water quality (10 CSR 80-3.010(8)), leachate collection (10 CSR 80-3.010(9)), liner system (10 CSR 80-3.010(10)), groundwater monitoring (10 CSR 80-3.010(11)), air quality (10 CSR 80-3.010(13)), gas control (10 CSR 80-3.010(14)), vector control (10 CSR 80-3.010(15)), aesthetic standards (10 CSR 80-3.010(16)), cover requirements (10 CSR 80-3.010(17)), compaction (10 CSR 80-3.010(18)), and safety requirements (10 CSR 80-3.010(19)) of the Missouri Solid Waste Regulations would be potentially applicable to the site selection, design, and operation of an engineered on-site disposal cell included in the scope of the "complete rad removal" alternative with on-site disposal. Because the on-site disposal cell would be a new unit and final grading of this cell would need to meet the minimum slope requirement of 5%.

The Missouri Solid Waste Regulations, 10 CSR 80-3.010(3)(A)2 B, specifically exclude from disposal in solid waste landfills "Any radioactively-contaminated material used in or resulting from the cleanup of radioactively contaminated sites." As indicated above, because the on-site disposal cell would be a new unit, the Design and Operations standards of the Solid Waste

Regulations, 10 CSR 80-3.010, including the criteria relative to what types of wastes are acceptable or excluded from disposal in a solid waste (sanitary) landfill are potentially applicable to the "complete rad removal" with on-site disposal alternative. These Solid Waste Regulations do not contain any procedures that would allow for acceptance of any of the wastes specifically excluded under 10 CSR 80-3(3)(A). The Solid Waste Regulations further state that plans for a landfill shall specify the operating procedures for screening and removal of wastes which are excuded from disposal according to subsection (3)(A) of this rule. The General Provision portion of the regulations, 10 CSR 80-3.010(1)(A), state "The requirement subsections contained in this rule delineate minimum levels of performance required of any sanitary landfill operation." The section of the regulations that describe the procedures for satisfactory compliance with the minimum design standards do, however, state:

> In consultation with the department, the applicant shall determine what wastes are to be accepted and shall identify them in the plan and the application for a construction permit. The criteria used to determine whether the waste can be accepted shall include the design of the landfill, the physical and chemical characteristics of the wastes, and the proposed operating procedures.

It is not clear from the regulations whether the above procedure could be used to obtain approval for disposal of wastes that were specifically excluded or was only intended to provide guidance as to determination of the potential acceptability of wastes that are not otherwise excluded under the regulations. The proposed design of a possible on-site disposal cell described in this report includes additional design criteria to address the presence of radionuclides within the waste materials that could be placed in the cell (e.g., additional landfill cover thickness to provide protection against gamma radiation and limit radon emissions). Inclusion of such additional design measures to address the presence of radionuclides within the waste materials may provide a sufficient basis to allow for placement of radioactively-contaminated material within what is essentially a solid waste disposal cell enhanced to address the presence of radionuclides; however, it is unclear from the regulations as to whether even with the inclusion of such design enhancements, the waste exclusion provisions of the regulations could be waived. The on-site cell included as part of the "complete rad removal" with on-site disposal alternative would be an on-site action; implementation of this alternative would not be subject to permitting under the State solid waste regulations. For purposes of preparation of this SFS, it will be assumed that the waste exclusion provisions would be potentially applicable to design and operation of a new on-site disposal cell; however, it is possible that a procedure may exist for approval of disposal of what otherwise would be an excluded waste will be identified.

3.1.4 RCRA Subtitle C Regulations

The RCRA Subtitle C requirements relative to identification of hazardous wastes (40 CFR Part 261), packaging, temporary storage, offsite transportation of hazardous wastes (40 CFR Parts 262 and 263), and treatment and disposal of hazardous wastes (40 CFR Part 268), are potentially applicable requirements in the event that hazardous wastes are encountered during implementation of any remedy at the site.

3.2 Additional Requirements Associated with Off-site Disposal

This section discusses additional requirements that would apply to the "complete rad removal" with off-site disposal alternative. The requirements under CERCLA for compliance with other laws differ in two significant ways for on-site and off-site actions. First, the ARARs provision applies only to on-site actions; off-site actions must comply fully and only with any laws that legally apply to such an action. Therefore, off-site actions need only comply with "applicable" requirements, not with "relevant and appropriate" requirements. Second, ARAR waivers are not available for requirements that apply to off-site actions. Consequently, CERCLA actions involving the transfer of hazardous substances, pollutants or contaminants off-site must comply with applicable Federal and State requirements and are not exempt from formal administrative permitting requirements. Off-site actions must comply with both substantive and administrative requirements including the permitting requirements of all applicable laws.

The primary requirements affecting off-site disposal are the CERCLA off-site rule, requirements associated with transportation of the RIM materials to an off-site disposal facility, and the waste acceptance criteria associated with each potential off-site disposal facility. These requirements are described below.

3.2.1 CERCLA Off-site Rule

Section 121(d)(3) of CERCLA(42 U.S.C.§ 9621(d)(3)) applies to any CERCLA response action involving the off-site transfer of any hazardous substance, pollutant or contaminant (CERCLA wastes). These principles are interpreted in the Off-Site Rule (OSR) set forth in the NCP at 40 CFR 300.440. The OSR requires that CERCLA wastes only be placed in a facility operating in compliance with RCRA or other applicable Federal or State requirements. The OSR prohibits the transfer of CERCLA wastes to a land disposal facility that is releasing contaminants into the environment, and requires that any releases from other waste management units at the disposal facility must be controlled. The purpose of the OSR is to avoid having CERCLA wastes from site response actions authorized or funded under CERCLA contribute to present or future environmental problems by directing these wastes to management units determined to be environmentally sound (preamble to final OSR, 58 FR 49200, 49201, Sept. 22, 1993).

The OSR establishes the criteria and procedures for determining whether facilities are acceptable for the receipt of CERCLA wastes from response actions authorized or funded under CERCLA. The OSR establishes compliance criteria and release criteria, and establishes a process for determining whether facilities are acceptable based on those criteria. The OSR also establishes procedures for notification of unacceptability, reconsideration of unacceptability determinations, and re-evaluation of unacceptability determinations.

EPA verifies the acceptability of off-site treatment, storage, and disposal facilities (TSDFs) on a frequent basis. Consequently, before any off-site shipment occurs, a verification of current acceptability (VCA) must be obtained from EPA certifying that the proposed receiving facility is operating in compliance with the requirements of CERCLA Section 121(d)(3) and 40 CFR 300.440. EPA (usually the EPA Regional Office) will determine the acceptability under this section of any facility selected for the treatment, storage, or disposal of CERCLA waste. EPA will determine if there are relevant releases or relevant violations at a facility prior to the facility's initial receipt of CERCLA waste. A facility which has previously been evaluated and found acceptable under this rule is acceptable until the EPA Regional Office notifies the facility otherwise pursuant to §300.440(d).

3.2.2 Off-site Transportation Requirements

Under the "complete rad removal" with off-site disposal alternative, RIM would be excavated and either loaded directly into rail cars at or near the site, or loaded into trucks and hauled to an off-site rail loading facility. Once loaded on rail cars, the RIM would be shipped via rail directly to the off-site disposal facility or to a rail unloading facility located near the off-site disposal facility where it would be loaded onto trucks and taken to the off-site disposal facility.

Because transportation to an off-site disposal location would constitute an off-site action, the transportation activities would need to comply with both the substantive and administrative requirements of any regulations legally applicable to transportation of radiologically-contaminated materials. The U.S. Department of Transportation (DOT) has developed regulations for transport of hazardous materials (49 CFR Parts 100 – 178), including specific regulations related to transport of radioactive materials (49 CFR Parts 171 – 180). These include regulations on hazardous materials communications, emergency response information, training requirements and security plans (49 CFR Part 172) which address special provisions, preparation and retention of shipping papers, packaging and container marking, emergency response, security and planning. The regulations contain specific requirements associated with shipment of radioactive materials (49 CFR 172.310, 172.436-440, and 172.556 for example). Other regulations (49 CFR Part 173) describe requirements for shipment and packaging that are applicable to shippers and again include specific requirements for shipment of radioactive materials. Regulations set forth in 49 CFR 174 address shipment by rail and include special handling requirements for radioactive materials (49 CFR 174.700). Required emergency response information is described in 49 CFR Subpart G (49 CFR 173.602). The NRC, through a Memorandum of Understanding with DOT, also has promulgated regulations relative to transport of radioactive materials (10 CFR Part 71).

Requirements established by rail carriers relative to transport of waste materials or radioactive wastes would also be applicable to this alternative. Because the specific carriers that might be used to transport the wastes under the "complete rad removal" with off-site disposal alternative cannot be identified at this time, identification and evaluation of the carrier-specific requirements has not been performed. This evaluation would be completed if and as necessary as part of design of the "complete rad removal" with off-site disposal alternative.

State requirements and fees, including Missouri fees for transport of the radioactively-impacted materials (Section 260.392 RSMo), would also potentially be applicable to the "complete rad removal" with off-site disposal alternative. Review, description and detailed evaluation of these requirements is beyond the scope of this SFS but would be addressed in detail in planning documents in the event the "complete rad removal" with off-site disposal alternative were to be implemented.

Only three disposal facilities (U.S. Ecology's facility in Grandview, Idaho; the Energy*Solutions* facility in Clive, Utah; and Clean Harbors' Deer Trail facility in Last Chance, Colorado), have been identified that could accept RIM from the West Lake Landfill for off-site disposal. Discussions with representatives of potential off-site disposal facilities indicate that most of the facilities would provide a turnkey service that includes transport of the RIM from the West Lake site and disposal. These companies provided unit costs for complete turnkey services for waste profiling and acceptance testing, waste transportation including all related fees and taxes, and waste disposal services including all related fees and taxes. Under a turnkey service, the disposal company would be responsible for arranging for transport, preparation of waste/shipping manifests, testing RIM materials after they are loaded into transportation vehicles/containers, securing vehicles/containers, unloading vehicles/containers, safety and emergency response plans, and all other aspects associated with transport of RIM from the West Lake site to an off-site disposal facility.

3.2.3 Waste Acceptance Criteria for Off-site Disposal

Waste Acceptance Criteria (WAC) are established pursuant to the specific permit or license issued to each waste disposal facility and consequently are different for each facility. As part of the evaluation of potential remedial technologies for the "complete rad removal" with off-site disposal alternative, potential off-site disposal facilities were identified. The WAC for the off-site disposal facilities were reviewed as part of the SFS evaluation to assess the ability of each facility to accept the RIM. Summaries of the WAC for each off-site disposal facility are presented below. Copies of the WAC provided by each of the facilities are contained in Appendix C.

3.2.3.1 U.S. Ecology, Grandview, Idaho

U.S. Ecology (USEI) has a RCRA Part B Permit that contains waste acceptance criteria relative to radionuclide levels (Appendix C-1). U.S. Ecology's WAC are listed in the tables below:

USEI Table C.1: Unimportant Quantities of Source Material Uniformly Dispersed in Soil or Other Media

Status of Equilibrium	Maximum Concentration of Source Material	Sum of Concentrations Parent(s) and all progeny present
Natural uranium in equilibrium with progeny	<500 ppm / 167 pCi/g (^{238}U activity)	≤ 3000 pCi/g
Refined natural uranium (^{238}U, ^{235}U, ^{234}U, ^{234}Th, ^{234m}Pa, ^{231}Th,	<500 ppm / 333 pCi/g	≤ 2000 pCi/g
Depleted Uranium (^{234}Th, ^{234m}Pa)	<500 ppm / 169 pCi/g	≤ 2000 pCi/g
Natural Thorium (^{232}Th, ^{228}Th)	<500 ppm / 110 pCi/g	≤ 2000 pCi/g
^{230}Th in equilibrium with progeny	<0.01 ppm / 200 pCi/g	≤ 2000 pCi/g
^{230}Th (with no progeny)	<0.1 ppm / ≤ 2000 pCi/g	
Any mixture of Thorium and Uranium	Sum of ratios <1	≤ 2000 pCi/g

USEI Table C.2: Naturally Occurring Radioactive Material (NORM) Other Than Uranium and Thorium Uniformly Dispersed in Soil or Other Media

Status of Equilibrium	Maximum Concentration of Parent Nuclide	Sum of Concentrations of Parent and All Progeny Present
^{226}Ra or ^{228}Ra with progeny in bulk form	500 pCi/g	≤ 4500 pCi/g
^{226}Ra or ^{228}Ra with progeny in reinforced 1P-1 containers	1500 pCi/g	13,500 pCi/g
^{210}Pb with progeny (Bi & ^{210}Po)	1500 pCi/g	4500 pCi/g
^{40}K	818 pCi/g	N/A
Any other NORM		≤ 3000 pCi/g

U.S. Ecology is also permitted to accept 11e.(2) mixed waste (Appendix C-1).

3.2.3.2 Clean Harbors, Deer Trail, Colorado

Clean Harbors Deer Trail, Colorado facility can only accept materials classified by Colorado Regulations as Naturally Occurring Radioactive Material (NORM) and Technologically Enhanced Radioactive Material (TENORM). This facility can only accept materials with total activity levels less than 2000 pCi/g and with total uranium and thorium content less than 500 mg/kg. Radium-226 must be less than 222 pCi/g if it is the only primary radionuclide present. Lead-210 must be less than 666 pCi/g if it is the only primary radionuclide present. In addition, the gamma dose rate must be less than 116 microRoentgens/hour (uR/hr) at the surface of the container. The Deer Trail facility can accept mixed RCRA/NORM wastes but additional testing of such wastes may be required.

3.2.3.3 Energy*Solutions*, Clive Utah

Energy*Solutions* has an Agreement State Radioactive Materials License issued by the State of Utah that authorizes Energy*Solutions* to receive Class A Low Level Radioactive Waste (LLRW), NORM and Accelerator-Produced Radioactive Material (NARM) waste. Energy*Solutions* also has a separate license to receive and dispose of uranium and thorium mill tailings byproduct material as defined by section 11e(2) of the Atomic Energy Act, as amended.

Energy*Solutions*' Radioactive Material License allows receipt and disposal of NORM or NARM. NORM/NARM does not include byproduct, source, or special nuclear material and generally contains radionuclides in the uranium and thorium decay series. Because NORM/NARM waste is not considered LLRW, the waste classification regulations do not apply.

Energy*Solutions* is licensed by the Utah Division of Radiation Control to receive and dispose of 11e.(2) byproduct material as defined by the Atomic Energy Act, as amended. 11e.(2) byproduct material is defined as the tailings or waste produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content. Shipments of 11e.(2) waste would be managed and disposed of in a separate disposal embankment specifically licensed and designed for this material.

Energy*Solutions* may accept 11e.(2) byproduct material with an average concentration in any transport vehicle (truck or railcar) not to exceed 4,000 pCi/g for natural uranium or for any radionuclide in the Radium-226 series, 60,000 pCi/g for Thorium-230, or 6,000 pCi/g for any radionuclide in the thorium decay series. Energy*Solutions*' 11e.(2) Byproduct Material License does not require a sum of fractions calculation. The concentration limits are based on the average concentration of the 11e.(2) byproduct material over the transport vehicle upon receipt and not each individual container on the transport vehicle.

Energy*Solutions* requires that each generator or owner certify in writing that the waste is 11.e(2) byproduct material as defined by the Atomic Energy Act, as amended. Specifically, the generator or owner must certify that the waste materials are tailings or waste produced by extraction or concentration of uranium or thorium from any ore processed primarily for its source material content. The generator or owner must also certify that the waste material does not contain any other radioactive waste or hazardous waste. The generator or owner must provide the following information as it relates to the 11e.(2) byproduct material:

- License under which the waste was processed
- Licensee that was issued the license
- License issue and/or expiration date
- Issuing agency

- Type of license
- Volume of tailings

The generator or owner must attach to the certification a list of all radiological and non-radiological constituents in the waste and the maximum and average concentrations of such constituents.

3.2.3.4 Other Off-site Disposal Facilities

Several other off-site disposal facilities were identified including the US Ecology facility in Robstown, Texas; the Waste Control Specialists facility in Andrews, Texas; and the Chem-Nuclear Systems facility in Barnwell, South Carolina. Based on the results of the prior EPA evaluation (TetraTech, 2009), subsequent discussions with representatives of these facilities, and review of the permit limitations or WAC for these facilities, it was determined that disposal of the West Lake RIM at these facilities was not likely to be acceptable. Factors anticipated to limit acceptance of RIM from the West Lake Landfill include prohibitions on landfilling of radioactive wastes mixed with other materials, limits on the total or specific radionuclide activity levels, and prohibitions on acceptance of wastes generated outside of particular low-level radioactive waste regional compact areas.

Although disposal of soil containing radionuclides may be acceptable at the US Ecology facility in Richland, Washington (Hanford Nuclear Reservation area), disposal of mixed refuse and soil was not likely to be acceptable at this facility. In addition, as this facility was designed to accept higher activity wastes, disposal fees at the Richland facility are substantially higher than those charged by U.S. Ecology at its Grandview, Idaho facility or at the Energy*Solutions* Clive, Utah facility. Both the prior EPA evaluation (TetraTech, 2009) and evaluations made for this SFS determined that disposal of West Lake RIM at the Richland, WA facility would be substantially more expensive than disposal at US Ecology's Grandview, Idaho facility.

3.3 Remedial Action Objectives

RAOs are developed based on contaminants, media of interest, and exposure pathways that permit a range of containment and treatment alternatives to be developed. RAOs are developed based on chemical-specific ARARs and site-specific risk-related factors.

The following RAOs are identified in the ROD for OU-1 (EPA, 2008):

RAOs for Areas 1 and 2 of OU 1:

- Prevent direct contact with landfill contents including exposure to external radiation;

- Minimize infiltration and any resulting contaminant leaching to groundwater;

- Control surface water runoff and erosion; and
- Control and treat landfill gas emissions including radon.

RAO for the Buffer Zone/Crossroad Property:

- Prevent direct contact with contaminated surface soils or ensure contaminant levels are low enough to allow for unlimited use and unrestricted exposure.

The ROD-selected remedy included groundwater monitoring as a component of the remedy in order to evaluate the continued effectiveness of the landfill remedy. The same principle will apply to the new excavation remedies evaluated under the SFS – groundwater monitoring will verify that a landfill remedy is working. Because the RI/FS did not identify a groundwater contamination problem and neither the ROD-selected remedy nor the excavation options include groundwater remediation, no groundwater RAO is required. Groundwater monitoring, however, is included as part of all remedial actions that may be taken at the site because it is a standard component of post-closure care at municipal solid waste landfills, regardless of whether a groundwater contaminant plume has been identified.

3.4 Cleanup Levels

EPA has defined (EPA, 2010a) “complete rad removal” to mean attainment of the risk-based radiological cleanup levels specified in OSWER directives 9200.4-25 and 9200.4-18 (EPA, 1998a and 1997a). The radiological cleanup levels specified in OSWER directive 9200.4-25 are total radium 226 + 228 greater than 5 pCi/g (above background) and total thorium 230 + 232 greater than 5 pCi/g (above background). For purposes of performing the SFS for “complete rad removal” alternatives, a cleanup level of 54.5 pCi/g was used for uranium based on the approachestablished by EPA for development of the uranium remediation goals for the St. Louis Downtown Site (SLDS) [EPA, 1998b] and the St. Louis Airport Site (SLAPS) (EPA, 2005a). Additional discussion regarding the approach used for development of the uranium remediation level is presented in the EPA-approved SFS Work Plan (EMSI, 2010) and in Section 2.8.2.1 of the Record of Decision for SLAPS (EPA, 2005a).

Based on these cleanup levels, the so-called “complete rad removal” alternatives would not result in complete removal of all radionuclides from the site. Rather, these alternatives are intended to result in removal of radionuclides to a level such that engineering measures and institutional controls intended to address radionuclide occurrences would no longer be required. EPA’s policies pursuant to CERCLA and the NCP do not require removal of all radionuclides. The radionuclide levels that would remain with Areas 1 and 2 under the “complete rad removal” alternatives would allow for unrestricted use of the site and therefore would be protective of human health for reasonably expected future exposure scenarios.

EPA has defined the "complete rad removal" alternatives to mean attainment of the risk-based radiological cleanup levels specified in OSWER directives 9200.4-25 and 9200.4-18. These directives provide guidance for establishing protective cleanup levels for radioactive contamination at CERCLA (Superfund) sites. In particular, these directives provide clarification as to the use of the UMTRCA soil cleanup criteria as remediation goals at CERCLA sites. The UMTRCA soil cleanup criteria are based on concentrations above background levels. Similarly, EPA has stated elsewhere that CERCLA cleanup levels are not set at concentrations below natural background levels (EPA, 2002). As a result, the cleanup standards to be used for the development and evaluation of the "complete rad removal" are background-based standards. Determination of background levels is an important part of the development of the soil cleanup levels for the "complete rad removal" alternatives.

As with any set of data, background values are subject to variability. By definition, the mean background value represents the central tendency of the background data set, but does not incorporate any measure of the variability of the background data set. Values greater than the mean value may nonetheless be representative of background conditions. Therefore, some measure of the variability of the background data is necessary to define the uncertainty associated with the mean of the background values. A common type of value for the interval around an estimate is a "confidence interval." A confidence interval may be regarded as combining an interval around an estimate with a probabilistic statement about the unknown parameter. Confidence intervals are based on the standard deviation of the data set and published statistical values defining population distributions.

Background concentrations of the various isotopes of radium, thorium and uranium are presented in Section 6.2 of the RI report (EMSI, 2000). These background concentrations were determined using analytical results from samples collected at four background locations. In order to account for the variability in the background results, the representative background values used in the RI are the mean values of the four results plus two standard deviations. Use of two standard deviations reflects the critical value of 1.96 used to calculate the 95% confidence limit for a normally distributed population with a large number (greater than 30) of sample results. Specifically, through repeated sampling, the true mean value is expected to fall within a range defined by two times the standard deviation 95% of the time. For smaller sample sizes, the critical values are larger. In the case of a sample set consisting of four data values, the critical value would be 2.35. Therefore, use of a value of two is a reasonable, yet slightly conservative (more protective) method of estimating the variability of the background values.

The mean background concentrations and the mean background concentrations plus two standard deviations were presented in the RI report (EMSI, 2000) and are listed below:

Parameter	Mean of the background sample results	Standard deviation of the background sample results	Mean value plus two standard deviations
Radium-226	1.06	0.12	1.30
Radium-228	1.65	0.36	2.37
Thorium-230	1.51	0.47	2.45
Thorium-232	0.90	0.33	1.55
Uranium-238	1.33	0.46	2.24
Uranium-235	0.39	0.38	1.15
Uranium-234	1.47	0.63	2.73

All values reported as pCi/g

Collection of additional background samples to provide a larger data set for use in estimating background values, or incorporation or use of background values obtained from other studies conducted in the general area of the site (such as SLAPS) may provide a better estimate of the background values, but these efforts are outside the scope of and are not necessary for completion of this SFS.

Each of these radionuclides are members of either the uranium-238 or the thorium-232 decay chains. The short lived members of these chains normally are in equilibrium with longer-lived progenitors in the same chain. For example, thorium-232 and radium-228 are members of the thorium-232 decay series and should be in equilibrium with each other. Examining the results listed above, it can be seen that they are noticeably different. These differences likely result from variations in the analytical results obtained from the four samples, combined with the effects of averaging the results and incorporation of two standard deviations about the results to address the overall variability of the sample results.

In order to address the difference in activity levels of the parent and daughter radionuclides for purposes of the SFS, the representative background concentration for all short-lived members of a decay chain were set to the lowest value calculated for any member in the chain. This is a small adjustment that results in a slightly lower derived concentration guideline (DCGL). In the case of the thorium-232 series, the background concentration of all members of the thorium-232 series was set to 1.55 pCi/g for this SFS. Applying this same logic to the remaining radionuclides, the background values to be used for series nuclides in this evaluation are as follows:

- Radium-226 = 1.3 pCi/g
- Radium-228 = 1.55 pCi/g
- Thorium 232 = 1.55 pCi/g (parent of Ra-228)

- Thorium-230 = 1.3 pCi/g (parent of Ra-226)
- Uranium-238 = 2.24 pCi/g (parent of U-234)
- Uranium 234 = 2.24 pCi/g (parent of Th-230)

These values are comparable to the following background values identified for SLAPS (EPA, 1998b):

- Radium-226 = 2.8 pCi/g
- Radium-228 = not identified
- Thorium 232 = not identified
- Thorium-230 = 1.9 pCi/g
- Uranium-238 = 1.4 pCi/g
- Uranium 234 = not identified

The resultant cleanup levels are the sum of the representative background concentrations and the appropriate risk-based remediation concentrations listed in the OSWER directives (*i.e.*, 5 pCi/g plus background). Based on the site background values presented in the RI (EMSI, 2000), the site cleanup values would be as follows:

- Radium-226+228 = 7.9 pCi/g[1]
- Thorium-230+232 = 7.9 pCi/g
- Total uranium = 54.5 pCi/g

These cleanup values were used to identify the site soils that would be included with the scope of the "complete rad removal" alternatives.

A uranium remediation goal of 50 pCi/g is equivalent to a mass-based uranium concentration of 71 mg/kg. EPA's current non-carcinogenic screening level for uranium is 3,100 mg/kg (http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/). Consequently, cleanup of uranium to 50 pCi/g plus background should not pose any non-carcinogenic risks. Therefore, the cleanup level (54.5 pCi/g) derived for the West Lake Landfill

[1] Total radium DCGL = 1.3 pCi/g radium-226 + 1.6 pCi/g radium-228 + 5 pCi/g radium cleanup level = 7.9 pCi/g total radium

OU-1 by use of the same approach used for the SLAPS which is part of the North St. Louis sites for potential carcinogenic risks should not present unacceptable non-carcinogenic risks and represents the more conservative cleanup target.

4 TECHNOLOGY SCREENING

The technology screening process in a CERCLA FS involves identifying General Response Actions (GRAs) that may be applicable for development of remedial alternatives based on the site characterization results and the RAOs established for the site or the operable unit. Potential remedial action technologies associated with each GRA that may be applicable to addressing the site characterization results and satisfying the RAOs are first identified and screened based on technical implementability. The resultant technologies are then evaluated based on anticipated effectiveness, implementability, and relative cost to identify the most applicable technologies. These technologies are then combined to develop remedial action alternatives for the FS.

In identifying potential GRAs and technologies, EPA's expectations with respect to developing appropriate remedial alternatives should be considered. These expectations are included in the National Contingency Plan (NCP) at §300.430 (a)(iii), specifically:

- EPA expects to use treatment to address the principal threats posed by a site, wherever practicable. Principal threats for which treatment is most likely to be appropriate include liquids, areas contaminated with high concentrations of toxic compounds, and highly mobile materials;

- EPA expects to use engineering controls, such as containment, for waste that poses a relatively low long-term threat or where treatment is impracticable;

- EPA expects to use a combination of methods, as appropriate, to achieve protection of human health and the environment. In appropriate site situations, treatment of the principal threats posed by a site, with priority placed on treating waste that is liquid, highly toxic or highly mobile, will be combined with engineering controls, as appropriate, for treatment residuals and untreated waste;

- EPA expects to use institutional controls such as water use and deed restrictions to supplement engineering controls as appropriate for short- and long-term management to prevent or limit exposure to hazardous substances, pollutants, or contaminants;

- EPA expects to consider using innovative technology when such technology offers the potential for comparable or superior treatment performance or implementability, fewer or lesser adverse impacts than other available approaches, or lower costs for similar levels of performance than demonstrated technologies; and

- EPA expects to return usable ground waters to their beneficial uses wherever practicable, within a timeframe that is reasonable given the particular circumstances of the site.

Because of the presence of radionuclides in the waste material in Areas 1 and 2 of OU-1 at the West Lake Landfill, EPA's Technology Reference Guide for Radioactively Contaminated Media (EPA, 2007a) was used as a reference for technologies that can effectively treat radioactively contaminated sites. This guidance document calls attention to the fact that the special characteristics of radioactive material in a waste constrain the technologies available to address site characterization results and satisfy RAOs. These special characteristics should be considered in light of the NCP's preference for treatment. The Technology Reference Guide for Radioactively Contaminated Media states:

> This is because unlike non-radioactive hazardous waste, which contains chemicals alterable by physical, chemical, or biological processes to reduce or destroy the hazard, radioactive waste cannot be similarly altered or destroyed. Since destruction of radioactivity is not an option, response actions at radioactively contaminated sites must rely on measures that prevent or reduce exposure to radiation.
>
> The concepts of "Time, Distance and Shielding" are used in radiation protection. Increasing the distance from radioactive material, increasing the shielding between the radioactive material and the point of exposure, and/or decreasing the time of exposure to radioactive material will rapidly reduce the risk from all forms of radiation. The concept of time as used in waste stream management and remediation has an additional meaning. Time allows the natural radioactive decay of the radionuclide to take place, resulting in reduction in risk to human health and the environment. Therefore all remediation solutions involve either removing and disposing of radioactive waste, or immobilizing and isolating radioactive material to protect human health and the environment.

EPA's reference guide includes 13 treatment technologies that can potentially be applied to radioactively-contaminated solid media. Descriptions of these technologies are included in Section 4.3.

Previously, GRAs were identified and technologies were screened and evaluated and used to develop the remedial alternatives in the FS (EMSI, 2006). To address the two "complete rad removal" alternatives in this SFS, some technologies that were screened-out or not retained in the FS were revisited, and additional technologies from the Technology Reference Guide for Radioactively Contaminated Media (EPA, 2007a) were also evaluated relative to the development of the two "complete rad removal" alternatives.

4.1 Technologies Evaluated in the FS Report

The results of the technical implementability screening and evaluation of technologies previously conducted for the site are presented in Figures 4-1 and 4-2 of the FS (EMSI, 2006). GRAs and retained technologies and process options within the technologies included:

General Response Action	Remedial Technology	Process Options
No Action		
Institutional Controls	Access Restrictions	• Fences and guards
	Proprietary Controls	• Deed restrictions • Deed notices • Easements • Covenants • Groundwater use restrictions
Monitoring	Monitoring	• Groundwater, surface water, and sediment monitoring
In-situ Containment	Surface Controls/Diversions	• Diversion/collection, grading, swales and berms, and vegetation to isolate storm water from Areas 1 and 2
	Surface Water/ Sediment Control Barriers	• Sediment traps, sedimentation basins
	Dust Controls	• Revegetation, capping
	Capping and Covers	• Soil, clay, and vegetation; asphalt or concrete; synthetic membrane material; and multilayer, multimedia material
Physical Treatment/Pre-Treatment following Removal	Solids Separation	• Soil sorting and screening
Removal	Excavation	• Backhoe, bulldozer, scraper, and front-end loader
Disposal	Off-site Disposal	• Off-site disposal facility
	On-site Disposal	• Disposal on Area 2 (for surface soil from Buffer Zone/Crossroad property)

4.2 Additional Technology Evaluations/Revisit Previously Eliminated Technologies

In its January 11, 2010, letter (EPA, 2010a) and the SOW attached to the letter (EPA, 2010b), EPA identified two "complete rad removal" alternatives that are to be developed and evaluated in this SFS:

- Excavation of radioactive materials with off-site commercial disposal of the excavated materials ("complete rad removal" with off-site disposal alternative); and

- Excavation of radioactive materials with on-site disposal of the excavated materials in an on-site engineered disposal cell with a liner and cap if a suitable location outside the geomorphic flood plain can be identified ("complete rad removal" with on-site disposal alternative).

The SOW also requires the "complete rad removal" alternatives be evaluated in comparison to the remedy selected in the OU-1 ROD.

Development and evaluation of the "complete rad removal" alternatives requires amendment of several remedial technologies and process options included in the FS, and inclusion in the SFS of a few technologies that were screened-out in the FS. These technologies and process options are listed below and presented on Figure 24.

Figure 24 is a graphical presentation of the technical implementability screening of remediation technologies and process options and provides a brief description for each of the potential technologies. Technical implementability screening comments are also included for each technology on Figure 24. In addition to the volume/size reduction technology, the following technologies and process options were added to the technical implementability screening in this SFS to potentially be considered as components of the "complete rad removal" alternatives. Long-term performance monitoring and short-term monitoring during construction specific process options under the "monitoring" GRA that were discussed in general in the FS are described in more detail in this section.

General Response Action	Remedial Technology	Process Options
Monitoring	Long-term performance monitoring Short-term monitoring during construction	• Landfill and radon gas monitoring • Perimeter environmental media air monitoring • Work zone monitoring • Excavation guidance/ clearance monitoring • Waste acceptance monitoring

General Response Action	Remedial Technology	Process Options
Monitoring (cont'd)	Short-term monitoring during construction (cont'd)	• Post cover construction radon flux monitoring
Containment	Land encapsulation	• On-site: new cell • Off-site licensed facility
	Cryogenic Barriers	• Subsurface cryogenic barrier
	Vertical Barriers	• Slurry wall • Grout curtain • Sheet pile cutoff wall
Physical/Chemical Treatment	Solidification/ Stabilization	• Cement solidification / stabilization • Chemical solidification / stabilization
	Chemical Separation	• Solvent/chemical extraction
	Physical Separation	• Dry soil separation • Soil washing • Flotation
	Vitrification	• In-situ vitrification • Ex-situ vitrification
Biological Treatment	Phytoremediation	• Phytoextraction • Phytostabilization
Removal	Excavation	• Backhoe, bulldozer, scraper, and front-end loader
	Storm Water Management	• Best Management Practices (BMPs) to route runon around working areas • BMPs to minimize waste exposure to direct precipitation • Enclose excavation with temporary structure • BMPs to collect, detain, treat, and release runoff
	Bird Nuisance Mitigation	• BMPs: excavation, staging, soil/tarp covers • Enclose excavation with temporary structure • Grids over exposed refuse • Visual deterrents • Auditory frightening devices • Chemical frightening agents or toxicants

General Response Action	Remedial Technology	Process Options
Transportation	Hauling of waste material	• On-site off-road trucks • Off-site on-road trucks • Rail

4.3 Descriptions of Additional Technologies

The technologies and process options that were added in this SFS to be considered as potential components of the "complete rad removal" alternatives are described and discussed in the following subsections.

4.3.1 Monitoring

Environmental monitoring is a technology used to assess the levels of chemical or radiologically constituents in environmental media at a site.

4.3.1.1 Long-term Performance Monitoring

In addition to long-term groundwater and surface water monitoring, samples of landfill gas and radon would be collected at landfill gas monitoring probes installed around the periphery of those areas where solid waste and radionuclides would still be present. Landfill gas monitoring is a potential component of the ROD-selected remedy if sufficient landfill gas is expected to be generated post-remediation to require installation of such a system.

4.3.1.2 Short-term Monitoring During Construction

Short-term monitoring activities that might be required during implementation of a "complete rad removal" alternative include perimeter environmental media air monitoring, work zone monitoring, excavation guidance/clearance monitoring, waste acceptance monitoring, and post cover construction radon flux monitoring. A detailed monitoring plan would be developed as part of RD.

Perimeter and local area environmental media air monitoring would use fixed monitoring stations containing low volume air samplers to collect airborne particulates and organic vapor samples for analysis of volatile organic compounds (VOCs) and radionuclide activity; continuous radon monitors; and radiation dosimeters. Air quality would be monitored during construction of the remedy. Concentrations of chemicals and radionuclides would be measured in areas where non-remediation workers might congregate and at the fence line. These measured air concentrations would be compared to air quality objectives for the remedy to assure that non-remediation workers who might be present in other portions of the West Lake Landfill site and members of the general public would not be exposed to radiation from the remediation activities. It is anticipated that the air quality objectives for the remedy would be health-based standards designed to satisfy State (10 CSR, Chapter 6) and Federal (40 CFR 61) requirements.

Regarding remediation workers, work zone monitoring activities would involve surveillance of working conditions during remediation. Air quality would be monitored in work areas and the breathing zone surrounding individual workers using fixed and portable air samplers. Air samples would be analyzed for a variety of potential RIM constituents including, radionuclides in particulate form, radon, radon daughters, asbestos, selected metals such as arsenic, lead and chromium, and explosive gases. Ambient radiation would be monitored using hand-held radiation detectors and personal dosimeters issued to individual workers. Remediation workers would participate in a medical monitoring program.

Excavation guidance/clearance monitoring would involve the use of walkover field radiological survey equipment and solids sampling to identify impacted materials above cleanup levels and to guide excavation equipment. To document that RIM has been removed, clearance monitoring would include final walkover radiological scans of exposed faces and bases of excavated areas as well as sampling of soil/trash at the base of excavations.

If excavated RIM would be disposed off-site, waste acceptance monitoring would entail scanning each load of material removed from the site to verify that the radiological Waste Acceptance Criteria of the facility where the RIM would be disposed is met. The material would also be inspected and tested as necessary to determine whether the waste materials contain or could be classified as hazardous wastes or contain asbestos. Discussions with potential disposal facilities indicate that they would conduct these inspections and testing including providing the necessary personnel and equipment as such testing is a requirement of their RCRA permits.

After construction is complete for the final cover systems associated with the ROD-selected remedy and the “complete rad removal” with on-site disposal alternative, Large Area Activated Charcoal Canisters would be used to measure radon flux of the cover surface.

4.3.2 Containment

Containment technologies are designed to isolate contaminated materials to prevent exposure to humans and the environment. Because most radionuclides require long-term disposal, remedies for radioactively-contaminated sites usually employ containment technologies. Some containment technologies are designed to prevent horizontal contaminant migration, some to prevent vertical migration, and others to prevent any form of migration. Four containment technologies are included in the Technology Reference Guide for Radioactively Contaminated Media: capping and covers (containment in place); land encapsulation (excavation and disposal, on-site or off-site); cryogenic barriers (containment in place); and vertical barriers (containment in place) (EPA, 2007).

4.3.2.1 Capping and Covers

A description and discussion of this technology were included in the FS (EMSI, 2006).

4.3.2.2 Land Encapsulation

Land encapsulation is a well-proven and readily implementable containment technology that is generally used at the disposal stage of radioactive waste management. Land encapsulation can either occur on-site or off-site if the waste is transported to an off-site land encapsulation facility (EPA, 2007).

4.3.2.2.1 On-Site: New Cell

The "complete rad removal" with on-site disposal alternative would involve construction of an engineered cell of sufficient volume to contain excavated RIM from Areas 1 and 2, with a liner system that meets MDNR Solid Waste Management Program (SWMP) regulations and a cover system that meets MDNR SWMP and UMTRCA requirements. The liner and cover would include leachate and landfill gas collection systems and landfill gas and groundwater monitoring systems. A cell would need to be sited on the West Lake Landfill property in an area not occupied by existing landfilled features and outside of the geomorphic flood plain. An area of sufficient size at the West Lake Landfill property that would be available for construction of a new engineered disposal cell would need to be identified. Post-closure maintenance and monitoring would also be required for the cell.

4.3.2.2.2 Off-Site Licensed Facility

The SFS evaluation included contacting low-level radioactive waste disposal facilities that could potentially accept the bulk debris-type of waste material to be excavated from the West Lake Landfill OU-1 areas. These facilities include the Energy Solutions facility in Clive, Utah; the US Ecology facilities in Grand View, Idaho and Robstown, Texas; the Waste Control Specialists facility near Andrews, Texas; and the Clean Harbors Deer Trail facility near Last Chance, Colorado.

As discussed in Section 3, prior to disposal, the waste material excavated from the West Lake Landfill would have to meet the WAC of the respective disposal facility. A preliminary evaluation of the WAC for the various facilities relative to the activity of the RIM material indicates that only three – the US Ecology, Grand View, ID; Energy Solutions, Clive, UT; and Clean Harbors Deer Trail, CO facilities – could accept waste material from the West Lake Landfill. The locations of these three facilities relative to the St. Louis, Missouri area are shown on Figure 25. Figure 25 also includes the various railroad lines that serve the areas where the various off-site disposal facilities are located. Because of the long distances between the facilities and the West Lake Landfill, rail transfer would be the most likely method of transporting waste materials for the "complete rad removal" with off-site disposal alternative.

Descriptions of these disposal facilities and the proposed methods of transportation of waste material from the West Lake Landfill are provided below. In addition to being permitted to accept low-level radioactive waste, each of these facilities is permitted to accept hazardous waste and low-level radioactive/hazardous mixed wastes if these wastes are encountered in Areas 1 and 2.

US Ecology: Grand View, Idaho. This 160-acre disposal facility (included within a 1,000 acre privately-owned buffer zone) is located 70 miles southeast of Boise in the Owyhee Desert, approximately 10 miles northwest of Grand View, ID. It has a permit from the State of Idaho to accept RCRA, NORM, TENORM, NRC-, and mixed waste (Part B Permit # IDD073114654). Information for the facility can be found at http://www.americanecology.com/grand_view.htm. The link to a photo gallery showing the facilities and nearby rail transfer facility is: http://www.americanecology.com/grand_view_photo_gallery.htm.

Wastes are received at the US Ecology facility by truck directly and by rail via their 130-car rail transfer facility located in Simco, Idaho, 36 miles from the disposal facility. Wastes shipped by rail are trucked from the rail transfer facility to the disposal facility. US Ecology has indicated that excavated material from the West Lake Landfill would be either: (1) loaded directly into bag-lined gondola cars if a rail spur could be extended across St. Charles Rock Road onto the West Lake Landfill property; or (2) loaded into 35 cubic yard IP-1 DOT bags that would be placed in a semi-trailer, transported to a truck-to-rail transloading operation at a leased rail spur located near the West Lake site (assuming one could be located), and then loaded into gondola rail cars. Under either a direct-to-rail or truck-to-rail loading procedure in St. Louis, the bagged excavated material in the gondola cars would be hauled by rail to the rail transfer facility east of Grand View, ID, then transferred from the gondola cars to transfer trucks with pup trailers and trucked the final 36 miles to the landfill for disposal.

The specific rail routes that would be followed from a rail spur extended onto the West Lake site or a truck-to-rail transloading operation at a leased rail spur located near the West Lake site to the US Ecology Grand View, ID facility are as follows: Burlington Northern Santa Fe (BNSF) from Bridgeton, MO to Kansas City, MO; then the Union Pacific from Kansas City, MO to Simco, ID. This route transits through the major cities and states of Bridgeton, MO, Kansas City, MO, Atchison, KS, Marysville, KS, Hastings, NE, North Platte, NE, Cheyenne, WY, Green River, WY, Salt Lake City, UT, Pocatello, ID, Nampa, ID, and Simco, ID.

Approximately 2.5 million tons of waste material containing radionuclides, including 2 million tons of USACOE FUSRAP waste containing uranium, radium, and thorium soils and debris, have been disposed at the Grand View, ID facility. Material containing radionuclides from SLAPS [634,000 tons], Latty Avenue [69,000 tons], and Denver Radium OU-8 (Shattuck Chemical) [243,000 tons] sites have also been disposed at this facility.

The WAC and RCRA Part B permit for this facility are included in Appendix C-1.

Energy Solutions: Clive, Utah. The 439-acre Energy Solutions Clive site is located in Utah's West Desert, approximately 75 miles west of Salt Lake City and about three miles south of Interstate 80, Exit 49. Information for the facility can be found at http://www.energysolutions.com/?id=OTkw. A video of the facilities at the Clive site can be found under the Media Room tab at this website. The facility is authorized to receive Class A LLRW, NORM/NARM, Class A Mixed LLRW (i.e., radioactive and hazardous), 11e.(2) Byproduct Material, and Special Nuclear Material based on concentration limits under Radioactive Material License (RML) Number UT 2300249, as amended, and 11e.(2) Byproduct Material License Number UT 2300478, as amended. The facility has a separate license to receive and dispose of uranium and thorium mill tailings byproduct material as defined by section 11e.(2) of the Atomic Energy Act of 1954, as amended.

The Clive, UT facility receives waste shipped via bulk truck, containerized truck, enclosed truck, bulk railcars, rail boxcars, and rail intermodals. The disposal site is accessed by the Union Pacific Railroad at Energy Solutions' 10-miles of private siding year-round. A covered railcar rotary dumper and covered railcar decontamination facilities are also located at the disposal facility.

Energy Solutions has indicated that excavated material from the West Lake Landfill would be either: (1) loaded directly into gondola cars if a rail spur could be extended across St. Charles Rock Road onto the West Lake Landfill property; (2) loaded into 10 cubic yard IP-1 DOT bags, with the bags placed on a flat bed semi-trailer and transported to a truck-to-rail transloading operation at a leased rail spur located near the West Lake site (assuming one could be located), and then loaded into gondola rail cars; or (3) bulk loaded into 25 cubic yard intermodal containers, with the intermodal containers then placed on a flat bed semi-trailer and transported to a truck-to-rail transloading operation and multiple intermodal containers stacked onto flat railcars. The gondolas or intermodal containers would be transported via rail directly to the Clive, UT facility and disposed.

The specific rail routes that would be followed from a rail spur extended onto the site or a truck-to-rail transloading operation at a leased rail spur located near the West Lake site to the Energy Solutions Clive, UT facility are as follows: Norfolk Southern (NS) from Bridgeton, MO to Kansas City, MO; then the Union Pacific from Kansas City, MO to Clive, UT. This route transits the major cities and states of Bridgeton, MO, Kansas City, MO, Atchison, KS, Marysville, KS, Hastings, NE, North Platte, NE, Cheyenne, WY, Green River, WY, Ogden, UT, Salt Lake City, UT, West Wendover, NV, and Clive, UT. (Note that Energy Solutions uses a different rail route from Bridgeton, MO to Kansas City, MO than US Ecology.)

Large volumes of soil and waste materials with low-levels of radionuclides have been disposed at the Clive facility from the following projects: DOE – Fernald, OH Closure; DOE – Rocky Flats, CO Closure; DOE – Mound, OH OU-1 Landfill Closure; DOE Columbus Closure; USACOE Maywood, NJ FUSRAP sites; USACOE St. Louis FUSRAP sites; and Denver Radium, CO CERCLA site.

The WAC for this facility is included in Appendix C-2.

Clean Harbors (Deer Trail) – Last Chance, Colorado. The 325-acre treatment, storage, and land disposal facility is located in a rural area approximately 75 miles east of Denver and is licensed to accept NORM and TENORM wastes and debris as well as landfillable mixtures of RCRA and NORM wastes under Colorado Department of Public Health and Environment Radioactive Materials License Number Colo. 1101-01 and Colorado RCRA Part B Permit renewed 2005, No. CO-05-12-21-01. A Fact Sheet for this facility can be downloaded from the Clean Harbors website at the following link: http://cleanharbors.com/locations/index.asp?id=55.

Wastes are received at the facility by truck directly and by rail via a trans-loading point located in Sterling, Colorado, approximately 73 miles from the disposal facility. Clean Harbors has indicated that West Lake Landfill wastes would be either: (1) loaded directly into lined gondola cars if a rail spur could be extended across St. Charles Rock Road onto the West Lake Landfill property, or (2) loaded into end-dump semi-trailers, transported to a truck-to-rail transloading operation at a leased rail spur located near the West Lake site (assuming one could be located), and discharged from the end-dump semi-trailers into lined gondola cars. The gondola cars would be hauled by rail to the trans-loading point in Sterling, transferred from the gondola cars to semi-trailer trucks, and trucked the 73 miles to the Deer Trail facility for disposal.

The specific rail routes that would be followed from a rail spur extended onto the site or a truck-to-rail transloading operation at a leased rail spur located near the West Lake site to the trans-loading point located in Sterling, CO for the Clean Harbors (Deer Trail) facility are as follows: NS or BNSF from Bridgeton, MO to Kansas City, MO; then the Union Pacific from Kansas City, MO to Sterling, CO. This route transits through the major cities and states of Bridgeton, MO, Kansas City, MO, Atchison, KS, Marysville, KS, Hastings, NE, North Platte, NE, Julesburg, CO, and Sterling, CO.

The Rocky Mountain Low Level Radioactive Waste Compact has designated Deer Trail as the Low Level Waste Facility for Colorado, New Mexico, and Nevada. Wastes from other states may be disposed at Deer Trail but an Application for Waste Import must be made to the Rocky Mountain Low Level Radioactive Waste Board and an application fee paid. DOE FUSRAP wastes have been disposed at the Deer Trail facility.

The WAC for this facility is included in Appendix C-3.

4.3.2.3 Cryogenic Barriers

Cryogenic barriers provide containment and reduce the mobility of radionuclide contaminants by freezing contaminated subsurface soils to create an ice barrier around a contaminated zone. Rows of freeze pipes are inserted in an array outside and beneath the contaminated zone and the array of pipes connected to a refrigeration plant. Coolants typically consist of salt water, propylene glycol or calcium chloride. Cryogenic barriers are considered a good application for the containment of short-lived radionuclides such as tritium. Both a full-scale field test and full-scale demonstration project of this technology have been performed in the Oak Ridge, TN area (EPA, 2007).

4.3.2.4 Vertical Barriers

A vertical barrier is a containment technology that is installed around a contaminated zone to assist in confining radioactive waste and any contaminated groundwater that might otherwise flow from a site. To be effective, vertical barriers should be constructed such that the bottom of the barrier is keyed-into a relatively impermeable natural horizontal barrier (i.e., a groundwater aquitard), such as a clay zone or bedrock, to limit groundwater flow. The vertical barrier technology is often used where the waste mass is too large to practically treat and where soluble and mobile constituents pose an imminent threat to a drinking water source (EPA, 1992). Vertical barriers are frequently used in conjunction with a surface cap to produce an above and below grade containment structure (EPA, 1988b).

4.3.2.4.1 Slurry Wall

Slurry walls consist of a vertically excavated trench filled with a slurry mix of soil, bentonite and water, or cement, bentonite and water. The slurry is pumped into the trench as the trench materials are being excavated, which provides short-term stability of the trench to prevent collapse of the side walls during excavation and producing a barrier to groundwater flow. Soil-bentonite slurry walls have a wider range of chemical compatibility and a lower permeability than cement-bentonite slurry walls or walls with other slurry compositions, but soil-bentonite slurry walls have lower shear strength and are subject to more settlement over time.

4.3.2.4.2 Grout Curtain

Grout curtains are thin vertical grout walls constructed by pressure-injecting grout directly into the soil at closely-space intervals around the waste mass. The spacing is designed so that each "pillar" of grout intersects the next, thus forming a continuous wall or curtain (EPA, 1988b). Grout curtains are generally used at shallow depths (i.e., less than 30 to 40 feet). Grouting materials can include hydraulic cements, clays, bentonite, silicates, and polymers (sometimes preferable because they are impermeable to gases and liquids, resist radiation, and perform well in acidic and alkaline environments).

4.3.2.4.3 Sheet Pile Cutoff Wall

Sheet pile cutoff walls are used for excavation stability and to control groundwater flow. Sheet pile cutoff walls are constructed by driving interlocking steel or high density polyethylene (HDPE) into the ground. The joints between individual sheets are typically plugged with clay slurry for steel sheets or an expanding gasket for HDPE sheets. Sheet pile cutoff walls have not been demonstrated as a containment barrier at a radionuclide-contaminated site (EPA, 2007a).

Potential application of sheet-pile walls for stabilization of possible waste excavation areas in Areas 1 and 2 is presented in Appendix D. Based on these evaluations, application of sheet pile technology for excavation stabilization is not considered to be implementable or cost effective for Areas 1 and 2.

4.3.3 Physical/Chemical Treatment

The Technology Reference Guide for Radioactively Contaminated Media (EPA, 2007a) includes four physical and chemical treatment technologies that can effectively treat wastes from radioactively-contaminated sites. These technologies include solidification/stabilization, chemical separation, physical separation, and vitrification.

4.3.3.1 Solidification/Stabilization

Solidification/stabilization technologies reduce the mobility of hazardous and radioactive contaminants in the environment through both physical and chemical processes. The goal of the solidification/stabilization process is to limit the spread of radioactive material via leaching, and to "trap" and contain radionuclides within a densified and hardened soil mass that has a high structural integrity. In stabilization, chemical reactions are induced between the stabilizing agent and contaminants. Solidification does not involve chemical interaction or chemical bonding between the contaminants and the solidification agent, but bonds them mechanically.

Solidification/stabilization can be employed in-situ or ex-situ. In-situ techniques use auger/caisson and injector head systems to apply agents to soils in-place, while ex-situ techniques involve excavation of the contaminated materials and machine-mixing them with the solidifying agent. Ex-situ processes typically require disposal of the resultant materials.

Solidification/stabilization techniques can involve either microencapsulation or macroencapsulation. Microencapsulation involves thorough and homogeneous mixing of small waste particles (typically 0.08 inches or less) with a liquid binder that then solidifies to form a solid, monolithic final waste form. Individual waste particles are coated and surrounded by the solidified binder to provide mechanical integrity and act as a barrier against leaching of contaminants. Macroencapsulation involves packaging large pieces of waste or containers of waste not suitable for processing by microencapsulation and surrounding the package with a layer of clean binder material. The binder forms a protective layer around the waste that provides structural support, prevents dispersion, and helps reduce migration of contaminants. EPA defines macroencapsulation as being appropriate for immobilizing low-level radioactive debris waste with dimensions greater than or equal to 2.5 inches (EPA, 2007a).

Cement solidification/stabilization processes involve the addition of cement or a cement-based mixture, while chemical solidification/stabilization involves adding chemical reagents including thermoplastic polymers (asphalt bitumen, paraffin, polyethylene, polypropylene, modified sulfur cement), thermosetting polymers (vinyl ester monomers, urea formaldehyde, epoxy polymers), and other proprietary additives. Cement solidification/stabilization is best suited to highly porous, coarse-grained, low-level radioactive waste in permeable matrices, while chemical solidification/stabilization is better suited to fine-grained soil with small pores (EPA, 2007a).

4.3.3.2 Chemical Separation

Chemical separation using solvent/chemical extraction is an ex-situ chemical separation technology that separates hazardous contaminants from soils, sludges, and sediments to reduce the volume of hazardous waste that must be treated. The resulting process residuals require further treatment, storage, or disposal. Solvent/chemical extraction involves excavation and transferring soil to equipment that mixes the soil with a solvent. Solvents that have been used to remove radionuclide contaminants include complexing agents such as ethylenediaminetetraacetic acid (EDTA); inorganic salts; organic solvents; and sulfuric, hydrochloric, and nitric mineral acids. Use of water alone as the solvent is referred to as soil washing – see Section 4.3.3.3.2.

Solvent/chemical extraction equipment processes contaminated soil either in batches for dry soil or as a continuous flow for pumpable waste. When the contaminants have been sufficiently extracted, the solvent is separated from the soil and is either distilled in an evaporator or column or removed from the leachate by precipitation. Distilled vapor consists of relatively pure solvent that is recycled into the extraction process; the liquid residue, which contains concentrated contaminants, undergoes further treatment or disposal. If the contaminants are precipitated, the sludge is dried with a filter press.

Not all radionuclides and solvent will be removed from the contaminated soil during the chemical extraction process, requiring further processing if the remaining concentrations are not below levels such that the soil can be returned to its original location. Results from 22 studies indicate contaminant removal rates using the solvent/chemical extraction process of 13 to 100% for soils contaminated with radioactive waste and heavy metals. Two studies (one pilot-scale and one full-scale) using sodium carbonate/sodium bicarbonate solution for uranium extraction achieved removal efficiencies of between 75 and 90%. A solvent/chemical extraction field demonstration project treating soil containing radium-226 and thorium-232 showed removals of 60 to 67% and 73 to 76%, respectively (EPA, 2007a).

Soil properties such as particle size, pH, partition coefficient, ion cation exchange capacity, organic content, moisture content, and contaminant concentrations and solubilities are factors that affect the efficiency and the operability of solvent/chemical extraction (FRTR, 2002). Bench-scale testing is required. Soils with high clay, silt, or organic content might cause dewatering problems in the contaminated waste stream. Debris greater than 2.4 inches in diameter typically must be removed prior to processing, and chemical extraction is not practical for soil with more than 6.7 percent organic material. If multiple radionuclides or metals are targeted for removal, multiple solvent extraction steps may be required using multiple solvents. Interference from thorium could limit the application of EDTA in removing radium when both radionuclides are present (EPA, 1995).

4.3.3.3 Physical Separation

Physical separation technologies are a class of treatment in which radionuclide contaminated media are separated into clean and contaminated fractions by taking advantage of the physical properties of the contaminants. These technologies work on the principal that radionuclides are associated with a particular fraction of a media which can be separated based on size and other physical attributes. In solid media such as soil or sediment, most radioactive contaminants are associated with smaller particles, known as soil fines (i.e., clays and silts). Physical separation of the contaminated media into clean and contaminated fractions could potentially reduce the volume of contaminated media requiring further treatment and/or disposal. Dry soil separation, soil washing, and column and centrifugal flotation are the three physical separation technologies included in EPA's Technology Reference Guide for Radioactively Contaminated Media (EPA, 2007a).

4.3.3.3.1 Dry Soil Separation

Dry soil separation segregates radioactive particles from clean soil particles. The simplest application involves screening and sieving soils to separate finer fractions, such as silt and clay, from coarser fractions of the soil. Since most contaminants tend to bind to the fine fraction of a soil either chemically or physically, separating the finer portion of the soil can concentrate the contaminants to a smaller volume of soil for subsequent treatment or disposal (FRTR, 2002).

A refinement of the dry soil separation process, the segmented gate system, uses radiation detectors to further separate materials. For this method, radionuclide-contaminated soil is first excavated and screened to remove large rocks and debris. Large rocks are crushed and placed with soil on a conveyor belt which carries the soil under radiation detectors that measure and record the level of radiation in the material. Radioactive batches of material on the conveyor belt are tracked and mechanically diverted through automated gates, which separate the soil into contaminated and clean segments. The radioactive materials then receive further treatment and/or disposal.

This system is best suited to sort any dry host matrix that can be transported by conveyor belts (EPA, 2003) and which is contaminated with no more than two radionuclides with different gamma energies (DOE, 1998). Large debris should be removed before processing the soil and large rocks, concrete, or asphalt must be crushed before being placed on the conveyor belt. Screening to size the feed material to diameters of less than 0.5 inches is desirable and material greater than approximately 1.5 inches in diameter cannot be processed without crushing. Optimal soil moisture content is between 5 and 15 percent (DOE, 1999). A soil sorter process such as the segmented gate system that uses gamma radiation to identify contaminated soil might have difficulty identifying soil with a thorium-230 concentration that would allow for unrestricted use (e.g., 5 pCi/g plus background) due to the lower gamma emissions associated with thorium decay.

Because radiological constituents at OU-1 Areas 1 and 2 occur in soil materials that are intermixed with and interspersed within the overall matrix of landfilled refuse, debris, fill materials, and soil and quarry spoils, prior to a dry soil separation process being considered, the interstitial soil materials would need to be separated from the other landfilled materials using a solids separation process. Solids separation processes can include hand picking for large bulky items and hazardous materials such as propane tanks; magnetic separation for ferrous metals and contaminants associated with ferrous metals; eddy current separation for non-ferrous metals (e.g., inducing an electric current to separate aluminum cans from other recyclables); air classification for papers and plastics; and various fixed, vibrating, or rotating screens. Trommel (revolving cylindrical sieve) screens are commonly used during landfill mining and reclamation (LFMR) projects to separate materials by size, with the soil fraction passing through the screen. Metal conveyor flights on the inside surface of the screen direct the non-soil fraction to the discharge end of the rotating cylinder. The size and type of screen used depends on the end use of the recovered material.

During LFMR projects, trommel screens are typically used downstream in series with a shear shredder with the recovered soil fraction directed to one side of the trommel. If the radiologically-impacted soil were to be separated from the landfilled waste materials, one or more mobile diesel-driven trommels would be used downstream of a shear shredder. A 1 to 1½-inch trommel screen size would likely be chosen to recover the most soil while passing through small pieces of metal, plastic, glass, and paper. This configuration of shear shredder and trommel in an LFMR pilot-test application is shown in Figure 26.

A comb and shaft shear shredder uses counter-rotating multi-edged knives or hooks rotating at a slow speed with high torque to shred materials fed into the inlet hopper. Shear shredders are employed prior to trommel screens in LFMR projects for three primary reasons:

- An approximate 30 percent volume reduction in waste material is achieved by shredding all filled material to a uniform 6 to 8-inch minus size. Separated material that is returned to the landfill is more easily compacted and takes up less volume than the original in-place waste material. (It should be noted that very large landfilled objects such as white goods and steel beams, etc. are "hand-picked" from the waste stream prior to shredding.)

- Shredding pretreatment breaks up pockets and clumps of organic and matted materials and soil; dislodges smaller materials that may be 'hidden" in among the larger materials; and pulverizes materials such as brick, concrete block, large chunks of concrete that contain rebar, and mattresses to provide a stream of more uniformly-sized material such that fines and the soil fraction of the waste can be more easily separated.

- Shear shredding reduces the size of materials (primarily from construction/remodeling and demolition of utilities, structures, and roads, including rebar and other pieces of steel, dimensional lumber and columns/beams, plumbing fixtures and piping, recycled asphalt, and electrical wiring and components) that would tend to clog, get hung up in, and increase the wear on the trommel screen and flights.

The benefits or impacts of using a shear shredder prior to a trommel screen relative to maximizing separation of radiologically-impacted soil from solid wastes typically is evaluated as part of a pilot test during RD prior to full-scale implementation.

4.3.3.3.2 Soil Washing

Soil washing is a process in which water, with or without surfactants, is mixed with contaminated soil and debris to produce a slurry feed. This slurry feed flows through a scrubbing process to segregate contaminated fine soil particles (silts and clays) from granular soil particles. Contaminants are generally bound more tightly to the fine soil particles and not to the larger-grained sand and gravel. Separation processes such as mechanical screening are needed to divide excavated soils into the coarse- and fine-grained fractions, and for dissolving or suspending contaminants in the slurry feed wash. The sand and gravel fraction is generally passed through an abrasive scouring or scrubbing action to remove surface contamination. The fine fraction can be separated further in a sedimentation tank, sometimes with the help of a flocculating agent. The output streams of these processes consist of clean granular soil particles, contaminated soil fines, and process/wash water, all of which need to be tested for contamination. Soil washing is effective only if the process transfers the radionuclides to the wash fluids or concentrates them in a fraction of the original soil volume. In either case, soil washing must be used with other treatment technologies, such as precipitation, filtration and/or ion exchange to recover the radionuclides. Clean soil (sands and gravels) can be returned to the excavation area while the contaminated soil fines and process water are further treated and/or disposed.

Soil washing is most effective when the contaminated soil consists of less than 25% silt and clay and at least 50% sand and gravel; soil particles should be between 0.01 to 0.08 inches in diameter for optimum performance. Soil characteristics including particle size distribution, moisture content, ion cation exchange capacity, and contaminant concentrations and solubilities are factors that impact the efficiency and operation of the soil washing process. Despite many bench- and pilot-scale tests, soil washing has not been fully demonstrated as a technology for reducing the volume of radionuclide-contaminated soil (EPA, 2007).a

4.3.3.3.3 Flotation

Flotation separates the radionuclide-contaminated soil fraction (usually the fine soil particles such as silts and clays) from the clean soil fractions (usually the large granular soil particles and gravel) in order to reduce the volume of soil requiring treatment or disposal. During flotation, radionuclide-contaminated soil is pretreated to remove coarse material and then mixed with water to form a slurry. A flotation agent (a chemical that binds to the surface of the contaminated soil particles to form a water repellant surface) is then added to the solution. Small air bubbles are then passed through the slurry. These air bubbles adhere to the floating particles, transport them to the surface, and produce a foam containing the radionuclide-contaminated soil particles. The foam is mechanically skimmed from the surface or allowed to overflow into another vessel. Residual radionuclide-contaminated soil fines and foam require further treatment and/or disposal. After dewatering and drying, the clean soil can then be returned to the excavation area (EPA, 2007a).

Soil-specific site considerations such as particle size and shape distribution, radionuclide distribution, soil characteristics (clay, sand, silt, and organic content), specific gravity, chemical composition and mineralogical composition can impact the effectiveness of flotation. Flotation is most effective at separating soil particles in the 0.0004 to 0.004 inch size range. For soils that include a wider range of particle sizes, flotation can sometimes be part of a treatment train (e.g., soil washing). Although mining industry operations have consistently and successfully segregated metal-containing fines from soil using this process, the flotation technology has not been fully demonstrated for reducing the volume of radionuclide-contaminated soil (EPA, 2007a).

4.3.3.4 Vitrification

Vitrification involves heating contaminated media to extremely high temperatures, then cooling them to form a solid mass. Upon cooling, a dense glassified mass remains, trapping the radioactive contaminants in a solid, inert form. The process can be applied to contaminated soil, sediment, sludge, mine tailings, buried waste, and metal combustibles. Although mobility is greatly reduced for contaminants trapped within the vitrified mass, the radioactivity of the radionuclide contaminants in not reduced. EPA has designated vitrification as a Best Demonstrated Available Technology (BDAT) for high level radioactive waste (EPA, 2007a).

Vitrification can be performed both in-situ and ex-situ. Traditional in-situ vitrification uses a square array of four graphite electrodes that allows a melt width of approximately 20 to 40 feet and a potential treatment depth of up to 20 feet. Multiple locations, referred to as settings, can be used for remediation of a larger contaminated area. The electrode array is lowered progressively, as the melt grows, to the desired treatment depth. Depending on the amount and types of organics and metals present in the soil or waste mass which may volatilize (e.g., mercury, lead, and cadmium), offgas treatment may be required. In the ex-situ configuration, waste is fed to a furnace (e.g., joule-process heating; plasma; electric arc; microwave; and coal-, gas- or oil-fired cyclone furnace) on either a batch or continuous feed basis.

In-situ vitrification should generally not be used on waste or contaminated soils with organic contents higher than 10 percent by weight or highly reactive materials. To effectively immobilize radionuclides and heavy metals, soils should have greater that 30 percent glass-forming materials (i.e., SiO_2). The waste and/or contaminated media must have sufficient alkali content (i.e., Na_2O, Li_2O, and K_2O) to ensure the proper balance between electrical conductivity and melting temperature. Void volumes and percentages of metals, rubble, and combustible organics (e.g., methane in landfill gas) need to be considered, as soils and waste that contain greater than 55 percent inorganic debris and/or rubble are difficult to treat with in-situ vitrification. The process is also not applicable to soils or waste containing sealed containers such as drums, tanks, or paint cans since pressurized gases will be released and may disrupt the melt (EPA, 2007a).

4.3.4 Biological Treatment

Biological treatment of radioactively-contaminated soils, sediments, and sludges involves stabilization of the contaminants in-place and/or removal via plant root systems. The contaminants are transferred to various parts of the plant, including the shoots and leaves, where they can be harvested. Phytoremediation is the use of plant systems to remove, transfer, stabilize, or destroy contaminants in soils, sediments and sludges. The mechanisms of phytoremediation applicable to solid media include enhanced rhizosphere biodegradation, phytoextraction, phytodegradation and phytostabilization.

Because radionuclides do not biodegrade, the mechanisms applicable to remediation of radionuclides are phytoextraction and phytostabilization (FRTR, 2002). Phytoremediation is limited to shallow soils and sediments. Because growth of plants can be affected by climatic or seasonal conditions, this technology may not be applicable in areas with cold climates and short growing seasons.

Phytoextraction (also known as phytoaccumulation), is the uptake of contaminants by plant roots and the translocation/accumulation of contaminants into plant shoots and leaves. Phytoextraction will produce a harvested biomass residual waste that must be further treated and/or disposed as a radioactive waste. For phytoextraction to be effective, the root system of the selected plants should be able to penetrate the entire contaminated zone, and to be cost-effective, the rate of plant uptake must be greater than one percent of the plant's weight per harvest and the time to complete the remediation process must be between two and 10 years. Phytoextraction has been pilot-tested to remove low levels of cesium and strontium from contaminated soils and sediments (EPA, 2007a).

Phytostabilization is the production of chemical compounds by plants to immobilize contaminants at the interface of roots and soil. Contaminant transport in soil, sediments, or sludges can be reduced through absorption and accumulation by roots; adsorption onto roots; precipitation, complexation, metal valence reduction in soil within the root zone; or binding into organic humic matter through the process of humification. Although considerable research has been conducted on phytostabilization of metals, little research or field testing has been performed regarding phytostabilization of radionuclides (Pivetz, 2001).

4.3.5 Removal

Several removal technologies may be considered as components of alternatives to address the site characterization results and attempt to address the potential bird nuisance issues, as well as to satisfy the RAOs, associated with OU-1 at the West Lake Landfill. Removal technologies considered include excavation, stormwater management, and bird nuisance mitigation.

4.3.5.1 Excavation

Excavation construction equipment includes back- and track-hoes, bulldozers, scrapers, and front-end loaders. This equipment would be used for cutting and filling of waste and fill materials to achieve surface grades, to excavate and move filled waste material, and to construct new site features such as stormwater lagoons, cell liners and cover systems.

4.3.5.2 Storm Water Management

During construction of the selected remedy, storm water management will be addressed by minimizing storm water flow into the working areas (also referred to as run-on); by minimizing the surface area of disturbed ground that is exposed to direct precipitation; and by properly detaining and treating, if necessary, runoff that has contacted the working areas. A Storm Water Management Plan that incorporates appropriate diversion, conveyance, detention, and treatment measures would be prepared as part of the remedial design and implemented during the remedial action to ensure that appropriate effective measures are taken to cost-effectively limit run-on, minimize waste contact with precipitation, and manage runoff in accordance with applicable regulations.

Applicable technologies that could be employed for storm water management include:

- Use of Best Management Practices (BMPs) such as diversion ditches, earthen berms, and culverts to divert storm water around the disturbed or working areas so as to prevent its contact with exposed waste material.

- Use of BMPs such as selective excavation, staging, daily soil cover or tarps, and covering truck loads during transportation to minimize the area of waste exposed to direct precipitation. In some cases, temporary sumps and pumps may also be used to augment conveyance of direct precipitation into run-on diversion ditches.

- Use of temporary structures (e.g., a tensioned fabric frame structure) erected above and around an excavation area to shield waste from contact with direct precipitation. A temporary enclosed structure would require construction of a relatively flat foundation system (e.g., spread footings, drilled piers, driven piles, or grade berms) to support the predicted loads. The maximum width of commercially-available structures is approximately 200 feet, with a reasonable maximum width of only 140 feet. Therefore, for excavations with widths greater than 140 feet, a temporary structure would need to be moved multiple times, with each move involving excavation and earthwork to prepare the next area and install a new foundation prior to disassembling and reassembling the structure. The buried refuse in Areas 1 and 2 would likely not support the loads induced by a temporary structure without an elaborate foundation system or localized ground improvement to strengthen the foundation materials.

- Use of BMPs to collect, detain, treat, and release runoff as required by Missouri storm water regulations. These BMPs would include the use of sumps, pumps, pipelines, lined impoundments and/or temporary storage tanks to collect, convey, and detain stormwater that has contacted waste material. If treatment is necessary, any radionuclides would likely be tied-up with the particulates in the storm water and would be removed via gravity settling within a detention or storm water pond and filtration to meet direct or indirect (i.e., to a Publically-Owned Treatment Works [POTW]) discharge limits. Radon gas would be removed via liquid-phase activated carbon (LPGAC) adsorption, if necessary. In addition, conventional flow control devices such a morning-glory spillway within, or fixed weir at, an outlet of, a detention pond could be used to limit discharge rates to those of the design storm or as allowed by State regulations.

4.3.5.3 Bird Nuisance Mitigation

As the contents of Areas 1 and 2 would be excavated under either of the "complete rad removal" alternatives, and as RIM would be placed in the on-site cell under the "complete rad removal with on-site disposal" alternative, the nuisance attraction to and congregation by birds at and above the affected areas could be problematic unless effectively controlled. The main concern would be the potential for increased bird strikes to aircraft approaching and departing from Lambert-St. Louis International Airport.

Ongoing research by the US Department of Agriculture Animal and Plant Health Inspection Service (USDA, 2008) and the National Wildlife Research Center (NWRC, 2008) into bird control mechanisms at landfills, as well as practical experience by landfill operators, offer control strategies that may help mitigate bird congregation above and within excavation areas. If needed, an avian management plan that incorporates appropriate measures would be prepared by a qualified wildlife expert as part of the remedial design process to ensure that appropriate effective measures are taken during excavation to cost-effectively limit bird congregation in order to protect approaching and departing aircraft from increased risk of bird-strikes. Potential control strategies include:

- Use of BMPs based on practical experience by landfill operators. These BMPs would include the use of selective excavation and staging of waste material to minimize the area of exposed waste at any given time, and using daily cover consisting of soil or a tarp placed over the exposed waste.

- Removal of food sources by covering exposed refuse with a temporary structure (e.g., a tensioned fabric frame structure).

- Erecting grids over exposed refuse to prevent bird access using stainless steel wire, monofilament, or Kevlar line placed above the working area in parallel lines or in spoke configurations. Parallel spacings of between 10 and 50 feet have been effective for most gulls such as those that nest in Missouri. Lines would be placed above the maximum height of working equipment, which would be approximately 15 feet above the original ground elevations for Areas 1 and 2, assuming scrapers and/or bulldozers are initially used. Lines would need to be placed at higher levels when excavators and loaders are employed. Line length would depend on the strength of the wire/filament used and available space for support poles. The size of open excavations may limit the constructability of wire or monofilament grids.

- Use of predator birds or visual deterrents such as effigies of predator birds.

- Use of auditory "frightening" devices such as pyrotechnics, propane exploders, bird alarm calls, or sound generators that produce noise that is irritating to birds.

- Use of chemical frightening agents or toxicants such as the EPA-registered gull toxicant DRC-1339 and/or Avitrol® that, when ingested by birds, can cause erratic flight that frighten other birds and/or death. DRC-1339 is applied to bread bait and causes renal failure, killing birds within days of ingestion. Avitrol® is a chemical frightening agent that causes birds to fly erratically and emit distress calls, frightening unaffected birds. Effective full-scale and long term application information regarding either chemical on gulls at landfills is not available in the literature. Killing or disorienting birds does not address the concern regarding congregating birds within the flight path of aircraft.

4.3.6 Transportation

Hauling of waste material on- and off-site would be conducted using on-road and off-road trucks, rail, or a combination of trucks and rail. Delivery of clean fill, liner and cover materials, and other materials and equipment associated with construction of the approved remedy also would be accomplished with a variety of trucks.

4.3.6.1 Hauling of Wastes and Construction Materials – On-site, Off-road and Off-site, On-road Trucks

Hauling of waste material by truck would be conducted off-site with on-road trucks and on-site with off-road trucks. Various off-site, on-road "highway" trucks would be used to haul clean fill material to the landfill, haul waste material from the site directly to a waste disposal facility, or haul waste material to a truck-to-rail transloading location where material would be transferred from the trucks to rail cars for subsequent rail hauling. If hauled off-site, wastes with radionuclides must be placed in appropriate containers and USDOT requirements for shipping must be met.

Highway trucks are equipped with tires suitable for long distances on flat surfaces and are used for transporting loose material such as sand, gravel, rock, asphalt, soil or waste materials on roads and highways to and from construction sites, quarries, borrow pits, landfills, and waste disposal facilities. Typical configurations include the standard dump truck (truck chassis with dump body mounted to the truck frame); the semi-trailer or tractor-trailer equipped with flat-bed and bottom-, end-, and side-dump cargo trailers; and the transfer dump truck that pulls a separate dump (or "pup") trailer. Semi-trailer trucks equipped with flatbed or end-dump trailers as well as transfer trucks with pup trailers are typically used to haul waste material from a site to a truck-to-rail transloading operation at a rail spur location.

On-site, off-road dump trucks or "haul trucks" resemble heavy construction equipment and are used strictly off-road for mining and heavy dirt or other construction materials hauling projects. These vehicles employ large diameter off-road patterned rubber tires and can have large payload capacities. There are two primary forms: the rigid frame and the articulated frame or "Yuke."

4.3.6.2 Hauling of Waste Material - Rail

Hauling of waste material via rail is typically accomplished with 110 ton capacity gondola cars (railroad car with an open top but enclosed sides and ends, for transporting bulk commodities) or with 32 cubic yard (20 ton) capacity DOT Industrial Packaging (IP) - 1 metal intermodal containers that can be stacked onto flatbed railcars (see 49 CFR Subparts A and B and 49 CFR 173.410 for IP design requirements for low specific activity (LSA) materials). Wastes hauled off-site to an off-site licensed facility must be shipped in appropriate containers and USDOT requirements for shipping must be met.

If waste material is loaded directly into gondola cars, rigid lids are locked onto the open top prior to transport. Waste material can also be placed into 10 or 35 cubic yard IP - 1 soft-sided shipping containers (bags), with the bags then loaded onto flatbed semi-trailers and trucked to a truck-to-rail transloading operation at a rail spur location where the containers are off-loaded from the flatbed into gondola cars. Nine to ten 10 cubic yard bags will fit in a standard sidewall height (5½ feet) gondola car. Four 35 cubic yard bags can be loaded into a larger volume 148 cubic yard gondola. After the gondola cars are filled with soft-sided shipping containers, rigid lids or tarps are placed over the top of the car prior to shipment. After the railcars arrive at an off-site disposal facility, the contents are either discharged directly at the facility using a rotary car dumper or "excavated" from the gondolas and transferred to trucks at a rail transfer facility and subsequently hauled to the disposal facility.

Metal intermodal containers have a hinged top and one end of the container is also hinged. After the waste material is loaded into the top of the container, the top is secured and the container lifted onto a flatbed trailer and hauled to a truck-to-rail transloading operation at a leased rail spur location, where the container is lifted off of the flatbed and stacked with other intermodals onto a flat railcar. At the off-site disposal facility, intermodal containers are lifted off of the railcar and the contents are discharged into the disposal cell through the hinged end of the container.

4.4 Implementability Screening of Remediation Technologies and Process Options

Potential remedial action technologies and process options that may be applicable to address the site characterization results and satisfy the RAOs are described in Section 4.3 and are also summarized in Figure 24. The technologies are screened based on technical implementability in Figure 24. The following remedial technologies and process options were eliminated from further consideration based on the rationale discussed in the Implementability Screening Comments column in Figure 24.

General Response Action	Remedial Technology	Process Options
Containment	Cryogenic Barriers Vertical Barriers	• Subsurface cryogenic barrier • Slurry wall • Grout curtain • Sheet pile cutoff wall
Physical/Chemical Treatment	Chemical Separation	• Solvent/chemical extraction
	Physical Separation	• Soil washing • Flotation
	Vitrification	• In-situ vitrification • Ex-situ vitrification
Biological Treatment	Phytoremediation	• Phytoextraction • Phytostabilization
Removal	Storm Water Management Bird Nuisance Mitigation	• Enclose excavation with temporary structure • Enclose excavation with temporary structure • Chemical frightening agents or toxicants

Implementability screening comments in addition to those provided on Figure 24 for the dry soil separation physical treatment process and the use of a temporary structure to enclose an excavation for stormwater management or bird nuisance mitigation are provided below.

4.4.1 Dry Soil Separation

Although it is expected that use of the shear shredder/trommel equipment would be effective at separating the majority of soil from the non-soil solid waste, the degree of separation that may be achieved by this technology is uncertain. Prior applications of this technology have been focused on separating the bulk of the soil volume from an overall matrix of landfill wastes in order to implement waste-to-energy or waste composting operations or to recover the soil for reuse. These applications were not designed or expected to recover 100% of all of the soil in a landfill and were not concerned with the fractions of soil that were contained in or adhered to the segregated refuse. These applications also were not concerned with the creation of additional fine-grained fractions that would become mixed with the recovered soil as a result of use of a shear-shredder prior to a trommel. Consequently, the effectiveness of this technology at separating RIM, and only RIM, from the overall mass of solid wastes could not be determined without performance of a full-scale pilot-test.

In Areas 1 and 2 of the West Lake Landfill, residual soil containing radionuclides that adheres to or is otherwise contained in the refuse after performance of waste segregation using a trommel screen could still produce processed waste exceeding the levels that would allow for unrestricted use. As a result, the effectiveness of this technology is uncertain. Furthermore, although a trommel includes an exterior brush (Figure 26) to remove debris that may otherwise become entangled in the rotating screen, there would still be instances in which laborers would have to enter the screen and physically remove wire, rebar, plastic, wood, or other entangled debris. During these events, workers would be exposed to increased radiation emitted by RIM that adheres to or otherwise remains in the trommel. The frequency and duration of physical removal of debris cannot be estimated at this time; however, it is clear that use of a trommel would create an additional mechanism for worker exposures to the RIM. Consequently, the potential effectiveness and implementability of this technology relative to segregation of RIM from non-RIM cannot be assessed.

Depending upon the production rate and dependability of the solids separation equipment, inclusion of a solids separation step as part of a process used for excavation and disposal of the RIM could become a factor relative to the daily production rates and project duration. In addition to the additional activities requiring workers and resultant exposures, use of such equipment could extend the overall project schedule and increase the potential or amounts of stormwater accumulation, airborne emissions, bird or other vector impacts due to a possible increase in the overall schedule.

In order to evaluate this technology, full-scale pilot testing of the shear shredder/trommel screen solids separation equipment for volume reduction would definitely be required using representative material from Areas 1 and/or 2. Pilot testing is typically performed prior to LFMR projects in order to assess screening and trommel equipment sizing, estimate production rates, determine the fraction of soil that can be separated from the filled material using varying trommel screen opening sizes (and therefore maximizing the amount of soil that can be removed), and obtain an indication of the type of material that was filled (e.g., construction and demolition debris such as bricks, concrete and rebar, dimensional lumber and/or municipal solid waste). Of particular interest in conducting pilot testing of material from Areas 1 and 2 would be obtaining an estimate of the degree of RIM volume reduction that could be achieved, assessing the moisture content of the filled material, and determining the fraction of soil that would be contained in or adhered to the segregated refuse.

Assuming pilot test results show that the radiologically-impacted soil fraction of RIM could be separated from the overall matrix of landfilled refuse, debris and fill materials, and unimpacted soil and quarry spoils using the revolving cylindrical sieve trommel technology, then additional dry soil separation technologies might be considered to further reduce the volume of radiologically-impacted soil. However, if results of pilot-testing indicate that the non-soil fraction of RIM that would be discharged out the end of the trommel exhibited radionuclide concentrations greater that those that would allow for unrestricted use, then the soils separation process would not be effective in reducing the volume of RIM that would be addressed under the two "complete rad removal" alternatives.

4.4.2 Temporary Structure to Enclose an Excavation

Use of a temporary enclosure to protect an exposed excavation from contact with stormwater or for a potential bird mitigation strategy was eliminated because the other potential process options would provide adequate stormwater controls or bird nuisance mitigation without the significant disadvantages (summarized below) of using a temporary enclosure. A temporary enclosed structure would require construction of a foundation system (e.g., spread footings, drilled piers, driven piles, or grade beams) to support the predicted loads. The foundation alignment must also be relatively flat from side-to-side and end-to-end. Because the topography of the existing landfills is variable, with slopes for drainage control, considerable earthwork would be necessary to prepare an area for foundation construction in advance of erecting the enclosed structure. This would likely include over-excavation for the foundation system that would support the structure. All of this earthwork would be performed without protective cover. In addition, the maximum width of commercially-available structures is approximately 200 feet, with a reasonable maximum width of only 140 feet. The width of RIM areas to be excavated, plus layback for overburden, is estimated to range from 250 feet to 1,050 feet. Thus, temporary structures would need to be moved many times, with each move involving excavation and earthwork to prepare the next area and installation of a new foundation prior to disassembling and reassembling the structure. Finally, the buried refuse would likely not support the loads induced by the structure without an elaborate foundation system or localized ground improvement to strengthen the foundation materials.

Beyond the construction difficulties, other complications would include (1) provision of proper ventilation inside the structure to protect workers from accumulation of radon, methane, hydrogen sulfide, heavy equipment exhaust, dust, and ambient heat, (2) provision of "explosion-proof" electrical conduit and fixtures within the structure because of the potential presence of landfill gas when wastes are excavated, (3) worker safety risk from assembling, disassembling, lifting, then reassembling the 30-40 foot tall structures, (4) durability of the structure for multiple moves, and wear and tear on the components causing the likelihood for ongoing replacements, maintenance and repair of the structure and associated construction delays, and (5) the need for construction of temporary drainage controls around the structure each time it is moved. In addition, for the "complete rad removal" with on-site disposal alternative, structures would need to be placed over the new on-site cell. In that case, construction of the foundation of the structure on top of the cell liner could potentially damage the upper layers of the liner (i.e., the geotextile, leachate collection/drainage, cushioning geotextile, and the geomembrane layers) that would not be designed and constructed to support temporary structures. Consequently, use of a temporary structure may not be implementable for the on-site cell component of that alternative. Overall, use of enclosed structures, where they can be applied, would add considerable time to the remediation schedule because each move would necessitate a new foundation, removal of fabric, disassembly of the structure, crane lifts, reassembly, demobilization and remobilization of electrical and ventilation equipment, removal of old foundations, and construction of new drainage controls. Capital and O&M costs associated with the structures, mobilizing them to the site, assembly/disassembly/reassembly, demobilizing them from the site, foundations, capital and operating costs for electrical and ventilation equipment, and the additional carrying costs for the project due to schedule delays would be considerable.

4.5 Evaluation of Remediation Technologies and Process Options

Potential remedial action technologies that may be applicable to address the site characterization results and satisfy the RAOs are described in Section 4.3 and are also summarized in Figure 24. The technologies are screened based on technical implementability in Figure 24. The resultant technologies are then evaluated in Figure 27 based on anticipated effectiveness, implementability, and relative cost to identify applicable technologies that might be used as components of the remedial action alternatives for this SFS.

Ordinarily in the CERCLA FS process, technologies identified in the technology screening step as being potentially applicable to site characterization results and RAOs are combined to develop remedial alternatives. The remedial alternatives are then screened, if necessary, and subjected a detailed analysis using nine prescribed evaluation criteria. In the case of this SFS, EPA stipulated the three alternatives to be developed and evaluated. Therefore, the step of combining technologies to develop alternatives and screening the alternatives is unnecessary and could result in the elimination of one or more of the alternatives that EPA determined must be evaluated in this SFS.

In addition to the technologies identify in the original FS report (EMSI, 2006) as being potentially applicable to the media and contaminants at the site, the various technologies identified in this section as potentially applicable have been included as appropriate within the three alternatives specified for this SFS. Specifically, the following additional technologies or process options were included: short- and long-term monitoring; capping and covers; land encapsulation including a new engineered disposal cell on-site and disposal in an off-site licensed facility; physical/chemical treatment including solidification/stabilization and soil separation; excavation; storm water management; bird nuisance mitigation; and truck and rail transportation.

5 REMEDIAL ACTION ALTERNATIVES

This section provides descriptions of the remedial alternatives evaluated in this SFS including the ROD-selected remedy and the two "complete rad removal" alternatives. As part of preparation of this SFS, preliminary, conceptual-level, designs were developed for each of the three alternatives in order to prepare estimates of the construction, operation, maintenance and monitoring costs; schedules for each alternative; and to evaluate the alternatives relative to the criteria specified in the NCP as described in Section 6. In addition to the conceptual designs of the alternatives, general procedures to be used for materials handling, surface water control, and methane gas management were also developed and are described in this section of the SFS. It should be noted that the feasibility study (FS) stage of a project is not the appropriate time to develop detailed design documents or formal Materials Handling, Surface Water/Leachate Control and Methane Gas Emergency Action plans. Development of detailed design drawings and planning documents requires development of a detailed design of the landfill regrading or waste excavation plans which would be developed as part of the remedial design (RD) activities.

5.1 Remedial Alternatives Evaluated in FS

A range of remedial alternatives addressing waste materials and contaminated soil present in OU-1 was developed for, and evaluated in the FS (EMSI, 2006). The remedial alternatives developed in the FS address containment of the wastes (landfill alternatives) and management of radiologically impacted soil on the Buffer Zone/Crossroad property (former Ford property). Detailed descriptions of the six landfill and four Buffer Zone/Crossroad property alternatives are presented in the FS report (EMSI, 2006).

The remedial alternatives developed and evaluated in the FS (EMSI, 2006) to address containment of the waste materials present in Areas 1 and 2 consisted of the following:

<u>Areas 1 and 2 Landfill Alternatives</u>

- Alternative L1 – No Action
- Alternative L2 – Cover Repair and Maintenance, Additional Access Restrictions, Additional Institutional Controls, and Monitoring
- Alternative L3 – Soil cover to address gamma exposure and erosion potential
- Alternative L4 –Regrading of Areas 1 and 2 (minimum slope of 2%) and installation of a Subtitle D cover system
- Alternative L5 – Regrading of Areas 1 and 2 (minimum slope of 5%) and installation of a Subtitle D cover system

- Alternative L6 – Excavation of material with higher levels of radioactivity from Area 2 and regrading and installation of a Subtitle D cover system

EPA (2008a) determined that all of the landfill alternatives except the No Action Alternative (Alternative L1) would protect human health and the environment by limiting exposure to the Site's contaminants through engineering means and land use controls. Due to the inclusion of engineering controls, EPA (2008a) determined that the landfill cover alternatives (Alternatives L3, L4, L5 and L6) offer much more reliable protection than Alternative L2, which is more reliant on land use controls. EPA (2008a) also determined that the more sophisticated design of multi-layer landfill cover with infiltration barrier (Alternatives L4, L5 and L6) would provide greater overall protection than the soil cover (Alternative L3). In addition, EPA (2008a) determined that Alternatives L4, L5 and L6 comply with all ARARs while alternatives L2 and L3 do not meet the basic cover design requirements found in the Missouri Solid Waste Rules for sanitary landfills (10 CSR 80-3.010) and therefore do not meet the NCP threshold criterion of compliance with ARARs.

In addition to the presence of RIM in Areas 1 and 2, the FS also developed remedial alternatives to address historic erosion of the landfill berm along the north side of Area 2 and the resultant deposition of radiologically impacted soil on the surface of the Buffer Zone/Crossroad property (formerly termed the Ford property). The remedial alternatives developed in the FS (EMSI, 2006) to address management of contaminated soil on the Buffer Zone/Crossroad property are as follows:

<u>Buffer Zone/Crossroad Property (former Ford property) Remedial Alternatives</u>

- Alternative F1 – No Action
- Alternative F2 – Institutional and Access Controls
- Alternative F3 – Capping and Institutional and Access Controls
- Alternative F4 – Soil Excavation and Consolidation in Area 2

EPA (2008) determined that all of the alternatives for the Buffer Zone/Crossroad property, except Alternative F1 (No Action), are protective of human health and the environment and would comply with ARARs.

Detailed evaluations of the six landfill and four Buffer Zone/Crossroad property alternatives relative to the nine criteria specified in the NCP are presented in the FS report (EMSI, 2006).

5.2 ROD-Selected Remedy

Upon completion and EPA acceptance of the FS (EMSI, 2006) in June 2006, EPA developed a Proposed Plan (EPA, 2006) and initiated a public comment period that opened on June 14, 2006 and remained open until December 29, 2006 (EPA, 2008a). EPA subsequently re-opened the public comment period in March 2008 and closed this additional public comment period on April 9, 2008 (EPA, 2008a). During these times, EPA held three separate public meetings on June 26, 2006, September 14, 2006, and March 27, 2008 (EPA, 2008a).

Based on the results of the RI and FS evaluations and the comments received during the various public meetings and comment periods, EPA prepared a Record of Decision (ROD) that identified the remedial actions that EPA selected for OU-1 (EPA, 2008a). The following paragraphs present the description of the selected remedy as presented in the ROD (EPA, 2008a).

The major components of the ROD-selected remedy for OU-1 are as follows:

- Installation of a landfill cover meeting the Missouri closure and post-closure care requirements for sanitary landfills, including enhancements consistent with the standards for uranium mill tailing sites, (i.e., armoring layer and radon barrier);

- Consolidation of radiologically contaminated surface soil from the Buffer Zone/Crossroad Property to the containment area;

- Application of groundwater monitoring and protection standards consistent with requirements for uranium mill tailing sites and sanitary landfills;

- Control of surface water runoff;

- Gas monitoring and control including radon and decomposition gas as necessary;

- Institutional controls to prevent land and resource uses that are inconsistent with a closed sanitary landfill site containing long-lived radionuclides; and

- Long-term surveillance and maintenance of the remedy.

Prior to construction of the landfill cover, the areas will be brought up to grade using placement of inert fill and regrading of existing material as determined in the RD. Final grades will achieve a minimum slope of two percent.

The landfill berm around Area 2 will be regraded through placement of additional clean fill prior to placement of the landfill cover resulting in an estimated 100 lateral feet of additional material between the current landfill toe and the toe at completion of the RA. In this area, the landfill is built over the geomorphic flood plain that is now protected by the Earth City Levee. In the unlikely event of levee failure during a 500-year flood event, the lowermost two feet of the toe of the landfill cover at the northwestern end of the Site could be impacted by the water. The Site is over a mile from the river and no high energy water would be expected. The flood protection needs of the toe of the landfill will be evaluated in design and appropriate bank protection methods will be used, e.g., rock rip rap apron. The vertical height of the flood protection feature will include a margin of safety over the 1993 flood level. Figure 12-1, showing a conceptual cross-section of the Selected Remedy, indicates the approximate flood level at the toe of the landfill.

Any radiologically contaminated soil on the Buffer Zone/Crossroad Property will be consolidated in the area of containment (Areas 1 or 2) prior to placement of fill material or construction of the cover. It is anticipated that construction of the landfill cover will require the toe of the landfill berm to be regraded and extended over the impacted area on the Buffer Zone/Crossroad Property. Although the extent of contamination on the Buffer Zone/Crossroad Property is thought to be minor, the precise nature and extent of contaminated soil is uncertain. Gamma scans and soil sampling will be used to support the RD and document the existing conditions. Any soil outside the footprint of the landfill will meet remediation goals that support unlimited use and unrestricted exposure and will be subject to verification sampling. Any excavation of contaminated material will include dust suppression and work place monitoring to ensure there is no release of fugitive dust.

The landfill cover, gas control, runoff control, long-term groundwater monitoring, and post-closure inspection and maintenance will at a minimum meet the relevant and appropriate requirements found in the Missouri Solid Waste Rules for sanitary landfills. Consistent with the requirements for uranium mill tailing sites, the landfill cover will also incorporate a rubble or rock armoring layer to minimize the potential for biointrusion and erosion and increase longevity. The landfill cover will also be designed to provide protection from radioactive emissions, i.e., gamma radiation and radon. See section 13.2 for a description of the ARARs. Figure 12-2 shows a conceptual cross-section of a sanitary landfill cover that has been augmented to include a crushed concrete or rock biointrusion layer. Figure 12-3 plots the cover thickness necessary to shield a person on the surface of the cover from gamma exposure.

Surface drainage diversions, controls, and structures will be designed and constructed to expeditiously route storm water runoff to the water drainage systems which are presently subject to state National Pollution Discharge Elimination System permits.

Landfill gas characterization during the RI indicated the sporadic presence of decomposition gases, e.g., methane, and radon. Radon gas needs only to be detained for a few days until it decays to its solid progeny, and a landfill cover designed to act as a diffusion barrier is generally sufficient to control radon. However, decomposition gases must be handled differently. Typically, gas generation in municipal solid waste increases for the first five or six years after placement in the landfill and then declines thereafter. Because these areas have been inactive for 30 years[2], decomposition gas generation is relatively low and expected to decline. However, even at low generation rates, placement of the landfill cover creates the potential for these gases to be trapped and accumulate under the cover. To prevent pressure build up under the landfill cover and/or lateral migration, gas control systems may be required. Gas control measures may involve passive venting or active collection. The need for and nature of the gas control measures will be evaluated and defined as part of the RD. The plans for the control and/or treatment of landfill gas will consider the presence of radon and be developed accordingly.

---

[2] With the passage of time since issuance of the ROD, these areas have now been inactive for even longer.

The landfill cover system will be routinely inspected and maintained to ensure the integrity of the remedy over time. In addition to surveillance of the physical remedy, the periodic site inspections will include administrative functions such as monitoring of institutional controls and coordination with key stakeholders, including the Earth City Levee District regarding management of the flood control system. See section 5.1 for a description of the levee maintenance program.

The O&M Plan[3] will be developed and submitted for approval as part of the RD/RA process. The O&M Plan will cover all the long-term remedy management functions including groundwater monitoring plans, site inspection, maintenance and repair, institutional control monitoring and enforcement, five-year reviews, notification and coordination, community relations, health and safety, emergency planning, activity schedules, reporting, etc. In practice, the O&M Plan may be developed as a compilation of more focused plans.

The detailed descriptions of the engineering components, groundwater monitoring objectives and institutional controls components of the ROD-selected remedy are summarized below along with additional information and details developed during preparation of this SFS.

5.2.1 Engineering Components of the ROD-Selected Remedy

The ROD-selected remedy includes both engineered and non-engineered components. The engineered components of the ROD-selected remedy include:

- Regrading of the existing landfill surface to comply with minimum and maximum slope angles pursuant to the Missouri Solid Waste Rules;
- Surveying and Removal of Radiologically-Impacted Soil from the Buffer Zone/Crossroad Property;
- Construction of a multi-layered, engineered landfill cover over Areas 1 and 2;
- Installation of rock armoring for flood protection along the toe of the northern portion of Area 2;
- Installation of stormwater/surface water runoff management structures;
- Landfill gas monitoring and if needed installation and operation of a landfill gas control system;
- Long term inspection and maintenance of the engineered components of the remedy; and
- Environmental monitoring during and after construction of the remedy.

[3] Operations and Maintenance (O&M) Plan referred to elsewhere in this report as the OM&M (Operations, Maintenance and Monitoring Plan

5.2.1.1 Regrading of the Landfill Surface for the ROD-Selected Remedy

Prior to construction of the landfill cover, the surfaces of Areas 1 and 2 would be recontoured to meet the applicable slope requirements using placement of inert fill and regrading of existing material as determined in the RD. Final grades would achieve a minimum slope of two percent (2%) and a maximum slope of twenty-five percent (25%). Final grades would be achieved through placement of additional material, regrading of existing waste materials or a combination of the two. The specific procedures to be used would be determined as part of Remedial Design based on site constraints, minimization of the amount of material to be moved or placed, other design requirements, health and safety considerations, cost and other factors as appropriate. As part of the development of this SFS, a preliminary evaluation of potential alternative designs was developed and is described below.

For the ROD-selected remedy, it is estimated that depending upon the final design, a total volume of as much as approximately 206,000 bank cubic yards or as little as 92,000 bank cubic yards of waste and soil in Area 1 and Area 2, would need to be cut, moved, and filled to reduce existing landfill slopes to 25% and to allow for construction of a perimeter access road and stormwater diversion ditch. Due to the close proximity of the waste materials to the property boundary, implementation of the ROD-selected remedy without performing any waste regrading (cutting) is not considered feasible.

Although the western portion of the landfill berm along the north side of Area 2 could be regraded through placement of inert fill material within property owned by one of the Respondents (e.g., the Buffer Zone), discussions with the Earth City Flood Control District performed in conjunction with development of a Remedial Design Work Plan identified the need for a stormwater retention basin to manage stormwater runoff from Area 2. The Buffer Zone property is the only available area to locate such a basin. In addition, the central and eastern portions of the landfill berm along the north side of Area 2 extend up to the boundary of the property owned by the Respondents (see Figure 2 in Appendix E). Therefore, there is no space available within the landfill property for placement of additional fill material and extension of the toe of the landfill in order to reduce the overall slope angle of the landfill berm. Although these areas were undeveloped when the initial FS work was performed, they were subsequently developed as part of the Crossroad development and currently are the site of facilities (buildings, parking areas, outdoor storage, landscaped areas, etc.) associated with various commercial operations. Furthermore, portions of Area 2 that contain slopes greater than 25% are located adjacent to St. Charles Rock Road, the proximity of which prevents placement of additional fill and extension of the landfill toe as a means of reducing the slope angles in this area (see Figure 2 in Appendix E). Similarly, portions of the landfill berm along the north and east sides of Area 1 are located immediately adjacent to the landfill access road or St. Charles Rock Road which prevent placement of additional fill and extension of the landfill toe as a means of reducing the slope angles in these areas (see Figure 1 in Appendix E).

As discussed further below, there are design optimizations that could be implemented to significantly reduce the amount of waste regrading required to construct the ROD-selected remedy. Specifically, as part of the SFS evaluations, the need for cutting and filling waste in each area was evaluated and possible alternative conceptual designs to reduce the volume of waste materials to be cut under the ROD-selected remedy were developed and analyzed. The specific alternatives examined included:

1. Use of a fill only approach to regrading the interior portions of Areas 1 and 2;

2. Elimination of the storm water basins in the northern corner of Area 1 and in the Buffer Zone that were included in the scope of the ROD-selected remedy described in the Remedial Design Work Plan (RDWP);

3. Construction of a 10-ft high perimeter earthen berm/access road embankment (i.e. starter berm) with an external slope angle of 40 degrees along the northern (adjacent to the landfill access road), eastern (adjacent to St. Charles Rock Road) and western (adjacent to the transfer station) portions of Area 1 and the northern (adjacent to Crossroads property and St. Charles Rock Road) and western (adjacent to Crossroads property, Buffer Zone, and Old St. Charles Rock Road) portions of Area 2 so as to reduce the amount of waste excavation required for these areas; and

4. Use of a 3:1 (33⅓ %) slope for that portion of the final landfill cover along the perimeter of Area 2.

Drawings displaying the final grading and the amount of cut and fill associated with each of these options are included in Appendix E. Engineering of potential mechanisms for achieving the appropriate slope angles for installation of the new landfill cover would be addressed during the RD phase.

Preliminary evaluation of these four options indicates that the volume of waste regrading can be reduced as compared to the base case. The table below summarizes the estimated amount of waste material (in bank cubic yards [bcy]) that must be regraded (cut) under the base case and each of the four options described above.

Option	Description	Area 1 Cut (bcy)	Area 2 Cut (bcy)	Total Cut (bcy)
0	Base case evaluation of ROD-selected remedy	57,000	149,000	206,000
1	No waste excavation within the interior portions of Areas 1 and 2	31,500	148,000	180,000
2	Elimination of the on-site stormwater ponds	7,400	92,000	99,000

Option	Description	Area 1 Cut (bcy)	Area 2 Cut (bcy)	Total Cut (bcy)
3	Construction of a new perimeter berm along portions of the perimeters of Areas 1 and 2	29,700	66,500	92,000
4	Use of 33⅓% slope angles along the perimeter of Area 2	26,100	107,500	134,000

Option 1 in the table above represents the expected excavation volumes to achieve the recontouring required for the ROD remedy as described above.

Elimination of the on-site stormwater ponds (Option 2 on the above table) would reduce the amount of waste required to be excavated. However, based on prior discussions with the Earth City Flood Control District, the likelihood (administrative feasibility) that any remedial action could be implemented without inclusion of on-site stormwater detention basins is considered to be low. It may be possible to still construct a smaller pond within the Buffer Zone and also rehabilitate and potentially expand the pond referred to in the RI as the North Surface Water Body which is located outside the northeastern corner of Area 2 to provide stormwater detention for both Area 1 and Area 2. It must be noted, however, the North Surface Water Body is located on land owned in part by not only West Lake Landfill but also Emerson Electric (Crossroad property) and Missouri Department of Transportation (right-of-way for St. Charles Rock Road, Missouri Route 180).

The amount of waste material that would need to be cut can be greatly reduced through use of a perimeter ("starter") berm constructed along portions of Area 1 and the toe of the northern portion of Area 2 (Option 3 on the above table). Construction of a starter berm would require minimal cutting of existing waste materials in order to construct the berm (approximately 5,000 cubic yards of waste in Area 1 and approximately 8,000 cubic yards of waste in Area 2). The starter berm would be constructed of compacted, engineered fill. The top of the starter berm could serve as the perimeter access road and surface water drainage conveyance. Use of a starter berm is standard practice in the design and construction of sanitary landfills and would provide a method of achieving the required final landfill grades while minimizing the amount of waste material that would need to be regraded (cut).

Reduction of the existing slopes to a 33⅓% slope (Option 4 on the above table) would reduce the overall amount of waste excavation as compared to grading to a 25% slope. However, EPA has indicated that they believe that a maximum slope angle of 25% would be appropriate for the final grading of Areas 1 and 2. As such, the likelihood (administrative feasibility) that any remedial action could be implemented utilizing a 33⅓% slope is considered to be low.

Based on these evaluations and discussion with EPA, it was determined that Case 3 (the starter-berm option) would be used for purposes of the SFS evaluations. Under this approach an approximately ten foot high starter berm would be constructed along portions of the outer boundaries of Areas 1 and 2 (e.g., along the northern portion of Area 1 adjacent to the landfill access road and along the northern boundary of Area 2 adjacent to the Crossroad Property and Buffer Zone). Construction of the starter berm would require excavation of waste materials present at the toe of the landfill in these areas. These materials would be replaced by earthen material that would provide the base for a perimeter access road and perimeter drainage features, incorporate rock armoring for flood control to the extent required, and through use of steeper side slopes for the soil/rock material in contrast to those allowed for waste materials, would result in greatly reducing the amount of waste material that would need to be regraded under the ROD-selected remedy. Detailed design and agency approval of the starter berm approach would be performed as part of the RD phase; however, based on initial agency comments, it was determined that incorporation and use of the starter berm approach for the ROD-selected remedy was appropriate for the SFS evaluations.

5.2.1.1.3 Management of Materials During Recontouring

It is anticipated that any waste that is excavated (cut) to create space for construction of the starter berm or as needed to regrade the surface of Areas 1 and 2 to meet the minimum and maximum slope requirements would immediately be placed in another portion of the landfill and therefore no temporary stockpiling of excavated waste would be required for implementation of the ROD-selected remedy. In the event that temporary stock-piling of some of the regraded waste material is necessary, it is anticipated that such stockpiling would be performed on other portions of Areas 1 and 2.

If any material was stockpiled for the ROD-selected remedy, the amount and duration of stockpiling would be minimized. All stockpiled waste material would be managed to control odors. For example, these materials would be covered with tarps, soil cover or chemical agents to suppress odor emissions and reduce the potential for windblown debris and dust, vectors (e.g., rodents and birds), and precipitation infiltration. All stockpiles of waste materials or imported construction materials would be managed to prevent dust emissions and storm water impacts. They could be covered with tarps and would be located away from drainage courses and storm water drop inlets so as to reduce windblown erosion and sediment runoff. Sediment netting, berms, straw bales, or equivalent measures would be employed to reduce sediment runoff from the stockpile(s) to the adjacent areas, as well as to prevent run-on contact with exposed waste. Water, tarps or other forms of dust suppression would be used to prevent wind erosion of soil stockpiles. The contractor would be responsible for ensuring that the stockpiles are stabilized from wind erosion at night and during non-construction days. A plan for stockpiling of waste materials including identification of actual or potential areas for temporary stockpiles, temporary covers, run-runoff controls, ongoing inspection and maintenance requirements, and other factors would be developed as part of the RD. A Stormwater Pollution Prevention Plan (SWPP) would be prepared prior to commencement of construction activities and would provide a detailed plan for the location and maintenance of the stockpiles.

Application of a temporary cover (e.g., clean soil or other means) to the landfill surfaces being regraded at the end of each workday would help to mitigate odors during non-working periods. This would also reduce radiological exposures to potentially exposed non-radiological workers in the vicinity, and would reduce the attractiveness of the exposed waste to birds and vermin. As such, the conceptual design of the ROD-selected remedy includes application of daily cover and the volume of additional soil to be added as a result of placement of daily cover has been incorporated into design of the grading plans and cost estimates for the ROD-selected remedy (Appendices D and J).

Much of the area requiring re-contouring is outside the area covered by the Negative Easement. Even in those portions subject to the Negative Easement, the re-contouring activity would not be prohibited since the Negative Easement mandates that the facility at all times "comply with all applicable federal, state and local laws and regulations regarding proper landfill cover." Because the re-contouring is necessary to comply with the maximum slope requirements of the Missouri Solid Waste regulations, it is consistent with the terms of the Negative Easement.

The nuisance attraction to and congregation by birds at and above the landfill if its contents are exposed could be problematic unless effectively controlled. If necessary, an avian management plan that incorporates use of best management practices (BMPs) such as daily soil cover and/or tarping, visual and auditory frightening devices, or wire or monofilament grids positioned over exposed refuse to prevent bird access, could be prepared and implemented prior to and during regrading of waste containing municipal refuse. In addition, for regrading required for the ROD-selected remedy, the area of regrading will be minimized and immediate replacement utilized as much as possible in order to minimize potential exposure of waste and ensure that mitigative measures can be utilized as effectively as possible.

5.2.1.2 Removal of Radiologically-Impacted Soil from the Buffer Zone/Crossroad Property

A design phase investigation would be performed to evaluate the presence and extent of occurrences of radionuclides beneath Lot 2A2 of the Crossroad property and the Buffer Zone (Figure 14). This design-phase survey only applies to the Buffer Zone/Crossroad Property and would be performed in accordance with the requirements of the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) (EPA, DOE, NRC, DOD, 1997). The remediation control and waste characterization surveys for the Buffer Zone/Crossroad property are discussed in Section 2.2.1 of Appendix G.

Any radiologically contaminated soil on the Buffer Zone/Crossroad Property would be removed and consolidated in the area of containment (Areas 1 or 2) prior to placement of fill material or construction of the cover over that portion of the landfill area. Although the extent of contamination on the Buffer Zone/Crossroad Property is thought to be minor, the precise nature and extent of contaminated soil is uncertain. Any soil outside the boundaries of the landfill would need to meet remediation goals that support unlimited use and unrestricted exposure and would be subject to verification sampling. Excavation of contaminated material would include dust suppression and monitoring (see Appendix G) to ensure there is no release of fugitive dust.

5.2.1.3 Engineered Landfill Cover for the ROD-Selected Remedy

The new engineered landfill cover included as part of the ROD-selected remedy is presented on Figure 28 and would consist of the following layers (from top to bottom):

- A one-foot thick layer of soil capable of sustaining vegetative growth;
- A two-foot thick infiltration layer of compacted USCS CL, CH, ML, MH, or SC soil-type with a coefficient of permeability of 1×10^{-5} cm/sec or less; and
- A two foot thick bio-intrusion/marker layer consisting of well-graded rock or concrete/asphaltic concrete rubble.

Specifically, the landfill cover to be installed over Areas 1 and 2 would consist of (from bottom to top): 2-ft of rock consisting of well-graded pit run rock and/or concrete/asphaltic rubble ranging from sand-sized up to 8-inches such that upon placement would contain minimal void spaces; 2-ft of compacted clay or silt that when compacted at optimum moisture content posses a coefficient of permeability of 1×10^{-5} cm/sec or less; and 1-ft of soil suitable of supporting vegetative growth. The thicknesses of these layers are based on the requirements of the Missouri Solid Waste Rules and the description of the cover system included in the ROD.

Additionally, as part of this SFS, detailed calculations were performed to select a design cover thickness that meets the remedial action objective for control of radon gas and to ensure that the cover provides sufficient shielding from gamma radiation (Appendix F). Consistent with the UMTRCA requirements and EPA's Office of Superfund Remediation and Technology Innovation May 2009 memorandum (EPA, 2009c), these evaluations were performed using the expected levels of radon, radium and thorium that would result from 1,000 years of thorium and radium decay and radium ingrowth and radon generation. These calculations were performed using RESRAD (Gnanapragasam, et al., 2007) to evaluate the level of protection against gamma radiation provided by the new landfill cover to be placed over Areas 1 and 2. Calculations were also performed using the RAECOM model (www.wise-uranium.org/ctc.html and Rogers, et al., 1984) to evaluate potential radon emissions through the new landfill cover to be placed over Areas 1 and 2 (Appendix F). These computer modeling calculations were performed using the design specified in the ROD (a minimum thickness of 2-ft of clay with a permeability of 10^{-5} cm/sec overlain by a minimum thickness of 1-ft soil to support a vegetative layer) which is based on the Missouri Solid Waste Regulations (CSR 80-3.10(17)4.A) cover design requirements for closure of unlined solid waste landfills, with the additional enhancement of a 2-ft concrete rubble/rock layer as described above.

Results of these evaluations indicated that the ROD specified cover design would have sufficient thickness and characteristics to be protective against gamma radiation and radon emissions in both Areas 1 and 2 (Appendix F). Additional evaluations of the cover design may be performed during the RD phase to further verify that the design of the landfill cover complies with the applicable and relevant and appropriate requirements of other environmental regulations. The design of the landfill cover, as well as the gas control, runoff control, long-term groundwater monitoring, and post-closure inspection and maintenance components, would at a minimum meet the relevant and appropriate requirements found in the Missouri Solid Waste Rules for sanitary landfills. Consistent with the requirements for uranium mill tailing sites, the landfill cover would also incorporate a rubble or rock armoring layer to minimize the potential for biointrusion and erosion and increase the overall longevity of the cover. The landfill cover would also be designed to provide protection from radioactive emissions (i.e., gamma radiation and radon). Figure 28 shows a conceptual cross-section of a sanitary landfill cover that has been augmented to include a crushed concrete or rock biointrusion layer.

A significant amount of earthen material would need to be obtained from off-site and delivered to the site for use in constructing the new landfill cover. Specifically, it is anticipated that all of the final cover system components, materials for construction of the bio-intrusion layer, low permeability soil (clay) layer, and vegetative layer, will need to be purchased and delivered to the site. FS level design projections determined that approximately 727,000 loose cubic yards of soil material will be required from off-site sources for implementation of the ROD-selected remedy.

There are several options for how this material could be managed. Depending upon the relative rates of landfill cover construction compared to the anticipated rate of delivery of the various soil materials, the required materials could be delivered directly to the work area and incorporated into cover construction, thereby avoiding the need to stockpile the materials. If the rate of material delivery does not match the rate of material required for landfill cover construction, then stockpiling may be necessary or advantageous to help prevent construction delays. The time required to deliver the necessary materials needed for construction of the new landfill cover represents a significant portion of the anticipated total construction schedule. As such, in order to shorten the anticipated duration of construction activities for the ROD-selected remedy, it may be advantageous to import and stockpile the required materials in advance of the time they are needed for cover construction. Subject to owner/operator approval, these materials could be stockpiled on inactive portions of the site such as the on-site soil borrow stockpile area (subject to requirements associated with OU-2 construction schedules), the closed demolition area landfill, and/or on portions of Areas 1 and 2 not contemporaneously subject to regrading (Figure 29). The feasibility, implementability, costs, and impacts to construction schedules associated with stockpiling of materials are addressed as part of the detailed evaluation of the ROD-selected remedy.

5.2.1.4 Rock Armoring/Flood Protection of the Toe of the Landfill

Portions of the landfill were developed over the geomorphic flood plain, but these areas were subsequently filled such that the surface elevations of these areas are now above flood plain elevation. These areas are also now protected by the 500-year levee and supporting flood control system of the Earth City Levee District. In the unlikely event of levee failure during a 500-year flood event, it is possible that flood waters could reach the lowermost approximately two feet of the toe of the landfill cover at the northwestern end of Area 2. Because the site is located more than 1.3 miles from the Missouri River, no high energy water flows would be expected by the time flood waters reached the site. The flood protection needs of the toe of the landfill would be evaluated in more detail in the remedial design, and appropriate bank protection methods would be used (e.g., a rock rip-rap apron). The vertical height of the flood protection feature would a subject of design phase evaluations but is expected to include a margin of safety over the 1993 flood level. As indicated in the May 2009 memorandum from EPA's Office of Superfund Remediation and Technology Innovation, flood control measures should meet or exceed design standards for a 500-year storm event under the assumption that the existing levee system is breached.

5.2.1.5 Stormwater Management/Surface Water Runoff Control

Management of stormwater during and after construction would be addressed in the Storm Water Pollution Prevention Plan (SWPP) that would be prepared during RD of the selected remedy. During construction, it is anticipated that:

- Temporary berms and/or ditches would be constructed as needed at the downstream edge of the existing landfill cover or the edges of any interim daily cover in excavation areas, to direct stormwater away from open excavations;

- Other practices may include installation of silt fencing and sedimentation barriers; slope minimization; stabilization of temporary waste stockpiles; use of plastic tarps, mulching, or hydro-seeding on areas not being actively graded or completed and that would be exposed for extended periods (i.e., longer than 45 days); construction and stabilization of storm water ditches and down chutes; and planting of permanent native vegetative cover when construction is complete. Additional prevention measures would include performing heavy equipment fueling and storing any hazardous materials in designated areas, as well as parking vehicles and locating waste stockpiles away from stormwater drainage points;

- Stormwater that contacts the existing surfaces of Areas 1 and 2, daily cover soil during regrading or excavation in Areas 1 and 2, and the surfaces of cover material as the covers over Areas 1 and 2 are being constructed would be managed as non-contact stormwater and directed off-site via the existing stormwater drainage system; and

- Stormwater that contacts exposed waste during regrading activities would be considered contact stormwater, requiring treatment and/or disposal as discussed below. Any accumulated contact stormwater would be pumped out of the low points in depressions created by the excavation and backfilling activities using portable pumps and directed via a new pipeline to a new lined stormwater lagoon to be constructed at the site of the former OU-2 landfill leachate lagoon located south of Old St. Charles Rock Road (Figure 30).

The new lined stormwater lagoon would be sized to accommodate the maximum historical 24-hour rainfall over the anticipated maximum area of exposed waste plus the area of the lagoon. Accumulated stormwater would be pumped out of the lagoon at a steady flowrate and directed to treatment equipment prior to discharge to the Metropolitan St. Louis Sewer District (MSD) in accordance with MSD procedures and discharge limitations. It is assumed that treated stormwater could be introduced to the MSD sanitary sewer system using the force main that is currently used to convey leachate from the OU-2 closed landfills or via tie-in to an MSD manhole in the vicinity of the West Lake Landfill. Representatives of MSD were contacted during the SFS process and indicated a willingness to accept perched water/leachate encountered during construction, stormwater generated during construction, and leachate from the on-site cell, subject to their standard approval procedures and discharge limitations. MSD has in the past accepted or is currently accepting similar waters from the Weldon Springs, SLAPS, and SLDS sites. MSD has preliminarily indicated that their discharge limitations would include Chemical Oxygen Demand (COD) of less than 600 milligrams per liter (mg/L), Total Suspended Solids (TSS) of less than 300 mg/L, and drinking water standards.

Given the variability of the waste, it is not possible to predict the quality of the stormwater that could come in contact with exposed waste during regrading at this time. It is anticipated that any radionuclides would be associated with particulates in the stormwater and might include isotopes of uranium and radium, radon-222 and various radon decay products, and potassium-40. It is not anticipated that there would be a significant amount of alpha activity actually dissolved in the stormwater, and as such removal of particulates should be sufficient for treatment of the storm water.

Notwithstanding these uncertainties, for purposes of preparing cost estimates for the alternatives in this SFS, it is assumed that 0.2 acres of exposed waste (based on an assumption that the total area of exposed waste at any given time would be approximately 20 acres and that the majority [99%] if this area would be covered by tarps, daily cover or other means) would be subjected to an 8.8 inch rainfall (maximum 24-hour rainfall for August 1946; NOAA, 2011) over a 24-hour period and that this stormwater would be pumped to the stormwater lagoon. This volume of stormwater as well as the volume of rainwater that would have collected in the lagoon would be pumped out of the lagoon, treated, and discharged to the MSD sewer system. Treatment would consist of bag filtration to remove particulates and liquid-phase granular activated carbon (LPGAC) to polish the filtered stormwater and remove any remaining radon and organics. Based on past experience operating an industrial wastewater treatment plant at a uranium fabrication facility, it is assumed that these treatment processes would be sufficient to meet the MSD discharge criteria. Two treatment trains would be provided for redundancy and in order to have a back-up system available at all times. It is anticipated that the treatment facilities would be located in a covered area or building adjacent to the stormwater lagoon.

Used filter bags and exhausted LPGAC would be tested and disposed at the appropriate facility according to the analytical test results. At the end of remedy construction, the liner of the stormwater pond would be removed, the pond backfilled, and the treatment facility demolished. For the ROD-selected remedy, the pond liner would be placed in Area 1 or 2 prior to completion the final portion of cover construction.

5.2.1.6 Landfill Gas Monitoring and Control

The presence and levels of landfill gas would be monitored both during and after construction of the ROD-selected remedy. Measures to control potential accumulations and/or migration of explosive or toxic gases would be taken as needed both during and after construction.

As part of RD, a general description and specifications for a Methane Gas Emergency Monitoring and Action Plan would be prepared. The contractor selected to perform the remediation would be required to provide a detailed plan that meets those specifications and they would be required to incorporate both methane gas monitoring procedures and emergency response actions into their operational Health and Safety Plan. Methane gas monitoring would be performed in any and all areas where waste materials are exposed or where methane could potentially occur or accumulate. In the event that methane monitoring indicated the presence of methane concentrations which exceed the standard permitted by the Plan in any of the work areas, all work in that area would be immediately stopped and all personnel and equipment would be immediately withdrawn from the area. Methane monitoring would continue to be performed along the margins of the subject area to identify the extent of the area containing the methane exceedence and to assess changes in methane levels over time. In the event that the methane levels declined to below the clearance level of the Plan, work in the area could proceed subject to the results of ongoing and continuous methane monitoring demonstrating that the results remain at the acceptable level. In the event that methane levels again rose above trigger level, work would again be stopped until the levels declined at which point one or more of the following mitigation procedures could be deployed:

- Work in the subject area could be delayed until methane levels dissipate on their own;
- Equipment could be used to remotely open up and aerate the waste materials to enhance dissipation of the methane; and/or
- Industrial fans could be brought to the work area to dissipate any methane occurrences.

A post-construction landfill gas monitoring program would be developed during the RD phase and implemented as part of the long-term monitoring program. The need for and scope of the landfill gas monitoring program including the exact number and locations of gas monitoring points and measurement frequency would be determined in the RD documents for the selected remedy for OU-1. Final landfill gas monitoring well locations and spacing would be based on geologic conditions and proximity to property boundaries and adjacent features. Section 3.1.2 in Appendix G discusses the assumed number and location of sub-surface landfill gas monitoring probes to be installed as part of the post-construction baseline monitoring program for the ROD-selected remedy. Long-term landfill gas monitoring is described in Section 4.1.1 of Appendix G.

Installation and operation of a landfill gas extraction system is included as a contingent action for the ROD remedy, in the event that the perimeter landfill gas or radon monitoring indicate that lateral migration of either explosive gases or radon is occurring along the site boundary. This would be evaluated by comparing the landfill gas or radon levels at the perimeter of Areas 1 and 2 under the ROD-selected remedy, to the appropriate performance standards. Due to the overall age of the landfill along with the relatively low levels of methane detected during the RI (EMSI, 2000), high levels of methane are not expected to occur in Areas 1 and 2.

If it is determined that a contingent landfill gas control system is necessary, it is expected that such a system would consist of either passive or active gas control wells and in the event that an active gas control system is determined to be necessary, a gas extraction blower and offgas treatment system (a landfill gas flare or granular activated carbon adsorption in the case of radon) would also be required. A contingent landfill gas control system would be implemented in accordance with the substantive requirements standards established by the MDNR Solid Waste Management regulations (10 CSR 80-3(14)(C)(5)), the Missouri Statutes (Chapter 643 RSMo) and corresponding rules and regulations governing air quality, and the UMTRCA regulations (40 CFR 192). Operation of a landfill gas extraction and treatment system would include monitoring of the emissions from any vents, pipes, or flares that discharge to the atmosphere. Results of this monitoring would be compared to the substantive requirements of the above cited regulations and/or to a site-specific risk-based value.

5.2.1.7 Management of Subsurface Liquids During Construction

It is not anticipated that groundwater will be encountered during regrading of the waste materials under the ROD-selected remedy. The potential does exist that perched layers/lenses of leachate may be encountered during waste regrading. Any perched liquid that may be encountered during implementation of the ROD-selected remedy would be pumped into temporary holding tanks (e.g., Baker or frac tanks), tested to determine whether treatment or pre-approval by MSD prior to discharge is required, and then would be discharged to MSD after authorization is granted.

5.2.1.8 Regulated Materials Management During Construction

As part of RD, a regulated materials identification and classification plan would be developed to address procedures to be employed in the event that suspected hazardous wastes or regulated asbestos containing material (RACM) are encountered during implementation of the ROD-selected remedy. Components of this plan would include training of the site health physicists in procedures and criteria to be used to identify potential hazardous wastes or RACM that may be encountered during waste regrading. The contractor's construction manager (CM), health physicist (HP), and construction quality assurance officer (CQAO) would be instructed on the requirements for compliance with 40 CFR Part 61.154(j), 10 CSR 10-6.241, and St. Louis County Ordinance 612.530, all of which pertain to excavating/disturbing asbestos. Specifically, the HP and/or CQAO would complete the required MDNR Certification; Missouri State Certificate for Asbestos-Related Occupations. The materials identification plan would also address procedures to be used for segregation, stockpiling and testing of possible hazardous wastes or RACM and procedures to be used for on-site or off-site disposal of the materials based on the results of the testing.

In the event testing of suspected hazardous wastes indicates that such materials are hazardous waste, these materials would need to be identified, classified, manifested and shipped to an off-site hazardous waste facility for treatment (e.g., solidification, stabilization, micro- or macro-encapsulation, incineration, etc.) in accordance with the Land Disposal Restrictions and associated Universal Treatment Standards of the RCRA Hazardous Waste regulations, and corresponding Missouri regulations. If any identified hazardous wastes also include radionuclides above levels that would allow for unrestricted use, these waste materials would need to be treated and disposed of as "Mixed Wastes" in a RCRA permitted disposal cell at one of the three radioactive waste disposal facilities identified in Section 4.3 of this SFS (U.S. Ecology Idaho, Energy*Solutions*, or Clean Harbors-Deer Trail). In the event that RACM is encountered during remedy implementation, this material would need to be managed and disposed in accordance with applicable state regulations (see discussion in Section 3).

5.2.1.9 Long-Term Operations and Maintenance for the ROD-Selected Remedy

Long-term operations, maintenance and monitoring (OM&M) activities would be performed upon completion of the remedy construction. An operations, maintenance and monitoring plan (OM&M Plan) would be developed and submitted for approval as part of the RD/RA process. The OM&M Plan would cover all the long-term remedy management and monitoring functions including groundwater monitoring plans; site inspection, maintenance and repair; notification and coordination; community relations; health and safety; emergency planning; activity schedules; reporting; etc. In practice, the OM&M Plan may be developed as a compilation of more focused plans.

Under the ROD-selected remedy, radiologically-impacted materials would remain on-site, and accordingly, the post-closure operations, maintenance and monitoring period would likely exceed the 30-year period specified in the Missouri Solid Waste Rules for a solid waste landfill. For purposes of this SFS, cost estimates for both 30 years and 1,000 years of OM&M have been developed as part of the detailed analysis of alternatives (Section 6).

The final landfill cover system would be routinely inspected and maintained to ensure the integrity of the remedy over time. The inspections would focus on identifying any erosion of the landfill cover, the condition and coverage of vegetation on the landfill cover, the presence of material, vehicle, or equipment storage, vehicle tracks, burrowing animals, or any other activities that could affect the integrity of the landfill cover. Periodic mowing or brush-hogging of the vegetative cover would also be performed as part of long-term OM&M in order to control weed and woody plant growth on the landfill cover and to provide for an aesthetically pleasing appearance of the landfill area.

Inspections would also be performed to assess the integrity and overall condition of the perimeter fencing around Areas 1 and 2. Any impacts to the integrity of the fence caused by activities on adjacent properties, snow accumulation, or other factors would be repaired. Any trash or debris that may accumulate along the fence would also be removed.

The various stormwater management structures (detention and sedimentation basins, diversion berms and ditches, runoff ditches and let-down structures, etc.) would be inspected for damage or the presence of erosional features or excessive sediment accumulation. Repairs to these features would be made as necessary.

In addition to surveillance of the physical remedy, the periodic site inspections would include administrative functions such as monitoring of institutional controls and coordination with key stakeholders, including the Earth City Levee District regarding management of the flood control system.

5.2.1.10 Environmental Monitoring for the ROD-Selected Remedy

The ROD-selected remedy would include monitoring activities that would be performed during and after construction of the remedy. The exact scope of this monitoring would be developed as part of the RD effort, but a preliminary description of the scope of potential monitoring activities was necessary to assess the anticipated effectiveness of a monitoring system as well as to provide the bases for estimated monitoring costs. The scope of potential monitoring activities is provided as Appendix G (Conceptual Bases for Costs of Occupational and Environmental Monitoring Associated with each Remedial Alternative) and includes monitoring activities with a limited duration that would be performed during construction (short-term monitoring), post-construction baseline monitoring, and longer duration monitoring activities performed following remedy construction (long-term monitoring).

Short-term monitoring activities that would be performed during construction of the remedial alternatives were divided into two categories: (1) health-based monitoring; and (2) remediation control monitoring. Data quality objectives would be different for each category of short-term monitoring activity. Health-based monitoring activities would be designed to evaluate potential emissions and human exposures that may occur during construction of a given alternative. The remediation control monitoring program would be designed to guide the construction contractor during construction of the ROD-selected remedy. Both of these categories of monitoring and survey activities would be limited to the period of construction. Short-term monitoring activities are described in Section 2 of Appendix G.

Post-construction baseline monitoring would be conducted to confirm that the remedial action was completed as designed and to provide initial post-construction values that could be compared to long-term monitoring results. Post-construction baseline monitoring activities are described in Section 3 of Appendix G.

Long-term monitoring activities are described in Section 4 of Appendix G and include landfill gas, groundwater, and surface water as well as annual post-construction site inspections that would be conducted after remedy construction to verify that the constructed remedy would be performing as designed.

Four types of radiological surveys would be conducted to guide the minor cut and fill operations in Areas 1 and 2, to guide the excavation and relocation of RIM from the Buffer Zone/Crossroad Property onto Area 2, and to obtain regulatory approval that final cover placement over Areas 1 and 2 would meet design criteria. These methods of remediation control monitoring for the ROD-selected remedy are described in Section 2.2.1 in Appendix G.

5.2.2 Non-Engineered Components of the ROD-Selected Remedy

In addition to the various engineered components of the ROD-selected remedy, non-engineered activities including implementation and maintenance and monitoring of institutional controls and periodic reviews by EPA and MDNR of the effectiveness and protectiveness of the remedy would be performed.

5.2.2.1 Institutional Controls Included in the ROD-Selected Remedy

Land use restrictions would be maintained and/or implemented for OU-1 to limit future uses and to prevent any allowable future uses from impacting the effectiveness or integrity of the remedial action, taking into consideration the presence of long-lived radionuclides. The restrictions must be maintained until the remaining hazardous substances are at levels allowing for unlimited use and unrestricted exposure. Due to the presence of long-lived radionuclides at OU-1, the restrictions would need to be maintained indefinitely. The existing Negative Easement and Restrictive Covenants on the West Lake Landfill (Appendix A) would also remain applicable as institutional controls.

The following long-term use restrictions would potentially apply within the boundary of the cover systems for Areas 1 and 2:

- Prevent development and use for residential housing, schools, childcare facilities, or playgrounds;

- Prevent development and use for industrial or commercial purposes such as manufacturing, offices, storage units, parking lots, or other facilities that are incompatible with the function or maintenance of the landfill cover;

- Prevent construction activities involving drilling, boring, digging, or other use of heavy equipment that could disturb vegetation, disrupt grading or drainage patterns, cause erosion, or otherwise compromise the integrity of the landfill cover or manage these activities such that any damage to the cover is avoided or repaired;

- Prevent groundwater use underlying these areas (for any purpose other than monitoring); and

- Provide for access necessary for continued maintenance, monitoring, inspections, and repair.

Property use restrictions have already been implemented at the site through the placement of institutional controls on the individual parcels as discussed in Section 2.1.4. Design and implementation of any additional institutional controls that may be necessary would be addressed as a component of the RD planning process. Where appropriate, multiple mechanisms or a layered approach would be used to enhance the effectiveness of the institutional control strategy. Access controls such as fences and gates would also be used to support the use restrictions.

At the site, the affected properties are privately owned and the use restrictions must be maintained for an indefinite period of time. Therefore, recorded covenants would be used because they generally run with the land and are enforceable. The Missouri Environmental Covenants Act (MECA), Mo. Rev. Stat.§ § 260.1012, et seq., specifically authorizes environmental covenants and authorizes the State to acquire property interests for the purpose of ensuring long term compliance with such covenants. An environmental covenant pursuant to MECA is a potential instrument for use at the site because such covenants are specifically designed to support use restrictions at contaminated sites.

The site has been listed by MDNR on the State's Registry of Confirmed, Abandoned, or Uncontrolled Hazardous Waste Disposal Sites in Missouri (Uncontrolled Sites Registry). The registry is maintained by MDNR pursuant to the Missouri Hazardous Waste Management Law (Mo. Rev. Stat. § 260.440). Sites listed on the registry appear on a publicly available list. A notice is filed with the County Recorder of Deeds and notice must be provided by the seller to any potential buyers of the property. Parties are not permitted to change the use of a listed site without approval of MDNR.

The OM&M Plan would contain procedures for surveillance, monitoring, and maintenance of the institutional controls. The OM&M Plan would provide for notice to EPA and the State of any institutional control violations, planned or actual land use changes, and any planned or actual transfers, sales, or leases of property subject to the use restrictions.

Financial assurance would be required to provide for operation, maintenance and monitoring of the remedy after construction..

5.2.2.2 Five Year Reviews

The ROD-selected remedy would also include performance of a 5-year review by EPA as required by Section 121 of CERCLA and the NCP. The specific questions to be addressed by each Five Year Review include the following:

1. Is the remedy functioning as intended by the decision documents?

2. Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of remedy selection still valid?

3. Has any other information come to light that could call into question the protectiveness of the remedy?

EPA and/or the State, with or without assistance of their contractors, would perform a Five Year Review at a minimum of every five years after completion of the Record of Decision for the Site or, if determined by EPA to be necessary, at more frequent intervals. The Five Year review would include an overall statement regarding the protectiveness of the remedy.

5.3 Additional "Complete Rad Removal" Remedial Action Alternatives

As described in Section 1.1, the two "complete rad removal" alternatives that are to be developed and evaluated in this SFS are:

- Excavation of RIM with off-site commercial disposal of the excavated materials ("complete rad removal" with off-site disposal alternative); and

- Excavation of RIM with on-site disposal of the excavated materials in an on-site engineered disposal cell with a liner and cap if a suitable location outside the geomorphic flood plain can be identified ("complete rad removal" with on-site disposal alternative).

This section includes a reference to RIM occurrences, extent, and volumes; describes RIM excavation and associated activities; references short-term, post-construction, and long-term monitoring associated with the "complete rad removal" alternatives; and describes the specific components of each of the "complete rad removal" with off-site disposal and "complete rad removal" with on-site disposal alternatives. Final grading, capping and closure of Areas 1 and 2 after RIM removal are also described.

5.3.1 RIM Occurrences, Extents and Volumes

As previously discussed, the total volumes of RIM contained in Areas 1 and 2 were estimated to be as follows:

Area 1 RIM	33,500 bank cubic yards (bcy)
Area 2 RIM	302,000 bcy
Total RIM	335,500 bcy

The volumes of non-radiological overburden soil and waste materials that would have to be removed to allow for excavation of the RIM were estimated to be as follows:

Area 1 overburden	49,000 bcy
Area 2 overburden	310,000 bcy
Total overburden	359,000 bcy

A discussion of the methods and supporting calculations used to estimate the extent and volumes of RIM above levels that would allow for unrestricted use, as well as the non-radiological overburden soil and waste materials that would have to be removed to allow for excavation of the RIM is included in Section 2.2.3 and is further described in Appendix B.

It should be recognized that the RIM and overburden volume estimates were performed to a feasibility-study level of accuracy, and there is a high degree of uncertainty in these quantities. The levels and distribution of radionuclide activity within the RIM is known to be highly variable due to the inherent heterogeneity of the waste as well as the variable locations where RIM is concentrated. Uncertainty also arises from the limits on the accuracy of the existing site topographic mapping, which is based on aerial photogrammetry without ground control, producing, at best, a topographic surface with a tolerance of approximately one foot. In addition, past subsurface investigations of the site were focused on providing information on the general nature and extent of occurrences of RIM. The current understanding of the lateral and vertical extent of the RIM is based on subsurface information obtained at a frequency of approximately one soil boring per acre. This site characterization information was determined to be sufficient to characterize the potential risks posed by the site and to identify and evaluate potential remedial alternatives in the FS (EMSI, 2006). However, the intent was not to accurately define the three-dimensional extent of the RIM for detailed quantity estimates. Consequently, precise estimates of the amounts and volumes of overburden materials that would need to be removed to access the RIM, the actual volumes and configurations of the RIM, and the relative amounts and distributions of soil and waste materials within the RIM cannot be made at this time. For purposes of this SFS evaluation, the estimated volume of RIM is the single largest uncertainty affecting the estimated costs for the "complete rad removal" alternatives.

5.3.2 RIM Excavation and Associated Activities

This section describes the various activities that are common to both of the "complete rad removal" alternatives. Specific activities that are associated with only the "complete rad removal" with off-site disposal alternative or the "complete rad removal" with on-site disposal alternative are described in Sections 5.3.3 and 5.3.4, respectively. Activities associated with regrading and installation of a new landfill cover over Areas 1 and 2 after removal and off-site or on-site disposal of the radioactively-impacted materials in Areas 1 and 2 are described in Section 5.3.5.

5.3.2.1 RIM Excavation Procedure and Sequencing

The RIM excavation process would be performed in a systematic manner that first identifies and designates the extent of RIM, allowing for efficient removal of the RIM and minimization of the excavation quantities to the extent practicable. The remainder of this subsection describes the RIM excavation process.

The logistics of RIM excavation sequencing in an affected area is illustrated on Figure 31. As shown, a grid-system would be marked in the field in an affected area. Using field radiological monitoring supplemented by on-site laboratory and/or off-site laboratory data, health physics (HP) technicians would begin excavation in a progressive manner from grid-to-grid to remove a specified lift thickness, and will guide the excavator operator where to remove materials. The radiological surveys that would be conducted to guide excavation of RIM are described in Section 2.2.2.1 of Appendix G.

As thin layer excavation progresses within the affected area, the HP technicians would follow the excavator at a close but safe distance to survey the surface. It is assumed that Ra-226 and its radioactive progeny will serve as a suitable surrogate for the activity for this purpose because the survey equipment would be able to detect < 3 pCi/g in the top few centimeters. The excavation would continue across the edge of the suspected RIM zone as guided by the radiation surveyors. It is anticpated that HP technicians could conduct periodic small-scale hand excavations when measurements indicated the presence of RIM just beneath the surface. If the RIM zone was judged to be relatively thin, these hand excavations could be used to attempt to verify the RIM thickness.

If the survey does not identify radioactivity above levels that would allow for unrestricted use in a particular excavation area, the survey technicians would direct the excavation to continue inward another grid width and reverse the direction of the excavation or direct the excavation back along the most recently surveyed area. This technique would be continued until a RIM zone was located. During the excavation and surveying in the RIM zones, some soil or soil/debris could be collected and analyzed in an on-site or off-site analytical laboratory to validate the field survey measurements. Determination of whether to use an on-site laboratory, off-site laboratory, or both to support RIM excavation activities would be determined as part of RD based on analytical detection limits, turnaround time for lab results, cost and other factors. Regardless of which method is used to guide the excavation activities, samples for laboratory confirmation would be collected from any areas of RIM excavation that are determined in the field to contain radionuclide activities below those that would allow for unrestricted use. If an on-site laboratory is used to make this determination, a specified percentage of the samples would also be sent to an off-site laboratory to independently verify the results obtained by the on-site laboratory.

The shaded area in Figure 31 is a hypothetical scenario that portrays the zone of RIM and the potential approach to excavation along the edge of the RIM zone. Ideally, the excavation would continue along the edges of the RIM zone until the extent of the zone was delineated and the uncontaminated soil/debris on top of it removed. Conditions of the materials surrounding the

RIM might limit how to proceed once the RIM zone was identified. The decision as to how to proceed would be made by the construction manager with input from the HP technicians.

The process of excavating the RIM material would continue laterally and with depth, following a similar procedure as described above. If possible, the excavator would remain outside the RIM zone and reach into the RIM zone to lift out the RIM material. If the RIM zone was very thin, it could be removed with a single pass and the process used to delineate the RIM could be followed. The excavator would still remain on the uncontaminated surface reaching out with the bucket to excavate RIM soil/debris. HP technicians would follow the excavation to verify the absence of radioactivity above levels that would allow for unrestricted use.

For areas where RIM may be present in a thicker or deeper band, it could be necessary to move the excavator into the RIM zone. Efforts would be undertaken to limit direct contact between the RIM and the excavator. A set of wooden tracks to move in front of the excavator tracks and a platform for the tracks would be considered.

As RIM is excavated, the nuisance attraction to and congregation by birds at and above the excavation could be problematic unless effectively controlled. An avian management plan that incorporates use of excavation BMPs such as daily soil cover and/or tarping, visual and auditory frightening devices, or wire or monofilament grids positioned over exposed refuse to prevent bird access, could be prepared prior to and implemented during excavation of the RIM.

5.3.2.2 Material Handling

It has been estimated that approximately 33,500 and 302,000 bank cubic yards of RIM would be excavated from Area 1 and Area 2, respectively, under the "complete rad removal" alternatives. In addition, an estimated approximately 49,000 and 310,000 bank cubic yards of non-RIM waste overburden would require excavation from Area 1 and Area 2, respectively, to access the RIM waste for the two "complete rad removal" alternatives. In order to access the underlying RIM waste, this non-RIM overburden material would be removed and temporarily stockpiled at the Site.

Characterization data generated during the RI work phase of this project (EMSI, 2000) indicated that the materials expected to be encountered during the excavation would consist of:

- Solid waste consisting of varying amounts of household wastes, commercial/industrial wastes, and construction and demolition debris;
- Daily/intermediate soil cover including some soil that had been mixed with leached barium-sulfate residues; and
- Final soil cover possibly including some soil that had been mixed with leached barium-sulfate residues.

The levels and distribution of radionuclide activity within the RIM is known to be highly variable. Consequently, precise estimates of the amounts and volumes of overburden materials that would need to be removed to access the RIM, the actual volumes and configurations of the RIM, and the relative amounts and distributions of soil and waste materials within the RIM cannot be made at this time. Until actual excavation was to commence and field screening and visual observation begin, the extent and volume of overburden and RIM material that would be removed under one of the "complete rad removal" alternatives can only be estimated using the available data and reasonable assumptions.

As discussed in Section 4, physical separation of the soil and solid waste is a technology that has potential to reduce the amount of waste material that would have to be transported and disposed off-site under the "complete rad removal" with off-site disposal alternative or the amount of waste material that would need to be disposed within a new engineered on-site disposal cell, and consequently reduce the size of the cell. As discussed in Section 4, although physical separation has been used to separate soil from refuse in old landfills, it has never been used to separate radiologically-impacted material from solid waste. Consequently, the degree to which this technology could effectively separate all or most of the soil, such that the remaining solid waste materials would not contain radionuclides at levels greater than those that would allow for unrestricted use, is unknown. Therefore, this technology, although a proven application for "mining" of old landfills, has never been applied and its performance has never been tested or demonstrated for the type of application associated with the "complete rad removal" alternatives. Pilot-scale testing of the degree of separation and resultant radionuclide activity levels within the separated fractions (i.e., garbage and soil) as well as other factors such as dust generation and air quality of the generated dust, worker maintenance activities and resultant radionuclide exposure levels to workers and the community, among others, would need to be evaluated through performance of a pilot-scale test as part of RD activities before a determination of the potential applicability, effectiveness, impacts and costs of this technology could be made. Performance of a pilot-scale test, evaluation of the test results, and, if appropriate, integration of this technology as part of the remedial action could increase the time and cost required for completion of the remedial design phase for this alternative.

5.3.2.3 Material Stockpiling

As previously noted, excavation of the RIM under the "complete rad removal" alternatives would require removal and stockpiling of non-RIM waste materials that overlie the RIM (overburden wastes). For the "complete rad removal" alternatives, excavated non-RIM overburden waste would be temporarily stockpiled adjacent to the excavation(s) or elsewhere on-site until areas containing RIM had been completely excavated, cleared of radiation and final samples confirm that all materials with radionuclide activities above levels that would allow for unrestricted use had been removed. Subsequently the non-RIM overburden waste would be placed back into the excavations upon completion of the RIM removal activities. As discussed previously, approximately 49,000 and 310,000 bank cubic yards of non-RIM waste overburden would need to be excavated from Area 1 and Area 2, respectively, in order to implement either of the "complete rad removal" alternatives.

For either of the “complete rad removal” alternatives, a significant amount of earthen material would also need to be delivered on-site and stockpiled for use in construction of the final landfill cover over Areas 1 and 2 once the RIM were removed. In addition, for the “complete rad removal” with on-site disposal alternative, soil excavated to construct the cell would need to be stockpiled. The materials needed for construction of the various components of the on-site cell (e.g., liner, leachate collection system, and final cover) would also need to be imported and stockpiled.

The overall preference would be to stockpile the required construction materials on portions of Areas 1 and 2 that would not be subject to excavation or that would not be contemporaneously subject to excavation activities. However, due to the limited size of Areas 1 and 2 and the extensive amount of excavation associated with the “complete rad removal” alternatives, it is likely that implementation of one of the “complete rad removal” alternatives would require some stockpiling materials (non-RIM waste and/or cover construction materials) outside of Areas 1 and 2. Figure 29 illustrates potential locations where stockpiles could be established. These locations potentially include the surface of the northern portion of Area 2 (during performance of excavation in Area 1) and on top of the closed demolition landfill. These locations appear viable for this preliminary feasibility-level evaluation, but their actual locations would vary depending on the results of the detailed design and in consideration of issues such as the final excavation layouts, limits, and procedures; discussions with the site owner and operator; and potential interference with existing utilities, roads, vehicular traffic patterns, or structures.

As an example to demonstrate the feasibility of stockpiling on inactive portions of Area 2, the following scenario is envisioned: Assume that RIM excavation would initially be conducted in the western portion of Area 2. Initially non-RIM waste would be stockpiled either on the eastern portion of Area 2 and/or adjacent to or on the upper surface of the closed demolition landfill. Once RIM removal from the west half of the Area 2 had been completed, excavated non-RIM waste from other portions of Area 2 and/or from the stockpiles would be placed in the previously excavated and cleared western half of Area 2. Placement of the non-RIM wastes back into the excavation areas would only occur after the remaining waste and soil materials in the excavation area had been screened for radionuclide levels, cleared by the HP, and the results of final samples had been verified by on-site or off-site laboratory analyses as meeting the required cleanup criteria.

For the “complete rad removal” with on-site disposal alternative, it is estimated that excavation for the cell liner would generate 651,000 loose cubic yards of excess soils. It is envisioned that this soil would be stockpiled on the closed demolition area landfill and/or on portions of Areas 1 and 2 not contemporaneously subject to RIM excavation (Figure 29) and could be used as the source for the random fill soil needs. The on-site cell low permeability soil material, bio-intrusion layer materials, and topsoil material would be purchased and delivered to the site. A portion of this soil would be stockpiled to ensure the construction activities would not be delayed. FS-level design projections estimated that approximately 750,000 loose cubic yards of soil material would be required from outside sources. Staging the on-site cell development and using the undeveloped portions of the site for temporary stockpiles during the first construction year could be used as a strategy to handle the incoming earthen materials. Staged construction and operation of portions of a new on-site engineered disposal cell would likely result in an increase in the overall schedule for implementation of this alternative.

For the "complete rad removal" with off-site disposal alternative, overburden waste could be stockpiled in the same locations and manner described above. The low permeability soil and vegetative cover material for the cover to be placed over Areas 1 and 2 after RIM removal would be purchased and delivered to the site. A portion of this soil would be stockpiled to avoid delay in construction activities. A bio-intrusion layer is not included as part of the "complete rad removal" with off-site disposal alternative. FS level design projections determined that approximately 560,000 loose cubic yards of soil material would be required from outside sources. These materials could be stockpiled on the closed demolition area landfill, on portions of Areas 1 and 2 not contemporaneously subject to RIM excavation, and/or the current on-site soil stockpile area (subject to requirements associated with implementation of the OU-2 remedy). Potential stockpile areas are shown on Figure 29.

Stockpiled non-RIM waste material would be managed to control odors. For example, these materials would be covered with tarps, soil cover or chemical agents to suppress odor emissions and reduce the potential for windblown debris and dust, vectors, and precipitation infiltration. The stockpiles would be managed to prevent dust emissions and storm water impacts; for example by applying water or other dust suppressants, and by strategically locating the stockpiles away from site drainage features to the extent possible. A plan for stockpiling of waste materials including identification of actual or potential areas for temporary stockpiles, temporary covers, runon-runoff controls, ongoing inspection and maintenance requirements, and other factors would be developed as part of the RD. A Storm Water Pollution Prevention Plan (SWPP) would be prepared prior to commencement of construction activities and would provide a detailed plan for the location and maintenance of the stockpiles.

While the non-RIM overburden waste is excavated and stored on site, the nuisance attraction to and congregation by birds at and above the excavation could be problematic unless effectively controlled. An avian management plan that incorporates use of excavation BMPs such as daily soil cover and/or tarping, visual and auditory frightening devices, or wire or monofilament grids positioned over exposed refuse to prevent bird access, could be prepared prior to and implemented during excavation of the non-RIM overburden waste.

5.3.2.4 Radiological Surveys during RIM Excavation

Based on evaluations of this SFS, it is expected that eight types of radiological surveys would be conducted to guide the excavation and verify that the RIM had been removed during and after the RIM excavation process. These surveys are described in detail in Section 2.2.2.1 of Appendix G.

5.3.2.5 Application of Daily Soil Cover

In order to minimize odors, vectors, windblown debris, and precipitation infiltration a nominal thickness of six (6) inches of soil would be applied as daily cover over grading, excavation, waste stockpile, and waste placement areas. Daily cover would be applied to the following areas:

- Stockpiles of non-RIM waste overburden material;
- RIM excavation areas; and
- The surface of areas where RIM is placed in the new on-site disposal cell (in the case of the "complete rad removal" with on-site disposal alternative only).

For cost purposes, the daily cover is assumed to be soil because it is the most conventional and widely used material for this purpose. The amount of daily cover included for each of these activities was estimated to be equal to 10% of the volume of the waste materials subject to daily cover. This value is based on professional experience with the development of design and operations plans for solid waste landfills and monitoring of in-place waste and soil volumes during landfill development. The actual amount of soil required for use as daily cover would be a function of the size and configuration of the various cut and fill areas, waste excavation areas, and overburden stockpiles that would be subject to daily cover under each of the three remedial alternatives addressed by the SFS as well as the physical configuration of the material to be covered. The amount of soil required for daily cover is also a function of equipment operator expertise, and desired production rates. For example, an expert operator can successfully cover an area with a lower percentage of daily cover, but sacrificing production rates by taking longer to accomplish the task. Conversely, it may be more optimal to use a greater percentage of daily cover for ease of compliance and to expedite production rates. Considering all of these factors, the actual amount of soil required could be slightly less (as low as 8%) than the 10% estimated in this SFS or substantially more (as much as 20%) than the amount included in this SFS.

Application of daily cover to the waste excavation areas would increase the volumes and mass of the RIM impacted waste materials to be addressed in the "complete rad removal" alternatives. Daily cover placed over the RIM excavation areas would mix with and become part of the volume of RIM therefore increasing the volume and mass of RIM that would be sent for off-site disposal. Similarly, the volumes of the waste materials that would be placed in a new on-site disposal cell would have to include both the RIM and the daily cover material that would be placed over the RIM excavation areas and become part of the RIM.

It may be possible to place tarps or foam over the non-RIM and RIM excavation areas and non-RIM overburden stockpiles under the "complete rad removal" alternatives in lieu of using soil as the daily cover material. The ability to use tarps or foam in place of soil as a daily cover material would be a function of the size and configuration of the various areas requiring cover, the ability of the tarps and foam to withstand wind loads, potential worker exposures during placement and removal of the tarps and/or foam, and various other factors that can only be evaluated and/or tested during design or possibly during the initial stages of implementation of a remedial action at the site.

To the extent that application of daily soil cover alone proves insufficient to address the nuisance attraction to and congregation by birds at and above the excavation, additional measures may need to be taken. These measures could include some or all of the technologies identified in Section 4 including minimization of areas of exposed wastes, use of tarps or additional thickness of daily cover material over areas of exposed waste, placement of wire or monofilament grids positioned over exposed refuse to prevent bird access, and/or implementation of visual deterrents (simulate predators) or frightening devices (noise makers) to deter bird activity.

5.3.2.6 Removal of Radiologically-Impacted Soil from the Buffer Zone/Crossroad Property

With the exception of the ultimate disposition of such soil, identification, characterization and removal of soil on the Buffer Zone or Crossroad Property that contained radionuclide levels above those that would allow for unrestricted used would be performed in the same manner as was previously described for the ROD-selected remedy (see Section 5.2.1.2). Under the "complete rad removal" with off-site disposal alternative any such soil would be disposed off-site while under the "complete rad removal" with on-site disposal alternative any such soil would be disposed in the new engineered on-site disposal cell.

5.3.2.7 Management of Subsurface Liquids During RIM Excavation

It is not anticipated that groundwater would be encountered during excavation of RIM. Pockets of perched leachate present in the waste mass may be encountered during implementation based on the extent and depths of excavation associated with the "complete rad removal" alternatives. Leachate, if any, that may be encountered during remedy implementation would be pumped into temporary holding tanks (e.g., Baker or frac tanks), tested to determine treatment requirements, if any, with the test results submitted to MSD for approval for discharge to MSD, and subsequently treated, if and as necessary, prior to discharge to MSD. It is not expected that groundwater will be encountered during RIM excavation, based on a comparison of typical measured site groundwater elevations to the anticipated bottom of the anticipated excavations for Areas 1 and 2.

5.3.2.8 Regulated Materials Management During RIM Excavation

Management of suspected hazardous wastes or RACM encountered during implementation of one of the "complete rad removal" alternatives would be conducted in the same manner described in Section 5.2.1.8 for the ROD-selected remedy.

5.3.2.9 Radiological Surveys after RIM Excavation

Final status surveys that would be conducted for completed RIM excavation areas and for the unexcavated areas involved with the movement and handling the RIM and overburden storage locations are described in Section 2.2.2.1 of Appendix G.

5.3.2.10 Stormwater and Landfill Gas Monitoring and Control

In addition to the surfaces that stormwater could contact under the ROD-selected remedy, stormwater under the "complete rad removal" alternatives could contact: (1) exposed waste during excavation of overburden and RIM from Areas 1 and 2; (2) daily cover soil that has been placed over areas of exposed overburden or RIM after excavation; and (3) surfaces of cover material as the covers over Areas 1 and 2 are being constructed. In addition, for the "complete rad removal" with on-site disposal alternative, stormwater could also contact: (1) exposed RIM during placement and compaction of the RIM in the on-site cell, (2) daily cover soil that has been placed over areas of compacted RIM in the on-site cell; and (3) surfaces of cover material as the cover is constructed on the on-site cell.

Stormwater management for the "complete rad removal" alternatives would be performed in the same manner as was described in Section 5.2.1.5 for the ROD-selected remedy except for possible variations in the locations and size of the stormwater control structures owing to the greater area of disturbance and topographic depressions during construction of the "complete rad removal" alternatives and the greater period of stromawater management resulting from the longer duration required for implementation of the "complete rad removal" alternatives. For the "complete rad removal" with off-site disposal alternative, the pond liner would be sent off-site for disposal, and for the "complete rad removal" with on-site disposal alternative, the pond liner would be placed in the on-site cell prior to cover construction.

Landfill gas monitoring and control during construction would be performed in the same manner as was described in Section 5.2.1.6 for the ROD-selected remedy. Long-term monitoring of landfill gas monitoring along the perimeters of Areas 1 and 2 would performed in the same manner as was described in Section 5.2.1.6 for the ROD-selected remedy except that radon monitoring would not be required. Additional landfill gas and radon monitoring would be required along the perimeter of a new, engineered disposal cell included as part of the "complete rad removal" with on-site disposal alternative.

Installation and operation of a landfill gas extraction system as described above for the ROD-selected remedy is also included as a contingent action under either of the "complete rad removal" alternatives in the event that the perimeter landfill gas or radon monitoring indicate that lateral migration of either explosive gases or radon is occurring along the site boundary. This would be evaluated by comparing the landfill gas or radon levels at the perimeter of Areas 1 and 2 under either of the "complete rad removal" alternatives or along the perimeter of the new engineered disposal cell under the "complete rad removal" with on-site disposal alternative, to the appropriate performance standards. Due to the overall age of the landfill along with the relatively low levels of methane detected during the RI (EMSI, 2000), high levels of methane are not expected to occur in Areas 1 and 2.

5.3.2.11 Baseline Monitoring for "Complete Rad Removal" Alternatives

Baseline monitoring for measurement of radon gas in landfill gas wells for the "complete rad removal" alternative with off-site disposal is described in Section 3.2 of Appendix G. Baseline monitoring for the "complete rad removal" with on-site disposal alternative is provided in Section 3.3 of Appendix G and includes measurement of radon gas in landfill gas wells installed along the boundaries of Areas 1 and 2 and around the perimeter of the on-site cell. In addition, a one-time radon flux monitoring program would be performed upon completion of the final cover surface of the on-site engineered cell to ensure that Remedial Action Objectives had been met.

5.3.2.12 Long-Term Operations, Maintenance and Monitoring and Non-Engineered Components

Long-term OM&M activities and the non-engineered components for the "complete rad removal" alternatives would generally be the same as those described in Sections 5.2.1.9 and 5.2.2 for the ROD-selected remedy and described in Appendix G (Section 4.2 for the "complete rad removal" with off-site disposal alternative and Section 4.3 for the "complete rad removal" with on-site disposal alternative). Because all of the radiologically-impacted materials containing radionuclides above levels that would allow for unrestricted use would have been removed from Areas 1 and 2 under the "complete rad removal" alternatives, some of the long-term OM&M activities and institutional controls should not be necessary for Areas 1 and 2 including:

- Long-term OM&M of Areas 1 and 2 would only need to be performed for a 30 year period;
- Institutional controls required solely for the presence of radionuclides in Areas 1 and 2 would no longer be necessary; and
- Monitoring of radon occurrences in landfill gas around Areas 1 and 2 should not be necessary.

In contrast, some additional long-term OM&M activities associated with the on-site cell would be required for the "complete rad removal" with on-site disposal alternative including:

- The landfill cover, stormwater controls and perimeter fencing of the on-site disposal cell would need to be inspected and maintained beyond the 30-year period;

- Monitoring of subsurface landfill gas and radon would need to be performed along the margins of the on-site cell for a period of at least 30 years and likely longer potentially in perpetuity;

- Groundwater monitoring wells would need to be installed and long-term groundwater monitoring would need to be performed around the margins of the on-site disposal cell for a period of at least 30 years and likely longer potentially in perpetuity; and

- Additional institutional controls to restrict land uses or activities that pose a potential to disrupt the integrity of the on-site cell would need to be implemented, monitored, and maintained.

Financial assurance would be required to provide for operation, maintenance and monitoring of the remedy.. In addition to the institutional controls described for the ROD-selected remedy, similar institutional controls would be implemented for the area of the new, engineered disposal cell under the "complete rad removal" with on-site disposal alternative. Five-year regulatory reviews, as described in Section 5.2.2.2, would also be conducted for the "complete rad removal" alternatives.

5.3.3 "Complete Rad Removal" with Off-site Disposal Alternative

This section presents the detailed analysis of the "complete rad removal" with off-site disposal alternative. This alternative consists of the following components:

- Excavation and stockpiling of overburden in OU-1 Areas 1 and 2 in order to access the RIM;

- Excavation of RIM from the OU-1 Areas 1 and 2 that contains radionuclides above levels that would allow for unrestricted use relative to the presence of radionuclides;

- Survey and identification of the presence and extent or radiologically-impacted soil on the Buffer Zone and Crossroad property;

- Excavation of any soil from the Buffer Zone and/or Crossroad property that contains radionuclides at levels greater than those that would allow for unrestricted use;

- Loading, transport, and disposal of the RIM and impacted soil at an off-site disposal facility;

- Regrading of the remaining solid waste materials within Areas 1 and 2 to meet the minimum (5%) and maximum (25%) slope criteria;

- Installation of a landfill cover meeting the Missouri closure and post-closure care requirements for sanitary landfills over Areas 1 and 2;

- Design, installation and maintenance of surface water runoff controls;

- Groundwater monitoring consistent with the requirements for sanitary landfills;

- Landfill gas monitoring and control, as necessary;

- Institutional controls to prevent land and resource uses that are inconsistent with a closed sanitary landfill site containing; and

- Long-term surveillance and maintenance of the landfill cover in Areas 1 and 2.

Several components of this alternative have been addressed above in the ROD-selected remedy or Excavation discussions and will not be repeated here. This section will address loading, transport and disposal of RIM and impacted soil at an off-site facility.

RIM that would be excavated from Areas 1 and 2 and the Buffer Zone/Crossroad property under the "complete rad removal" with off-site disposal alternative would be hauled to one of the off-site disposal facilities described in Section 4.3.7. Because of the long distances between the West Lake Landfill and any off-site disposal facility, and the large volume of RIM estimated to be excavated and considering effectiveness, safety, and cost, direct hauling of RIM to the disposal facility using trucks was eliminated as a transportation technology. Rather, RIM would be hauled to the disposal facilities via rail.

As described in Section 4.3.5, there are several methods for containment of waste material for rail transport including:

- RIM loaded directly into gondola cars, if a rail spur could be extended onto the West Lake Landfill site;

- RIM loaded into an open 35 cubic yard soft-sided U.S. DOT Industrial Packaging (IP)-1 shipping container bags that had been placed in an end-dump semi trailer, the bag closed and trucked to a truck-to-rail transloading operation at a rail spur location near the West Lake Landfill site (assuming a location could be identified), the trailer backed onto a transload ramp, and the bag dumped into the gondola car;

- RIM placed into 10 cubic yard soft-sided IP-1 shipping container bags located near the excavation area, the bags loaded onto flatbed semi-trailers with a forklift or crane and trucked to a truck-to-rail transloading operation at a rail spur location near the West Lake Landfill site (assuming a location could be identified), and the containers off-loaded from the flatbed and into gondola cars with a forklift or crane; or

- RIM loaded into the top of a metal intermodal container, the top secured, the intermodal container lifted onto a flatbed trailer and hauled to a truck-to-rail transloading operation at a leased rail spur location (assuming a location could be identified) where the container would be lifted off of the flatbed and stacked with other intermodals onto a flat railcar.

For the "complete rad removal" with off-site disposal alternative, determination of the containment method for rail transport would be made as part of the RD effort. Extending a rail spur onto the site, if possible, and loading RIM material directly onto railcars would reduce material handling steps and probably reduce transportation costs. Extending a spur would likely require the following activities and facilities, as shown on Figure 32:

- Purchase or long-term lease of portions of the PM Resources, Inc and CP III Properties, LLC properties located across St. Charles Rock Road from the landfill entrance (Figure 32);

- Approvals to construct a rail spur across private property located to the east of St. Charles Rock Road, across St. Charles Rock Road, and along the access roads to the existing solid waste transfer station and asphalt and concrete batch plant operations at the site;

- A new switch and tie-in to the existing spur located on CP III Properties, LLC property;

- Removal of trees and brush in the wooded area between the tie-in and St. Charles Rock Road;

- Assessment of whether the wooded area is a designated wetlands and, if so, obtaining approvals and potential wetlands mitigation;

- Laying of flat track in the cleared area between the tie-in and St. Charles Rock Road;

- Installation of an electrically-gated and signed crossing and flat track across St. Charles Rock Road (Missouri State Highway 180) including appropriate coordination with and approval from local and state authorities;

- Installation of flat track on the West Lake Landfill site on surfaces that have not been landfilled, including north of and along the transfer station access road, between the OU-2 Closed Demolition and Inactive Sanitary Landfills to OU-1 Area 1, and parallel tracks to the west of the asphalt/concrete batch plant areas (Note: it is assumed that two sets of tracks would extend onto the site to provide enough room for switching and staging of empty gondola cars during simultaneous loading of gondola cars, to maximize the volume of RIM that could be removed per day;

- Two switches on the tracking within the West Lake Landfill site;

- Renegotiation of the long-term leases of the asphalt plant, concrete batch plant, trucking company, and potential other lessees who lease land south of the solid waste transfer facility and whose property would be impacted by the on-site spur;

- Potential relocation of the facilities of the above listed lessees;

- Installation of a reinforced concrete (estimated as at least a 100 ft by 100 ft area) loading platform at the edge of Area 2 where excavated RIM would be placed by articulated trucks and then loaded into gondola rail cars with front-end loaders. (Note: it is anticipated that the loading platform would be placed in one permanent location adjacent to Area 2 and the smaller volume of RIM from Area 1 would be transported via articulated on-site trucks to the loading platform);

- Installation of a tensioned fabric frame structure over the loading platform such that loading of rail cars can be performed regardless of weather conditions;

- Installation of a scale within the loading platform structure; and

- Purchase of a "trackmobile" (small rail locomotive) to be used to move empty and loaded gondola rail cars around on-site.

A detailed evaluation of the above issues and whether an on-site rail spur extension is technically or economically feasible is beyond the scope of this SFS, and would need to be conducted during the RD phase. For the purposes of evaluating this alternative in this SFS, it was assumed that excavated RIM would be loaded into 35 cubic yard soft-sided shipping container bags and hauled via truck to a truck-to-rail transloading operation at a rail spur location within a 10-mile radius of the West Lake Landfill site and that four 35 cubic yard bags would be shipped in each 148 cubic yard gondola car to one of the off-site disposal facilities described in Section 4.3.7.

Excavation surveys and verification sampling would be performed during and upon completion of excavation activities in each area as described in Section 5.3.2.1 and Appendix G. As only the RIM would be removed, waste materials would still remain on-site in Areas 1 and 2. Regrading and construction of the final cover would be performed for Areas 1 and 2 as described in Section 5.3.5 below. Long-term inspection and maintenance of the final cover would be required. Groundwater and landfill gas monitoring of Areas 1 and 2 would also be mandated for a period of 30-years consistent with the post-closure monitoring requirements for solid waste landfills (10 CSR 80-2.030(4)(A)3.E(I)). Maintenance and monitoring of institutional controls would also be necessary, similar to the requirements described above for the ROD-selected remedy. EPA and/or MDNR would perform five year reviews, consistent with the format described above.

5.3.4 "Complete Rad Removal" with On-site Disposal Alternative

This section presents the detailed analysis of the "complete rad removal" with on-site disposal alternative. This alternative consists of the following components:

- Excavating stockpiled soil from the current OU-2 on-site soil borrow and stockpile area and relocating the soil material to the area of the previously closed leachate lagoon;
- Construction of the liner system for the on-site engineered disposal cell at the site of the current OU-2 on-site soil borrow and stockpile area;
- Excavation and stockpiling of overburden in OU-1 Areas 1 and 2 in order to access the RIM;
- Excavation of RIM from OU-1 Areas 1 and 2 that contains radionuclides above levels that would allow for unrestricted use relative to the presence of radionuclides;
- Survey and identification of the presence and extent or radiologically-impacted soil on the Buffer Zone and Crossroad property;
- Excavation of any soil from the Buffer Zone and/or Crossroad property that contains radionuclides at levels greater than those that would allow for unrestricted use;
- Loading and transport of the RIM and impacted soil to the on-site engineered disposal cell and placement and compaction of the RIM in the cell;
- Closure of the on-site cell with a final cover configuration consistent with both the MDNR solid waste regulations and UMTRCA requirements;
- Regrading of the remaining solid waste materials within Areas 1 and 2 to meet the minimum (5%) and maximum (25%) slope criteria;
- Installation of a landfill cover meeting the Missouri closure and post-closure care requirements for sanitary landfills over Areas 1 and 2;
- Design, installation and maintenance of surface water runoff controls;
- Groundwater monitoring consistent with the requirements for sanitary landfills;
- Landfill gas monitoring and control, as necessary;
- Leachate monitoring and control for the on-site cell, as necessary;

- Institutional controls for the on-site cell to prevent land and resource uses that are inconsistent with a closed sanitary landfill site containing long-lived radionuclides and institutional controls for Areas 1 and 2 relative to the presence of solid wastes in these area; and

- Long-term surveillance and maintenance of the landfill cover in Areas 1 and 2 and the cover of the on-site engineered cell.

This section presents a discussion of issues that are specific to the On-site Disposal Alternative, namely: siting of a location for an on-site cell, the configuration of the liner and cover for the cell, construction of the liner components, filling of the cell with RIM, construction of the cell cover components, and the OM&M elements of this alternative are discussed in this section. The remaining components are equivalent to those components in the ROD-selected remedy, excavation, or "complete rad removal" with off-site disposal discussions and will not be repeated here.

5.3.4.1 Siting of On-site Cell

As discussed in Section 2.3 and shown on Figure 33, the only available undeveloped portion of the West Lake Landfill property that is located outside of the geomorphic floodplain is the area that contains the Bridgeton Landfill, LLC on-site soil borrow area and soil stockpile. This area is located to the east of the former Bridgeton Sanitary Landfill and south of the site stormwater management pond and the Bridgeton Landfill/hauling company yard area. This area is currently an open field containing natural in-situ soil and previously stockpiled soil for use in post-closure care of the inactive sanitary landfill and as potential cover soils for remedial actions for OU-2.

Use of this area to locate a new on-site engineered disposal cell would require the excavation and relocation of the stockpile soil prior to cell construction. If such excavation occurs to facilitate use of stockpiled soils as cover materials as part of the OU-2 remedy, then implementation of the OU-1 remedy (e.g., construction of the new on-site cell) could be delayed. Other constraints associated with the on-site soil borrow and soil stockpile area include the fact that construction and operation of a disposal cell would be in close proximity to other property owners and businesses located along St. Charles Rock Road. This location is also the portion of the West Lake Landfill property located nearest to the Spanish Village residential area (approximately 3,200 ft), a mobile home park (approximately 800 feet), and the Lambert-St. Louis International Airport.

10 CSR 80-3.010(4)(B) lists the Site Selection Criteria that would need to be reviewed during design of an on-site cell as follows::

- Airport safety;
- Floodplains;
- Wetlands;

- Seismic areas;
- Holocene faults; and
- Unstable areas.

A preliminary screening-level review of these criteria suggests the following:

- The on-site cell location would be approximately 8,000 feet from the end of Runway 11/29 (formerly referred to as Runway12W/30W) at the Lambert-St. Louis International Airport (Figure 33). As previously discussed, it is considered unlikely that the RIM can be separated from the municipal solid waste, and therefore the on-site cell will likely involve the disposal of putrescible waste. Discussions with the Federal Aviation Administration and the Airport owner (the City of St. Louis) would be necessary during the remedial design to develop cell construction and RIM relocation plans that would address bird hazard mitigation and satisfy those parties that the remedy would not pose a hazard to air navigation. Additionally, the City of St. Louis would need to be satisfied of the bird hazard mitigation and grant a waiver of the existing Negative Easement and Restrictive Covenant prohibiting disposal of putrescible waste within the West Lake Landfill property.

- As shown on Figure 33, the on-site cell area would be outside the limit the Missouri River geomorphic floodplain. Based upon a review of the most current published Federal Emergency Management Agency Flood Insurance Rate map number 29189C0039 H (August 2, 2005), this potential on-site cell location is also outside the limits of the 100-year floodplain.

- Review of the U.S. Fish and Wildlife Service's National Wetlands Inventory indicates that the potential on-site cell location area does not contain mapped wetland areas.

- In accordance with the MDNR SWMP regulation 10 CSR 80-2.015(1)(B), the geologic and hydrologic conditions of a proposed location for an on-site engineered disposal cell would need to be investigated and then described in sufficient detail to allow a thorough evaluation. The results of the investigation would need to support the conclusion that the site area is in compliance with the above regulations and, in the process, confirm the suitability of the site's geologic and hydrologic setting for the on-site engineered disposal cell. During this investigation, the study would review whether the site is located within a seismic impact zone, within 200 feet of a fault that has had displacement in Holocene time, and if any subsurface unstable areas exist beneath the proposed foundation location for the on-site cell. This investigation would be completed during the Remedial Design phase.

Based on the above siting criteria, it is apparent that a determination on the suitability of the proposed location for the on-site cell cannot be made at this time and would have to be evaluated in more detail during RD. The presence of the existing landfill stormwater retention basin adjacent to the possible location of an on-site cell could result in mounding of groundwater in this area which could potentially impact the depth of the base of the on-site cell, based on the required minimum 1-foot separation between the landfill liner and groundwater, as well as the soil suitability and stability in this area.

5.3.4.2 General Configuration of On-site Cell

Both the MDNR solid waste regulations and UMTRCA requirements were considered during preparation of a conceptual design for an on-site engineered cell. Site selection and suitability requirements established under both of these regulations were reviewed and evaluated relative to the potential location, but as mentioned a final determination on site suitability will need to be made during RD. No permits would be required; however, in accordance with the NCP, the substantive requirements of the siting and permitting portions of these regulations would be considered during the conceptual design. The final design for a new on-site cell would primarily be based on the MDNR Solid Waste Regulations (10 CSR 80-3.010) but also incorporate features to address the applicable requirements of UMTRCA (40 CFR 192.02).

The on-site cell would consist of an engineered liner and a final cover consistent with the MDNR solid waste regulations (10 CSR 80-3(10) and 10 CSR 80-3(17)). In addition to the cover mandated by the MDNR solid waste regulation requirements, a rock/concrete rubble layer would also be included in the final cover design to address the longevity requirements of UMTRCA. The intended purpose of the rock/rubble layer would be to:

- Reduce the potential for biointrusion into the underlying waste materials;
- Provide a marker layer to identify the materials as artificial deposits/waste materials; and
- Serve as a final barrier against erosion into or of the underlying waste materials.

The liner design would consist of the following components from the bottom layer up:

- Foundation layer or subgrade;
- 2-ft thick low permeability earthen liner (“clay” layer);
- 60 mil high density polyethylene (HDPE) geomembrane;
- cushioning geotextile;
- 1-ft thick leachate drainage layer; and
- Separation geotextile.

The design of the landfill cover for a new on-site disposal cell was also evaluated to ensure that it would be sufficiently thick to reduce potential risks from exposure to gamma radiation from the underlying waste materials and to ensure sufficient radon attenuation so as to meet the radon emissions ARAR of UMTRCA. Consistent with the longevity requirements of UMTRCA, evaluations of the required cover thickness were performed based on the maximum expected gamma radiation and radon emission levels calculated to occur over the next 1,000 years.

The final cover system would consist of the following components from the waste layer up:

- 2-ft thick biointrusion layer;
- 1.3-ft thick low permeability earthen layer (“clay” layer);
- 40 mil low density polyethylene (LDPE) geomembrane;
- 1-ft thick granular drainage layer; and
- 2-ft thick protective soil and vegetative layer.

A profile of the liner and cover systems for the on-site cell is provided as Figure 34.

Although the multiple synthetic components of the on-site cell’s proposed liner and cap design are necessary to meet the requirements of the MDNR solid waste program rules, these components are not expected to remain effective over the design life of 200 years set forth under the UMTRCA regulations. Long-term performance of the liner and cover system would rely on the natural material components such as the clay layers contained within both the liner and cover systems described above. Evaluation of the performance of the on-site cell relative to potential long-term risks, and design of the landfill cover pursuant to UMTRCA requirements relative to gamma radiation and radon emissions, were both performed without consideration of any potential benefits that may accrue from inclusion of a geomembrane in the landfill cover. Consistent with the longevity requirements of UMTRCA (40 CFR 192.02), these evaluations were also performed based on the maximum expected gamma radiation levels and radon emissions calculated to occur within a 1,000 year period as a result of decay and ingrowth of the radionuclides present in OU-1.

Performance of the cap system relative to the UMTRCA design life could be augmented through inclusion of a combination of synthetic and natural materials such as a geosynthetic clay liner that incorporates bentonite with a geomembrane in place of individual geosynthetic liners specified in the MDNR regulations. Regardless, only those components that are composed of natural earth materials would be considered to have a sufficient design life for the UMTRCA requirements.
As required by the MDNR solid waste regulations (10 CSR 80-3(17)(C)4.B.(II)) the design of the landfill cover for the new cell includes a granular drainage layer between the vegetative layer and the underlying geomembrane liner. The proposed granular drainage layer required by the MDNR regulations as part of the landfill cover could represent, if inadequately designed, a potential plane of weakness along which the upper layer of the cap could fail and slump off the landfill at some point during the UMTRCA-specified design life. Although the granular drainage layer theoretically could represent a plane of potential shear failure, the intended purpose of the drainage layer would be actually to maintain and enhance the stability of the cover slopes by eliminating pore water pressures above the low-permeability layer (EPA, 1993d and 1994). Therefore, the presence of the sand drainage layer should actually increase the long-term stability of the landfill cover. The stability of the landfill cover would be evaluated as part of the RD and as required by the MDNR solid waste regulations (10 CSR 80-3(17)(C)5). If it is determined that the presence of a granular drainage layer could undermine the long-term stability

of the landfill cap, modifications to the cell design (e.g., lowering of the side slope angles) or changes to the layer thickness and designs may be necessary.

5.3.4.3 Liner Construction – On-site Cell

The initial activity for construction of the on-site disposal cell would be excavating approximately 590,000 cubic yards of stockpiled soil and relocating the soil material to the closed demolition area landfill and/or on portions of Areas 1 and 2 not contemporaneously subject to RIM excavation (Figure 29). After the stockpiled soil has been removed, the liner components would be constructed in accordance with the Missouri Solid Waste Program Regulations, as amended to address the requirements of the UMTRCA regulations, as described further below.

Subgrade Foundation. If required after relocation of the stockpiled soil, a compacted earth subgrade (foundation) and perimeter berms would be constructed using on-site soils. Roots, cobbles, debris, and other deleterious material would be removed from the soil prior to compaction and the soil would not be used for construction when frozen or placed on frozen ground. Each soil layer would be worked sufficiently to break down oversized clods, obtain uniform moisture content and ensure uniform density.

Low Permeability Earthen Liner. After removal of the stockpiled soil (or after construction of a subgrade foundation), a low permeability earthen liner would be constructed by compacting cohesive soils delivered to the site in loose lifts utilizing moisture correction techniques. This earthen cohesive liner would consist of a 2 feet thick low permeability soil material. The selected soil material would be classified under the USCS as CL, CH, or SC (ASTM Test D2487-85); allow more than thirty percent (30%) passage through a No. 200 sieve (ASTM Test D1140); have a liquid limit equal to or greater than 20 (ASTM Test D4318- 84); have a plasticity index equal to or greater than ten (ASTM Test D4318-84); and have a coefficient of permeability equal to or less than 1×10^{-7} cm/sec when compacted to ninety-five percent (95%) of standard Proctor density with the moisture content between optimum moisture content and four percent (4%) above the optimum moisture content, when tested by using (ASTM D-5084) a flexible-wall permeameter.

During construction of the low permeability earthen liner, testing of each lift for field density and field moisture would be conducted in accordance with the requirements of the Construction Quality Assurance (CQA) Plan. During liner construction, continuous visual classification of borrow soil would be performed by a qualified QC inspector or certifying professional engineer.

Soil materials for subgrade (foundation) preparation, if required, and liner construction would be hauled by scrapers or trucks to areas requiring these materials. Scrapers or haul trucks would place the loads in an effort to produce approximate 8-inch loose lifts. Dozers would be used to spread any soils that had been placed in thicker lifts. Compaction of the subgrade and liner materials would be achieved by self-propelled sheepsfoot rollers (compactors) to compact the loose lift to approximately 6-inches. Fine grading of materials to design grades would be performed with graders and bulldozers.

Geomembrane. After certification of the low permeability earthen liner by the Construction Quality Assurance (CQA) engineer, a geosynthetic membrane liner would be installed over the earthen liner, to provide intimate contact with the underlying surface. The top of the low permeability earthen liner would be graded and rolled smooth prior to placement of the geomembrane, and would be free of all rocks, stones, sticks, roots, sharp objects or debris. This surface would provide a firm, unyielding foundation for the geomembrane.

The geosynthetic membrane liner would be constructed of 60 mil thick HDPE and installed by welding contiguous panels of membranes together to form a monolithic low permeability layer. During liner installation, all seams would be nondestructively tested and random destructive testing of selected seams of the geomembrane liner would occur. Most welds would be accomplished by using a hot wedge welder, which fuses the two sheets together, creating an air channel that can be tested. Secondary welds would be accomplished using an extrusion welder, which uses molten HDPE extrudate to weld two HDPE pieces together. The HDPE material is chemically compatible with any leachate expected to be generated.

Lower Geotextile. After the geomembrane is installed, tested, and certified by the CQA engineer, a cushioning geotextile would be installed over the geomembrane. This geotextile would be used to protect the geomembrane from the placement of the leachate drainage layer. This geotextile layer would be installed by unrolling rolls of geotextile and sewing the individual panels together.

Leachate Drainage and Collection Layer. After the cushioning geotextile was installed, a granular leachate drainage layer would be placed. Any leachate generated from the relocated RIM would be collected via a leachate collection system installed within the granular drainage media. The leachate collection system would consist of a 1 ft thick granular drainage media layer which would convey leachate to a perforated HDPE collection pipe, which in turn would lead to a sump at the low end of the cell containing a pump to remove leachate.

The leachate collection system would be designed and operated to maintain a leachate liquid layer head of one (1) foot or less on the liner. A layer of pea gravel or similar stone material would be used for the drainage layer media, with a minimum permeability of $1x10^{-2}$ cm/sec. The slope of the leachate collection system would be designed such that the longitudinal and cross slopes would allow for gravity drainage into collection areas from which accumulated leachate can be removed. One or more riser pipes would extend from the leachate collection system sump at the end of the cell, up the side- slope of the cell to the ground surface at the perimeter of the cell. Submersible pumps positioned at the bottom of the riser pipes would remove accumulated leachate in the sump.

As a part of the SFS evaluation, preliminary, feasibility-level leachate generation calculations were performed using the HELP Model (Schroeder, et. al., 1994). Results predict the quantity of leachate that would be generated from the volume of RIM in the on-site cell would be approximately 3,320,000 gallons per year (approximately 6.3 gpm) in the first year after construction of the on-site cell is completed and would decline over time as the cell is filled, covered, and closed, to a rate of approximately 5,000 gallons per year in year 20 and beyond. For purposes of preparing a cost estimate in this SFS for the "complete rad removal" with on-site disposal alternative, it is assumed that the leachate would be pumped out of the on-site cell into a holding/equalization tank, pumped through filtration and LPGAC treatment processes, and then discharged to MSD. The holding/equalization tank and building housing the treatment equipment would be located adjacent to the on-site cell. Used filter bags and exhausted LPGAC would be tested and disposed at the appropriate facility according to the analytical test results.

Upper Geotextile. After the thickness of the leachate drainage layer has been verified, a cushioning geotextile would be installed over the drainage layer to separate the RIM from the leachate drainage layer. This geotextile would be sized to allow sufficient hydraulic flow through the waste mass into the leachate drainage layer.

5.3.4.4 Filling of On-site Cell with RIM

Once the liner had been fully constructed, the on-site cell would be ready for filling of the RIM material excavated and transported from Areas 1 and 2. As discussed in Section 5.3.2.1, RIM would be excavated using a hydraulic excavator (assumed to be equipped with a bucket of between 3 and 5 cubic yard capacity). Excavated RIM would be placed into off-road articulated haul trucks and transported to the on-site cell. For purposes of schedule duration and cost estimation in this SFS, it is assumed that each haul truck load to the on-site cell would consist of 20 loose cubic yd (lcy) of RIM. The RIM would be carefully placed in approximately 2-ft thick lifts within the on-site cell limits and compacted with a landfill compactor. RIM placement would continue in lifts to the design contours of the cell. Daily cover consisting of stockpiled soil or alternate materials (tarps or spray) would be applied to the "working face" (surface of exposed RIM) at the end of each operating day.

In addition to contacting exposed waste during excavation of overburden and RIM from Areas 1 and 2, stormwater could contact exposed RIM during placement and compaction of the RIM in the on-site cell prior to daily soil cover being placed over the compacted RIM. Any contact stormwater would be pumped out of the low point in the on-site cell, piped to the new lined stormwater lagoon (Figure 30), pumped from the lagoon, treated, and discharged to MSD.

As RIM is placed in the on-site cell, the nuisance attraction to and congregation by birds at and above the new cell could be problematic unless effectively controlled. An avian management plan that incorporates use of excavation BMPs such as daily soil cover and/or tarping, visual and auditory frightening devices, or wire or monofilament grids positioned over exposed refuse to prevent bird access, could be prepared prior to and implemented during placement of the RIM in the on-site cell.

5.3.4.5 Cover Construction – On-site Cell

Once disposal of RIM from Areas 1 and 2 and the Buffer Zone/Crossroad property was complete, the on-site cell would be closed with the approved final cover configuration. In accordance with the MDNR SWMP regulation 10 CSR 80-3.010 (17)(C)(4)B and UMTRCA, the final cover system would consist of a bio-intrusion layer, a low permeability cohesive soil layer, a geomembrane, a protective drainage layer, and a topsoil layer. A conceptual cross section of the on-site engineered disposal cell final cover configuration is depicted on Figure 34.

Bio-intrusion Layer. The final waste grades would be covered with the daily cover layer, which would also be compacted to be used as a grading layer to form the subgrade on which the bio-intrusion layer would be constructed. Once the grading layer was prepared, 2 feet thick of "shot rock" from a local quarry, or similarly graded rock/rubble material, would be delivered to the site and installed as a bio-intrusion layer. This layer would be a well graded rock which would have fines mixed with the larger particles. Once this layer was graded to its desired thickness, a 1.3 feet thick low permeability cohesive soil layer would be constructed.

Low Permeability Cohesive Soil Layer. The final cover low permeability layer would consist of a minimum 1 ft thick low permeability soil material. The selected soil material would be classified under the USCS as CL, CH, ML, MH or SC (ASTM Test D2487-85and have a coefficient of permeability equal to or less than 1×10^{-5} cm/sec when compacted

The low permeability cohesive material would be delivered from an off-site source. Roots, cobbles, debris, and other deleterious material would be removed from the soil prior to compaction and the soil would not be used for construction when frozen or placed on frozen ground. Each soil layer would be worked sufficiently to break down oversized clods, obtain uniform moisture content and ensure uniform density.

During construction of the low permeability layer, testing of each lift of the layer for field density and field moisture would be conducted a minimum of once per every 10,000 sq ft and provide for relatively uniform coverage over the landfill surface. In addition, laboratory hydraulic conductivity testing of the soil used for low permeability layer construction would be conducted once for every 5,000 cubic yard of material placed.

The top of the low permeability cohesive layer would be graded and rolled smooth and would be free of rocks, stones, sticks, roots, sharp objects or debris. This surface would provide a firm, unyielding foundation for the geomembrane.

Geomembrane. After certification of the low permeability cohesive soil layer by the CQA engineer, a geosynthetic membrane liner would be installed over the low permeability layer in a manner that provides intimate contact with the underlying low permeability layer. The geosynthetic membrane liner would be constructed of 40 mil thickness LDPE material, which would be installed by welding contiguous panels of membranes together to form a monolithic low permeability layer. The LDPE material would be chemically compatible with any infiltrated water from the above layer. Most welds would be accomplished by using a hot wedge welder, which fuses the two sheets together, creating an air channel that could be tested. Secondary welds would be accomplished using an extrusion welder, which uses molten LDPE extrudate to weld two LDPE pieces together. All seams would be nondestructively tested and random destructive testing of the seams of the geomembrane would occur on an average frequency of at least one (1) every 500 linear feet of seam.

Protective Drainage Layer. After the final cover geomembrane liner had been installed, tested, and certified by the CQA engineer, a 1 ft thick granular drainage layer would be placed for the purpose of draining the protective layer of the final cover system. This layer would be constructed of sand, using USCS soil type SC. Sand for this layer would be delivered from off-site borrow sources and stockpiled until needed. A series of drainage pipes would be placed in this drainage layer to collect any infiltrated water that has accumulated on top of the geomembrane liner and direct it to the perimeter stormwater drainage system.

Topsoil Layer. The final layer to support vegetation would consist of 2 feet of top soil. The material would typically be a soil with sufficient organic content, agricultural properties, and grain size distribution to allow for vegetation growth. Soils for this layer would be delivered from off-site borrow sources and stockpiled until needed.

A combination of grasses (typically fescue, bluegrass, rye grass, and clover) would be used to establish vegetation on the final cover. The vegetation mixture would be chosen for rapid establishment, sustainability, compatibility with site conditions (e.g., climate, soil agricultural properties), and minimal maintenance requirements. Erosion control practices may be utilized during seeding operations. These measures could include mulch, straw, erosion control matting, or chemical soil stabilizers. To aid in the development of vegetation, use of a temporary irrigation system would be considered and used until the vegetation was established.

Consistent with MDNR requirements for new landfills, the final cover would be designed with a maximum slope of 25% and minimum slope of 5%. Once all the closure activities were completed, perimeter drainage systems, terraces, and a security fence would be installed as necessary to restrict access to the unit.

5.3.4.6 OM&M Components – On-site Disposal in Engineered Cell Alternative

As discussed in Section 5.3.3 for the ”complete rad removal” with off-site disposal alternative, excavation surveys and verification sampling would be performed during and upon completion of excavation activities in Areas 1 and 2 as described in Appendix G. As only the RIM would be removed, waste materials would still remain on-site in Areas 1 and 2. Regrading and construction of the final cover for Areas 1 and 2 would be performed as described in Section 5.3.5 below. Long-term inspection and maintenance of the final cover over Areas 1 and 2 as well as the 10-acre cover on the on-site cell would be required. Groundwater and landfill gas monitoring of Areas 1 and 2 would also be required for a period of 30 years consistent with the post-closure monitoring requirements for solid waste landfills (10 CSR 80-2.030(4)(A)3). Groundwater monitoring around the new on-site disposal cell would be required for a minimum of 30 years and potentially in perpetuity. For costing purposes in this SFS, it is assumed that 10 additional groundwater monitoring wells associated with the on-site cell would be constructed and monitored. Maintenance and monitoring of institutional controls would also be required similar to the requirements described above for the ROD-selected remedy. Five year reviews would also be required.

5.3.5 Closure Construction - Remaining Solid Waste Areas of Areas 1 and 2

After RIM had been removed from Areas 1 and 2, only waste materials below the appropriate rad screening level would remain in these areas. The presence of these materials would require a final RCRA Subtitle D cover to be constructed over these areas. As the "complete rad removal" cleanup criteria would have been met, it is assumed that 10 CSR 80-3.010(17)(C)(4)A would govern the requirements for the landfill cover over Areas 1 and 2.

In order to safely access and remove RIM described previously, it could be necessary to temporarily excavate and stockpile solid wastes (overburden wastes) that currently lie on top of the RIM. Once removal of RIM over the levels permitted for unrestricted use has been verified, this overburden waste material would be returned to the excavated areas. These wastes would then be graded and a new Subtitle D landfill cover installed. It is envisioned that the overburden wastes would be suitable for backfilling into the excavations of Areas 1 and/or 2, which would aid in the proper regrading of the two excavations and promote positive drainage from the two areas. The design criteria specified for the ROD-selected remedy (e.g., minimum 2% slopes) would also apply to design of the final grades for any waste materials that would remain after excavation of the RIM. A conceptual design of the final closed topography for the cover over Areas 1 and 2 is depicted on Figure 35.

Consistent with MDNR regulations for existing solid waste landfills without liners (10 CSR 80-3.010(17)(C)(4)(A)), the cover envisioned for Areas 1 and 2 would consist of the following layers (from top to bottom):

- 1-ft vegetative soil; and
- 2-ft compacted clay layer (10^{-5} cm/sec).

The uppermost one (1) ft soil layer would have to be capable of sustaining vegetative growth. It would typically be comprised of a soil with sufficient organic content and permeability to allow vegetative growth. USCS soil types such as OH and OL are often found suitable for this end use. The United States Department of Agriculture (USDA) soil taxonomy system would also be referenced and used to aid in identifying suitable vegetative layer soils.

The two (2) ft compacted clay layer would consist of a USCS CL, CH, ML, MH, or SC soil-type with characteristics such that a compacted permeability 1×10^{-5} cm/sec or less could be achieved during construction.

6 DETAILED ANALYSIS OF ALTERNATIVES

In this section, the ROD-selected remedy and the two "complete rad removal" alternatives developed in Section 5 are subjected to detailed analysis. The purpose of this detailed analysis is to provide sufficient information to allow for comparisons among the alternatives based on the criteria specified in the NCP.

The detailed evaluation of final alternatives for a remedial action is a two-stage process. This section presents the first stage of evaluation, in which each of the alternatives is assessed against the nine criteria prescribed by the NCP. This evaluation is based on the conceptual descriptions of the alternatives provided in Sections 5.2 and 5.3.

Section 7 will set out the second stage of the evaluation process, in which the alternatives are compared against each other to identify relative advantages, disadvantages and trade-offs using the nine NCP criteria. The purpose of the comparative analysis is to provide information for a balanced remedy selection.

The nine NCP evaluation criteria consist of:

Threshold Criteria:
- Overall Protection of Human Health and the Environment
- Compliance with ARARs

Primary Balancing Criteria:
- Long-Term Effectiveness and Permanence
- Reduction of Toxicity, Mobility, or Volume through Treatment
- Short-Term Effectiveness
- Implementability
- Cost

Modifying Criteria:
- State Acceptance
- Community Acceptance

The NCP (40 CFR Section 300.430(e)(9)(iii)) categorizes these nine criteria into three groups (see above): threshold criteria, primary balancing criteria, and modifying criteria. Each type of criteria has its own weight when it is evaluated. Threshold criteria are requirements that each alternative must meet to be eligible for selection as the preferred alternative, and include overall protection of human health and the environment and compliance with ARARs (unless a waiver is obtained).

Primary balancing criteria are used to weigh effectiveness and cost tradeoffs among alternatives. The primary balancing criteria include long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost. The primary balancing criteria represent the main technical criteria upon which the alternative's evaluation is based.

Modifying criteria include State acceptance and community acceptance. State and community acceptance will be evaluated by EPA as part of any decision process that may be undertaken by EPA after completion of the SFS. Accordingly, only the seven threshold and primary balancing criteria are used in the detailed analysis phase of this section.

6.1 Description of Evaluation Criteria

Specific elements to be considered in the evaluation of the nine NCP criteria are discussed below.

6.1.1 Overall Protection of Human Health and the Environment

This criterion assesses how each alternative provides and maintains adequate protection of human health and the environment. Alternatives are assessed to determine whether they can adequately protect human health and the environment from unacceptable risks posed by contaminants present at the site, in both the short and long term. This criterion is also used to evaluate how risks would be eliminated, reduced, or controlled through implementation of the remedial activities. Overall protection of human health and the environment draws on the assessments of other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

6.1.2 Compliance with ARARs

This evaluation criterion is used to evaluate whether each alternative would comply with federal and State ARARs, or, if not, whether invoking waivers to one or more specific ARARs is adequately justified. Other information such as advisories, criteria or guidance, is considered during the ARARs analysis as "to be considered" elements (TBCs). The considerations evaluated during the analysis of the ARARs applicable to each alternative are presented below. Potential chemical-, location-, and action-specific ARARs for West Lake Landfill OU-1 are discussed in detail in Subsection 3.1.

Chemical-specific ARARs:

- Likelihood that the alternative will achieve compliance with chemical-specific ARARs within a reasonable period of time.
- If it appears that compliance with chemical-specific ARARs will not be achieved, then evaluation of whether a waiver is appropriate.

Location-specific ARARs:

- Determination of whether any location-specific ARARs apply to the alternative.
- Likelihood that the alternative will achieve compliance with the location-specific ARAR.
- Evaluation of whether a waiver is appropriate if the location-specific ARAR cannot be met.

Action-specific ARARs:

- Likelihood that the alternative will achieve compliance with action-specific ARARs.
- Evaluation of whether a waiver is appropriate if the action-specific ARAR cannot be met.

Other criteria and guidance:

- Likelihood that the alternative will achieve compliance with other criteria, such as risk-based criteria.

6.1.3 Long-Term Effectiveness and Permanence

This criterion addresses the long-term effectiveness and permanence of maintaining the protection of human health and the environment after implementing the remedial action imposed by the alternative. The primary components of this criterion are the magnitude of residual risk remaining at the site after remedial objectives have been met, and the extent and effectiveness of controls that may be required to manage the risk posed by treatment residuals or untreated wastes. The analysis of each alternative for long-term effectiveness and permanence is presented below.

<u>Magnitude of residual risks</u>:

- Identify remaining risks (risks from treatment residuals) as well as risks from untreated residual contamination.
- Magnitude of the remaining risks.

The magnitude of residual risk at the end of remedial activities is evaluated against numerical standards (e.g., cleanup levels or chemical-specific ARARs), or the volume or concentration of contaminants remaining. The characteristics of the residuals remaining are also evaluated, considering their volume, toxicity, and mobility.

<u>Adequacy and reliability of controls</u>:

- Likelihood that the technologies will meet required process efficiencies or performance specifications.
- Type and degree of long-term management required.

- Long-term monitoring requirements.
- Operations, Maintenance and Monitoring (OM&M) functions that must be performed.
- Difficulties and uncertainties associated with long-term OM&M functions.
- Potential need for technical components replacement.
- Magnitude of threats or risks should the remedial action need replacement.
- Degree of confidence that controls can adequately handle potential problems.
- Uncertainties associated with land disposal of residuals and untreated wastes.

This criterion requires evaluation of the adequacy and reliability of controls that are used to manage either treatment residuals or untreated materials that remain after attaining remediation goals. This evaluation includes an assessment of containment systems and institutional controls to assess the degree of confidence that they will adequately handle potential problems and provide sufficient protection. The evaluation also addresses long-term reliability, the need for long-term management and monitoring, and the potential need to replace technical components of the alternative.

6.1.4 Reduction of Toxicity, Mobility or Volume through Treatment

This criterion addresses the anticipated performance of the treatment technologies employed by each alternative in permanently and significantly reducing toxicity, mobility, and/or volume of contaminants. The NCP prefers remedial actions in which treatment is used to reduce the principal threats at a site through destruction of toxic contaminants, irreversible reduction in contaminant mobility, or reduction of total volume of contaminated media. The considerations evaluated during the analysis of each alternative for reduction of toxicity, mobility, or volume of contaminants are presented below:

Treatment process and remedy:

- Likelihood that the treatment process addresses the principal threat.
- Special requirements for the treatment process.

Relative amount of hazardous material destroyed or treated:

- Portion (mass) of constituents of potential concern (CoPC) that is destroyed.
- Portion (mass) of CoPC that is treated.

Reduction in toxicity, mobility, or volume:

- Extent that the total mass of contaminants is reduced.
- Extent that the mobility of contaminants is reduced.
- Extent that the volume of contaminants is reduced.

Irreversibility of treatment:

- Degree that the effects of the treatment are irreversible.

Type and quantity of residuals remaining following treatment:

- Residuals that will remain.
- Quantities and characteristics of the residuals.
- Risk posed by the treatment residuals.

Statutory preference for treatment as a principal element:

- Extent to which the scope of the action covers the principal threats.
- Extent to which the scope of the action reduces the inherent hazards posed by the principal threats at the site.

6.1.5 Short-Term Effectiveness

Short-term effectiveness considers the effect of each remedial alternative on the protection of human health and the environment during the construction and implementation phase. The short-term effectiveness evaluation only addresses protection prior to meeting the RAOs. The considerations evaluated during the analysis are presented below.

Protection of the community during any remedial action:

- Risks to the community that must be addressed.
- How the risks will be addressed and mitigated.
- Remaining risks that cannot be readily controlled.

Protection of workers during remedial actions:

- Risks to the workers that must be addressed.
- How the risks will be addressed and mitigated and the effectiveness and reliability of measures to be taken.
- Remaining risks that cannot be readily controlled.

Environmental impacts of any remedial action:

- Environmental impacts that are expected with the construction and implementation of the alternative.
- Mitigation measures that are available and their reliability to minimize potential impacts.
- Impacts that cannot be avoided, should the alternative be implemented.

Time until RAOs are achieved:

- Time to achieve protection against the threats being addressed.
- Time until any remaining threats are addressed.
- Time until RAOs are achieved.

6.1.6 Implementability

Implementability evaluates the technical and administrative feasibility (i.e., the ease or difficulty) of implementing each alternative and the availability of required services and materials during its implementation. The following considerations are evaluated for implementability:

Technical Feasibility

Ability to construct and operate the technology:

- Difficulties associated with the construction.
- Uncertainties associated with the construction.

Reliability of the technology:

- Likelihood that technical problems will lead to schedule delays.

Ease of undertaking additional remedial actions:

- Likely future remedial actions that may be anticipated.
- Difficulty implementing additional remedial actions.

Monitoring considerations with respect to effectiveness of the remedy:

- Migration or exposure pathways that cannot be monitored adequately.
- Risks of exposure, should the monitoring be insufficient to detect failure.

Administrative Feasibility

Coordination with other agencies:

- Steps required to coordinate with regulatory agencies other than EPA to implement any remedy.
- Steps required to establish long-term or future coordination among agencies.
- Ease of obtaining permits for off-site activities, if required.

Availability of Services and Materials

Availability of treatment, storage capacity, and disposal services:

- Availability of adequate treatment, storage capacity, and disposal services.
- Additional capacity that is necessary.
- Whether lack of capacity prevents implementation.
- Additional provisions required to ensure that additional capacity is available.

Availability of necessary equipment and specialists:

- Availability of adequate equipment and specialists.
- Additional equipment or specialists required.
- Whether there is a lack of equipment or specialists.
- Additional provisions required to ensure that equipment and specialists are available.

Availability of prospective technologies:

- Whether technologies under consideration are generally available and sufficiently demonstrated.
- Further field applications needed to demonstrate that the technologies may be used full-scale to treat contaminants.
- When the technology would be available for full-scale use.
- Whether more than one vendor would be available to provide a competitive bid.

6.1.7 Cost

In accordance with the NCP as well as the "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA" (EPA, 1988a) and "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study" (EPA, 2000), estimated capital costs, annual OM&M costs, periodic costs, and present worth costs have been prepared for the ROD-selected remedy and the two "complete rad removal" alternatives. As specified in the RI/FS guidance (EPA, 1988a), the estimated costs were developed to provide a level of accuracy of +50/-30 percent, that is the actual costs can be up to 50% higher or 30% lower than the estimated costs.

Estimates of probable costs for each of the two "complete rad removal" alternatives were developed during preparation of this SFS. The cost estimates presented in the FS (EMSI, 2006) for remedial alternatives L4 and F4, which most closely parallel the ROD-selected remedy, were reviewed, revised and updated to reflect placement of rip-rap along the toe of the Area 2 portion of the landfill, the results of preliminary engineering evaluations performed during preparation of the RD Work Plan (EMSI, 2008) and this SFS, and current published unit costs and cost factors.

6.1.7.1 Capital and Operation, Maintenance, and Monitoring Costs

Capital costs include (1) direct costs for labor, equipment, materials, subcontractors, contractor markups such as overhead and profit, and professional/technical services that are necessary to support construction of the remedial action; and (2) indirect capital costs that are not part of the actual construction but are necessary to implement the remedial action (e.g., engineering, legal, construction management, and other technical and professional services). Operation, maintenance, and monitoring (OM&M) costs include annual post-construction costs for labor, equipment, materials, subcontractors, and contractor markups such as overhead and profit associated with activities such as monitoring and maintaining the components of the remedial action. Annual OM&M costs also include expenditures for professional/technical services necessary to support OM&M activities. Periodic costs are those that might occur only once every few years (e.g., five-year reviews, cap/cover repair, and equipment replacement), or expenditures that will occur only once during the entire OM&M period or remedial timeframe (e.g., well abandonment, update of the Institutional Controls (ICs) Plan, and site closeout).

In preparing the cost estimates used in this SFS, quantities for labor, equipment, and materials were developed as discussed in Sections 2 and 5 of this report. Cost data were obtained from a variety of sources including cost estimating guides and references such as unit prices in the latest RS Means Heavy Construction and Sitework & Landscaping Cost Data, RS Means CostWorks First Quarter 2011 digital cost data, site-specific vendor and contractor quotes and discussions, experience with actual costs from similar projects, other historical project costs updated to 2011 costs using the Engineering News Record Construction Cost Index (ENR CCI), and engineering judgment.

As discussed in Section 4, only three disposal facilities (U.S. Ecology's facility in Grandview, Idaho the Energy*Solutions* facility in Clive, Utah; and Clean Harbors' Deer Trail facility in Last Chance, Colorado), have been identified that could accept RIM from the West Lake Landfill for off-site disposal. For the "complete rad removal" with off-site disposal alternative, this SFS considered unit costs for complete ("turnkey") services for waste classification, transportation, and disposal provided by these three disposal facilities. The information provided by U.S. Ecology, Energy*Solutions*, and Clean Harbors is considered appropriate for an FS-level evaluation of potential alternatives. These companies provided unit costs for complete turnkey services for waste profiling and acceptance testing, waste transportation including all related fees and taxes, and waste disposal services including all related fees and taxes. Contacting trucking and rail companies to obtain independent estimates of the potential costs of transportation separate from the potential costs for disposal is beyond the scope and level of detail required to prepare FS-level cost estimates. Furthermore, it would be difficult to ascertain the degree of qualifications, capabilities and understanding such transportation firms might have regarding the licensing, permitting, applicable fees, manifesting, placarding, health and safety monitoring, and other aspects of interstate transportation of radioactive wastes.

In addition to the appropriateness of these cost evaluations for this phase of evaluation of potential alternatives, the companies evaluated in the SFS have experience performing the type of services that would be necessary for implementation of a "complete rad removal" with off-site disposal alternative. In particular, U.S. Ecology's Idaho facility has experience relative to excavation, transport and off-site disposal of radiologically-impacted soils from the St. Louis Airport Site (SLAPS), which is geographically close to the West Lake Landfill. The other two disposal facilities have performed similar services for Formally Utilized Sites Remedial Action Program (FUSRAP) and DOE sites, as well as for remedial actions at other Superfund sites that contained radioactively-impacted materials.

Because these turnkey disposal firms performed removal, transportation and off-site disposal services for SLAPS and DOE FUSRAP sites, use of these firms to provide estimates of the expected costs for transport and disposal of the West Lake Landfill site RIM is considered appropriate for preparation of FS-level cost estimates. Each of the identified contractors could provide all coordination involved with leasing a nearby rail spur, waste profiling and acceptance testing, loading and manifesting each truck that leaves the site, and scheduling gondola car transportation with the respective railroads who own the track along the rail routes between the West Lake Landfill and the disposal facility location. In addition, transportation/disposal would be performed under a single agreement with the disposal facility contractor who would indemnify against liability after the RIM left the West Lake site. Use of estimates from three turnkey contractors provides a sufficient basis to assure the reasonableness and competitiveness of the unit costs. Solely for purposes of preparing the cost estimates for the SFS, the unit costs for the complete "turnkey" services provided by U.S. Ecology were used. The possible cost impacts of using the Energy*Solutions* facility are discussed as part of the sensitivity evaluation of the cost estimates.

Estimates for professional/technical services cost elements (project management, RD, construction management, and technical support) were based on the example percentages provided in Exhibit 5-8 for construction of remedies greater than $10 million in "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study" (EPA, 2000). These percentages of total construction cost are 5%, 6%, and 6%, respectively, for project management, RD, and construction management. Costs for regulatory oversight were estimated at 5% of the capital costs (exclusive of off-site transportation and disposal costs and contingency costs), and 5% of the long-term OM&M costs.

The factors (e.g., total number of acres to be regraded under the ROD-selected remedy, the volume of RIM to be excavated under the two "complete rad removal" alternatives, the total length of fencing, etc.) and the assumptions (e.g., material densities and swell factors, volume of leachate encountered or stormwater generated during construction, excavation efficiency factors, etc.) used to prepare the cost estimates are presented in Appendix K-1.

6.1.7.2 Contingency Costs

A contingency was added as a percentage of the total capital, annual OM&M, and periodic costs to cover unknowns, unforeseen circumstances, or unanticipated conditions that are not possible to evaluate from the data on hand at the time the FS-level cost estimates are prepared. Contingency is comprised of two elements: scope and bid.

Scope contingency covers unknown costs due to scope changes that may occur during RD and represents project risks associated with an incomplete design, because design concepts are not typically developed enough during preparation of a FS to identify all project components or quantities. This type of contingency represents costs unforeseeable at the time of FS, and conceptual design cost estimate preparation, both of which are likely to become better known as RD proceeds. For this reason, scope contingency is sometimes referred to as "design" contingency. In general, scope contingency should decrease as RD progresses and should be near 0% at the 100% design stage. At the early stages of RD (e.g., during the FS stage, which represents 0% to 10% design completion), concepts are not typically developed enough to identify all project components or quantities. Higher scope contingency values may be justified for alternatives with greater levels of cost growth potential. A low percentage for scope contingency indicates an opinion that the project scope will undergo minimal change during design. A high percentage indicates an opinion that the project scope may change considerably between the FS and final design. In accordance with EPA guidance (EPA, 2000), engineering judgment was used whenever selecting a scope contingency percentage, and the value used was clearly identified in the cost estimate.

For this SFS, scope contingency factors ranged from 10% to 55%, depending upon the degree of certainty or uncertainty associated with each alternative and the remedial technologies that comprise each alternative, and taking into consideration the ranges in FS-level scope contingency percentages listed in Exhibit 5-6 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study" (EPA, 2000). Exhibit 5-6 of that guidance provides a range of scope contingencies to consider for various remedial technologies. As examples, the following ranges from Exhibit 5-6 were considered and selected for this SFS.

Remedial Technology	Scope Contingency Range from Exhibit 5-6 (%)	Selected Scope Contingency for SFS (%)
Soil excavation	15 – 55	55
Off-site disposal	5 – 15	15
Clay cap	5 - 10	10

The uppermost values for these remedial technologies were selected for use in this SFS due to the high level of uncertainty associated with the scope of each of the remedial alternatives. Factors contributing to the high level of uncertainty for the ROD-selected remedy and the two "complete rad removal" alternatives include the following:

- The estimated volume of RIM to be removed under the two "complete rad removal" alternatives. As presented in Appendix B of the SFS, the RI data and various interpolation techniques were used to estimate the volume of waste material that might need to be removed, and those estimated volumes then served as the basis for the cost estimates. Costs for excavation, off-site transportation and disposal, and for construction of an on-site disposal cell are directly proportional to the estimated volume of RIM to be excavated, removed or disposed on-site. The data quality objectives (DQOs) for the RI were to develop site characterization data, not to estimate volumes of waste material for RD.

- The assumed unit weight of the existing in-place filled material in Areas 1 and 2, and the assumed waste volume expansion or "swell" factor for the filled material after excavation. Based on experience from other sites and engineering judgment, a unit weight of 1,500 pounds per cubic foot (lbs/cf) and a swell factor of 1.5 were used in this SFS. Swell factors reported for the CERCLA landfill excavation remedial action for OU-1 at the Mound (Miamisburg, OH) site varied from 1.2 to 1.6 (Lee, 2010), while a swell factor of 2 was experienced during excavation of the former CERCLA site Tulalip Landfill near Marysville, WA (Richtel, 2010). Assuming a swell factor of 1.3 instead of the 1.5 used in this SFS would result in 13% less volume of RIM that would be disposed off-site or relocated to an on-site cell under the "complete rad removal" alternatives, while a swell factor of 2.0 would result in 33% more RIM volume than the amount estimated using the 1.5 expansion factor.

- The uncertain level-of-effort for radiation surveying and confirmatory laboratory sample turnaround time and analysis required to guide the excavation of RIM, and the effect of such uncertainties on excavation progress.

- The undeterminable ability and level of effort required to excavate the three non-contiguous areas of deeper occurrences of RIM in Area 2.

- The methods assumed to handle overburden materials so as to minimize "double handling" of the materials during excavation and subsequent replacement have not been fully developed or designed.

- The actual equipment production rates for regrading or excavation of the landfilled wastes in Areas 1 and 2 are uncertain at this time.

- It was not possible to estimate precise volumes of precipitation and resultant contact stormwater that might be generated when precipitation is exposed to: waste during regrading activities under the ROD-remedy; waste and RIM during excavation of overburden and RIM from Areas 1 and 2 under the two "complete rad removal" alternatives; or RIM during placement and compaction of the RIM in the on-site cell for the "complete rad removal" with disposal with on-site disposal alternative. Detailed design would be conducted during RD to address management of the types and quantities of stormwater that might be generated during construction of the selected remedy. For purposes of preparing cost estimates for the alternatives evaluated in this SFS, it is assumed that precipitation that contacts wastes and/or RIM during regrading, excavation, or placement in an on-site cell and accumulates in the low point of an excavation or fill would be pumped to a new lined stormwater lagoon located at the site of the previously closed leachate lagoon. Stormwater would be pumped from the lagoon to a treatment building, subjected to filtration and liquid phase granular activated carbon (LPGAC) treatment processes and discharged to the Metropolitan Sewer District (MSD) in accordance with MSD procedures and discharge limitations. Capital and OM&M costs for stormwater collection and on-site treatment are included for each of the three alternatives assuming a maximum historical 24-hour rainfall over an anticipated maximum area of exposed waste at any one time of 0.2 acres (representing between 1% and 10% of the total work area). This value is based on an assumption that the majority of the work area would be covered with tarps or other means to reduce the amount of precipitation which comes into contact with the overburden, waste or RIM. Although the same storm event and exposed area were assumed for all three alternatives, the estimated OM&M costs vary among the alternatives as a result of differences in the estimated construction schedules (i.e., the estimated duration that areas being excavated might be exposed to precipitation) for each alternative.

- Uncertainties regarding the rates at which liner and cover construction materials could be delivered from off-site sources.

- Uncertainties regarding the actual type of materials to be used for cover construction (e.g., the use of "shot rock" from a nearby quarry was assumed for the materials for the biointrusion layer rather than more uniformly sized large rip-rap).

- For the "complete rad removal" with off-site disposal alternative, uncertainties exist regarding the methods of transport, the amount of handling of material at truck/rail transloading stations, which facilities are able to accept the RIM, and the overall validity and duration of reliability of the verbal quotes received from disposal facility representatives.

Bid contingency represents costs, unforeseeable at the time of estimate preparation, which are likely to become known as the remedial action construction or OM&M proceeds. Bid contingency accounts for changes that occur after a construction or OM&M contract is awarded and represents a reserve for quantity overruns, modifications, change orders, or claims during construction or OM&M. Examples include changes due to adverse weather, material or supply shortages, or new regulations. A bid contingency of 20% was included for all of the alternatives in this SFS, in accordance with the range of bid contingency factors from "A Guide to Developing and Documenting Cost Estimates during the Feasibility Study" (EPA, 2000).

6.1.7.3 Present Worth and Non-discounted Constant Dollar Costs

A present worth analysis has been prepared to allow comparison of the estimated costs of each alternative on the basis of a single figure – i.e., a single dollar amount that, if invested in the base year and disbursed as needed, would be sufficient to cover all costs associated with the remedial action over its planned life. In accordance with EPA's "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA" (EPA, 1988a), a 30 year period of performance was used in the development of the present worth analysis. The use of a 30 year period for the present worth analysis is not intended to imply or otherwise provide a basis to limit future site maintenance and monitoring activities to 30 years. The need for and scope of continued monitoring and maintenance both within and beyond 30 years would be subject to ongoing evaluation as part of the five year review process for the site. For some of the alternatives, radioactively-impacted materials would remain on-site and active beyond 30 years, and monitoring and maintenance activities would likely be required beyond the 30 year period used in the cost estimates. Therefore, for the alternatives in which radioactively-impacted materials would remain on-site, OM&M cost estimates and present worth estimates were prepared for both 30-year and 1,000-year periods.

While the "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA" (EPA, 1988a) recommends the general use of a 30-year period of analysis for estimating present worth costs during a FS, the more recent "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study" (EPA, 2000), recommends that for projects with durations exceeding 30 years, the FS should prepare both a present worth analysis using the project duration and a non-discounted constant dollar cash flow over time scenario. In this SFS, both present worth and non-discounted constant dollar cash flow analyses have been developed for all three alternatives. It should be noted that the 2000 guidance states "Non-discounted constant dollar costs are presented for comparison purposes only and should not be used in place of present value costs in the Superfund remedy selection process."

EPA policy on the use of discount rates for RI/FS present worth cost analyses is stated in the preamble to the NCP (55 FR 8722) and in Office of Solid Waste and Emergency Response (OSWER) Directive 9355.3-20 entitled "Revisions to OMB Circular A-94 on Guidelines and Discount Rates for Benefit-Cost Analysis" (EPA, 1993a). The latest (December 2010) Office of Management and Budget (OMB) Circular A-94 Appendix C 30-year Real Discount Rate for 2011 is 2.3 percent. This rate has been applied to the present worth analyses.

6.1.8 State Acceptance

This criterion involves technical and administrative concerns that the state may communicate in its comments concerning the alternatives addressed in an FS. State acceptance will initially be evaluated based on comments provided by MDNR on this SFS. A final evaluation of state acceptance will be performed by EPA as part of any decision process that may be undertaken by EPA after completion of the SFS.

6.1.9 Community Acceptance

Community acceptance will be evaluated by EPA as part of any decision process that may be undertaken by EPA after completion of the SFS.

6.2 Detailed Analysis of Alternatives

The detailed analysis of the ROD-Remedy and the two "complete rad removal" alternatives is included in the following sections: 6.2.1 for the ROD-selected remedy; 6.2.2 for the "complete rad removal" with off-site disposal alternative; and 6.2.3 for the "complete rad removal" with on-site disposal alternative.

6.2.1 Regrading and Enhanced Capping (ROD-Selected Remedy)

As discussed in Section 5.2, the ROD-selected remedy consists of the following components:

- Installation of a landfill cover meeting the Missouri closure and post-closure care requirements for sanitary landfills, including enhancements consistent with the standards for uranium mill tailing sites (i.e., armoring layer and radon barrier), and inclusion of flood protection measures along the toe of the Area 2 landfill.

- Survey and identification of the presence and extent of radiologically-impacted soil on the Buffer Zone and Crossroad Property.

- Excavation of any soil containing radionuclides above levels that would allow for unrestricted use from the Buffer Zone and/or Crossroad Property and consolidation of the excavated soil within Areas 1 or 2.

- Application of groundwater monitoring and protection standards consistent with requirements for uranium mill tailing sites and sanitary landfills.

- Design, installation and maintenance of surface water runoff controls.

- Gas monitoring and control, including radon and decomposition gas as necessary.

- Institutional controls to prevent land and resource uses that are inconsistent with a closed sanitary landfill site containing long-lived radionuclides.

- Long-term surveillance and maintenance of the remedy.

The ROD-selected remedy consists of regrading (cutting and filling) of the existing landfill materials along with placement of additional soil or clean fill material (as defined in the Missouri solid waste regulations [10 CSR 80-2.010(11)]) over Areas 1 and 2 to adjust the final grades to achieve minimum slope angles of 2% and maximum angles of 25%. Portions of the landfill berm that contain slopes greater than 25% would be regraded through construction of a perimeter “starter” berm, regrading the existing landfill materials, and/or placement of additional material to reduce the slope angles to 25%. The method used to regrade the perimeter portions of Areas 1 and 2 would be subject to physical constraints associated with the location of the toe of the landfill relative to the property boundary or adjacent site features (e.g., the transfer station access road).

Upon completion of the landfill regrading, a new Subtitle D-equivalent landfill cover would be constructed over Areas 1 and 2 consistent with the MDNR final cover requirements for operating sanitary landfills without composite liners. The final cover system would encompass approximately 16 acres for Area 1 and 39 acres for Area 2. Although not required for a Subtitle D cover, a layer of well-graded rock or concrete/asphaltic-concrete rubble would be installed immediately beneath the clay layer to minimize the potential for bio-intrusion and erosion, increase the longevity of the landfill cover, and enhance the radon attenuation capability of the cover system. Surface drainage diversions, controls and structures would also be designed and constructed on the surface of or adjacent to the landfill cover as necessary to route non-impacted, uncontaminated storm water (storm water that has not contacted the underlying waste materials) off of Areas 1 and 2 onto the adjacent areas of the site or into off-site storm water drainage systems.

The cover system under the ROD-selected remedy would consist of the following layers (from top to bottom):

- A one foot thick layer of soil capable of sustaining vegetative growth;

- A two feet thick infiltration layer of compacted low permeability clay soil with a coefficient of permeability of 1×10^{-5} cm/sec or less; and

- A two feet thick bio-intrusion/erosion protection layer consisting of well-graded rock or concrete/asphaltic concrete rubble consisting of pieces up to 8-inches in size.

Sampling would be performed to evaluate the presence and extent of radiologically-impacted soil that may still be present on the Buffer Zone/Crossroad Property. To the extent that soil containing radionuclides at levels greater than those which would allow for unrestricted use are present on these properties, this soil would be removed and placed into Area 1 or 2. Based on sampling performed during the RI prior to subsequent regrading and placement of gravel cover by the adjacent property occupant in these areas, it was estimated that approximately 7,000 bank cubic yards (bcy) of potentially impacted soil may be present on these properties.

The existing institutional controls on Areas 1 and 2 would be maintained and additional institutional controls would be implemented as needed as part of the ROD-selected remedy. These institutional controls are necessary to insure that residential uses do not occur at the landfill and that commercial and industrial uses or ancillary uses that could result in unacceptable risks do not occur on Areas 1 and 2. In addition to prohibiting land uses that could result in potential exposure to waste materials or contaminants in the landfill, these institutional controls would also limit or prohibit land uses or activities that could disrupt the integrity of the new landfill cover or other components of the remedy. Landfill gas and groundwater monitoring as described in Sections 5.2.1.6 and 5.2.1.9, respectively, are also included as part of the ROD-selected remedy. Finally, the ROD-selected remedy calls for long-term inspections and maintenance activities of the engineered components and enforcement of the institutional controls.

6.2.1.1 Overall Protection of Human Health and the Environment

The ROD-selected remedy would protect human health and the environment through the use of engineered containment, long-term surveillance and maintenance, and institutional controls on land and resource use. The landfill cover would reduce potential risks from exposure to external gamma radiation or radon gas emissions, and eliminate potential risks associated with inhalation or ingestion of contaminated soils or other wastes, dermal contact with contaminated soils or other wastes, and wind dispersal of fugitive dust.

The cover would prevent users of the site from exposure to external gamma radiation primarily through shielding and increasing the distance to the radiation source (i.e., the cover materials would be of sufficient thickness and design to attenuate gamma radiation). For the types of clay soils used for infiltration protection in the construction of final covers, the depth of cover required for gamma radiation shielding is on the order of two feet (60 cm). The total thickness of the final cover required by the ROD-selected remedy would be a minimum of five feet (two feet of biointrusion rock/rubble, two feet of clay soil, and one foot of vegetative soil).

The cover materials would also be of sufficient thickness and design to retard or divert the vertical migration of radon. The landfill cover acts as a diffusion barrier allowing time for the decay of the relatively short-lived radon-222 gas (the half-life for radon-222 is 3.8 days) during migration through the pore spaces of the cover soil. Radon is continually produced from the radium source, but need only be detained in the cover materials for a few days to decay to its non-radiological progeny, thereby eliminating any significant radon emissions. The radon may also be intentionally vented or diverted to a gas control system. Calculations presented in Appendix F indicate that a clay layer thickness of two feet, combined with a two foot thick rock/rubble layer and a one foot thick vegetative layer would provide sufficient radon attenuation to meet the radon emissions ARAR of 20 picocuries per square meter per second ($pCi/m^2/s$). As discussed in Appendix F, these calculations were based on the increased levels of radium expected to be present at the site after 1,000 years of in-growth of radium from decay of thorium.

The potential for direct contact with waste materials is eliminated by placing a barrier (multi-layer landfill cover including biointrusion layer) between the waste materials and any potential receptors. Likewise, there is no potential for the generation of fugitive dust from the waste material as long as the barrier remains in place.

The multi-layer cover would also be designed to minimize infiltration of surface water through the wastes and thereby reduce the potential for leaching of contaminants to the groundwater. This is typically accomplished by promoting surface drainage and using a hydraulic barrier (e.g., a compacted clay layer meeting the specified permeability requirements). These are all conventional functions for landfill cover technologies and are widely used by government and industry to address similar circumstances where contaminated materials must be encapsulated to protect against future potential contact. Long-term maintenance of the cover and monitoring of the groundwater would ensure that the ROD-selected remedy functions as intended.

Environmental monitoring of groundwater quality would be performed to ensure that groundwater quality at the perimeter of the site meets state standards or other ARARs or risk-based levels. Monitoring of subsurface occurrences of landfill gas and radon and, if necessary, implementation of contingent landfill gas extraction along the perimeter of Areas 1 and 2 would be performed to ensure that gas migration above regulatory thresholds does not occur beyond the site perimeter.

Institutional controls would ensure that land and resource uses are consistent with permanent waste disposal. The use restrictions would reflect the presence of radionuclides at the site.

6.2.1.2 Compliance with ARARs

The ROD-selected remedy would comply with all ARARs as identified below.

6.2.1.2.1 Missouri Solid Waste Rules for Sanitary Landfills

Under RCRA Subtitle D, a state may promulgate more stringent regulations for landfills in that state, provided that EPA approves of the state's regulations. Missouri is an approved state for regulating landfills. Missouri promulgated its solid waste regulations in 1997 (22 Mo Reg 1008, June 2, 1997) and they became effective July 1, 1997. The Missouri Solid Waste Rules establish closure and post-closure requirements for existing sanitary landfills that close after October 9, 1991. Although not applicable to the closure of Areas 1 and 2, the Missouri Solid Waste requirements described below are considered relevant and appropriate and therefore would be met.

The MDNR regulations require cover to be applied to minimize fire hazards, infiltration of precipitation, odors and blowing litter, control gas venting and vectors, discourage scavenging, and provide a pleasing appearance (10 CSR 80-3.010(17)(A)). Final cover shall consist of at least two feet of compacted clay with a coefficient of permeability of 1×10^{-5} cm/sec or less overlaid by at least one foot of soil capable of sustaining vegetative growth (10 CSR 80-3.010(17)(C)(4)). Placement of soil cover addresses the requirements for minimization of fire hazards, odors, blowing litter, control of gas venting, and scavenging. Placement of clay meeting the permeability requirement addresses the requirement for minimization of infiltration of precipitation. Placement of soil and establishment of a vegetative cover meet the requirement of providing for a pleasing appearance. The final cover prevents users of the site from coming into contact with the waste material.

The MDNR landfill regulations also contain minimum and maximum slope requirements. Specifically, these regulations require the final slope of the top of the sanitary landfill shall have a minimum slope of 5% (10 CSR 80-3.010(17)(B)(7)). MDNR regulations also require that the maximum slopes be less than 25% unless it has been demonstrated in a detailed slope stability analysis that steeper slopes can be constructed and maintained throughout the entire operational life and post-closure period of the landfill. Even with such a demonstration, no active, intermediate, or final slope shall exceed 33.33%.

The objective of these requirements is to promote maximum runoff without excessive erosion and to account for potential differential settlement. Because landfilling of Areas 1 and 2 was completed approximately 30 years ago, most compaction of the refuse has taken place and differential settlement is no longer a significant concern. The 5% minimum sloping requirement is greater than necessary and may not be optimal in this case. Therefore, the 5% minimum sloping requirement is not considered appropriate. Sloping specifications would be designed to promote drainage and reduce infiltration of precipitation while minimizing the potential for erosion. It is anticipated that a 2% slope would be sufficient to meet drainage requirements while resulting in a lower potential for erosion. This approach should increase the life of the cover and overall longevity of the remedy compared to a steeper slope, which would be subject to increased erosion potential. The maximum sloping requirements would be met.

The requirements for decomposition gas monitoring and control in 10 CSR 80-3.010(14) are considered relevant and appropriate and would be met. The number and locations of gas monitoring points and the frequency of measurement would be established in RD submittals to be approved by EPA and the state. In the event landfill gas is detected at the landfill boundaries above the regulatory thresholds, appropriate gas controls would be implemented.

The requirements for a groundwater monitoring program in 10 CSR 80-3.010(11) are considered relevant and appropriate. The monitoring program must be capable of monitoring any potential impact of the landfill on underlying groundwater. The monitoring program would enable the regulatory agencies to evaluate the need for any additional requirements.

The substantive MDNR landfill requirements for post-closure care and corrective action found in 10 CSR 80-2.030 are also considered relevant and appropriate. These provisions provide a useful framework for OM&M and corrective action plans. These substantive provisions require post-closure plans describing the necessary maintenance and monitoring activities and schedules. These requirements would be used in addition to EPA CERCLA policy and guidance on developing robust OM&M and long-term monitoring plans.

6.2.1.2.2 Environmental Protection Standards for Uranium and Thorium Mill Tailings

The Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings (40 CFR 192 Subpart B) provide standards for land and buildings contaminated with residual radioactive materials from inactive uranium processing sites. The standards were developed pursuant to the Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA) (42 U.S.C. §§ 2022, 2113, 2114, 7901, 7911-7925, 7941 and 7942). Although not applicable, some of the regulations that provide for closure performance standards are considered relevant and appropriate to the ROD-selected remedy for OU-1. Specifically, to address longevity considerations, 40 CFR 192.02(d) requires that each disposal site "shall be designed and stabilized in a manner that minimizes the need for future maintenance." For UMTRCA tailings piles, the longevity consideration has often been addressed through placement of a rock armoring layer over the upper surface of the tailings pile capping system. To address longevity considerations for OU-1 and long-term hazards relating to disruption of the disposal site by natural phenomena, the ROD-selected remedy would use a hybridized cover system which incorporates a rock or concrete rubble layer under the clay soil layer to restrict biointrusion and erosion into the underlying landfilled materials.

Three chemical-specific standards of the UMTRCA regulations are considered relevant and appropriate to OU-1. First, UMTRCA standards state that control of residual radioactive materials and their listed constituents shall be designed to provide reasonable assurance that the release of radon-222 from residual radioactive materials to the atmosphere would not exceed an average release rate of 20 pCi/m^2s (40 C.F.R. §192.02 (b)(1)). For inactive sites, this standard can be satisfied alternatively by providing reasonable assurance that releases of radon-222 from residual radioactive materials to the atmosphere would not increase the annual average concentration of radon-222 in air at or above any location outside the disposal site by more than one-half of a picocurie per liter (0.5 pCi/L) (40 CFR §192.02(b)(2)). The ROD-selected remedy would meet the radon emission standard promulgated under UMTRCA through placement of clean fill material and construction of the landfill cover. The landfill cover system would be designed appropriately to take into consideration future radon generation resulting from increased radium levels owing to the decay of thorium over time.

Second, the UMTRCA regulations establish concentration limits for groundwater protection. Based on the presence of radioactive materials in OU-1, the groundwater protection standards (40 CFR 192.02(c)(3) and (4)) and monitoring requirements (40 CFR 192.03) are relevant and appropriate and must be met.

Third, the soil standards found in the UMTRCA regulations are relevant and appropriate requirements for the cleanup of any radiologically impacted soil that may be present outside of Areas 1 and 2 (e.g., on the Buffer Zone/Crossroad Property). These soil standards address the cleanup of soil contaminated with radium. The standards are:

> The concentration of Ra-226 (or Ra-228) in land averaged over any area of 100 square meters shall not exceed the background level by more than:
>
> 1. 5 pCi/g, averaged over the first 15 centimeters of soil below the surface; and
> 2. 15 pCi/g, averaged over 15 centimeter-thick layers of soil more than 15 centimeters below the surface.

Guidance on the use of these UMTRCA soil standards for CERCLA site cleanups is contained in "Use of Soil Cleanup Criteria in 40 CFR Part 192 as Remediation Goals for CERCLA Sites" (OSWER Directive 9200.4-25, February 12, 1998).

6.2.1.2.3 National Emissions Standards for Hazardous Air Pollutants (NESHAPs)

The NESHAPs include standards for radon-222 emissions to ambient air from designated uranium mill tailings piles that are no longer operational. Specifically, radon-222 emissions from inactive uranium mill tailings piles should not exceed 20 pCi/m^2s (40 CFR 61 Subpart T). OU-1 is not a designated uranium mill tailings site and this requirement is not applicable. However, a portion of the waste materials in OU-1 do emit radon; therefore, the radon-222 NESHAP is considered to be relevant and appropriate. The ROD-selected remedy would ensure the radon emission standard is met through placement of clean fill material and construction of the landfill cover. The RD evaluation and design would account for future radon generation resulting from increased radium levels owing to the decay of thorium over time.

6.2.1.2.4 Clean Water Act

The Clean Water Act sets standards for ambient water quality and incorporates chemical-specific standards including federal water quality criteria and state water quality standards. The substantive requirements for storm water runoff are relevant and appropriate.

6.2.1.2.5 Safe Drinking Water Act

40 CFR part 141 establishes primary drinking water regulations including maximum contaminant levels (MCLs) pursuant to section 1412 of the Public Health Service Act, as amended by the Safe Drinking Water Act (Public Law 93-523), and related regulations applicable to public water systems. These MCLs apply to public drinking water systems. Missouri regulations (10 CSR 60-4.010 et seq.) also establish MCLs for public drinking water systems (Table 5). Consistent with the NCP, MCLs and non-zero Maximum Contaminant Level Goals (MCLGs) are considered relevant and appropriate to all potentially usable groundwater.

6.2.1.2.6 Missouri Radiation Regulations for Protection Against Ionizing Radiation

The Missouri Radiation Regulations for Protection Against Ionizing Radiation (19 CSR 20-10.040) contain chemical-specific standards that address radiation protection. These regulations define maximum permissible exposure limits for specific radionuclides in air at levels above background inside and outside of controlled areas. These requirements are considered applicable during implementation of any remedial action. Specifically, these regulations would require perimeter air monitoring during implementation of any remedy that may be undertaken at OU-1. Site health and safety plans will address worker protection consistent with these requirements.

6.2.1.2.7 Missouri Well Construction Code

MDNR has promulgated regulations pertaining to the location and construction of water wells. The Well Construction Code (10 CSR 23-3.010) prohibits the placement of a well within 300 feet of a landfill. These rules should provide protection against the placement of wells on or near the site. The regulations on monitoring well construction (10 CSR 23-4) would apply to the construction of new or replacement monitoring wells.

6.2.1.2.8 Missouri Storm Water Regulations

The Missouri regulations governing storm water management at construction sites are set out in 10 CSR 20-6.200 (Table 7). A disturbance of greater than one acre or the creation of a storm water point source during construction of the remedy would trigger these requirements.

6.2.1.3 Long-Term Effectiveness and Permanence

This criteria refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time. The ROD-selected remedy provides engineered containment in conjunction with long-term monitoring, maintenance, and land use controls designed to be effective over the long term. Because radiologically-impacted materials would remain on-site under this remedy, potential risks associated with the radiologically-impacted materials would remain. Construction of an engineered cover for Areas 1 and 2 would reduce the potential for exposure from the following potential pathways: external gamma exposure; inhalation of radon gas or dust containing radionuclides or other constituents; dermal contact with impacted materials; and incidental ingestion of soil containing radionuclides or other chemicals. Maintaining the integrity of the engineered covers would protect the underlying RIM from erosion and intrusion. An intact cover provides a reliable method to control exposure of the RIM to surface receptors and mitigates potential migration of the covered materials.

Long-term site management plans and institutional controls would be robust and durable. Long-term groundwater monitoring is effective in verifying the remedy is performing as required and groundwater is protected. While not anticipated, even with the loss of institutional controls and long-term management, the landfill cover would still act to passively prevent potential contaminant migration and human exposures for an indefinite period.

By moving the contamination from the Buffer Zone/Crossroad Property to the landfill, the ROD-selected remedy provides long-term effectiveness and permanence relative to the Buffer Zone/Crossroad Property.

6.2.1.3.1 Magnitude of Residual Risks

The calculated life time risks following the exposure scenarios in the risk assessment from Areas 1 and 2 after the ROD-selected remedy has been implemented (Appendix H) are as follows:

- Area 1: $<1 \times 10^{-7}$ for year 1 and 3.1×10^{-7} for year 1,000; and
- Area 2: 2.0×10^{-7} for year 1 and 1.3×10^{-6} for year 1,000.

These calculated risks are attributable to gamma radiation and radon emissions from the RIM which remains at the site after implementation of the containment ROD-selected remedy. Given that the RIM would be capped and thus rendered inaccessible, along with the use of access restrictions and institutional controls, direct contact with RIM and exposure from ingestion, inhalation, or dermal contact with the waste materials is not expected to occur. These are the primary exposure pathways for any non-radiological chemicals of concern (COCs) that may also be present in Areas 1 and 2. Because no complete exposure pathway would exist for such materials after completion of the cap construction, the landfill waste materials would not be expected to produce non-carcinogenic effects or carcinogenic risks.

The calculated risk levels are below or within (for year 1,000 at Area 2) EPA's target risk range of 1×10^{-6} to 1×10^{-4}, and the magnitude of the radiological carcinogenic risk from capped RIM in these two remediated areas is acceptable. These risks do not specifically include potential exposures from non-radiological landfill waste after construction is complete; however, those wastes would also be covered by a cap which would prevent exposures. Additional information regarding the risk assessment calculations is presented in Appendix H.

After soils containing radionuclide concentration above the cleanup levels are removed from the Buffer Zone/Crossroad Property, residual risks posed by the remaining radionuclide-impacted soil on these properties, if any, should be indistinguishable from variations in background levels.

6.2.1.3.2 Adequacy and Reliability of Controls

The conceptual design of the engineered cover has been developed to provide protection against all potential exposure pathways. Cover construction is based on and relies upon the use of natural materials would be expected to remain in place and meet performance criteria for at least 200 years as required by the UMTRCA ARARs. Post-closure inspection and maintenance of the cover as required by the solid waste regulation ARARs and as routinely performed at thousands of landfills across the country also would ensure long-term reliability of the landfill cover.

Covenant restrictions (Appendix A) have been recorded by each of the West Lake landfill site property owners against their respective parcels and the entire West Lake Landfill (including Areas 1 and 2) prohibiting residential and groundwater use. Construction work, as well as commercial and industrial uses, is precluded on Areas 1 and 2 by a Supplemental Declaration of Covenants and Restrictions recorded by Rock Road Industries, Inc., prohibiting the placement of buildings and restricting the installation of underground utilities, pipes and/or excavation upon its property. The recording information for the restrictive covenants precluding residential use is Book 11208 pages 2499, 2507, and 2514 in the Recorder of Deeds Office for St. Louis County, Missouri. The recording information for the restrictive covenant prohibiting the placement of buildings and restricting the installation of underground utilities, pipes and/or excavation is Book 11427 page 1633 in the Recorder of Deeds Office for St. Louis County, Missouri. Covenant restrictions cannot be terminated without the written approval of the then-owners, MDNR and EPA.

The current covenants and restrictions for Areas 1 and 2 would be adequate to provide protection to human health. Permanence of these restrictions is assumed to be adequate for the foreseeable future as both EPA and MDNR approval are required to remove or modify the restrictions. The adequacy of the restrictions would be continually evaluated during the statutory-required Five Year Reviews.

6.2.1.4 Reduction of Toxicity, Mobility or Volume through Treatment

Reduction of toxicity, mobility, or volume through treatment refers to the anticipated performance of the treatment technologies that may be included as part of a remedy. Overall, the ROD-selected remedy is a containment remedy and therefore generally would not result in any reduction in the toxicity, mobility, or volume of the waste material through treatment technology.

As discussed in Section 4, radionuclides are naturally occurring elements which cannot be neutralized or destroyed by treatment. Occurrences of radionuclides within Areas 1 and 2 are dispersed within soil material that is further dispersed throughout the overall, heterogeneous matrix of municipal refuse, construction and demolition debris, and other non-impacted soil materials. Consequently, ex situ treatment techniques are considered impracticable. In addition, the heterogeneous nature of the solid waste materials and the dispersed nature of the radionuclide occurrences within the overall solid waste matrix make in situ treatment techniques impracticable. The ROD-selected remedy for the Buffer Zone/Crossroad Property also would not reduce toxicity, mobility, or volume through treatment technologies.

In the event that hazardous wastes are encountered during implementation of the remedy, such materials would be separated from the other solid wastes and subjected to waste profiling to determine the appropriate treatment and disposal requirements. Suspect material would initially be stored on-site while test results were obtained to verify the presence, if any, and type of hazardous wastes encountered. Storage would be conducted in accordance with RCRA and State hazardous waste regulation requirements for storage containers or units and limitations on the duration of storage (90 days if the amount of hazardous waste exceeds 2,200 lb in a month or 270 days if the amount is less than 2,200 lb a month [Note: these storage limitations assume that the off-site facility is located more than 200 miles from the site. This distance is assumed based on the expectation that any identified hazardous waste would also be rad-contaminated and therefore shipped to one of the three off-site disposal facilities identified in Section 4.3.2.2.2.]). Procedures to be used for testing, storage, management, treatment and disposal of any hazardous wastes or mixed wastes that could be encountered during implementation of the alternative would be documented as part of the RD activities.

To the extent that hazardous wastes or mixed wastes are encountered, they would be shipped off-site and would be treated at the disposal facility in accordance with the hazardous waste regulations (e.g., EPA's Land Disposal Restrictions (LDR) program and Universal Treatment Standards (UTS)) and in accordance with the receiving facility's permits and standard operating procedures. Examples of treatment processes include stabilization of soil and micro- or macroencapsulation of debris. To the extent that treatment of the hazardous waste or mixed waste would be required for off-site disposal, stabilization or encapsulation treatment would result in a reduction of the mobility of the hazardous waste or the radiologically-impacted components of the mixed waste. Toxicity and volume would not be reduced by these technologies but may be reduced by other technologies potentially applicable to hazardous wastes that do not contain RIM such as incineration of drummed solvents, if such wastes were encountered during implementation of the remedial action at the site.

Depending on the amount of hazardous waste or mixed waste, the material would be shipped to an off-site disposal facility by either rail or truck. If the volume of material is significant enough to support the costs associated with establishing a truck-to-rail transfer facility, shipment would be conducted by rail because shipping by rail would be less expensive than shipping by truck. If only small volumes are encountered, the material would be shipped directly by truck from the West Lake Landfill site to the off-site disposal facility.

6.2.1.5 Short-Term Effectiveness

During the construction period, the ROD-selected remedy would result in additional local truck traffic and pose some physical hazards for workers. The ROD-selected remedy for the Buffer Zone/Crossroad Property would be effective over the near term and due to the relatively small magnitude of effort involved, would result in no significant adverse impacts.

Potential short-term risks to the community and workers would be addressed through monitoring and dust control and other mitigative measures to assess and limit worker and community exposures during construction. Adherence to OSHA practices would be necessary to limit worker exposures and accidents.

The ROD-selected remedy would entail limited excavation, handling, loading and transport of RIM at the site associated with recontouring to achieve slope requirements, and therefore would pose some risks to on-site workers. The number of truck trips required to import construction materials to the landfill site would also result in additional physical risks to the community and/or workers due to the potential for traffic accidents.

6.2.1.5.1 Protectiveness of the Community During Remedial Actions

Effective dust control measures would be implemented from the start of the project. An extensive environmental monitoring system would be installed that would alert the on-site personnel of any releases that could impact the area outside the work location.

The risk assessment (Appendix H) includes an estimate of the projected incidence of transportation accidents associated with each alternative. For the ROD-selected remedy, the projected incidence of transportation accidents associated with importing of materials for construction of the multi-layer landfill cover is 0.62, meaning that there would be a 62% probability of one traffic accident occurring during implementation of the remedy. To address this risk, traffic control for the incoming shipment of the materials would be implemented from the project start. All drivers would be cautioned about the normal congestion existing on St. Charles Rock Road. Routing of trucks, safety briefings, and adherence to traffic laws would reduce but not necessarily eliminate the potential for accidents. To the extent possible, shipments would be scheduled to avoid the highest traffic times.

Vehicle operations for importing the materials to be used to construct the multilayer landfill cover and during landfill regrading and cover construction are projected to emit 8,350 tons of carbon dioxide to the atmosphere (Appendix I).

As Areas 1 and 2 are regraded during cap installation, the nuisance attraction to and congregation by birds at and above the affected areas could be problematic unless effectively controlled. Concerns include odor management, vector control, and the potential for increased bird strikes to aircraft approaching and departing from the Lambert-St. Louis International Airport. Excavation best management practices including immediate redeposition of cut material, limiting the area of excavation, and application of daily soil cover are included in the planned remedy, and, if necessary, mitigation measures such as tarps, visual and auditory frightening devices, or wire or monofilament grids strung over exposed refuse to prevent bird access, could be implemented to minimize bird attraction to and congregation at and above the disturbed areas.

As Areas 1 and 2 are regraded during cap installation, stormwater controls would be implemented in accordance with Missouri Storm Water regulations to protect the community.

6.2.1.5.2 Protectiveness of Workers During Remedial Actions

The risk assessment (Appendix H) presents an evaluation of potential risks to site-workers that may occur for each alternative. These include risks from industrial accidents, exposure to carcinogenic substances, and projected radiation exposures. For the ROD-selected remedy, the projected incidence of industrial accidents is 4.7 over the life of the project. The projected carcinogenic risk to the maximally exposed individual is 7.2×10^{-5} and the projected radiation dose to a remediation worker is 50 millirems/year (mrem/yr) [Appendix H)].

A complete and comprehensive Health and Safety Program would form the core of the worker protectiveness. The program would direct protective actions of all personnel on the site. All workers at the site would be trained to handle both radioactive materials (Rad Worker Training) and hazardous materials (HAZMAT Training). Protective clothing and equipment and constant monitoring for toxic hazards and radioactive emissions would be mandated. All workers on the project would be required to adhere to the project safety requirements, including any sub-contractors or vendors who are at the site for an extended period of time.

6.2.1.5.3 Environmental Impacts

No measurable long-term impacts to plants or animals in surrounding ecosystems are expected from implementation of the ROD-selected remedy. A screening-level ecological assessment was performed as part of the original RI/FS. The results of that assessment were presented in Section

7 of the BRA. No wetlands are located within the on-site construction footprint of this alternative and no endangered species were identified.

The activities to be conducted during landfill regrading and cover construction would affect wildlife and plant life on Areas 1 and 2 and possibly adjacent portions of the landfill. This disruption would be temporary and would last for the period of active construction. Disturbance of the landfill surface would destroy those portions of the habitats that currently exist on the surface of Areas 1 and 2, forcing wildlife to migrate to other areas. Vegetative cover would be placed on the site as a part of the final cover, and the landfill would be allowed to return to an early-stage field ecosystem with periodic mowing and maintenance.

6.2.1.5.4 Ability to Monitor Effectiveness

Measurement of gamma radiation and radon flux through the newly constructed landfill cover would be conducted on Areas 1 and 2 after construction is complete. Regular monitoring of groundwater quality would be performed at appropriate locations around Areas 1 and 2. Measurements of subsurface occurrences of landfill gas and radon levels would be conducted along the property boundaries adjacent to Areas 1 and 2 to verify that off-site gas migration above regulatory thresholds does not occur.

6.2.1.5.5 Time Until Remedial Action Objectives are Achieved

The RAO of preventing direct contact with landfill contents and exposure to radiation associated with anticipated future uses of the West Lake Landfill and adjacent areas would be met immediately upon implementation of an amendment to the land use covenants. The RAOs of: (1) minimizing infiltration and any resulting contaminant leaching to groundwater; (2) controlling surface water runoff and erosion and decreasing the potential for erosion and subsequent transport of RIM; and (3) controlling radon and landfill gas emissions from Areas 1 and 2 would be met once construction of the new landfill cover over Areas 1 and 2 is completed. Construction completion is estimated within approximately 1.7 years of approval of the RD. Preparation of the RD should be completed within approximately one year of authorization to proceed with the RD and therefore, the remedial action objectives should be achieved within approximately 2.7 years of authorization to begin (Appendix J-1). For a fiscally-constrained approach that limits annual expenditures to $10 million, the overall duration for completion of the ROD-selected remedy would increase to 5.1 years including preparation and approval of the RD.

6.2.1.6 Implementability

Design and construction of a landfill cover with subsequent monitoring and maintenance as specified for the ROD-selected remedy, are not expected to pose any significant implementability challenges. Materials and services necessary for the regrading and construction of the final landfill covers over Areas 1 and 2 should be available and the technologies have been proven through application at other landfills. Monitoring of the cover surfaces, landfill gas, groundwater, and surface water are proven methods for demonstrating the long-term effectiveness of landfill covers and are easily implemented.

6.2.1.6.1 Ability to Construct and Operate the Technology

Regrading of existing materials along with installation of a starter berm and/or placement of additional soil to achieve minimum slopes of 2%, to achieve minimum and maximum slopes of 2% and 25% respectively, and to construct an upgraded landfill cover over Areas 1 and 2 is technically feasible. Regrading of existing landfills through placement of additional soil or regrading of existing materials is a common remedial action that has been implemented at innumerable other CERCLA landfill sites as well as at RCRA corrective action sites.

Because of the configuration and location of Areas 1 and 2 within the overall existing larger landfill footprint and the existing relatively steep side slopes on portions of the northern and eastern edges of Area 1 and the northern and western edges of Area 2, achieving the required maximum slope grades along the entire margin of Areas 1 and 2 cannot be achieved by placement of additional fill material alone. The toe of the landfill in the northern portion of Area 2 is located near or coincident with the property boundary/fence line, and therefore placement of additional soil or fill material is not an option to reduce the slope angle of the landfill berm in this area. Similar grading constraints exist for portions of the landfill in Area 1 due to the presence of the transfer station access road located along the northern toe of the landfill berm in Area 1, and the presence of the property/fence line along the eastern toe of the landfill. An existing drainage ditch located along the St. Charles Rock Road immediately outside of the fence line would also pose grading restraints around Area 1. For these areas, recontouring the waste materials is a viable option to achieve the proper slope for construction of the cover. Recountouring can be greatly reduced through use of a starter berm, as discussed elsewhere in this SFS report.

Bird nuisance mitigation measures such as best management practices (including, but not limited to, selective excavation, daily soil cover, and tarping of exposed wastes), visual and auditory frightening devices, and use of wire or monofilament grids strung over exposed refuse to prevent bird access, are demonstrated technologies that can be readily constructed and operated as part of the ROD-selected remedy.

Effective storm water controls can be readily implemented using conventional construction equipment, materials and best management practices.

6.2.1.6.2 Reliability of the Technology

Landfill cover systems that are designed and constructed consistent with State and Federal regulations and with post-closure care implemented in accordance with current regulatory guidance have been demonstrated to be reliable at: 1) minimizing percolation and infiltration of precipitation; 2) minimizing leachate generation; 3) minimizing impacts to groundwater quality; 4) minimizing impacts to surface water quality and quantity; 5) minimizing erosion of cover material; and 6) minimizing uncontrolled releases of landfill gas. In addition, security systems would be implemented or enhanced, including gating, fencing, and/or routine surveillance. These are reliable mechanisms to prevent unauthorized access to the site.

Bird nuisance mitigation measures such as best management practices (including, but not limited to, selective excavation, daily soil cover, and tarps), visual and auditory frightening devices, and wire or monofilament grids strung over exposed refuse to prevent bird access, are demonstrated reliable technologies. While visual or auditory frightening devices can be effective in the short-term, birds tend to habituate to deterrents over time, causing the deterrent to lose effectiveness. Frequent relocation of predator birds and predator effigies and/or altering the timing of auditory activation may help, but long-term effectiveness is not assured.

Storm water controls are also well-established technologies that have been implemented and proven reliable at most landfill sites.

6.2.1.6.3 Ease of Undertaking Additional Remedial Actions, if Necessary

The only potential additional remedial actions that may need to be taken for the ROD-selected remedy would be maintenance activities to sustain the cover system, repair areas of differential settlement or erosion, or possible implementation of a contingent landfill gas control system. Regrading and contouring the existing waste materials to achieve final grades would require re-compaction of the regraded waste materials in order to minimize the potential for compaction or differential settlement over time that could affect the integrity of the landfill cover. Placement of additional fill material to achieve the final slope requirements and for construction of the landfill cover may result in differential compaction of the waste materials dependent upon the nature, age and amount of prior degradation of the waste materials. Runoff of stormwater can result in formation of erosional rills. Depressions caused by differential settlement of the wastes or erosional features can easily be (and commonly are) addressed at landfill sites through placement of additional soil material to fill such features.

In the event that monitoring of subsurface landfill gas and radon detects the presence of gas levels above regulatory thresholds along the perimeter of the landfill, a landfill gas control system could be implemented as an additional remedial action. Implementation of a contingent landfill gas control system would entail drilling and installation of gas extraction wells, installation of conveyance piping, installation and operation of landfill gas extraction blowers and a landfill gas treatment (flare) system, and/or possible use of a carbon adsorption system to remove radon from the extracted gas stream. Installation of a contingent gas system can easily be performed as a future action. Any disruption to the final landfill cover resulting from the installation of a contingent gas extraction system would need to be repaired. Such activities are commonly and routinely undertaken at solid waste disposal sites.

Long-term monitoring and maintenance of the landfill covers at other Superfund sites and at non-Superfund site solid waste landfills is typically required to assess whether differential settlement or surface erosion of the cover has occurred over time. Long-term maintenance including cover inspection and repair would be part of this alternative. Cover repair, if necessary, would be straightforward, primarily entailing placement of additional fill, regrading, and revegetation of the repaired area.

Bird nuisance mitigation measures such as best management practices (including, but not limited to, selective excavation, daily soil cover, and tarps), visual and auditory frightening devices, and wire or monofilament grids strung over exposed refuse to prevent bird access, are demonstrated to be readily implementable at landfill sites.

Storm water management measures other than those using conventional earth-moving equipment, piping, pumps, liners, filtration and carbon adsorption water treatment equipment, rip-rap, and pond outlet structures are not anticipated.

6.2.1.6.4 Ability to Monitor Effectiveness of Remedy

One purpose of installing a landfill cover would be to prevent direct contact with the waste materials. The integrity of a landfill cover relative to protection from direct contact can easily be monitored through visual inspection to identify the presence of exposed waste or the existence of erosional features that could impact the landfill cover.

Another long-term goal of constructing new landfill covers over the surfaces of Areas 1 and 2 would be to minimize percolation and infiltration of precipitation with subsequent leachate generation and potential impacts to groundwater. Visual inspection of the cover integrity relative to the potential for erosion and infiltration impacts to the landfill cover is easily performed. Groundwater monitoring to detect the presence of, or verify the absence of, impacts to groundwater is a standard technology that also can easily be performed at the site.

Demonstrating the effectiveness of the cover systems would be accomplished by implementing ROD-selected remedy required monitoring programs for the cover surface, landfill gas system, groundwater, and surface water monitoring programs as previously described in Section 5.2.1. These types of monitoring programs are proven at demonstrating cover effectiveness and are easily implemented.

6.2.1.6.5 Ability to Obtain Approvals from Other Agencies

No approvals of other agencies would be required to implement the ROD-selected remedy. The potential for increased bird-strikes to aircraft approaching and departing the Lambert-St. Louis International Airport is a major concern of the Federal Aviation Administration (FAA) and the St. Louis Airport Authority (STLAA or Airport Authority). Whether best management practices and proposed bird nuisance mitigation measures would be effective will be of interest to the FAA and the Airport Authority.

6.2.1.6.6 Coordination with Other Agencies

Coordination with other agencies would not be necessary to implement the ROD-selected remedy.

Although they would not be considered “agencies,” coordination with the landfill owner and operator; owners of the various parcels that comprise the West Lake Landfill property; and the concrete plant, asphalt batch plant, and trucking company tenants would be required during regrading and installation of an upgraded landfill cover under the ROD-selected remedy. Coordination would be necessary because:

- Access to operations conducted on other portions the site would need to be maintained;
- Areas 1 and 2 are within a larger existing landfill footprint and use of areas on the West Lake Landfill property outside of Areas 1 and 2 might be necessary to stockpile cover materials or otherwise to facilitate cover construction;
- Additional institutional controls could need to be implemented; and
- For the time period during construction when trucks would be delivering rock, clay, and soil materials for cover construction, the flow of vehicles associated with remedy construction would need to be coordinated with the traffic patterns of vehicles associated with the on-site solid waste transfer station and other site tenants.

The owners of all of the various parcels that comprise the West Lake Landfill are participating PRPs and given this, coordination with owners is expected to be feasible.

Coordination with other agencies including the Earth City Flood Control District and MSD and the Missouri Department of Transportation (MDOT), as well as the adjacent property owners and businesses (i.e., Crossroad property/AAA Trailer) would also be necessary to:

- Coordinate with the Earth City Flood Control District regarding the design of non-contact stormwater management and discharge facilities both during and after completion of construction;
- Coordinate with MSD regarding permitting and design of leachate/contact stormwater discharge during construction;
- Coordinate with MDOT for access to areas along St. Charles Rock Road (MO Route 180) and for any traffic control or ingress and egress additions along St. Charles Rock Road in the vicinity of the landfill entrance; and
- Obtaining legal and physical access from AAA Trailer for testing and, if necessary, remediation of the Crossroad Property and for implementation of remedial actions that may need to be performed along the property boundary (e.g. regrading, fencing, etc.).

6.2.1.6.7 Availability of Off-site Treatment, Storage and Disposal Services and Capacity

No off-site treatment, storage or disposal services are envisioned as part of the direct implementation of the ROD-selected remedy. Off-site treatment, storage and disposal may be required in the event that hazardous wastes or regulated asbestos-containing materials (RACM) are encountered during recontouring Areas 1 and 2. Off-site treatment and discharge of any leachate that may be encountered or stormwater that may contact RIM during the landfill recontouring activities could also be required. Initial discussions with MSD indicated that they are willing to accept such materials. Additionally, the three off-site disposal facilities identified for the "complete rad removal" with off-site disposal alternative are permitted to accept liquid, hazardous, and mixed wastes and asbestos, as well as to treat soil and/or debris that contain hazardous or mixed waste.

6.2.1.6.8 Availability of Necessary Equipment and Specialists

Personnel, equipment, and materials are readily available to implement the cover systems, institutional controls, and monitoring components of this alternative. The implementability and potential cost of this alternative will be influenced by the availability and location of clean fill materials and/or off-site soil borrow sources at the time this alternative is implemented. Potential vendors of rock, clay and soil were contacted during the development of the FS (EMSI, 2006), and during preparation of the Remedial Design Work Plan for the ROD-selected remedy (EMSI, 2008). These vendors indicated that rock, clay and clean fill material were readily available from sources located near the site at the time these inquiries were made. If these local sources of cover materials become exhausted prior to remedy implementation, cover materials would have to be obtained from suppliers at greater distances from the site; however all of the materials are expected to be available.

The necessary materials, equipment and personnel required for assessment and removal of radiologically-impacted soil that may be present at the Buffer Zone/Crossroad Property are also readily available.

6.2.1.6.9 Availability of Prospective Technologies

The ROD-selected remedy is based on proven, established, commonly used technologies. Use of prospective technologies is not anticipated to be part of the ROD-selected remedy.

6.2.1.7 Cost

Estimated capital, annual OM&M, and 30-year present worth costs for the ROD-selected remedy are included in Appendix K-2 and summarized on Table 9. The estimated costs to construct the ROD-selected remedy (i.e., design costs, capital costs, and costs for monitoring during the construction period) are $41.4 million. The estimated annual OM&M costs range from $42,000 to $414,000 per year depending upon the specific activities that occur each year (e.g., higher costs for years with additional environmental monitoring, years when landfill cover repairs may occur, and years when five year reviews are conducted). The present worth costs of the ROD-selected remedy are projected to be $43 million over a 30-year period based on the OMB discounted rate of 2.3%. The total non-discounted costs for the ROD-selected remedy over 30 years are projected to be $45 million. The cost estimates provided in this SFS are feasibility level cost estimates; that is they were developed to a level of accuracy such that the actual costs incurred to implement this alternative should fall within a range bounded by 50% above and 30% below these estimates.

If a fiscally-constrained approach was employed which limited annual expenditures to $10 million, the total costs for the ROD-selected remedy would increase to $49 million owing to the additional costs associated with the overall increased duration of the project. The present worth costs for the ROD-selected remedy would increase to $46 million over 30 years.

Given the long-life of the radionuclides present at OU-1, the costs for the ROD-selected remedy were also evaluated for 200 and 1,000 year periods (without consideration of any constraints on annual expenditures). The total non-discounted and present worth costs of the ROD-selected remedy are projected to be $61.3 million and $45 million, respectively over a 200-year period. The total non-discounted and present worth costs of the ROD-selected remedy are projected to be $137 million and $45 million, respectively, over a 1,000-year period.

For purposes of demonstrating the extent to which shipping of mixed waste could influence costs, it was assumed that mixed waste would represent one percent of the total mass of the relocation volume for the ROD-selected remedy. The added costs for handling, sampling/analysis, shipping, treating, and disposing of mixed waste under the ROD-selected remedy are estimated to range from $0.6 to 2.3 million (Appendix K-5). The range of costs primarily results from variations in the fees charged by the off-site disposal facilities and uncertainties associated with the nature of such wastes and the required method of treatment. If the volume of mixed waste is higher than the one percent of total mass assumption, the added costs would be higher as well.

6.2.2 "Complete Rad Removal" with Off-site Disposal Alternative

This section presents the detailed analysis of the "complete rad removal" with off-site disposal alternative. As previously described in Section 5.3.3, this alternative consists of the following components:

- Excavation and stockpiling of overburden in OU-1 Areas 1 and 2 in order to access the RIM;

- Excavation of RIM from OU-1 Areas 1 and 2that contains radionuclides above levels that would allow for unrestricted use relative to the presence of radionuclides;

- Survey and identification of the presence and extent or radiologically-impacted soil on the Buffer Zone and Crossroad Property;

- Excavation of any soil from the Buffer Zone and/or Crossroad Property that contains radionuclides at levels greater than those that would allow for unrestricted use;

- Loading, transport, and disposal of the RIM and impacted soil at an off-site disposal facility;

- Regrading of the remaining solid waste materials within Areas 1 and 2 to meet the minimum (5%) and maximum (25%) slope criteria;

- Installation of a landfill cover meeting the Missouri closure and post-closure care requirements for sanitary landfills over Areas 1 and 2;

- Design, installation and maintenance of storm water runoff controls;

- Groundwater monitoring consistent with the requirements for sanitary landfills;

- Landfill gas monitoring and control, as necessary;

- Institutional controls to prevent land and resource uses that are inconsistent with a closed sanitary landfill site; and

- Long-term surveillance and maintenance of the landfill cover in Areas 1 and 2.

An estimated 335,500 bcy of RIM and impacted soils would be excavated for off-site disposal from Areas 1 and 2, and an additional approximately 7,000 bcy of impacted soil from the Buffer Zone/Crossroad Property would be excavated for off-site disposal under this alternative. Because the volume of material would increase upon excavation due to swelling, handling and loading for off-site transport, it is estimated that after applying an assumed swell factor of 1.5, approximately 510,000 loose cubic yards (lcy) would be transported off-site for disposal at a permitted disposal facility.

As indicated in Section 5.3.3, it is unknown whether extending a rail spur onto the site would be feasible. If feasible, loading RIM material directly onto railcars on site would reduce material handling steps and probably reduce transportation costs. Based on information provided by the turnkey off-site disposal facility representatives, transportation costs might be reduced as much as $35 per lcy of RIM if a rail spur of sufficient length could be extended onto the West Lake Landfill site; however this estimate does not take into account the costs of property acquisition, regulatory approval, or capital construction associated with an on-site rail spur so the true cost reduction, if any, is unknown. Preparation of an engineering feasibility evaluation and a conceptual design to potentially extend a rail spur onto the site is outside the scope of this SFS.

Therefore, for purposes of preparing a cost estimate for this alternative in this SFS, it was assumed that excavated RIM would be loaded into 35 cubic yard soft-sided shipping container bags and hauled via truck to a truck-to-rail transloading operation at a rail spur location within a 10-mile radius of the West Lake Landfill site, where the bags would be placed into gondola cars for shipment to one of the off-site disposal facilities described in Section 4.3.2.2.2.

For purposes of this SFS alone, it has been assumed that the RIM would be shipped for disposal at the U.S. Ecology, Inc. facility in Grandview, Idaho. U.S. Ecology provided the most complete information regarding transportation mechanisms and transportation and disposal costs. U.S. Ecology has prior experience with transport and disposal of radioactive materials from SLAPS and other DOE/FUSRAP sites (Latty Avenue and Denver Radium Site Operable Unit 8). Due to the limited number of facilities available to dispose of the RIM and the fact that waste acceptance has not yet been established for any of the facilities, unit costs provided by Energy*Solutions*, which can accept much higher levels of radionuclides, were also considered as part of the cost estimation effort.

Once all of the RIM material above levels which will allow for unrestricted use has been removed from each area, the remaining solid waste materials in Areas 1 and 2 would be regraded to meet the final closure standards for sanitary landfills and a final sanitary landfill cover would be constructed over Areas 1 and 2. This cover would not include the additional hybrid components included in the ROD-selected remedy to address the UMTRCA requirements, because the RIM above cleanup levels would have been removed under this alternative.

However, because solid wastes would still be present in Areas 1 and 2, this alternative includes installation and maintenance of storm water runon and runoff controls, groundwater and landfill gas monitoring, and institutional controls as described for the ROD-selected remedy. Environmental monitoring of groundwater quality would be performed to ensure that groundwater quality at the perimeter of the site met State standards or other ARARs or risk-based levels. Monitoring of subsurface occurrences of landfill gas and, if necessary, implementation of contingent landfill gas extraction along the perimeter of Areas 1 and 2 would be performed to ensure that migration landfill gas above regulatory thresholds does not occur beyond the site perimeter.

Institutional controls would ensure that land and resource uses are consistent with permanent waste disposal. The use restrictions under the “complete rad removal” with off-site disposal alternative would only reflect the presence of solid wastes because the radioactively-impacted material containing radionuclides activities greater than the levels that would allow for unrestricted use of the site would have been removed.

6.2.2.1 Overall Protection of Human Health and the Environment

Conditions at the site would be protective of human health and the environment after completion of construction of this alternative. This alternative would protect human health and the environment by limiting potential exposure to the site contaminants through the removal and off-site disposal of RIM and implementation of engineering methods and land use controls relative to the remaining solid wastes.

6.2.2.2 Compliance with ARARs

The "complete rad removal" with off-site disposal alternative would comply with the ARARS discussed below.

6.2.2.2.1 CERCLA Off-site Rule

Section 121(d)(3) of CERCLA (42 U.S.C.§ 9621(d)(3)) applies to any CERCLA response action involving the off-site transfer of any hazardous substance, pollutant or contaminant (CERCLA wastes). These principles are stated in the Off-Site Rule (OSR) set forth in the NCP at 40 CFR 300.440. The OSR requires that CERCLA wastes only be placed in a facility operating in compliance with RCRA or other applicable Federal or State requirements. The OSR prohibits the transfer of CERCLA wastes to a land disposal facility that is releasing contaminants into the environment, and requires that any releases from other waste management units at the disposal facility must be controlled.

The OSR establishes the criteria and procedures for determining whether facilities are acceptable for the receipt of CERCLA wastes from response actions authorized or funded under CERCLA. The OSR establishes compliance criteria and release criteria, and establishes a process for determining whether facilities are acceptable based on those criteria. The OSR also establishes procedures for notification of unacceptability, reconsideration of unacceptability determinations, and re-evaluation of unacceptability determinations.

EPA verifies the acceptability of off-site treatment, storage, and disposal facilities (TSDFs) on a frequent basis. Consequently, before any off-site shipment occurs, a verification of current acceptability (VCA) must be obtained from EPA certifying that the proposed receiving facility is operating in compliance with the requirements of CERCLA Section 121(d)(3) and 40 CFR 300.440. EPA (usually the EPA Regional Office) will determine the acceptability under this section of any facility selected for the treatment, storage, or disposal of CERCLA waste. EPA will determine if there are relevant releases or relevant violations at a facility prior to the facility's initial receipt of CERCLA waste. EPA typically makes such determinations every 60 days. The compliance status of an off-site disposal facility would need to be evaluated during RD and would need to be regularly evaluated and updated during remedy implementation.

6.2.2.2.2 Off-site Transportation Requirements

Transportation to an off-site disposal location would need to comply with both the substantive and administrative requirements of any regulations legally applicable to transportation of radiologically-contaminated materials. These would include U.S. Department of Transportation (DOT) regulations for transport of hazardous materials (49 CFR Parts 100 – 178), and specific regulations related to transport of radioactive materials (49 CFR Parts 171 – 180). These include regulations relative to hazardous materials communications, emergency response information, training requirements and security plans (49 CFR Part 172) which address special provisions, preparation and retention of shipping papers, packaging and container marking, emergency response, security and planning. The regulations contain specific requirements associated with shipment of radioactive materials (49 CFR 172.310, 172.436-440, and 172.556 for example). Other regulations (49 CFR Part 173) describe requirements for shipment and packaging that are applicable to shippers and again include specific requirements for shipment of radioactive materials. Regulations set forth in 49 CFR 174 address shipment by rail and include special handling requirements for radioactive materials (49 CFR 174.700). Required emergency response information is described in 49 CFR Subpart G (49 CFR 173.602). The NRC, through a Memorandum of Understanding with DOT, also has promulgated regulations relative to transport of radioactive materials (10 CFR Part 71).

Requirements established by common carriers including rail carriers relative to transport of waste materials or radioactive wastes would also be applicable to this alternative. Because the specific carriers that might be used to transport the wastes under the "complete rad removal" with off-site disposal alternative have not been and cannot be identified at this time, identification and evaluation of the carrier-specific requirements has not been performed.

Discussions with representatives of potential off-site disposal facilities indicate that most of the facilities would provide a turnkey service that includes transport of the RIM from the West Lake site and subsequent treatment and disposal. As such, the disposal company would be responsible for arranging for transport, preparation of waste/shipping manifests, testing of RIM materials after they are loaded into transportation vehicles/containers, securing of vehicles/containers, unloading of vehicles/containers, safety and emergency response plans, and all other aspects associated with transport of RIM from the West Lake site to an off-site disposal facility.

6.2.2.2.3 Waste Acceptance Criteria (WAC) for Off-site Disposal

WAC are established pursuant to the specific permit or license issued to each waste disposal facility, and consequently are different for each facility. Summaries of the WAC for each off-site disposal facility were presented in Section 3.2.3 of this SFS and would be complied with, as appropriate. Copies of the WAC provided by each of the facilities are contained in Appendix C.

6.2.2.2.4 Missouri Solid Waste Rules for Sanitary Landfills

Regrading, cover and closure of the remaining solid waste at OU-1 Areas 1 and 2 after RIM removal would need to comply with the MDNR regulations described in Section 6.2.1.2.1 of this SFS, with the exception that regrading Areas 1 and 2 after removal of the RIM would need to meet a minimum slope angle of 5% instead of the 2% permitted for the ROD-selected remedy, to account for the increased risk of differential settlement resulting from the greater extent of excavation and material disturbance caused by the RIM removal.

6.2.2.2.5 Clean Water Act

The Clean Water Act sets standards for ambient water quality and incorporates chemical-specific standards including federal water quality criteria and state water quality standards. The substantive requirements for storm water runoff are relevant and appropriate.

6.2.2.2.6 Safe Drinking Water Act

40 CFR Part 141 establishes primary drinking water regulations including maximum contaminant limits (MCLs) pursuant to section 1412 of the Public Health Service Act, as amended by the Safe Drinking Water Act (Public Law 93-523), and related regulations applicable to public water systems. These MCLs apply to public drinking water systems. Missouri regulations (10 CSR 60-4.010, et seq.) also establish MCLs for public drinking water systems. MCLs are considered relevant and appropriate to all potentially usable groundwater. As set forth in the NCP, non-zero maximum contaminant level goals (MCLGs) are also potentially relevant and appropriate to potentially usable groundwater. This alternative is expected to maintain groundwater quality that continues to meet the MCLs and non-zero MCLGs.

6.2.2.2.7 Missouri Radiation Regulations for Protection Against Ionizing Radiation

The Missouri Radiation Regulations for Protection Against Ionizing Radiation (19 CSR 20-10.040) contain chemical-specific standards that address radiation protection. These regulations define maximum permissible exposure limits for specific radionuclides in air at levels above background inside and outside of controlled areas. These requirements are considered applicable during implementation of any remedial action. Specifically, these regulations would require perimeter air monitoring during implementation of the off-site disposal alternative. In addition, site health and safety plans would address worker protection consistent with these requirements.

6.2.2.2.8 Missouri Well Construction Code

MDNR has promulgated regulations pertaining to the location and construction of water wells. The Well Construction Code (10 CSR 23-3.010) prohibits the placement of a well within 300 feet of a landfill. These rules should provide protection against the placement of wells on or near the site. The regulations on monitoring well construction (10 CSR 23-4) would apply to the construction of new or replacement monitoring wells.

6.2.2.2.9 Missouri Storm Water Regulations

The Missouri regulations governing storm water management at construction sites are set out in 10 CSR 20-6.200 (Table 7). A disturbance of greater than one acre or the creation of a storm water point source during construction of the remedy would trigger these requirements.

6.2.2.3 Long-Term Effectiveness and Permanence

Because the RIM above the cleanup levels would be removed from the site, the “complete rad removal” with off-site disposal alternative would provide permanent protection against exposures to radionuclides. This conclusion assumes there would be no long-term impacts to the off-site disposal facility which receives the RIM, to the environment in the vicinity of the off-site disposal facility, or to any communities along the transport route from the transport and off-site disposal of the RIM.

RIM containing radionuclides at levels above those that would allow for unrestricted use would be removed from the site under this alternative; however, other solid wastes would still remain at the site and the site would still remain a landfill subject to the applicable requirements for closed solid waste landfills. Therefore, a new landfill cover would need to be installed over the remaining solid wastes after removal of the RIM above cleanup levels. Groundwater monitoring would need to be performed consistent with the applicable or relevant and appropriate requirements for a solid waste landfill. Institutional controls would also be required to ensure that future land uses at the site would be compatible with the presence of a solid waste landfill and to prevent intrusion into the waste materials, disruption of the landfill cover, monitoring points, or other aspects of the solid waste landfill containment system.

6.2.2.3.1 Magnitude of residual risk

The calculated life time risks from radiological materials that would remain in Areas 1 and 2 after implementation of the “complete rad removal” with off-site disposal alternative are as follows:

- Area 1: $<1 \times 10^{-7}$ for year 1 and $<1 \times 10^{-7}$ for year 1,000.
- Area 2: $<1 \times 10^{-7}$ for year 1 and $<1 \times 10^{-7}$ for year 1,000.

These calculated risks are attributable to gamma radiation and radon emissions from the radionuclide occurrences that would remain after implementation of the “complete rad removal” with off-site disposal alternative. Any such residual materials would be present at levels which do not require further remediation. Additionally, the remaining landfill wastes, including any residual RIM, would be capped with access to and future use of the capped waste disposal areas limited by site access restrictions and institutional controls. Direct contact with residual RIM under the cap and ingestion, inhalation, or dermal contact with such materials is not expected to occur. These also are the primary exposure pathways for any non-radiological COCs which may be present in the landfill wastes remaining in Areas 1 and 2 after removal of the RIM. Because no complete exposure pathway would exist for such materials after completion of the cap construction, the landfill waste materials would not be expected to produce non-carcinogenic effects or carcinogenic risks.

The calculated risk levels are below EPA’s target risk range of 1×10^{-6} to 1×10^{-4} and the magnitude of the radiological carcinogenic risk from residual RIM in these two remediated areas is acceptable. These risks do not specifically include potential exposures from non-radiological landfill waste after construction is complete; however, those wastes would also be covered by a cap which would prevent exposures. Additional information regarding the risk assessment calculations is presented in Appendix H.

After soils containing radionuclide concentration above the cleanup levels are removed from the Buffer Zone/Crossroad Property, residual risks posed by the remaining radionuclide-impacted soils on these properties, if any, should be indistinguishable from variations in background levels.

6.2.2.3.2 Adequacy and reliability of controls

There is uncertainty as to whether all of the RIM above cleanup levels in Area 2 could be removed. There are several areas where RIM is located at substantial depth and two of these areas are located adjacent to the closed demolition landfill or the inactive sanitary landfill which are part of OU-2. The proximity of these adjacent landfills greatly increases the level of difficulty and the amount of overburden material that would have to be moved to access and remove some of the RIM in Area 2. These conditions would increase the potential for failure of the adjacent landfill units during implementation of the OU-2 remedy and the potential that all of the RIM above cleanup levels would not be removed from Area 2.

There are a very limited number of possible off-site facilities where the RIM could be disposed and therefore there are uncertainties regarding land disposal. There also are uncertainties regarding the acceptability of the wastes at some of the facilities further limiting the number of facilities that could accept the wastes. At this time only three facilities might be able to accept these wastes. See the discussion in Section 3.2.3 for a description of these facilities and their capabilities.

The engineered measures and institutional controls that would be implemented for Areas 1 and 2 under the "complete rad removal" with off-site disposal alternative (landfill cover, groundwater and landfill gas monitoring, and institutional controls), are considered to be adequate and reliable. OM&M requirements for the "complete rad removal" with off-site disposal alternative would be the same as those included in the ROD-selected remedy. No difficulties or uncertainties or potential need to replace significant components are envisioned for the long-term OM&M functions for the "complete rad removal" with off-site disposal alternative.

There is no expectation that any of the remedial actions would need to be replaced, but if this should occur, unacceptable risks are not expected to occur because the site presents only slight risks under current conditions. Moreover, given that the components of the final covers at Areas 1 and 2 would be constructed from natural materials with properties that limit migration potential of any residual RIM or solid waste constituents, there is a high degree of confidence that the engineered controls would prevent or otherwise address potential problems.

6.2.2.4 Reduction of Toxicity, Mobility or Volume through Treatment

Reduction of toxicity, mobility, or volume through treatment refers to the anticipated performance of the treatment technologies that may be included as part of a remedy. The "complete rad removal" with off-site disposal alternative is an off-site disposal action that does not include treatment as a primary component of this alternative.

As discussed in Section 4, radionuclides are naturally occurring elements which cannot be neutralized or destroyed by treatment. Occurrences of radionuclides within Areas 1 and 2 are dispersed within soil material that is further dispersed throughout the overall, heterogeneous matrix of municipal refuse, construction and demolition debris, and other non-impacted soil materials. Consequently, ex situ treatment techniques are considered impracticable. In addition, the heterogeneous nature of the solid waste materials and the dispersed nature of the radionuclide occurrences within the overall solid waste matrix make in situ treatment techniques impracticable. The remedy for the Buffer Zone/Crossroad Property also would not reduce toxicity, mobility, or volume through treatment technologies.

The only on-site treatment technology that may potentially be applicable to the "complete rad removal" with off-site disposal alternative is physical separation of impacted soil from the solid wastes using solids separation techniques such as hand picking for large bulky items and various fixed, vibrating, or rotating screens (see discussion in Section 4.3.3.3.1). The use of revolving cylindrical trommel sieve screens during landfill mining and reclamation (LFMR) projects to separate materials by size, with the soil fraction passing through the screen is discussed in Section 4.3.3.3.1. While not specifically a "treatment," this physical separation process could potentially be employed to reduce the volume of radiologically-impacted material that would be transported to an off-site disposal facility. It would not, however, reduce the toxicity or mobility of the radiologically-impacted material.

As previously discussed, any solids separation techniques would need to be pilot-tested using materials from Areas 1 and 2 during remedial design to ascertain the potential effectiveness, implementability, and cost of this technology. Of particular interest in conducting pilot testing with material from Areas 1 and 2 would be obtaining an estimate of the degree of RIM volume reduction that could be achieved, assessing the moisture content of the filled material, determining the fraction of soil that would be contained in or adhered to the segregated refuse, and determining the residual levels of radioactivity that would be present in the non-soil refuse after screening out the soil fraction. Assuming that solids separation could prove to be an effective and implementable technology (that is, it could effectively separate the radiologically-impacted soil from the other landfilled waste materials such that the other landfilled wastes would contain radionuclide activities below the levels that would allow for unrestricted use), it has the potential to reduce the volume of radiologically-impacted material that would need to be transported to an off-site disposal facility. However, little is known about the potential application of a soils separation technology to this situation and it is possible that pilot testing would demonstrate the treatment to be ineffective for separating RIM from non-radiologically impacted materials. At this stage of analysis, neither the SFS estimated costs nor the estimated schedules include any allowance for solids separation pilot testing or implementation.

In the event that hazardous wastes are encountered during implementation of the remedy, such materials would be separated from the other solid wastes and subjected to waste profiling to determine the appropriate treatment and disposal requirements. To the extent that hazardous wastes or mixed wastes are encountered, they would be shipped off-site and would be treated at the disposal facility in accordance with the hazardous waste regulations (e.g., EPA's Land Disposal Restrictions (LDR) program and Universal Treatment Standards (UTS)) and in accordance with the receiving facility's permits and standard operating procedures. After arriving at an off-site disposal facility and undergoing a waste receipt analysis, RCRA soil and RCRA soil with radionuclide material would be stabilized prior to placement in a disposal cell. Depending on the physical characteristics of debris, RCRA debris and RCRA debris with radionuclide material would undergo either micro- or macro-encapsulation prior to placement in a disposal cell. To the extent that treatment of the hazardous waste or mixed waste would be required for off-site disposal, stabilization or encapsulation treatment would result in a reduction of the mobility of the hazardous waste and radiologically-impacted components of the mixed waste. Toxicity and volume would not be reduced by these technologies but may be reduced by other technologies potentially applicable to hazardous wastes that do not contain RIM, such as incineration of drummed solvents if such wastes were encountered during implementation of the remedial action at the site.

For the "complete rad removal" with off-site disposal alternative, any hazardous waste or mixed waste would be shipped to the off-site disposal facility by rail along with the RIM material. Shipping of mixed waste to an off-site disposal facility by rail would not be significantly different than shipping of RIM. Like the RIM, the mixed waste would be loaded into 35 cubic yard soft-sided DOT shipping container bags and hauled by truck to a truck-to-rail transloading station. The soft-sided bags would be placed into 148 cubic yard gondola rail cars and transported via rail to one of the off-site disposal facilities described in Section 4.3.2.2.2. While the RIM would be shipped under a bill of lading, the mixed waste would require use of a uniform hazardous waste manifest and specific placards and markings on the semi trucks and gondola rail cars while en route to the off-site disposal facility.

Beyond the shipping aspect, the hazardous component of any mixed waste would present additional issues with respect to waste segregation, sampling/analysis, and ultimate disposition at the off-site disposal facility. During excavation, any suspected hazardous or mixed waste would be segregated from the waste containing only overburden or RIM material, stockpiled in a separate area, sampled and analyzed for toxic characteristic leaching procedure (TCLP) parameters, and covered with a tarp or other cover material until analytical results were available. Sampling procedures and analytical methods would be addressed in a Remedial Action Sampling and Analysis Plan to be developed during the remedial design phase.

Based on analytical results, segregated materials would be assigned a waste profile of non-RCRA soil and debris, non-RCRA soil and debris with radionuclide material, RCRA soil, RCRA soil with radionuclide material, RCRA debris, or RCRA debris with radionuclide material. The non-RCRA soil and debris would be relocated with the overburden stockpile; the non-RCRA soil and debris with radionuclide material would be managed along with the RIM; and the RCRA soil, RCRA soil with radionuclide material, RCRA debris, and RCRA debris with radionuclide material would be packaged and shipped to the off-site disposal facility in containers separate from the RIM with appropriate marking/placarding under a unique manifest. In order to comply with the RCRA waste storage limitations, stockpiled RCRA soil, RCRA soil with radionuclide material, RCRA debris, and RCRA debris with radionuclide material would not be stored on-site beyond the RCRA specified maximum accumulation periods prior to shipment to the off-site disposal facility.

The three off-site disposal facilities identified in the SFS are all permitted to accept RCRA wastes and mixed wastes. After arriving at the selected off-site disposal facility and undergoing a waste receipt analysis, RCRA soil and RCRA soil with radionuclide material would be stabilized prior to placement in a disposal cell. Depending on the physical characteristics of the debris, RCRA debris and RCRA debris with radionuclide material would undergo either micro- or macro-encapsulation prior to placement in a disposal cell.

6.2.2.5 Short-Term Effectiveness

This alternative poses significant potential short-term risks as described below. During a public meeting held as part of the ROD-selected remedy process, EPA identified and discussed the following short-term risk issues for waste excavation: waste handling, sorting and stockpiling; water management; noise, odor and windblown trash; worker health and safety (PPE, gamma exposure, physical stress, physical hazards, workplace monitoring); contaminant migration/spreading (fugitive dust and airborne migration, fugitive dust control and water application, leachate generation, equipment decontamination water, and water from open excavations); and waste hauling and transportation/truck decontamination issues (transfer facilities, increased local traffic, waste handling on public roads, interstate transport by rail, DOT requirements, safety issues).

6.2.2.5.1 Protection of the Community During Remedial Actions

Unless a rail spur is extended onto the West Lake Landfill site, significant additional local truck traffic would occur during the construction period for the "complete rad removal" with off-site disposal alternative. The additional truck traffic is created by the need to transfer the excavated RIM to a local off-site truck-to-rail trans-loading location. It is estimated that nearly 15,000 round trips of semi-trucks would be required to truck the excavated RIM to a rail spur location. These additional truck trips would result in additional physical risk due to potential traffic accidents. Transfer of RIM from the site by truck to an off-site rail trans-loading facility, by rail to the general geographic area of the disposal facility, and off-loading and transfer by truck to the actual disposal facility would be required, all of which would result in increased potentials for release of RIM as a result of traffic or train accidents and the extensive amount of additional handling of the RIM required for this alternative.

The risk assessment (Appendix H) includes an estimate of the projected incidence of transportation accidents associated with each SFS alternative. For the "complete rad removal" with off-site disposal alternative, the projected incidence of transportation accidents associated with removal of RIM, regrading of the landfill, and importing of materials for construction of the multi-layer landfill cover is 1.4, meaning that at least one traffic accident involving injury or death is expected to occur if this option were implemented. If an on-site rail spur were determined to be feasible (i.e., if an at-grade rail crossing across St. Charles Rock Road could be permitted, if off-site property could be acquired or leased to provide right-of-way access for an on-site spur, and if access to tie into an existing private off-site rail spur could be acquired, among other factors), the projected incidence of transporation accidents associated with this alternative are projected to be reduced to 1.3.

The excavated waste to be shipped offsite would be placed in sealed containers (sealed DOT Industrial Packaging [IP] bags) before leaving the site and therefore, there should not be any spillage or other release of RIM from the containers during transport unless a major vehicular accident occurs that results in significant damage to both the transport vehicle (truck trailer or railroad gondola car) and the DOT IP bags. A potential does exist for loose debris that may contain RIM to adhere to the wheels, under-carriage, or sides of the transport vehicles. All vehicles leaving the site would be subject to screening for potential radioactivity and cleaning as necessary to remove any debris that may contain radioactivity prior to leaving the site. In the event that such material was not identified during screening or removed during cleaning, a potential exists for this material to be released along the route of transport from the site to the off-site disposal facility. If such releases were to occur, members of the public that traverse the same roads or that trespass onto the railroad tracks could potentially be exposed to RIM that may be released. Such exposures are not expected to pose a significant risk due to the anticipated distance between such materials and possible receptors, the limited duration of exposure, and the presence of shielding associated with vehicular use of the roads or limited trespass onto the rail lines (see Appendix H).

Disturbing the waste material may expose the community to radioactive waste, methane and radon gas and other contaminants, and cause an undesirable release of odors. Excavation of existing waste materials would undoubtedly result in odor emissions during the period of time that existing wastes may be handled or exposed. Mitigation of odors through engineering means is limited.

For the “complete rad removal” with off-site disposal alternative, vehicle operations for excavation, loading, and transport of the RIM to an off-site disposal facility and for landfill regrading, import of materials to be used to construct the multilayer landfill cover, and construction of the cover are projected to emit approximately 35,400 tons of carbon dioxide to the atmosphere (Appendix I).

As Areas 1 and 2 would be excavated, overburden would be stockpiled and stored and RIM loaded into transport containers. During these activities the nuisance attraction to and congregation by birds at and above the affected areas will be problematic unless effectively controlled. The main concern will be the potential for increased bird strikes to aircraft approaching and departing from the Lambert-St. Louis International Airport. Mitigation measures such as excavation best management practices, which include application of daily soil cover and/or tarping of exposed waste, visual and auditory frightening devices, or use of wire or monofilament grids positioned over exposed refuse to prevent bird access, could be implemented to attempt to minimize bird attraction to and congregation at and above the disturbed areas.

Excavation of waste materials from Areas 1 and 2 would require removal of the existing landfill cover and overburden from Areas 1 and 2 and portions of adjacent areas of OU-2. Excavation of overburden and RIM would create depressions in the landfill area during the period of time required to remove the RIM and regrade and cover the remaining landfill wastes. Precipitation that falls on the landfill while such depressions are open would potentially flow into and accumulate in the depressions. Any accumulation of precipitation in depressions created during waste excavation could result in infiltration of precipitation runoff through the underlying waste materials, which could result in leaching of volatile organic compounds (VOCs) or other soluble contaminants from the waste materials. Accumulation could be significant during a heavy rainstorm insofar as the maximum historical 24-hour rainfall for the St. Louis area ranges from a low of 3.7 inches in November to a high of 8.8 inches in August (NOAA, 2011). Such leaching potentially could contaminate the underlying groundwater and create a plume of non-radiological contamination that could flow off-site, potentially exposing receptors who are not currently exposed and who would not be expected to be exposed in the future under existing site conditions or under the ROD-selected remedy.

As Areas 1 and 2 would be excavated and RIM loaded into transport containers, storm water controls would be implemented in accordance with the Missouri Storm Water regulations to protect the community. During construction, consideration would be given to minimizing the areas of excavation that would be open and the areas of exposed waste materials at any given time. Temporary diversion berms would also be constructed above the open excavation areas on the previously excavated (and temporarily covered) surface of any excavation depressions in order to divert precipitation runoff around the open excavation to prevent the runoff from contacting uncovered waste materials. Precipitation that would contact uncovered waste materials would flow into the low point of the excavation and be pumped out into temporary storage tanks using portable gas-driven pumps. Samples from each tank would be collected and sent to a laboratory for analysis. The stored water would be directly discharged or treated and disposed appropriately based on the analytical results.

6.2.2.5.2 Protection of Workers During Remedial Actions

This option would entail significant excavation, handling, loading and transport of RIM at the site and therefore would pose both significantly increased radiological exposure risks as well as construction safety risks to on-site workers. The risk assessment (Appendix H) presents an evaluation of potential risks to site-workers that may occur for each alternative. These include risks from industrial accidents, exposure to carcinogenic substances, and projected radiation exposures. For the “complete rad removal” with off-site disposal alternative, the projected incidence of industrial accidents is 7.6 over the life of the project. The projected carcinogenic risk to the maximally exposed individual is 7.6×10^{-4}, and the projected radiation dose to a remediation worker is 260 mrem/yr (Appendix H).

Workers involved in the excavation activities may be subject to potential short-term risks. Possible short-term impacts associated with excavation of the waste materials include the following potential risk: exposure of workers to contaminated waste; excavation/trenching instability; stormwater runoff entering areas where waste is exposed, resulting in the exposure of workers to contact storm water; and odor emissions or other aesthetic issues arising from exposed waste. Worker exposures would be addressed through development and implementation of a site safety plan and performance of personnel and environmental monitoring during implementation of remedial action. Workers would be protected during construction by adhering to OSHA practices; however, as this alternative entails extensive excavation, handling and transportation of radiologically impacted materials, OSHA work practices and personal protective equipment may not provide full protection against exposure to external gamma radiation.

Excavation would require construction workers and equipment that would initially disturb the overburden soil and underlying waste materials. Dust control measures would be required to limit worker exposure to fugitive dust during construction. As discussed in Section 6.2.2.4 above, the separation of radiologically-impacted soil from solid wastes and construction/demolition debris may be a potential means of reducing the overall volume of material and resultant cost of off-site transport and disposal; however, this action may increase short-term exposures and risks to remediation worker because the screens or other equipment used to segregate large items and debris from the soil become fouled with plastic, wood, and other debris that potentially would need to be physically removed by workers. Such activities would require workers to be in close proximity to the RIM, thereby increasing their short-term exposure risks. The risk assessment portion of this SFS does not account for such physical separation/segregation exposures to workers.

6.2.2.5.3 Environmental Impacts

No measurable long-term impacts to plants or animals in surrounding ecosystems are expected from this alternative. As noted in the BRA (Auxier, 2000), some of the ecosystems present at the landfill are the result of existing institutional controls and other limitations on land use within or adjacent to OU-1 that have allowed field succession to take place. With respect to short-term environmental impacts during performance of this alternative, disturbance of the landfill surface would destroy those portions of the habitats that currently exist on the surface of Areas 1 and 2, forcing wildlife to migrate to other areas. Vegetative cover would be placed on the site as a part of the final cover, and the landfill would be allowed to return to an early-stage field ecosystem with periodic mowing and maintenance.

6.2.2.5.4 Ability to Monitor Effectiveness

Regular monitoring of groundwater quality would be performed at appropriate locations around Areas 1 and 2 to assess the effectiveness of this alternative.

6.2.2.5.5 Time Until Remedial Action Objectives are Achieved

The RAO of preventing direct contact with landfill contents and exposure to radiation associated with anticipated future uses of the West Lake Landfill and adjacent areas would be met immediately upon implementation of an amendment to the land use covenants. Achievement of this RAO would be further ensured once construction of the new landfill cover over Areas 1 and 2 is completed.

The RAOs of: (1) minimizing infiltration and any resulting contaminant leaching to groundwater; (2) controlling surface water runoff and erosion and decreasing the potential for erosion and subsequent transport of RIM; and (3) controlling radon and landfill gas emissions from Areas 1 and 2 would be met once RIM excavation and off-site disposal and construction of the new landfill cover over Areas 1 and 2 is completed. Excavation and off-site disposal of RIM makes achievement of these RAOs post-excavation more certain because all RIM above cleanup levels would be removed from the site, thereby greatly reducing the RIM source term and the magnitude of potential exposures to radionuclides, potential future radon emissions, and potential leaching of radionuclide constituents in the unlikely event that the landfill cover or institutional controls were to fail.

Initiation of this alternative would require significant planning and permitting due to the limited number of off-site disposal facilities capable of taking this material and the extensive logistics associated with identifying, handling, classifying and loading the materials for transport to the selected off-site facility. Preparation of the remedial design should be completed within approximately 1 year of authorization to proceed with the RD. (RD could take significantly longer if full-scale pilot testing of solids separation equipment were to be performed.) The RAOs would be achieved upon completion of construction which is estimated to be finished within approximately 3 years of approval of the RD. Therefore, the remedial action objectives should be achieved within 4 years of approval to proceed with the RD (Appendix J-2).

If this alternative proceeds on a fiscally-constrained approach that limits annual expenditures to $10 million, the overall duration for planning and construction of the "complete rad removal" with off-site disposal alternative would be 29 years. The evaluation of a construction schedule constrained by a $10 million per year expenditure limitation is included because there are limits to the annual amount of money provided by the Superfund program to any given Fund-lead site. The figure of $10 million per year was identified by EPA as a reasonable estimate of the maximum annual funding that would be available for OU-1 based on past experience at other large Fund-lead sites.

The projected construction schedule and the cost estimate for the "complete rad removal" with off-site disposal alternative are highly dependent on the waste material swell factor; that is the amount the in-place waste volume expands as it is excavated, handled and loaded for transport to a new disposal cell. For purposes of this SFS, a swell factor of 1.5 has been assumed. A swell factor greater than 1.5 would result in an increase to the overall construction schedule and the estimated costs. The projected construction schedule and the cost estimate for the "complete rad removal" with off-site disposal alternative also are highly dependent on the number of rail cars that could be loaded and shipped per day. The schedule and cost estimate developed in this SFS for this alternative are based on an assumption that 15 rail cars can be loaded, switched out and replaced every day, which is the maximum expected rate. If the actual rate is less than 15 cars per day, the time required to complete construction and consequently the costs for the "complete rad removal" with off-site disposal alternative would increase.

6.2.2.6 Implementability

This alternative would involve excavation and off-site disposal of RIM in Areas 1 and 2, repair and restoration of the disturbed portions of the OU-2 landfill units adjacent to Areas 1 and 2, grading of the surfaces and installation of upgraded landfill covers over the excavated areas of Areas 1 and 2, long-term monitoring and maintenance of the covers, and long-term monitoring of landfill gas and groundwater and surface water quality.

While excavation with subsequent off-site transportation and disposal has been implemented at other sites containing radioactively-impacted materials, materials from these other sites have not included significant amounts of landfill solid wastes. Significant technical and administrative implementability issues are associated with excavating the RIM and loading it into railcars for transportation if this alternative were to be implemented. These include the following:

- Reduced excavation production rates and increased volume of RIM subject to excavation resulting from application of daily cover over an extended excavation schedule;

- Ability to construct an on-site rail spur and rail loading facility, or alternatively the ability to locate and obtain a lease to an off-site rail spur for use as a truck-to-rail transfer facility;

- Increased potential for aviation-bird strikes as a result of excavation of RIM contaminated putrescible or organic solid waste and overburden from Areas 1 and 2 within the flight path of Lambert–St. Louis International Airport;

- Ability to remove all of the RIM due to the close proximity of some of the deeper RIM at Area 2 to adjacent landfill units; and

- Impacts to other site operations from construction and operation of an on-site rail spur and loading facility (if construction is possible), or alternatively, impacts to other site operations and traffic on surrounding roads from additional truck traffic used to haul wastes to an off-site truck-to-rail transfer facility.

Design and construction of post-RIM-excavation landfill covers over Areas 1 and 2, with subsequent monitoring and maintenance, are not expected to pose any implementability challenges. Materials and services necessary for the regrading and construction of the final landfill covers over Areas 1 and 2 after RIM removal are available and the technologies have been proven through application at other landfills. Design and construction of landfill covers post RIM removal over Areas 1 and 2 are not expected to pose any significant implementability challenges.

The actions included for the Buffer Zone/Crossroad Property are implementable.

Monitoring of the cover surfaces, landfill gas, groundwater, and surface water are proven methods for demonstrating the long-term effectiveness of the covers placed over Areas 1 and 2 and are easily implemented.

6.2.2.6.1 Ability to Construct and Operate the Technology

In general, excavation and off-site disposal are standard technologies. However, there are unique circumstances associated with excavation of RIM in Areas 1 and 2, located as they are within an overall larger closed/inactive landfill site, which would complicate implementation of standard excavation technologies.

There are questions regarding the ability to remove all of the RIM from Area 2 due to the depth of the RIM and proximity to the OU-2 closed construction and demolition waste landfill (the C&D landfill) and the OU-2 inactive solid waste landfill. RIM is not present in these other landfill units, but it would be necessary to excavate into these OU-2 units in order to access some of the deepest RIM in OU-1 Area 2.

Figure 36 displays the anticipated extent of excavation from Area 2 and the overlap with adjacent OU-2 landfill units. Figure 37 presents two profile views of the extent of excavation into the C&D landfill and the inactive solid waste landfill that would be required to remove the RIM from Area 2. Upon completion of removal of the RIM from OU-1, disturbed portions of the adjacent landfill units in OU-2 would need to be repaired and restored to a condition that meets or exceeds existing closure conditions prior to implementation of this alternative and subject to the requirements of any additional remedial actions required for either of these areas as part of implementation of the OU-2 remedy. Although sheet piling as a site-wide replacement for excavation sidewall sloping was evaluated as part of this SFS and found not to save money or time compared to sloping the sidewalls, small areas of sheet piling where the OU-1 Area 2 RIM is closest to the OU-2 adjacent landfill units may prevent or minimize encroachment of excavation slopes into the OU-2 units and therefore prove economical for the "complete rad removal" with off-site disposal alternative. Such targeted use of sheet piling would be evaluated during remedial design.

RIM excavation and placement in trucks for subsequent transfer to rail, or direct placement into railcars, is also expected to present implementability concerns, challenges, and risks, specifically those associated with the following:

- Excavation and handling of contaminated materials;
- Safety risks associated with encountering methane gas during excavation;

- Management of fugitive dust and potential odors;
- Mitigation of bird hazards;
- Management and treatment of stormwater exposed to RIM during excavation; and
- Identifying, segregating, and disposing off-site of any hazardous wastes, polychlorinated biphenyls (PCBs) or RACM that may be encountered during RIM excavation.

If hazardous wastes, PCBs, or RACM are encountered during excavation of RIM, these materials would need to be segregated from the other waste materials, characterized, and transported to an off-site disposal facility in containers separate from the other RIM. Additional health and safety procedures would be required during excavation of these materials. These materials would require separate handling at the off-site disposal facility and could require treatment prior to disposal. Depending on the characteristics of any hazardous waste encountered during excavation, the hazardous waste could need to be transported to a different off-site facility for treatment and disposal in accordance with RCRA.

Directing and controlling the RIM excavation process using radiological scanning and sampling techniques would significantly impact overburden and RIM excavation production rates. Based on experience in excavation of radiologically-impacted waste at other sites, a reduction in efficiency is expected for overburden excavation and a greater reduction is expected for RIM excavation.

Daily soil cover and tarps would need to be placed over open excavation areas and stockpiled overburden to minimize dust, odor, and the attraction of birds and other wildlife. The proximity of Areas 1 and 2 to Lambert-St. Louis International airport poses a potential risk to aviation operations. The St. Louis Airport Authority and the US Department of Agriculture have identified as a problem the potential for increased bird activity in conjunction with waste excavation at West Lake and the resultant increased risk of aviation bird strikes. Bird nuisance mitigation measures such as best management practices (including, but not limited to, daily soil cover and tarps over exposed overburden and wastes), visual and auditory frightening devices, and wire or monofilament grids strung over exposed refuse to prevent bird access, could be evaluated for use at Areas 1 and 2. The size of open excavations may limit the constructability of wire or monofilament grids. Careful evaluation of material properties would be necessary during remedial design to assure that the appropriate strength and elasticity of materials are considered, that the materials are available, and that grids can be reasonably constructed.

Effective storm water controls could be readily implemented using conventional construction equipment and materials. Temporary berms to direct stormwater away from open excavations would need to be constructed and precipitation accumulation in depressions created by the excavation activities would need to be pumped out and managed. Direct precipitation or runoff that may contact waste material could become contaminated with soils or wastes containing thorium or radium. These elements would be entrained in colloidal material that would readily settle in a lined detention pond in the location of the closed former leachate lagoon. At the end of excavation when all RIM above cleanup levels would have been removed, pond sediment and the liner would also be removed and transported off-site to the off-site disposal facility. Affected areas of the detention pond would then need to be reconstructed.

Excavated RIM exposed to precipitation would be subject to the paint filter liquids test (PFLT) to determine if free liquids exist prior to being loaded for off-site disposal. If the excavated material to be hauled off-site does not pass the PFLT, a dewatering area would need to be staged and collected water treated and/or disposed, potentially through off-site disposal. The current costs and schedules do not address any dewatering activities. Should such activities be necessary, a suitable area would have to be identified within the site.

Truck hauling of RIM to a truck-to-rail transloading facility and transferring the RIM to gondola railcars, or loading RIM directly into railcars on-site if a rail spur could be extended onto the West Lake Landfill property, are technically implementable. However, it is not known whether extension of a spur onto the property is implementable. If construction of an on-site rail spur were to be considered, an engineering study and development of a detailed design would be necessary to determine the feasibility and implementability. As discussed in detail in Sections 6.2.2.6.5 and 6.2.2.6.6 below, construction of an on-site rail spur would also require coordination with a number of local and state regulatory authorities as well as private landowners.

An initial comparison of the US Ecology Grand View facility WAC to estimated activity levels in the OU-1 RIM is presented on Table 8. Although a representative of the turnkey contractor would be on-site during RIM excavation to coordinate loading of containers, there is a potential that one or more shipping containers (gondola cars or IP-1 soft-sided containers) could contain activity levels that exceed the WAC and may have to be unloaded and re-distributed prior to shipment or, in the worst case, returned to the site by the disposal facility and/or sent to a different disposal facility. These additional activities could result in additional worker exposures, additional time to complete the project, and potentially additional costs.

Upon completion of the RIM excavation and removal process at Areas 1 and 2, the necessary regrading the remaining landfills and placement of final cover is implementable and has been performed at other landfills including CERCLA sites. Environmental monitoring is routinely performed at most sites and is not expected to present any feasibility challenges.

6.2.2.6.2 Reliability of the Technology

Excavation and off-site disposal of radioactively-impacted material has been performed at other facilities and is a reliable technology. For example, DOE's FUSRAP program involved the remediation of 46 sites where radioactive contamination remained from Manhattan Project and early U.S. Atomic Energy Commission (AEC) operations. Most of the sites required some form of excavation with off-site disposal in licensed low-level radioactive waste disposal facilities, though waste deemed "inaccessible" has been allowed to remain in place. Most of the sites have been remediated to conditions that pose no risk to human health and the environment under any future use scenarios, though in the case of the St. Louis North County Sites, this was achieved even with waste left in place where such material was deemed "inaccessible". With regulatory concurrence, these sites have been released for unrestricted use. For more information about these sites, see http://www.lm.doe.gov/land/sites/fusrap/fusrapmain2.htm. It should be noted, however, that none of these FUSRAP sites involved radiological materials commingled with municipal solid waste and disposed in a landfill setting. The reliability associated with disposal in an off-site facility would be dependent on the integrity of the liner and cover systems at the off-site facility being maintained as well as the effectiveness of the various off-site facility monitoring programs.

Landfill cover systems such as those that would be implemented over Areas 1 and 2 after RIM removal and which are designed and constructed consistent with State and Federal regulations and with post-closure care implemented in accordance with current regulatory guidance, have been demonstrated to be reliable at: (1) minimizing percolation and infiltration of precipitation; (2) minimizing leachate generation; (3) minimizing impacts to groundwater quality; (4) minimizing impacts to surface water quality and quantity; (5) minimizing erosion of cover material; and (6) minimizing uncontrolled releases of landfill gas. Landfill cover systems have been demonstrated to be reliable methods for isolating waste materials. Similarly, access restriction measures have been demonstrated to be reliable mechanisms to prevent unauthorized access to a site.

Bird nuisance mitigation measures such as best management practices (including, but not limited to daily soil cover and tarps over exposed RIM and waste), visual and auditory frightening devices, and wire or monofilament grids strung over exposed refuse to prevent bird access, are demonstrated reliable technologies under proper operating and excavating conditions. While visual or auditory frightening devices can be effective in the short-term, birds tend to habituate to deterrents over time, causing the deterrent to lose effectiveness. Frequent relocation of predator birds and predator effigies and/or altering the timing of auditory activation may help, but long-term effectiveness in not assured. In addition, the FAA has stated that “To date, no such [putrescible waste] facility has been able to demonstrate an ability to reduce and sustain hazardous wildlife [birds] to levels that existed before the putrescible-waste landfill operations began operating.” (FAA, 2007).

Storm water controls are well-established technologies that are implemented at most landfill sites. For this alternative, gravity settling of suspended solids potentially containing radionuclides is a well established and reliable technology.

6.2.2.6.3 Ease of Undertaking Additional Remedial Actions, if Necessary

The only anticipated additional remedial actions that may need to be taken for the “complete rad removal” with off-site disposal alternative would be maintenance activities needed to sustain the cover system, repair areas of differential settlement or address erosion, or possible implementation of a contingent landfill gas control system. Differential settlement or compaction of the underlying remaining waste materials after RIM excavation could necessitate placement of additional soil over all or portions of Areas 1 or 2 to maintain the required final grades. Long-term monitoring and maintenance of the landfill covers at other Superfund sites and at non-Superfund site solid waste landfills is typically required to assess whether differential settlement or surface erosion of the cover has occurred over time. Long-term monitoring and maintenance including cover inspection and repair would be part of this alternative. Cover repair, if necessary, would be easy and would involve placement of additional fill, regrading, and revegetation of the repaired area.

In the event that monitoring of subsurface landfill gas and radon detects the presence of gas levels above regulatory thresholds along the perimeter of the landfill, a landfill gas control system could be implemented as an additional remedial action. Implementation of a contingent landfill gas control system would entail drilling and installation of gas extraction wells, installation of conveyance piping, installation and operation of landfill gas extraction blowers and a landfill gas treatment (flare) system, and/or possible use of a carbon adsorption system to remove radon from the extracted gas stream. Installation of a contingent gas system can easily be performed as a future action. Any disruption to the final landfill cover resulting from the installation of a contingent gas extraction system would need to be repaired. Such activities are commonly and routinely undertaken at solid waste disposal sites.

Bird nuisance mitigation measures such as best management practices (including, but not limited to daily soil cover and tarps over exposed waste), visual and auditory frightening devices, and wire or monofilament grids strung over exposed refuse to prevent bird access, can be applied to additional excavated area in the event that additional waste volume is encountered.

Storm water management measures other than those using conventional earth-moving equipment, piping, pumps, liners, filtration and carbon adsorption water treatment equipment, rip-rap, and pond outlet structures are not anticipated.

6.2.2.6.4 Ability to Monitor Effectiveness of Remedy

Demonstrating the effectiveness of the cover systems constructed over Areas 1 and 2 after RIM removal above cleanup levels would be accomplished by implementing monitoring programs for the cover surface, landfill gas system, groundwater and surface water programs as previously described in Section 5.2.2. These types of monitoring programs have been proven at demonstrating cover effectiveness and are easily implemented.

6.2.2.6.5 Ability to Obtain Approvals from Other Agencies

Implementation of the “complete rad removal” with off-site disposal alternative would require approvals from other agencies, including the following:

- Approval from the FAA to conduct waste excavation activities within 10,000 feet of an active airport runway. FAA Advisory Circular AC 150/5200-33B, dated August 28, 2007, “Hazardous Wildlife Attractants On or Near Airports,” recommends “against locating a MSWLF [municipal solid waste landfill] within the separation distances identified in Sections 1-2 through 1-4. The separation distances should be measured from the closest point of the airport’s AOA [airport operations area] to the closest planned MSWLF cell.” AC 150/5200-33B, p. 4. The separation distances referenced are 5,000 feet from the end of a runway for airports serving piston-powered (propeller) aircraft; 10,000 feet for airports serving turbine-powered (jet) aircraft; and 5 miles of protection from hazardous wildlife movement for approach, departure and circling airspace. The FAA strongly recommends against allowing a waste disposal operation within 10,000 feet of a jet aircraft runway if the material contains putrescible waste and so has the potential to attract wildlife that could threaten air traffic. The excavation of RIM material containing putrescible waste within 10,000 feet of the westernmost runway (11/29, formerly known as 12W/30W) at Lambert-St. Louis International Airport, as would occur during excavation of the RIM in Areas 1 and 2, is limited by the need to mitigate potential bird activity during excavation to address the requirements of the FAA Advisory Circular and to comply with the same prohibitions in the Missouri solid waste regulations. It may be necessary to work directly with the FAA and MDNR to identify specific bird mitigation measures during implementation.

- Approval of St. Louis Airport Authority relative to obtaining a release for the Negative Easement and Declaration of Restrictive Covenants Agreement. Excavation of RIM from Areas 1 and 2 poses a potential to increase the bird populations at the site if mitigation procedures are not employed or prove ineffective. An increase in bird populations presents a greater potential for aircraft-bird strikes. The STLAA and USDA have identified this as a concern relative to construction and operation of a new on-site disposal cell. Based on the STLAA's position stated at a discussion held in September 2010 and in the STLAA's September 20, 2010 letter to EPA, STLAA acceptance of RIM waste excavation would not be likely if bird activity were to increase. It may be necessary to work directly with the FAA and the Airport Authority to address these concerns, either by amending the FAA ROD, amending the Negative Easement, requiring specific bird mitigation measures during implementation, or making other changes to secure STLAA's cooperation.

- Location of off-site truck-to-rail loading facility. At the discussion held in September 2010, the STLAA indicated that they would not allow the use of the existing SLAPS truck-to-rail transloading facility for loading waste from the West Lake Landfill into railcars. The SLAPs rail spur is reportedly owned by the U.S. Army Corps of Engineers and the land upon which the railspur is built is owned by the City of St. Louis. It is not clear that the STLAA could prevent use of the SLAPs railspur for loading and shipping; however, as the STLAA is the owner of the property, their concurrence must be considered. No other nearby off-site truck-to-rail loading facilities have been identified.

- Approval for construction of on-site rail spur. If a rail spur were to be extended onto the West Lake Landfill property, necessary permitting and approval to construct a rail spur across St. Charles Rock Road (Missouri Route 180) would need to be obtained from the Missouri Department of Transportation, St. Louis County and/or the City of Bridgeton.

- Compliance with EPA's Off-Site Rule. The EPA Region where the off-site disposal facility is located would need to be continuously contacted every 60 days during the period of off-site waste shipments to obtain a compliance determination as to whether the disposal facility currently meets the criteria under the OSR to accept CERCLA waste. If during RIM excavation the contracted off-site disposal facility were to not be in compliance for a period of time, excavation and transportation would need to cease until the facility becomes compliant or RIM would need to be transported to another facility in compliance. Besides schedule delays, temporary stoppage of construction would present significant technical implementability concerns regarding open excavation areas.

- Rocky Mountain Low Level Radioactive Waste Compact Consent. If RIM were to be disposed at the Clean Harbors Deer Trail, CO facility, an application would have to be submitted to and accepted by the Rocky Mountain Low Level Radioactive Waste Compact. Disposal at the US Ecology Grand View, ID and Energy*Solutions* Clive, UT facilities would not be subject to a Waste Compact consent.

6.2.2.6.6 Coordination with Other Agencies

Although not all would be considered "agencies," coordination with many entities would be necessary to implement the "complete rad removal" with off-site disposal alternative. Coordination with the landfill owner and operator and owners or occupants of the various parcels that comprise the West Lake Landfill property would be necessary because of the following:

- Access to operations conducted on other portions the site would need to be maintained.

- Areas 1 and 2 are within a larger existing landfill footprint and use of areas on the West Lake Landfill property outside of Areas 1 and 2 might be necessary to stockpile cover materials or otherwise to facilitate cover construction.

- Implementation of this alternative would require excavation of portions of landfill units located outside of OU-1. Upon completion of removal of the RIM, disturbed portions of the adjacent landfill units would need to be repaired and restored, and regrading and installation of a replacement landfill cover over areas outside of OU-1 would need to be performed. Coordination would also be required relative to integration of the slopes and grading for adjacent landfill areas and routing and design of stormwater diversion and conveyance structures between OU-1 and other landfill areas.

- Use of other areas of the West Lake Landfill site that may be necessary for stockpiling of overburden and staging or routing of trucks or rail cars used to haul the excavated RIM off-site.

- Additional institutional controls would need to be implemented for properties owned by the landfill owners.

For the duration of excavation, off-site transport, and import of cover materials, the flow of vehicles associated with remedy construction would need to be coordinated with the traffic patterns of vehicles associated with the current on-site solid waste transfer station and other site tenants.

If a truck-to-rail transloading facility at an off-site rail spur location were to be used, a suitable location would need to be identified and a long-term lease secured with the land owner. As noted above, it does not appear that the existing SLAPS truck-to-rail transloading facility would be available, so costs for establishing a new facility would need to be considered.

If a rail spur were to be extended onto the West Lake Landfill property:

- Land located across St. Charles Rock Road would either need to be purchased or long-term leases would be needed with landowners;
- State and local government, private landowner, facility occupant and community approval to construct a rail spur across private property located to the east of St. Charles Rock Road, across St. Charles Rock Road, and along the access roads which serve the existing solid waste transfer station and asphalt and concrete batch plant operations located at the site would need to be obtained;
- Appropriate safety measures for the crossing at St. Charles Rock Road would have to be installed, consistent with requirements of state and local governments;
- The long-term leases of the asphalt plant, concrete batch plant, trucking company, and potential other tenants who lease land south of the solid waste transfer station would need to be renegotiated or otherwise acquired;
- The facilities of the current site tenants would need to be relocated; and
- Because of the high traffic volume on St. Charles Rock Road during the day, dropping off empty and picking-up loaded railcars would likely be possible only during late nighttime and early morning hours.

Switching of gondola railcars either at a truck-to-rail transloading facility spur or an on-site rail spur would need to be coordinated with the railroad company that would be hauling the railcars to the off-site disposal facility.

Future groundwater monitoring activities could require obtaining and maintaining access to off-site properties if off-site groundwater monitoring were required as part of the remedy.

The potential for increased bird-strikes to aircraft approaching and departing the Lambert-St. Louis International Airport is a major concern of the FAA and St. Louis Airport Authority. Whether proposed bird nuisance mitigation measures would be effective would be of interest to the FAA and Airport Authority. Consequently, the FAA and Airport Authority would need to be involved in the remedial planning process.

Coordination with other agencies including the Earth City Flood Control District, MSD and MDOT, as well as the adjacent property owners and businesses (for example, the Crossroad Property/AAA Trailer) would also be necessary to:

- Coordinate with the Earth City Flood Control District regarding the design of non-contact stormwater management and discharge facilities both during and after completion of construction;

- Coordinate with MSD regarding permitting and design of leachate/contact stormwater discharge during construction;

- Coordinate with MDOT for access to areas along St. Charles Rock Road and for any traffic control or ingress and egress additions along St. Charles Rock Road in the vicinity of the landfill entrance; and

- Obtain legal and physical access from AAA Trailer for testing and if necessary remediation of the Crossroad Property and possibly for implementation of remedial actions that may need to be performed along the property boundary (e.g. regrading, fencing, etc. in Area 2).

6.2.2.6.7 Availability of Off-site Treatment, Storage and Disposal Services and Capacity

As discussed in Section 4.3.2.2.2, three off-site disposal facilities that could accept excavated RIM from the West Lake Landfill OU-1 have been identified. All three facilities have accepted similar radiologically impacted waste from projects or sites in the United States and have available capacity to accept the estimated volume of RIM from the site. The volumetric rate of acceptance for all facilities would be limited by the number of gondola railcars that could be loaded at or near the site, as well as the number that could be unloaded at or near the disposal facility. Off-site treatment, storage and disposal may be required in the event that hazardous wastes or regulated asbestos-containing materials (RACM) are encountered in the overburden or RIM excavated from Areas 1 and 2.

The identified facilities are also permitted to: (1) accept liquid wastes, should any stormwater accumulated in excavations during RIM excavation become contaminated and require disposal off-site; (2) accept mixed wastes if mixed wastes are encountered during excavation; and (3) treat soil and/or debris that contains hazardous waste or mixed waste.

As discussed in Section 3.2.1, the CERCLA Off-site Rule requires that waste materials removed from a CERCLA site only be placed in a facility operating in compliance with RCRA or other applicable Federal or State requirements. EPA makes such determinations every 60 days. The compliance status of an off-site disposal facility would need to be evaluated during remedial design and would need to be regularly evaluated and updated during remedy implementation.

Off-site treatment and discharge of any leachate that may be encountered or stormwater that may contact RIM during the landfill excavation activities could also be required. Initial discussions with MSD indicated that they are willing to accept such materials.

6.2.2.6.8 Availability of Necessary Equipment and Specialists

Materials, equipment and personnel required for excavation and transport of RIM to an off-site disposal facility are readily available. Trained health physics technicians and specialized equipment required to monitor personnel and environmental conditions, as well as to assist in directing the RIM excavation sequencing, are also available.

As discussed above, there are a limited number of disposal facilities that can accept these types of wastes and most of these have stringent waste acceptance criteria which may limit the ability of some of the facilities to receive the wastes.

Availability of rail service, particularly the number of gondola cars that can be switched daily by the railroad, would also affect the production rate of RIM excavation and disposal and therefore the cost.

All of the materials, equipment and personnel to construct the covers over Areas 1 and 2 RIM removal are readily available and the technologies have been generally proven through application at other landfills. The implementability and potential cost of the covers would be influenced by the availability and location of clean fill materials and/or off-site borrow sources at the time this alternative would be implemented. Potential vendors of rock, clay and soil were contacted during the development of the FS (EMSI, 2006) and during preparation of the Remedial Design Work Plan for the ROD-selected remedy (EMSI, 2008). Information obtained from the vendors at these times indicated that rock, clay and clean fill material were readily available from sources located near the site. If these local sources of cover materials become exhausted prior to remedy implementation, cover materials would have to be obtained from suppliers at greater distances from the site.

The necessary materials, equipment and personnel required for assessment and removal of RIM at cleanup levels that may be present at the Buffer Zone/Crossroad Property and to implement the institutional controls and monitoring components of this alternative are also readily available.

6.2.2.6.9 Availability of Prospective Technologies

The "complete rad removal" with off-site disposal alternative is based on proven, established, commonly used technologies. Use of prospective technologies is not currently envisioned to be part of this alternative.

6.2.2.7 Cost

Estimated capital, annual OM&M, and 30-year present worth costs for the “complete rad removal” with off-site disposal alternative are included in Appendix K-3 and summarized on Table 9. The estimated costs to conduct the “complete rad removal” with off-site disposal remedy (i.e., design costs, capital costs, and costs for monitoring during the construction period) range from $259 million up to $415 million, depending upon which disposal facility is used. The cost estimates provided in this SFS are feasibility level cost estimates; that is they were developed to a level of accuracy such that the actual costs incurred to implement this alternative should fall within a range bounded by 50% above and 30% below these estimates.

These costs do not include costs to conduct full-scale pilot testing of solids separation equipment. The estimated annual OM&M costs range from $40,000 to $412,000 per year depending upon the specific activities that occur each year (e.g., higher costs for years with additional environmental monitoring, years when landfill cover repairs may occur, and years when five year reviews are conducted). The present worth costs of the “complete rad removal” with off-site disposal alternative are projected to range between $250 million to $401 million over a 30-year period based on the OMB discount rate of 2.3%. The total non-discounted costs for this alternative over 30 years are projected to range from $262 million to $419 million.

If a fiscally-constrained approach that limits annual expenditures to $10 million were employed, the total costs for the “complete rad removal” with off-site disposal alternative at the lower cost disposal facility would increase to $286 million owing to the additional costs associated with the overall increased duration of the project. The present worth costs for the “complete rad removal” with off-site disposal alternative at the same facility would be $211 million over 30 years.

The costs for the “complete rad removal” with off-site disposal alternative were also evaluated for 200 and 1,000 year periods (without any constraints on annual expenditures). The total non-discounted and present worth costs of the “complete rad removal” with off-site disposal alternative at the lower cost disposal facility are projected to be $278 million and $252 million, respectively, over a 200-year period. The total non-discounted and present worth costs of the “complete rad removal” with off-site disposal alternative are projected to be $352 million and $252 million, respectively over a 1,000-year period at the same facility.

Unit costs associated with transportation by rail and disposal of RCRA soil, RCRA soil with radionuclide material, RCRA debris, and RCRA debris with radionuclide material would have added treatment costs in order to meet the LDRs and UTS. Based on discussions with representatives of the disposal facilities, the additional costs for treatment at their facilities are estimated to range from $45 to $153 per ton depending on the type of treatment.

For purposes of demonstrating how much shipping of mixed waste could influence costs, it was assumed that mixed waste would represent 1% of the sum of the volumes of overburden wastes and RIM for the “Complete Rad removal” with off-site disposal alternative. The added costs for handling, sampling/analysis, shipping, treating, and disposing of mixed waste for this alternative are estimated to range from $4.5 to $5 million. The range of costs primarily results from variations in the fees charged by the off-site disposal facilities and uncertainties associated with the nature of such wastes and the required method of treatment. If the volume of mixed waste is higher than the 1% of total mass assumption, the added costs would be higher.

6.2.3 "Complete Rad Removal" with On-site Disposal Alternative

This section presents the detailed analysis of the "complete rad removal" with on-site disposal alternative. As previously described in Section 5.3.4, this alternative consists of the following components:

- Excavating stockpiled soil from the current OU-2 on-site soil borrow and stockpile area and relocating the soil material onto the surface of the Closed Demolition Landfill;
- Construction of the liner system for the on-site engineered disposal cell at the site of the current OU-2 on-site soil borrow and stockpile area;
- Excavation and stockpiling of overburden in OU-1 Areas 1 and 2 in order to access the RIM;
- Excavation of RIM from the OU-1 Areas 1 and 2 that contains radionuclides above levels that would allow for unrestricted use relative to the presence of radionuclides;
- Survey and identification of the presence and extent or radiologically-impacted soil on the Buffer Zone and Crossroad Property;
- Excavation of any soil from the Buffer Zone and/or Crossroad Property that contains radionuclides at levels greater than those that would allow for unrestricted use;
- Loading and transport of the RIM and impacted soil from Areas 1 and 2 to the on-site engineered disposal cell and placement and compaction of the RIM in the cell;
- Closure of the on-site cell with a final cover configuration consistent with both the MDNR solid waste regulations and UMTRCA requirements;
- Regrading of the remaining solid waste materials within Areas 1 and 2 to meet the minimum (5%) and maximum (25%) slope criteria;
- Installation of a landfill cover meeting the Missouri closure and post-closure care requirements for sanitary landfills over Areas 1 and 2;
- Design, installation and maintenance of storm water runoff controls;
- Groundwater monitoring consistent with the requirements for sanitary landfills;

- Landfill gas monitoring and control, as necessary;
- Leachate monitoring and control for the on-site cell, as necessary;
- Institutional controls for the on-site cell to prevent land and resource uses that are inconsistent with a closed sanitary landfill site containing long-lived radionuclides and institutional controls for Areas 1 and 2 relative to the presence of solid wastes in these areas; and
- Long-term surveillance and maintenance of the landfill cover in Areas 1 and 2 and the cover of the on-site engineered cell.

An estimated 335,500 bcy of RIM would be excavated from Areas 1 and 2 for relocation and an additional approximately 7,000 bcy of RIM-impacted soil from the Buffer Zone/Crossroad Property would be excavated under this alternative. Because the volume of material would increase upon excavation due to swelling, handling and loading for transport to a new engineered disposal cell, it is estimated that, after applying the swell factor of 1.5, approximately 510,000 lcy would be transported to and disposed in the on-site engineered cell.

Once all of the RIM material above cleanup levels would have been removed from Areas 1 and 2 and the Buffer Zone/Crossroads Property, the remaining solid waste materials in Areas 1 and 2 would be regraded to meet the final closure standards for sanitary landfills and a final sanitary landfill cover would be constructed over Areas 1 and 2. This cover would not include the additional hybrid components included in the ROD-selected remedy to address the UMTRCA requirements because the RIM above cleanup levels would have been removed under this alternative.

Given that solid wastes would still be present in Areas 1 and 2, this alternative also includes installation and maintenance of surface water runon and runoff controls, groundwater and landfill gas monitoring, and institutional controls for Areas 1 and 2. Environmental monitoring of groundwater quality would be performed to ensure that groundwater quality at the perimeter of the site met State standards or other ARARs or risk-based levels. Monitoring of subsurface occurrences of landfill gas and, if necessary, implementation of contingent landfill gas extraction along the perimeter of Areas 1 and 2 would be performed to ensure that migration of landfill gas above regulatory thresholds does not occur beyond the site perimeter. Monitoring of subsurface occurrences of landfill gas and radon and, if necessary, implementation of contingent landfill gas extraction around the new engineered on-site disposal cell also would be performed to ensure that gas migration above regulatory thresholds does not occur beyond the perimeter of the area containing this unit.

Institutional controls would ensure that land and resource uses are consistent with permanent waste disposal. The use restrictions under the "complete rad removal" with on-site disposal alternative would only have to reflect the presence of solid wastes in Areas 1 and 2 because all RIM above cleanup levels that would allow for uncontrolled use of the site (from the perspective of the presence of radionuclides) would have been removed from these areas. Institutional controls reflecting the presence of both solid wastes and radioactively-impacted materials would be required for the area of the new engineered on-site disposal cell.

6.2.3.1 Overall Protection of Human Health and the Environment

Conditions at the site would be protective of human health and the environment after completion of construction of this alternative. This alternative would protect human health and the environment by limiting potential exposure to the site contaminants through the excavation and on-site disposal of RIM in a new engineered cell on-site and implementation of engineering methods and land use controls relative to the remaining solid wastes.

6.2.3.2 Compliance with ARARs

Insofar as the "complete rad removal" with on-site disposal alternative includes excavation and disposal of RIM above cleanup levels in a new, engineered on-site disposal cell and regrading of the remaining solid wastes and installation of a new landfill cover over Areas 1 and 2, the Missouri solid waste rules for sanitary landfills would be relevant and appropriate to this alternative. Assuming all of the RIM above cleanup levels would be removed from Areas 1 and 2, the UMTRCA standards would not be relevant and appropriate for Areas 1 and 2; however, they would be relevant and appropriate requirements for construction of the new on-site engineered cell. Therefore, final cover configuration for the on-site cell would need to be designed consistent with both the MDNR solid waste regulations and UMTRCA design standards. Sections 6.2.1.2.1 and 6.2.1.2.2 contain full discussions of the MDNR solid waste regulations and the UMTRCA standards.

The on-site engineered cell component of the "complete rad removal" with on-site disposal alternative would also need to comply with the applicable or relevant and appropriate requirements of NESHAPs, the Safe Drinking Water Act, Missouri Radiation Regulations for Protection Against Ionizing Radiation, the Missouri Well Construction Code, the Missouri Storm Water Regulations, and for storm water runoff under the Clean Water Act. Sections 6.2.1.2.3 through 6.2.1.2.8 contain full discussions of these regulatory requirements.

The on-site engineered cell component of the "complete rad removal" with on-site disposal alternative would not comply with the Missouri Solid Waste Regulations (10 CSR 80-3.010(3)(A)(2)), which prohibit the disposal of radioactive wastes in a permitted solid waste landfill. Specifically, 10 CSR 80-3.010(3)2 B excludes disposal of "Any radioactively-contaminated material used in or resulting from the cleanup of radioactively contaminated sites." Although the Solid Waste Regulations do not contain any provisions for acceptance of excluded wastes, it is possible that the enhancements to the design of a possible new on-site disposal cell intended to address the presence of radioactive materials could provide a basis to allow placement of what would otherwise be excluded wastes within a sanitary landfill cell was discussed earlier in Section 3.1.3.2 of this SFS. If the agencies determined that such enhancements would provide sufficient basis to overrule the waste exclusion provisions of the Solid Waste Regulations, then this alternative could potentially comply with all of the provisions of the Solid Waste Regulations.

6.2.3.3 Long-Term Effectiveness and Permanence

This criteria refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time. The "complete rad removal" with on-site disposal alternative provides engineered containment in conjunction with long-term monitoring, maintenance, and land use control designed to be effective over the long term. Although it would be contained in an engineered cell, RIM would still remain on-site under this remedy. Potential risks associated with the RIM would remain. Placing the RIM in a lined engineered cell would essentially eliminate the potential for gamma exposure, inhalation of radon gas or dust containing radionuclides or other constituents, dermal contact with impacted materials, and incidental ingestion of soil containing radionuclides or other chemicals. The liner system of the engineered cell would also prevent migration of leachate from emplaced material into underlying groundwater. Maintaining the integrity of the engineered cover would protect the underlying RIM from erosion and intrusion. An UMTRCA-compliant cover would provide a reliable method to control exposure of the RIM to surface receptors and mitigate potential migration of the covered materials.

Long-term site management plans and institutional controls would be made as robust and durable as possible. Long-term groundwater monitoring would be effective in verifying a remedy is performing as required and groundwater is protected. While not anticipated, even with the loss of institutional controls, the landfill cover would passively prevent potential contaminant migration and human exposures for an indefinite period.

By moving the contamination from the Buffer Zone/Crossroad Property to the engineered disposal cell, the remedy provides long-term effectiveness and permanence relative to the Buffer Zone/Crossroad Property.

6.2.3.3.1 Magnitude of residual risk

The calculated lifetime risks following the exposure scenarios in the risk assessment after the RIM had been removed from Areas 1 and 2 and consolidated into the on-site engineered cell and the remainder of this remedial alternative has been implemented (Appendix H) are as follows:

- Area 1: $<1 \times 10^{-7}$ for year 1 and $<1 \times 10^{-7}$ for year 1,000.
- Area 2: $<1 \times 10^{-7}$ for year 1 and $<1 \times 10^{-7}$ for year 1,000.
- On-site Cell: 2.4×10^{-7} for year 1 and 1.5×10^{-6} for year 1,000.

These calculated risks are attributable to gamma radiation and radon emissions from any radionuclide occurrences that would remain in Areas 1 and 2 and in the RIM located in the on-site cell after implementation of the "complete rad removal" with on-site disposal alternative. Any residual RIM materials in Areas 1 and 2 would be present at levels which do not require remediation, and the on-site disposal cell would provide full containment of the relocated RIM materials. Additionally, the RIM in both locations would be capped, and access to and future use of the waste areas would be limited by site access restrictions and institutional controls. Direct contact with the RIM in the on-site disposal cell and the residual RIM under the cap at Areas 1 and 2, and exposure by ingestion, inhalation, or dermal contact with such materials, is not expected to occur. These are the primary exposure pathways for any non-radiological COCs which may be mixed with the relocated RIM in the on-site disposal cell or which may be present in the landfill wastes which will remain in Areas 1 and 2 after removal of the RIM. Because no complete exposure pathway would exist for such materials after completion of the on-site disposal cell and cap construction in Areas 1 and 2 after relocation of the RIM above cleanup levels, the landfill waste materials would not be expected to produce non-carcinogenic effects or carcinogenic risks.

The calculated risk levels are below or within (for year 1,000 at the on-site cell) EPA's target risk range of 1×10^{-6} to 1×10^{-4}, and the magnitude of the radiological carcinogenic risk from RIM in the on-site disposal cell and residual RIM in Areas 1 and 2 is acceptable. These risks do not specifically include potential exposures from non-radiological landfill wastes after construction is complete; however those wastes would also be covered by caps which would prevent exposures. Additional information regarding the risk assessment calculations is presented in Appendix H.

After soils containing radionuclide concentration above cleanup levels are removed from the Buffer Zone/Crossroad Property, residual risks posed by the remaining radionuclide impacted soil on these properties, if any, should be indistinguishable from variations in background levels.

6.2.3.3.2 Adequacy and reliability of controls

The on-site engineered cell, in conjunction with long-term OM&M, is a reliable containment system that would be expected to be protective of human health and the environment. Long-term OM&M would include routine cover and storm water ditch inspection and service, if necessary, to mitigate erosion; OM&M of a landfill gas collection and treatment system, as needed; and routine servicing of a leachate collection system. Long-term monitoring would also be implemented to assess compliance with environmental performance standards. The performance of these engineering controls would also be reevaluated during statutory five-year reviews.

The current Covenants and Restrictions for Areas 1 and 2 would be adequate to provide protection to human health. The permanence of these restrictions is assumed to be adequate for the foreseeable future as both EPA and MDNR approval are required to remove or modify the restrictions. The adequacy of the restrictions would be continually evaluated during the statutory-required five-year reviews.

6.2.3.4 Reduction of Toxicity, Mobility or Volume through Treatment

Reduction of toxicity, mobility, or volume through treatment refers to the anticipated performance of the treatment technologies that may be included as part of a remedy. Overall, the "complete rad removal" with on-site disposal alternative is a containment remedy and therefore generally would not reduce the toxicity, mobility, or volume of the waste material through treatment.

As discussed in Section 4, radionuclides are naturally occurring elements which cannot be neutralized or destroyed by treatment. Occurrences of radionuclides within Areas 1 and 2 are dispersed within soil material that is further dispersed throughout the overall, heterogeneous matrix of municipal refuse, construction and demolition debris, and other non-impacted soil materials. Consequently, ex situ treatment techniques are considered impracticable. In addition, the heterogeneous nature of the solid waste materials and the dispersed nature of the radionuclide occurrences within the overall solid waste matrix make in situ treatment techniques impracticable. The remedy for the Buffer Zone/Crossroad Property also would not reduce toxicity, mobility, or volatility through treatment technologies.

The only treatment technology that may potentially be applicable to this alternative is physical separation of impacted soil from the solid wastes using solids separation techniques such as hand picking for large bulky items and various fixed, vibrating, or rotating screens among others (see prior discussion in Section 4.3.3.3.1). Physical separation would not decrease the mobility or toxicity of the radiologically impacted materials, but has the potential to separate existing RIM from non-radiologically impacted materials. As previously discussed, solids separation techniques would need to be pilot-tested during remedial design to ascertain the potential effectiveness and implementability of this technology. Of particular interest in conducting pilot testing with material from Areas 1 and 2 would be obtaining an estimate of the degree of RIM volume reduction that could be achieved, assessing the moisture content of the filled material, determining the fraction of soil that would be contained in or adhered to the segregated refuse, and determining the residual levels of radioactivity that would be present in the non-soil refuse after screening out the soil fraction. Assuming that solids separation proved to be an effective and implementable technology (that is, it could effectively separate the radiologically-impacted soil from the other landfilled waste materials such that the other landfilled wastes would contain radionuclide activities below the levels that would allow for unrestricted use), it has the potential to reduce the volume of radiologically-impacted material that would need to be transported to and disposed in a new engineered on-site disposal cell. However, little is known about the potential application of a soils separation technology to this situation and it is possible that pilot testing could demonstrate the treatment to be ineffective for separating RIM from non-radiologically impacted materials. At this stage of analysis, neither the SFS estimated costs nor the estimated schedules include any allowance for solids separation pilot testing or implementation.

In the event that hazardous wastes are encountered during implementation of the remedy, such materials would be separated from the other solid wastes and subjected to waste profiling to determine the appropriate treatment and disposal requirements. To the extent that hazardous wastes or mixed wastes are encountered, they would be shipped off-site and would be treated at the disposal facility in accordance with the hazardous waste regulations (e.g., EPA's LDR program and UTS) and in accordance with the receiving facility's permits and standard operating procedures. After arriving at an off-site disposal facility and undergoing a waste receipt analysis, RCRA soil and RCRA soil with radionuclide material would be stabilized prior to placement in a disposal cell. Depending on the physical characteristics of debris, RCRA debris and RCRA debris with radionuclide material would undergo either micro- or macro-encapsulation prior to placement in a disposal cell. To the extent that treatment of the hazardous waste or mixed waste would be required for off-site disposal, stabilization or encapsulation treatment would result in a reduction of the mobility of the hazardous waste and radiologically-impacted components of the mixed waste. Toxicity and volume would not be reduced by these technologies but may be reduced by other technologies potentially applicable to hazardous wastes that do not contain RIM such as incineration of drummed solvents if such wastes were encountered during implementation of the remedial action at the site.

Section 6.2.2.4 contains a full discussion of the procedures, protocols and concerns associated with the off-site shipment of hazardous wastes or mixed wastes.

6.2.3.5 Short-Term Effectiveness

This alternative poses significant potential short-term risks as described below. During a public meeting held as part of the ROD-selected remedy process, EPA identified and discussed the following short-term risk issues for waste excavation: waste handling, sorting and stockpiling; water management; noise, odor and windblown trash; worker health and safety (PPE, gamma exposure, physical stress, physical hazards, workplace monitoring); contaminant migration/spreading (fugitive dust and airborne migration, fugitive dust control and water application, leachate generation, equipment decontamination water, and water from open excavations); and waste hauling and transportation issues/truck decontamination (transfer facilities, increased local traffic, waste handling on public roads, interstate transport by rail, DOT requirements, safety issues).

6.2.3.5.1 Protection of the Community During Remedial Actions

The risk assessment (Appendix H) includes an estimate of the projected incidence of transportation accidents associated with each SFS alternative. For the "complete rad removal" with on-site disposal alternative, the projected incidence of transportation accidents associated with importing of materials for construction of the multi-layer landfill cover is 0.79, meaning that there is a 79% chance of at least one traffic accident if this alternative were implemented. This risk is wholly associated with the delivery of construction materials to the site because with the possible exception of hazardous waste or mixed wastes which must be transported off-site for appropriate treatment or disposal, all RIM materials and solid waste will remain on-site in either the new engineered disposal cell or the post-RIM removal landfills at Areas 1 and 2.

Disturbing the waste material may expose the community to radioactive waste, methane and radon gas, dust and particulates and cause an undesirable release of odors. Excavation of existing waste materials would undoubtedly result in odor emissions during the period of time that existing wastes may be handled or exposed. Mitigation of odors through engineering means is limited.

For the "complete rad removal" with on-site disposal alternative, vehicle operations for excavation, loading, and transport of the RIM to an on-site disposal facility, for construction and operation of the new on-site disposal cell and landfill regrading and cover construction in Areas 1 and 2, and for import of materials to be used to construct the on-site disposal cell and the multilayer landfill cover for Areas 1 and 2 are projected to emit approximately 17,900 tons of carbon dioxide to the atmosphere (Appendix I).

As Areas 1 and 2 would be excavated overburden would be stockpiled and stored, and RIM would be moved and placed in the on-site cell. During these activities the nuisance attraction to and congregation by birds at and above the affected areas could be problematic unless effectively controlled. The main concern would be the potential for increased bird strikes to aircraft approaching and departing from the Lambert-St. Louis International Airport. Mitigation measures such as excavation best management practices, which include application of daily soil cover and/or placement of tarps over areas of exposed waste, visual and auditory frightening devices, or wire or monofilament grids positioned over exposed refuse to prevent bird access, could be implemented to minimize bird attraction to and congregation at and above the disturbed areas.

Excavation of waste materials from Areas 1 and 2 would require removal of the existing landfill cover and overburden from Areas 1 and 2 and portions of adjacent areas of OU-2. Excavation of overburden and RIM would create depressions in the landfill area during the period of time required to remove the RIM and regrade and cover the remaining landfill wastes. Precipitation that falls on the landfill while such depressions are open would potentially flow into and accumulate in the depressions. Any accumulation of precipitation in depressions created during waste excavation could result in infiltration of precipitation runoff through the underlying waste materials, which could result in leaching of VOCs or other soluble contaminants from the waste materials. Accumulation could be significant during a heavy rainstorm as the maximum historical 24-hour rainfall for the St. Louis area ranges from a low of 3.7 inches in November to a high of 8.8 inches in August (NOAA, 2011). Such leaching potentially could contaminate the underlying groundwater and create a plume of non-radiological contamination that could flow off-site, potentially exposing receptors who are not currently exposed and who would not be expected to be exposed in the future under existing site conditions or under the ROD-selected remedy.

As Areas 1 and 2 would be excavated and RIM placed in the on-site cell, storm water controls would be implemented in accordance with the Missouri Storm Water regulations to protect the community. During construction, consideration would be given to minimizing the areas of excavation that would be open and exposed to waste materials at any given time. Temporary diversion berms using daily cover material would also be constructed above the open excavation areas on the previously excavated (and temporarily covered) surface of any excavation depressions in order to divert precipitation runoff around the open excavation to prevent the runoff from contacting uncovered waste materials. Precipitation that would contact uncovered waste materials would flow into the low point of the excavation and be pumped out into temporary storage tanks using portable gas-driven pumps. Samples from each tank would be collected and sent to a laboratory for analysis. The stored water would be directly discharged or treated and disposed appropriately based on the analytical results.

6.2.3.5.2 Protection of Workers During Remedial Actions

This alternative would entail significant excavation, handling, loading and transport of RIM at the site and therefore would pose both significantly increased radiological exposure risks as well as construction safety risks to on-site workers.

Workers involved in the excavation activities would be subject to potential short-term risks. Possible short-term impacts associated with excavation and regrading of the RIM include the following potential risks: exposure of workers to contaminated waste; excavation/trenching instability; stormwater runoff entering areas where waste is exposed resulting in the exposure of workers to contact storm water; and odor emissions or other aesthetic issues arising from exposed waste. Worker exposures would be addressed through development and implementation of a site safety plan and performance of personnel and environmental monitoring during implementation of remedial action. Workers would be protected during construction by adhering to OSHA practices; however, as this alternative entails extensive excavation, handling and on-site transportation of radiologically-impacted materials, OSHA work practices and personal protective equipment may not provide full protection against exposure to external gamma radiation.

The risk assessment (Appendix H) presents an evaluation of potential risks to site-workers that may occur for each alternative. These include risks from industrial accidents, exposure to carcinogenic substances, and projected radiation exposures. For the "complete rad removal" with on-site disposal alternative, the projected incidence of industrial accidents is 9.0 over the life of the project. The projected carcinogenic risk to the maximally exposed individual is 7.4×10^{-4} and the projected radiation dose to a remediation worker is 260 mrem/yr (Appendix H).

Excavation would require construction workers and equipment that would disturb the overburden soil and underlying waste materials. Dust control measures would be required to limit worker exposure to fugitive dust during construction.

6.2.3.5.3 Environmental Impacts

No measurable long-term impacts to plants or animals in surrounding ecosystems are expected from this alternative. As noted in the BRA (Auxier, 2000), some of the ecosystems present at the landfill are the result of existing institutional controls and other limitations on land use within or adjacent to OU-1 that have allowed field succession to take place. With respect to short-term environmental impacts during performance of this alternative, disturbance of the landfill surface would destroy those portions of the habitats that currently exist on the surface of Areas 1 and 2, forcing wildlife to migrate to other areas. Vegetative cover would be placed on the site as a part of the final cover, and the landfill would be allowed to return to an early-stage field ecosystem with periodic mowing and maintenance.

6.2.3.5.4 Ability to Monitor Effectiveness

Measurements of gamma radiation and radon flux through the newly constructed landfill cover would be made on Areas 1 and 2 and the new engineered disposal cell after construction is complete. Regular monitoring of groundwater quality would be performed at appropriate locations around Areas 1 and 2 and the new engineered disposal cell. Measurements of subsurface occurrences of landfill gas and radon levels would be performed along the boundaries of the area of the new engineered disposal cell to verify that off-site gas migration above regulatory thresholds does not occur.

6.2.3.5.5 Time Until Remedial Action Objectives are Achieved

The RAO of preventing direct contact with landfill contents and exposure to radiation associated with anticipated future uses of the West Lake Landfill and adjacent areas would be met immediately upon implementation of an amendment to the land use covenants. Achievement of this RAO would be further ensured once the RIM is removed from Areas 1 and 2 and the Buffer Zone/Crossroads area, construction of the new landfill cover over Areas 1 and 2 is conducted, and construction and closure of the new engineered disposal cell are completed.

The RAOs of (1) minimizing infiltration and any resulting contaminant leaching to groundwater; (2) controlling surface water runoff and erosion and decreasing the potential for erosion and subsequent transport of radiologically impacted materials; and (3) controlling radon and landfill gas emissions from Areas 1 and 2 would be met once RIM excavation and disposal into the new disposal cell is complete and construction of the new landfill cover over Areas 1 and 2 and of the new engineered disposal cell are completed.

Initiation of this alternative would require significant planning and permitting due to the need to re-locate the existing soil borrow stockpile and the limited space available for relocation of this stockpile, the need to complete construction of at least a portion of the new engineered disposal cell prior to implementation of RIM excavation, removal and disposal, the extensive logistics associated with identifying, handling, classifying and loading the materials for transport to and disposal in the new cell, and the need to coordinate and route truck traffic associated with hauling of waste from Areas 1 and 2 around truck traffic associated with other site operations, among other factors. Preparation of the RD should be completed within approximately 1 year of authorization to proceed with the RD. (RD could take significantly longer if full-scale pilot testing of solids separation equipment were to be performed.) The RAOs would be achieved upon completion of construction which is estimated to be finished within approximately 4.6 years of approval of the RD. Therefore, the remedial action objectives should be achieved within 5.6 years of approval to proceed with the RD (Appendix J-3).

If this alternative proceeds on a fiscally-constrained approach that limits annual expenditures to $10 million, the overall duration for planning and construction of the "complete rad removal" with on-site disposal alternative would be 13 years. The evaluation of a construction schedule constrained by a $10 million per year expenditure limitation is included because there are limits to the annual amount of money provided by the Superfund program to any given Fund-lead site. The figure of $10 million per year was identified by EPA as a reasonable estimate of the maximum annual funding that would be available for OU-1 based on past experience at other large Fund-lead sites.

The projected construction schedule and the cost estimate for the "complete rad removal" with on-site disposal alternative are highly dependent on the waste material swell factor. For purposes of this SFS, a swell factor of 1.5 has been assumed. A swell factor greater than 1.5 would result in an increase to the overall construction schedule. The projected construction schedule and estimated cost for the "complete rad removal" with on-site disposal alternative are also sensitive to the rate at which soil in the existing soil stockpile and soil excavated for construction of a new engineered disposal cell can be transported across the site and the rate at which RIM could be transported from Areas 1 and 2 to a new disposal cell. The rates of material transport used to develop the cost estimates (Appendix K-4) would result in between approximately 160 and 360 off-road haul truck trips per day which translates into an off-road haul truck passing any given point along the site roads or through site road intersections approximately every 40 to 80 seconds during the day. When combined with the number of truck trips per day that are required to deliver materials for construction of the engineered disposal cell and the final covers for Areas 1 and 2 and the engineered disposal cell, along with the existing truck traffic associated with the transfer station, cement and asphalt plant operations, there would be an extensive amount of truck traffic on the site roads. The actual rate of truck traffic may be limited by the site road and intersection capacities, which could result in a greater duration and higher costs for completion of construction of the "complete rad removal" with on-site disposal alternative. Evaluation of site road and intersection capacities and vehicle usage rates would need to be performed as part of RD.

6.2.3.6 Implementability

This alternative would involve construction of an on-site engineered cell, excavation and stockpiling of overburden in Areas 1 and 2, excavation of RIM from Areas 1 and 2, on-site transport and placement of the RIM in the on-site cell, repair and restoration of the disturbed portions of the OU-2 landfill units adjacent to Areas 1 and 2, grading of the surfaces and installation of upgraded landfill covers over the excavated areas of Areas 1 and 2, installation of a cover system over the on-site cell, long-term monitoring and maintenance of the covers over Areas 1 and 2 and the on-site cell, long-term monitoring of landfill gas and groundwater and surface water quality associated with Areas 1 and 2, and long-term monitoring of landfill gas, radon, and groundwater and surface water quality related to the on-site cell.

Several significant technical and administrative implementability issues associated with the RIM excavation, on-site transport to an on-site cell, and placement in an engineered on-site cell are anticipated if the "complete rad removal" with on-site disposal alternative were to be implemented. These include the following:

- Reduced excavation production rates and increased volume of RIM subject to excavation and relocation, resulting from application of daily cover over an extended excavation schedule;
- Limited locations and areas for siting and constructing a new engineered landfill cell;
- Uncertainty regarding the geologic and geotechnical conditions of the potential site for a new engineered landfill cell;
- Uncertainty regarding the constructible size and volumetric capacity of a new engineered landfill cell;
- Need for off-site handling of excess RIM or of mixed or liquid wastes encountered or created during excavation of RIM and placement of excavated waste in an on-site cell;
- Even with use of mitigation procedures (e.g., movable cover, netting) there may be increased potential for aviation-bird strikes as a result of excavation of RIM contaminated putrescible or organic solid waste and overburden, and placement of excavated wastes in a new engineered cell located within the flight path of the Lambert – St. Louis International Airport;
- Ability to remove all of the RIM due to the close proximity of some of the deeper RIM at Area 2 to adjacent landfill units; and
- Intersection of the on-site haul route from Areas 1 and 2 to the on-site cell with the access road for the existing on-site solid waste transfer station and concrete and asphalt batch plants.

Design and construction of post-RIM excavation landfill covers on Areas 1 and 2 and the new engineered cell, with subsequent monitoring and maintenance, are not expected to pose any implementability challenges. Materials and services necessary for the regrading and construction of the final landfill covers over Areas 1 and 2 after RIM removal, and the final cover and closure of the on-site cell after RIM disposal are available and the technologies have been proven through application at other landfills. Design and construction of landfill covers post RIM removal over Areas 1 and 2 and over the new on-site cell following RIM disposal are not expected to pose any significant implementability challenges. The actions included for the Buffer Zone/Crossroad Property are implementable. Monitoring of the cover surfaces, landfill gas, groundwater, and surface water are proven methods for demonstrating the long-term effectiveness of the covers placed over Areas 1 and 2 and are easily implemented.

6.2.3.6.1 Ability to Construct and Operate the Technology

In general, construction of a lined/covered engineered cell, excavation of waste materials, and placement/compaction of waste materials in a cell are standard technologies. However, there are unique circumstances at the West Lake Landfill site which would complicate implementation of new engineered cell construction and standard excavation technologies.

All of the liner and cover materials as well as the equipment and personnel to construct the on-site cell are readily available and the technology has been proven through application at other landfills. Design and construction of the cell liner and cover would not be expected to pose any technical implementability challenges.

Excavation and placement of RIM in the on-site cell would be expected to present implementability challenges, specifically those associated with the excavation and handling of contaminated materials; management of fugitive dust and potential odor; mitigation of bird hazards; management and treatment of stormwater exposed to the RIM during excavation; and identifying, segregating, and disposing off-site of any hazardous materials, potentially including asbestos, encountered during RIM excavation. Directing and controlling the RIM excavation using scanning and sampling techniques would greatly restrict excavation production rates.

The conceptual design for the on-site cell contemplated in this SFS assumes that an approximate 10-acre area located outside of the geomorphic floodplain in the undeveloped portion of the West Lake Landfill property in the area that contains an on-site soil borrow area and soil stockpile would be the only potentially suitable area for constructing an on-site cell. Geological and geotechnical field investigations and piezometric surface data collection to determine site suitability would be completed as pre-design studies during RD. If the results of the pre-design investigations indicate that the assumed location for the on-site cell is not suitable, then this alternative would not be implementable.

The estimated available landfill disposal volume in the on-site cell conceptual design is based on a bottom liner elevation that is situated at the minimum allowable separation from extrapolated piezometric surface in this area. However, since the on-site cell area was not within the scope of past hydrogeologic characterization studies, there is more uncertainty in the piezometric conditions, and the actual conditions would influence the bottom grades of the on-site cell. For example, if the measured piezometric groundwater surface elevation under the proposed location for the on-site cell is 2.3 or more feet higher than the elevation assumed, the capacity of the on-site cell could be insufficient (based on current quantity estimates) to accommodate the total volume of RIM excavated from Areas 1 and 2, radiological soil from the Buffer Zone/Crossroad Property, and daily cover needed during RIM excavation and placement in the on-site cell. This could require re-design of the on-site cell and/or require that some RIM be disposed off-site. Similarly, if the RIM volume excavated during implementation of the remedial action for this alternative is significantly greater than the RIM volume calculated in this SFS such that the capacity of the on-site cell is exceeded, the volume of excess RIM would be required to be transported and disposed at an off-site facility. If solids separation technologies were demonstrated to be implementable and effective in reducing the volume of RIM requiring re-disposal, it is more likely that the depth of the on-site cell could be reduced, which could alleviate potential concerns regarding the depth of groundwater in the area of the proposed cell.

There are questions regarding the ability to remove all of the RIM from Area 2 due to the depth of the RIM and proximity to the OU-2 closed construction and demolition waste landfill (the C&D landfill) and the OU-2 inactive solid waste landfill. RIM is not present in these other landfill units, but it will be necessary to excavate into these units in order to access some of the deepest RIM in Area 2. Figure 36 displays the anticipated extent of excavation from Area 2 and the overlap with adjacent OU-2 landfill units. Figure 37 presents two profile views of the extent of excavation into the C&D landfill and inactive solid waste landfill that would be required to remove the RIM from Area 2. Upon completion of removal of the RIM from OU-1, disturbed portions of the adjacent landfill units in OU-2 would need to be repaired and restored to a condition that meets or exceeds existing closure conditions prior to implementation of this alternative and subject to the requirements of any additional remedial actions required for either of these areas, as part of implementation of the OU-2 remedy. Although sheet piling as a site-wide replacement for excavation sidewall sloping was evaluated as part of this SFS and found not to save money or time compared to sloping the sidewalls, small areas of sheet piling where the OU-1 Area 2 RIM is closest to the OU-2 adjacent landfill units may prevent or minimize encroachment of excavation slopes into the OU-2 units, and therefore might prove economical for the "complete rad removal" with on-site disposal alternative. Such targeted use of sheet piling would be evaluated during remedial design.

RIM excavation and placement in articulated off-road construction trucks for subsequent transfer to the on-site cell is expected to present implementability concerns, challenges, and risks, specifically those associated with the following:

- Excavation and handling of contaminated materials;
- Safety risks associated with encountering methane gas during excavation;
- Management of fugitive dust and potential odor;
- Mitigation of bird hazards;
- Management and treatment of stormwater exposed to RIM during excavation; and
- Identifying, segregating, and disposing off-site of any hazardous wastes, polychlorinated biphenyls (PCBs) or RACM that may be encountered during RIM excavation.

If hazardous wastes, PCBs, or RACM are encountered during excavation of RIM, these materials would need to be segregated from the other waste materials, characterized, and transported to an off-site disposal facility. Additional health and safety procedures would be required during excavation of these materials. These materials could require treatment prior to disposal at the off-site disposal facility.

Directing and controlling the RIM excavation process using radiological scanning and sampling techniques would significantly impact overburden and RIM excavation production rates. Based on experience in excavation of radiologically-impacted waste at other sites, a reduction in efficiency is expected for overburden excavation and a greater reduction is expected for RIM excavation.

Daily soil cover and tarps would need to be placed over open excavation areas and stockpiled overburden to minimize dust, odor, and the attraction of birds and other wildlife. The proximity of Areas 1 and 2 to Lambert-St. Louis International Airport poses a potential risk to aviation operations. The St. Louis Airport Authority and the US Department of Agriculture have identified as a problem the potential for increased bird activity in conjunction with waste excavation at West Lake and the resultant increased risk of aviation bird strikes. Bird nuisance mitigation measures such as best management practices (including, but not limited to, daily soil cover, and tarps over exposed overburden and wastes), visual and auditory frightening devices, and wire or monofilament grids strung over exposed refuse to prevent bird access, could be evaluated for use at Areas 1 and 2, and at the new landfill site. The size of open excavations may limit the constructability of wire or monofilament grids. Careful evaluation of material properties would be necessary during remedial design to assure that the appropriate strength and elasticity of materials are considered, that the materials are available, and that grids can be reasonably constructed.

Effective storm water controls could be readily implemented using conventional construction equipment and materials. Temporary berms to direct stormwater away from open excavations would need to be constructed and precipitation accumulation in depressions created by the excavation activities would need to be pumped out and managed. Direct precipitation or runoff that may contact waste material could become contaminated with soils or wastes containing thorium or radium. These elements would be entrained in colloidal material that would readily precipitate in a lined detention pond in the location of the closed former leachate lagoon. At the end of excavation, when all RIM above cleanup levels would had been excavated and placed in the on-site cell, pond sediment and the liner would also need to be removed and placed in the on-site cell. Affected areas of the detention pond would then need to be reconstructed.

Excavated RIM exposed to precipitation would be subject to the paint filter liquids test (PFLT) to determine if free liquids exist prior to being transported and disposed in the on-site cell. If the excavated material does not pass the PFLT, a dewatering area would need to be staged and collected water treated and/or disposed of, potentially off-site. A location for a potential dewatering area has not been identified and time and cost for operating or a dewatering system are not included in the current estimates.

Because of the significant volume of truck traffic in and out of the West Lake Landfill property associated with the solid waste transfer station and other entities who lease property at the site, operation of a controlled intersection or construction of an overpass over the access road between the landfill entrance and the solid waste transfer station would be necessary to avoid potential collisions between off-road haul trucks used to carry the RIM to the on-site cell and solid waste transfer station and cement/asphalt plant vehicles. Construction of an overpass to be used by the articulated off-road construction trucks in transporting excavated RIM from Area 2 to the on-site cell could be a potential method to reduce the potential for accidents and interruption in the flow of truck traffic in and out of the West Lake Landfill property. Site constraints may require that the overpass be partially constructed over filled material, potentially waste, and pre-design studies would be necessary to determine a location and foundation requirements for the overpass. The overpass would need to be constructed in advance of excavation activities, creating a delay in work on-site. In addition, construction of the overpass could be impacted by ongoing site activities. An alternative to an overpass could be a stop-light on site to control the traffic crossing. Such an option would create delay in movement of the RIM from the excavation point to the on-site cell and delay for solid waste transfer station and cement/asphalt plant vehicles.

Construction of a temporary gravel access road on the top of the existing cover of the Former Active Sanitary Landfill “North Quarry Pit,” wide enough such that two large articulated off-road construction trucks could pass each other traveling in opposite directions, would be necessary so that excavated RIM from Areas 1 and 2 could be transported to the on-site cell. The access road would have to be designed and constructed to prevent differential settlement of filled materials under the cover and to not affect the integrity of the existing sanitary landfill cover. As discussed below, MDNR concurrence may be necessary for this activity. After all excavated RIM was transferred to the on-site cell, materials used to construct this temporary access road would have to be removed and the cover of the Former Active Sanitary Landfill “North Quarry Pit” restored.

Upon completion of the RIM excavation and removal process at Areas 1 and 2, the necessary regrading of the remaining landfills and placement of final cover, as would be conducted for Areas 1 and 2 after RIM removal, is implementable and has been performed at other landfills including CERCLA sites. Environmental monitoring is routinely performed at most sites.

6.2.3.6.2 Reliability of the Technology

Construction of a lined/covered engineered cell, excavation of waste materials, placement/ compaction of waste materials in an engineered cell, and construction of an engineered cover over an engineered cell are reliable technologies that have been implemented at other CERCLA sites. Landfill cover systems, such as the covers that would be implemented over Areas 1 and 2 after RIM removal and over the on-site cell after RIM placement, and which are designed and constructed consistent with state and federal regulations and whose post-closure care is implemented in accordance with current regulatory guidance, have been demonstrated to be reliable at (1) minimizing percolation and infiltration of precipitation; (2) minimizing leachate generation; (3) minimizing impacts to groundwater quality; (4) minimizing impacts to surface water quality and quantity; (5) minimizing erosion of cover material; and (6) minimizing uncontrolled releases of landfill gas. Landfill cover systems have been demonstrated to be reliable methods for isolating waste materials. Similarly, site access controls have been demonstrated to be reliable mechanisms to prevent unauthorized access to a site.

Bird nuisance mitigation measures such as best management practices (including, but not limited to, daily soil cover, and tarps over exposed overburden, RIM and waste), visual and auditory frightening devices, and wire or monofilament grids strung over exposed refuse to prevent bird access, are demonstrated reliable technologies under proper operating and excavating conditions. While visual or auditory frightening devices can be effective in the short-term, birds tend to habituate to deterrents over time, causing the deterrent to lose effectiveness. Frequent relocation of predatory birds and predator effigies and/or altering the timing of auditory activation may help, but long-term effectiveness in not assured. In addition, the FAA has stated that "To date, no such [putrescible waste] facility has been able to demonstrate an ability to reduce and sustain hazardous wildlife [birds] to levels that existed before the putrescible-waste landfill operations began operating." (FAA, 2007).

Storm water controls are well-established technologies that are implemented at most landfill sites. For this alternative, gravity precipitation of suspended solids potentially containing radionuclides is also a well established and reliable technology.

6.2.3.6.3 Ease of Undertaking Additional Remedial Actions, if Necessary

The only anticipated additional remedial actions that may need to be taken for the "complete rad removal" with on-site disposal alternative would be maintenance activities needed to sustain the cover system ,repair areas of differential settlement or address erosion, or possible implementation of a contingent landfill gas control system. Differential settlement or compaction of the underlying remaining waste materials after RIM excavation and RIM placement in an on-site cell could necessitate placement of additional soil over all or portions of Areas 1 or 2 or the on-site cell to maintain the required final grades. Long-term monitoring and maintenance of the landfill covers at other Superfund sites and at non-Superfund site solid waste landfills is typically required to assess whether differential settlement or surface erosion of the cover has occurred over time. Long-term monitoring and maintenance including cover inspection and repair of the covers over Areas 1 and 2 as well as the cover of the on-site cell will be part of this alternative. Cover repair, if necessary, would be easy and would involve placement of additional fill, regrading, and revegetation of the repaired area.

In the event that monitoring of subsurface landfill gas and radon detects the presence of gas levels above regulatory thresholds along the perimeter of the landfill, a landfill gas control system could be implemented as an additional remedial action. Implementation of a contingent landfill gas control system would entail drilling and installation of gas extraction wells, installation of conveyance piping, installation and operation of landfill gas extraction blowers and a landfill gas treatment (flare) system, and/or possible use of a carbon adsorption system to remove radon from the extracted gas stream. Installation of a contingent gas system can easily be performed as a future action. Any disruption to the final landfill cover resulting from the installation of a contingent gas extraction system would need to be repaired. Such activities are commonly and routinely undertaken at solid waste disposal sites.

Bird nuisance mitigation measures such as best management practices (including, but not limited to, daily soil cover, and tarps over exposed waste), visual and auditory frightening devices, and wire or monofilament grids strung over exposed refuse to prevent bird access, can be applied to additional excavated and/or filled area in the event that additional waste volume is encountered.

Storm water management measures other than those using conventional earth-moving equipment, piping, pumps, liners, filtration and carbon adsorption water treatment equipment, rip-rap, and pond outlet structures are not anticipated.

6.2.3.6.4 Ability to Monitor Effectiveness of Remedy

Demonstrating the effectiveness of the cover systems constructed over Areas 1 and 2 after removal of RIM above cleanup levels would be accomplished by implementing monitoring programs for the cover surface, landfill gas, groundwater and surface water programs as previously described in Section 5.2.2. Demonstrating the effectiveness of the on-site cell liner and cover systems would be achieved by implementing monitoring programs for the cover surface, landfill and radon gas, groundwater and surface water. As discussed under the ROD-Selected Remedy, these types of monitoring programs have been proven at demonstrating cover and cell effectiveness and are easily implemented.

6.2.3.6.5 Ability to Obtain Approvals from Other Agencies

Implementation of the "complete rad removal" with on-site disposal alternative would require approvals from other agencies, including the following:

- Approval from the FAA to conduct waste excavation activities within 10,000 feet of an active airport runway: FAA Advisory Circular AC 150/5200-33B dated August 28, 2007, "Hazardous Wildlife Attractants On or Near Airports," recommends "against locating a MSWLF (municipal solid waste landfill) within the separation distances identified in Sections 1-2 through 1-4. The separation distances should be measured from the closest point of the airport's AOA (airport operations area) to the closest planned MSWLF cell." AC 150/5200-33B, p. 4. The separation distances referenced are 5,000 feet from the end of a runway for airports serving piston-powered (propeller) aircraft; 10,000 feet for airports serving turbine-powered (jet) aircraft; and 5 miles of protection from hazardous wildlife movement for approach, departure and circling airspace. The FAA strongly recommends against allowing waste disposal operation within 10,000 feet of a jet aircraft runway if the material contains putrescible waste and so has the potential to attract wildlife that could threaten air traffic. The excavation of RIM material containing putrescible waste within 10,000 feet of the westernmost runway (11/29, formerly known as 12W/30W) at the Lambert-St. Louis International Airport, as would occur during excavation of the RIM in Areas 1 and 2, is limited by the need to mitigate potential bird activity during excavation to address the requirements of the FAA Advisory Circular and to comply with the same prohibitions in the Missouri solid waste regulations. It may be necessary to work directly with the FAA and MDNR to identify specific bird mitigation measures during implementation.

- Approval of St. Louis Airport Authority relative to obtaining a release for the Negative Easement and Declaration of Restrictive Covenants Agreement. This restrictive covenant runs to the benefit of the City of St. Louis as owner of Lambert-St. Louis International

Airport (Appendix A) and may be waived by the City in its sole and absolute discretion. Excavation of RIM from Areas 1 and 2 poses a potential to increase the bird populations at the site if mitigation procedures are not employed or prove ineffective. An increase in bird populations presents a greater potential for aircraft-bird strikes. The STLAA and USDA have identified this as a concern relative to construction and operation of a new on-site disposal cell. Based on the STLAA's position stated at a discussion held in September 2010 and in the STLAA's September 20, 2010 letter to EPA, STLAA acceptance of RIM waste excavation would not be likely if bird activity were to increase. It may be necessary to work directly with the FAA to address the Airport Authority concerns, either by amending the FAA ROD, amending the Negative Easement, requiring specific bird mitigation measures during implementation, or making other changes to secure STLAA's cooperation;

- The Negative Easement and Restrictive Covenant recorded against the majority of the West Lake Landfill property, including the only area available for an on-site engineered disposal cell, provides that there shall be no new or additional depositing or dumping of putrescible waste at the property. This restrictive covenant runs to the benefit of the City of St. Louis as owner of Lambert-St. Louis International Airport (Appendix A) and may be waived by the City in its sole and absolute discretion. Based on the positions stated by the STLAA at the September 2010 meeting and in its September 20, 2010 letter, it is not expected that the City would waive the restrictive covenant, and therefore the administrative implementability of this alternative is uncertain. It may be necessary to work directly with the FAA and the Airport Authority to address these concerns, either by amending the FAA ROD, amending the Negative Easement, requiring specific bird mitigation measures during implementation, or making other changes to secure STLAA's cooperation;

- Missouri MSWLF siting regulations require landfill units operating within 10,000 feet of a commercial airport to demonstrate that "they are designed and operated" so as not "to pose a bird hazard to aircraft." 10 CSR 80-3.010(4)(B)1.A. Moreover, owners or operators proposing to site a new MSWLF "within five (5) miles of any airport runway end used by turbojet aircraft or piston-type aircraft shall notify the affected airport and the Federal Aviation Administration (FAA)." 10 CSR 80-3.010(4)(B)1.B. These regulations require a proposed new landfill that will be located within 10,000 feet of an airport that has jet traffic to demonstrate to the MDNR and to the airport that the landfill operations will not pose a bird hazard to air traffic. MDNR regulations also require providing the airport and the FAA notice of any new landfill proposed to be sited within five miles of an airport.

- Approval of Federal Aviation Administration for Excavation and Landfilling: FAA Advisory Circular AC 150/5200-33B dated August 28, 2007, "Hazardous Wildlife Attractants On or Near Airports," recommends "against locating MSWLF within the separation distances identified in Sections 1-2 through 1-4. The FAA strongly recommends against allowing waste disposal operation within 10,000 feet of a jet aircraft runway if the material contains putrescible waste and so has the potential to attract wildlife that could threaten air traffic. The relocation and disposal of excavated RIM material containing putrescible waste within 10,000 feet of the westernmost runway at Lambert-St. Louis International Airport, as would occur during excavation of the RIM in Areas 1 and 2 and subsequent placement of the RIM in the only potentially suitable location for an on-site engineered disposal cell, would contradict this guidance. Specifically, the on-site cell location would be approximately 8,000 feet from the end of Runway 11/29 (formerly referred to as Runway 12W/30W) at the Lambert –St. Louis International Airport. As noted above, it will be necessary to work directly with the FAA and the STLAA to obtain approval for locating a new engineered disposal cell within 10,000 ft of the end of the runway at Lambert-St. Louis International Airport. If the City were to waive the Restrictive Covenant mentioned earlier, discussions with the FAA and the Airport owner, and the City of St. Louis, would be necessary during RD of the on-site cell so that the cell construction and RIM excavation, transport and disposal efforts could occur in a manner that would reduce bird hazards to aircraft as much as possible.

- Approval of MDNR for On-Site Haul Route: If the "complete rad removal" with on-site disposal alternative were implemented, use of and design and construction of a gravel access road on the top of the existing cover of the Former Active Sanitary Landfill "North Quarry Pit" would require the approval of MDNR.

6.2.3.6.6   Coordination with Other Agencies

Although not all would be considered "agencies," coordination with several entities would be necessary to implement the "complete rad removal" with on-site disposal alternative. Coordination with the landfill owner and operator and owners or occupants of the various parcels that comprise the West Lake Landfill property would be necessary because of the following:

- Access to operations on other portions of the site would need to be maintained;

- Areas 1 and 2 are within a larger existing landfill footprint and use of areas on the West Lake Landfill property outside of Areas 1 and 2 might be necessary to stockpile cover materials or otherwise to facilitate cover construction;

- Implementation of this alternative would require excavation of portions of landfill units located outside of OU-1 and upon completion of removal of the RIM, disturbed portions of the adjacent landfill units would need to be repaired and restored and regrading and installation of an upgraded landfill cover over Areas 1 and 2 would need to be constructed;

- Use of the current OU-2 on-site soil borrow and stockpile area as the location of the new on-site cell, as well as excavating the stockpiled soil from the current OU-2 on-site soil borrow and stockpile area and relocating the soil material to the area of the previously closed leachate lagoon, would be required for construction of the on-site cell (Alternatively, implementation of the OU-1 remedy could be delayed until after completion of the OU-2 remedy so that a portion of the stockpiled soils could be removed prior to possible use of this area for construction of a new on-site cell.);

- Use of areas on the West Lake Landfill property might be necessary to stockpile the current OU-2 soil stockpile materials, to stockpile soil excavated to construct the new engineered cell, to stockpile overburden material during RIM excavation, and to stockpile liner and cover construction materials in order to facilitate construction of the on-site cell;

- Construction of an overpass over the access road between the landfill entrance and the solid waste transfer station may be necessary to facilitate transport of RIM from Area 2 to the on-site cell. If footings must be placed in waste, additional approval may be required. If an overpass is not feasible, a stop-light controlled crossing would have to be constructed which could disrupt the traffic flow for current site occupants;

- Use of and design and construction of a gravel access road on the top of the existing cover of the Former Active Sanitary Landfill "North Quarry Pit" would be necessary to facilitate transport of RIM from Areas 1 and 2 to the on-site cell, which may also require coordination with MDNR;

- Additional institutional controls would need to be implemented for properties owned by the landfill owners.

For the duration of excavation activities, on-site transport of the excavated materials, and import of cover materials, the flow of vehicles associated with remedy construction would need to be coordinated with the traffic patterns of vehicles associated with the current on-site solid waste transfer station and other site tenants.

Future groundwater monitoring activities could require obtaining and maintaining access to off-site properties if off-site groundwater monitoring were required as part of the remedy.

As indicated above, the potential for increased bird-strikes to aircraft approaching and departing the Lambert-St. Louis International Airport is a major concern of the FAA and St. Louis Airport Authority. Consequently, the FAA and Airport Authority would need to be involved in the remedial planning process.

Coordination with other agencies including the Earth City Flood Control District, MSD and MDOT as well as the adjacent property owner and businesses (for example, the Crossroad Property/AAA Trailer) would also be necessary to

- Coordinate with the Earth City Flood Control District regarding the design of non-contact stormwater management and discharge facilities both during and after completion of construction;

- Coordinate with MSD regarding permitting and design of leachate/contact stormwater discharge during construction;

- Coordinate with MDOT for access to areas along St. Charles Rock Road and for any traffic control or ingress and egress additions along St. Charles Rock Road in the vicinity of the landfill entrance; and

- Obtain legal and physical access from AAA Trailer for testing and if necessary remediation of the Crossroad Property and possibly for implementation of remedial actions that may need to be performed along the property boundary (e.g. regrading, fencing, etc. in Area 2).

6.2.3.6.7 Availability of Off-site Treatment, Storage and Disposal Services and Capacity

Off-site treatment, storage or disposal services are not principal components of this alternative. Offsite treatment and discharge of any leachate that may be encountered or stormwater that may contact RIM during the landfill excavation activities could be required. Initial discussions with MSD indicated that they are willing to accept such materials. Hazardous waste or RACM that may be encountered during excavation of RIM in Areas 1 and 2 and contaminated stormwater or leachate that cannot be discharge to MSD would require disposal off-site. The three off-site disposal facilities identified for the "complete rad removal" with off-site disposal alternative are permitted to accept liquid, hazardous, and mixed wastes and RACM as well as treat soil and/or debris that contains hazardous waste or mixed waste.

It would also be necessary to use these facilities for disposal of excess RIM if the volume removed exceeds the capacity of the on-site disposal cell. If excess RIM needs to be disposed off-site, additional implementability issues would come in to play, as described in Section 6.2.2.6.

6.2.3.6.8 Availability of Necessary Equipment and Specialists

Materials, equipment, and personnel required for construction of an on-site engineered cell, excavation from Areas 1 and 2, on-site transport and placement of the RIM in the on-site cell, and construction of covers over Areas 1 and 2 are available. Trained health physics technicians and specialized equipment required to monitor personnel and environmental conditions as well as to assist in directing the RIM excavation sequencing are also available.

The implementability and potential cost of the on-site cell liner and cover, and covers over Areas 1 and 2 post RIM-removal would be influenced by the availability and location of clean fill materials and/or off-site borrow sources if this alternative were to be implemented. Potential vendors of rock, clay and soil were contacted during the development of the FS (EMSI, 2006), and during preparation of the Remedial Design Work Plan for the ROD-selected remedy (EMSI, 2008). Information obtained from these vendors indicated that rock, clay and clean fill material were readily available from sources located near the site at the time these inquiries were made. If these local sources of cover materials become exhausted prior to remedy implementation, cover materials would have to be obtained from suppliers at greater distances from the site.

The necessary materials, equipment and personnel required for assessment and removal of RIM above cleanup levels that may be present at the Buffer Zone/Crossroad Property and to implement the institutional controls and monitoring components of this alternative are also readily available.

6.2.3.6.9 Availability of Prospective Technologies

The "complete rad removal" with on-site disposal alternative is based on proven, established, and commonly used technologies. Use of prospective technologies is not currently envisioned to be part of this alternative.

6.2.3.7 Cost

Estimated capital, annual OM&M, and 30-year present worth costs for the "complete rad removal" with on-site disposal alternative are included in Appendix K-4 and summarized on Table 9. The estimated costs to construct the "complete rad removal" with on-site disposal alternative (i.e., design costs, capital costs, and costs for monitoring during the construction period) are $116.6 million. These costs do not include costs to conduct full-scale pilot testing of solids separation equipment. The estimated annual OM&M costs range from $52,000 to $604,000 per year depending upon the specific activities that occur each year (e.g., higher costs for years with additional environmental monitoring, years when landfill cover repairs may occur, and years when five year reviews are conducted). The present worth costs of the "complete rad removal" with on-site disposal alternative are projected to be $112 million over a 30-year period based on the OMB discounted rate of 2.3%. The total non-discounted costs for this alternative over 30 years are projected to be $121 million. The cost estimates provided in this SFS are feasibility level cost estimates; that is they were developed to a level of accuracy such that the actual costs incurred to implement this alternative should fall within a range bounded by 50% above and 30% below these estimates.

If a fiscally-constrained approach that limits annual expenditures to $10 million were employed, the total costs for the "complete rad removal" with on-site disposal alternative would increase to $141 million owing to the additional costs associated with the overall increased duration of the project. The present worth costs for the ROD-selected remedy would increase to $121 million over 30 years.

The costs for the "complete rad removal" with on-site disposal alternative were also evaluated for 200 and 1,000 year periods (without any constraints on annual expenditures). The total non-discounted and present worth costs of the "complete rad removal" with on-site disposal alternative are projected to be $143 million and $114 million, respectively over a 200-year period. The total non-discounted and present worth costs of the "complete rad removal" with on-site disposal alternative are projected to be $245 million and $114 million, respectively over a 1,000-year period.

For the "complete rad removal" with on-site disposal alternative, mixed waste would have to be shipped off-site rather than disposed on-site with non-RCRA RIM material. The three off-site disposal facilities identified in the SFS are all permitted to accept RCRA wastes and mixed wastes.

Since the amount of mixed waste, if any that might be excavated along with the RIM is unknown and because of the RCRA restrictions on waste accumulation amounts and timeframes and limited storage space on site, it is unclear if volumes would support shipment by rail. As such, the mixed waste would likely be shipped to the off-site disposal facility directly via truck. For truck hauling to the off-site disposal facility, the interior of the semi trailer would be lined with a disposable polyethylene slip liner and after the waste was loaded the trailer would be covered and the cover securely strapped down. The capacity of each truckload would be 22 tons or 17 cubic yards, depending on the weight of the material. Current trucking costs range from \$4.70 to \$5.10 per loaded mile. Road mileage from the West Lake Landfill to the Clean Harbors Deer Trail, Colorado; Energy Solutions Clive, Utah; and U.S. Ecology Grandview, Idaho facilities are 720, 1,340, and 1,580 miles, respectively. Therefore, RCRA or mixed-waste truck transportation costs to an off-site facility could range from \$200 to \$470 per cubic yard or \$150 to \$370 per ton, depending on where the material is ultimately disposed.

For purposes of demonstrating how much shipping of mixed waste could influence costs, it was assumed that mixed waste would represent 1% of the sum of the volumes of overburden wastes and RIM for the "complete rad removal" with on-site disposal alternative. The added costs for handling, sampling/analysis, shipping, treating, and disposing of mixed waste for this alternative are estimated to range from \$5.3 to \$10.2 million. The range of costs primarily results from variations in the fees charged by the off-site disposal facilities and uncertainties associated with the nature of such wastes and the required method of treatment. If the volume of mixed waste is higher than the 1% of total mass assumption, the added costs would be higher.

7 COMPARATIVE ANALYSIS OF ALTERNATIVES

This section presents a comparative analysis of the ROD-selected remedy and the two "complete rad removal" alternatives evaluated in Section 6. The relative performance of each alternative, including advantages and disadvantages, is compared to the performance of the other alternatives for each of the threshold (subsection 7.1) and primary balancing (subsection 7.2) criteria prescribed in the NCP as previously discussed in Section 6 and summarized below.

Threshold Criteria:

- Overall Protection of Human Health and the Environment
- Compliance with ARARs

Primary Balancing Criteria:

- Long-Term Effectiveness and Permanence
- Reduction of Toxicity, Mobility, or Volume through Treatment
- Short-Term Effectiveness
- Implementability
- Cost

This comparative analysis identifies the relative advantages and disadvantages of each alternative and trade-offs among the alternatives in terms of the above NCP criteria. The purpose of the comparative analysis is to provide information for a balanced remedy selection. The results of this comparative analysis are discussed below and summarized on Table 10. It is noted that the NCP "modifying criteria" (state acceptance and community acceptance) will be evaluated by EPA as part of any decision process that may be undertaken by EPA after completion of the SFS, and therefore the comparison of alternatives using the modifying criteria is beyond the scope of this SFS.

7.1 Threshold Criteria

Two of the nine criteria specified in the NCP relate directly to statutory findings that must ultimately be made in the ROD. These two criteria are (1) overall protection of human health and the environment, and (2) compliance with ARARs. They are classified as threshold criteria, as each alternative must meet these two criteria.

7.1.1 Overall Protection of Human Health and the Environment

This criterion addresses how risks would be eliminated, reduced, or controlled by each remedial alternative to provide short- and long-term protection of human health and the environment from unacceptable risks posed by contaminants present at the site. All of the alternatives are expected to be protective of human health and the environment through the use of engineered containment, long-term surveillance and maintenance, and institutional controls on land and resource use.

Installation of a new multi-layer landfill cover under the ROD-selected remedy and excavation of RIM under both “complete rad removal” alternatives would reduce potential risks from exposure to external gamma radiation or radon gas emissions from the RIM in Areas 1 and 2. Installation of a multi-layer cover over a new engineered disposal cell as part of the “complete rad removal” with on-site disposal alternative would reduce potential risks from exposure to external gamma radiation or radon gas emissions from excavated RIM. Installation of a new multi-layer landfill cover over Areas 1 and 2 is included as part of all of the alternatives and would eliminate potential risks associated with inhalation or ingestion of contaminated soils or wastes, dermal contact with contaminated soils or wastes, and wind dispersal of fugitive dust. Installation of a cover over Areas 1 and 2 also would greatly reduce the potential for infiltration of precipitation and thus the potential for leaching of contaminants from wastes into groundwater. Installation of a liner system beneath a new, engineered disposal cell included in the scope of the “complete rad removal” with on-site disposal alternative would further reduce the potential for leaching to groundwater for those waste materials that are placed in the cell.

Long-term maintenance of the cover under each alternative and monitoring of the groundwater and subsurface occurrences of landfill gas and radon would ensure that each remedial action functions as intended. The institutional controls included as part of each alternative would ensure that land and resource uses are consistent with permanent waste disposal. These use restrictions address the presence of radionuclides under the ROD-selected remedy and the “complete rad removal” with on-site disposal alternative.

7.1.2 Compliance with ARARs

Compliance with ARARs also serves as a threshold criterion that must be met by any alternative for it to be selected as a remedy, unless a waiver is obtained for any particular ARAR. Possible ARARs that may potentially be applicable or relevant and appropriate to OU-1 are summarized on Tables 5, 6 and 7.

7.1.2.1 Chemical-Specific ARARs.

All of the alternatives will meet the chemical-specific ARARs. These include: the uranium mill tailings and NESHAP standards for radon emissions; the uranium mill tailings standards for cleanup of contaminated land (Buffer Zone and Crossroad Property) as modified by the EPA OSWER Directives regarding use of these standards at Superfund sites; Missouri radiation protection standards; the maximum concentrations for groundwater protection under the uranium mill tailing standards; and the Missouri maximum contaminant levels (MCLs).

7.1.2.2 Location-Specific ARARs.

The ROD-selected remedy and the “complete rad removal” with off-site disposal alternative would meet the location-specific ARARs found in the Missouri solid waste regulations standards for landfills located within the 100-year floodplain or within 10,000 feet of an airport runway. The “complete rad removal” with on-site disposal alternative could be designed to meet most but possibly not all of the location-specific ARARs.

EPA directed that the proposed location of a new engineered disposal cell must be located on the site property but outside of the geomorphic floodplain. There is one potential location on-site which meets this directive, therefore this alternative would meet the Missouri MSWLF site selection criteria for floodplains. The Missouri solid waste management regulations also require owners or operators proposing to site a new landfill or landfill cell “within five (5) miles of any airport runway end used by turbojet aircraft or piston-type aircraft to notify the affected airport and the Federal Aviation Administration (FAA).” 10 CSR 80-3.010(4)(B)1.B. The only available site for a new on-site engineered disposal cell is located within 8,000 feet of the end of the westernmost runway at Lambert-St. Louis International Airport. Therefore, implementation of this alternative would require notification of the FAA and the St. Louis Airport Authority in order to comply with this ARAR.

The Missouri Solid Waste Management regulations also require owners or operators of sanitary landfills located within 10,000 feet of an airport runway end used by turbojet aircraft to demonstrate to the department that the landfill is designed and operated such that it does not pose a bird hazard to aircraft. To meet this ARAR, the design and operating procedures for a new on-site engineered disposal cell would need to include measures to control potential bird activity in the area of the cell. Specifically, an avian management plan that incorporates the various techniques described in Section 4.3.5 of this SFS would need to be developed and approved by EPA and MDNR. Such a plan would undoubtedly also be of interest to the FAA and the Airport Authority. If such a plan were developed and approved by EPA, MDNR, the FAA and the Airport, the FAA has stated “To date, no such facility has been able to demonstrate an ability to reduce and sustain hazardous wildlife to levels that existed before the putrescible-waste landfill began operating.” (FAA Advisory Circular 150/5200-33B at page 16, August 2007).

Although the FAA Advisory for siting new landfill units is not a promulgated FAA regulation and so is not an ARAR, it may qualify as a “to be considered” (TBC) element. FAA Advisory Circular AC 150/5200-33B, “Hazardous Wildlife Attractants On or Near Airports” (August 28, 2007) “recommends against locating MSWLF within the separation distances identified in Sections 1-2 through 1-4. The separation distances should be measured from the closest point of the airport’s AOA [Area of Operations] to the closest planned MSWLF cell.” AC 150/5200-33B, p. 4. The separation distances referenced by this Advisory are 5,000 feet from the end of a runway for airports serving piston-powered (propeller) aircraft; 10,000 feet for airports serving turbine-powered (jet) aircraft; and 5 miles of protection from hazardous wildlife movement for approach, departure and circling airspace. The “complete rad removal” with on-site disposal alternative would not comply with the Advisory because the new disposal cell would be built within 8,000 feet or less of Runway 11/29 and inside the 5 mile approach, departure and circling airspace.

In addition, siting the on-site engineered disposal cell in the only location which satisfies EPA's directive (on-site and outside the geomorphic floodplain) also would conflict with the Negative Easement and Restrictive Covenant (Restrictive Covenant) previously granted to the City of St. Louis which prohibits any new or additional deposition or dumping of municipal waste, organic waste, and/or putrescible waste above, upon, on, or under the West Lake property. The Restrictive Covenant is not a federal or state regulation and so is not an ARAR, but may qualify as a TBC factor.

7.1.2.3 Action-Specific ARARs.

The ROD-selected remedy and the "complete rad removal" with off-site disposal alternative would meet the requirements of the action-specific ARARs, while the "complete rad removal" with on-site disposal alternative would meet most but not all of these requirements.

All three alternatives would meet the Missouri closure and post-closure standards of the solid waste regulations, the radiation protection standards, and the noise protection standards during implementation of a remedial action and closure of Areas 1 and 2.

Design of the final cover for Areas 1 and 2 under the ROD-selected remedy and for the new engineered disposal cell under the "complete rad removal" with on-site disposal alternative would meet the design standards for landfill covers established by the Missouri solid waste management regulations and the substantive relevant and appropriate requirements of the UMTRCA regulations. Although the design of the new engineered landfill cover to be placed over Areas 1 and 2 and the new on-site disposal cell included as part of the "complete rad removal" with on-site disposal alternative would primarily be based on the design standards of the solid waste regulations, additional components such as incorporation of a rock layer within the landfill cover would be included to address the longevity criteria of the UMTRCA standards.

The "complete rad removal" with off-site disposal alternative would also need to meet the requirements of the CERCLA Off-Site Rule, DOT and NRC requirements for transport of radioactive materials/wastes, and the waste acceptance criteria (WAC) of an off-site disposal facility.

The new engineered disposal cell included in the "complete rad removal" with on-site disposal alternative would meet the Missouri solid waste regulations for design, operations, closure and post-closure standards for a new solid waste landfill; however, it would not meet the prohibition against disposal in a solid waste cell of radioactively-contaminated material resulting from cleanup of radioactively-contaminated sites. 10 CSR 80-3.010 (3)(A)2.B. Although the Solid Waste Regulations do not contain any provisions for acceptance of excluded wastes, it is possible that the enhancements to the design of a possible new on-site disposal cell intended to address the presence of radioactive materials could provide a basis to allow placement of what would otherwise be excluded wastes within a sanitary landfill cell was discussed earlier in Section 3.1.3.2 of this SFS. If the agencies determined that such enhancements would provide sufficient basis to overrule the waste exclusion provisions of the Solid Waste Regulations, then this alternative could potential comply with all of the provisions of the Solid Waste Regulations.

7.1.2.4 Remedy Selection Absent ARAR Compliance.

Assuming that the waste exclusions of the Solid Waste Regulations are applicable to this alternative and that there is no procedure that would allow for placement of excluded wastes within a new on-site disposal cell, a waiver of the waste exclusion provisions of the Solid Waste Regulations would need to be granted to allow for selection of the "complete rad removal" with on-site disposal alternative. 40 CFR 300.430(f)(1)(ii)(C) sets forth the following six circumstances under which an alternative that does not meet an ARAR under federal or state environmental or facility siting laws may be selected:

(1) The alternative is an interim measure and will become part of a total remedial action that will attain the applicable or relevant and appropriate federal or state requirement;

(2) Compliance with the requirement will result in greater risk to human health and the environment than other alternatives;

(3) Compliance with the requirement is technically impracticable from an engineering perspective;

(4) The alternative will attain a standard of performance that is equivalent to that required under the otherwise applicable standard, requirement, or limitation through use of another method or approach;

(5) With respect to a state requirement, the state has not consistently applied, or demonstrated the intention to consistently apply, the promulgated requirement in similar circumstances at other remedial actions within the state; or

(6) For Fund-financed response actions only, an alternative that attains the ARAR will not provide a balance between the need for protection of human health and the environment at the site and the availability of Fund monies to respond to other sites that may present a threat to human health and the environment.

The "complete rad removal" with on-site disposal alternative is not an interim measure. As discussed further in the next subsection, compliance with the applicable requirement would not pose significantly greater potential risk to human health or the environment compared to this alternative. There are no engineering constraints preventing compliance with the prohibition on disposal of radioactively-contaminated material used in or resulting from the cleanup of radioactively contaminated sites in a solid waste landfill. No alternative standard of performance equivalent to the solid waste management regulation prohibition has been identified. There is no indication that Missouri has not consistently applied this prohibition, and in fact this prohibition was referenced by MDNR in comments provided on an earlier version of this SFS. Evaluation of the Fund balancing criteria is beyond the scope of this SFS and is the responsibility of EPA. Therefore, there currently does not appear to be a basis for waiver of this siting requirement.

7.2 Primary Balancing Criteria

The five NCP primary balancing criteria are: (1) long-term effectiveness and permanence; (2) reduction of toxicity, mobility and volume through treatment; (3) short-term effectiveness; (4) implementability; and (5) cost. Primary balancing criteria are used to weigh effectiveness and cost tradeoffs among alternatives. The primary balancing criteria represent the main technical criteria upon which the alternatives evaluation is based, and provide the primary basis for differentiation among the various alternatives.

7.2.1 Long-Term Effectiveness and Permanence

This criterion addresses the risks that may remain at a site after the remedial action objectives have been met. The primary focus of this evaluation is the extent and effectiveness of the controls that may be required to manage the risk posed by the wastes that remain at the site.

All of the alternatives result in waste materials remaining on site thereby necessitating installation, maintenance and monitoring of engineered containment structures and institutional controls. Under the "complete rad removal" with off-site disposal no radiologically-impacted materials containing radionuclides at levels above those that would allow for unrestricted use would remain on site. The long-term risks associated with each of the alternatives are essentially the same, and the residual cancer risks posed by all three alternatives are below or within EPA's target risk range of 1×10^{-6} to 1×10^{-4}. The estimated long-term risks associated with each alternative are listed on Table 10. Detailed information regarding the estimated potential long-term risks associated with each alternative is provided as part of the assessment of risks included as Appendix H.

Engineering measures are the primary method that would be used to control waste materials that remain on site. The primary engineering measures included in the ROD-selected remedy and in the "complete rad removal" with on-site disposal alternative are construction, inspection and maintenance of multilayer engineered landfill cover systems over Areas 1 and 2 and a new engineered on-site disposal cell that are designed to reduce potential exposures to gamma radiation and reduce radon emissions, including increased levels of gamma radiation and radon emissions occurring after 1,000 years of radioactive decay of thorium. The "complete rad removal" with off-site disposal alternative includes excavation and off-site disposal of the RIM to reduce potential exposures to gamma radiation and reduce radon emissions as well as construction, inspection and maintenance of multilayer engineered landfill cover systems over Areas 1 and 2.

The conceptual designs of the multilayer engineered landfill cover systems for the ROD-selected remedy and the on-site disposal alternative were based on the projected levels of gamma radiation and radon generation that would occur after 1,000 years of ingrowth of radium from thorium due to the existing disequilibrium between radium and thorium levels in the radiologically-impacted material. These risk evaluations considered only those components of the cover systems that would be constructed from natural earthen materials and did not take into account any synthetic components which might degrade over time (i.e., a geomembrane liner for the on-site cell landfill cover) associated with the "complete rad removal" with on-site disposal alternative. All of the alternatives rely on the construction, inspection and maintenance of multilayer covers over on-site radiological and non-radiological materials to prevent potential exposures resulting from direct contact with the waste materials, ingestion or inhalation of contaminated soil or dust, radon emissions or gamma radiation.

Although the radioactively-impacted materials and other wastes have been present in Areas 1 and 2 for many decades, no plume of contaminated groundwater (for either radionuclides or non-radionuclide constituents) exists beneath the site. To further ensure that a plume of groundwater contamination does not occur in the future, all of the alternatives rely on the construction, inspection and maintenance of multilayer covers to prevent or reduce the potential for infiltration of precipitation and resultant leaching to groundwater. The "complete rad removal" with off-site disposal alternative includes removal of the radioactively-impacted material from the site and thus providing an additional level of effectiveness and permanence relative to potential leaching of radionuclides to groundwater. The "complete rad removal" with on-site disposal alternative includes removal of the radioactively-impacted material from Areas 1 and 2 and placement of these materials in a new engineered disposal cell that would include a liner system to further reduce the potential for leaching to groundwater.

The performance and effectiveness of the engineered measures for each of the alternatives is primarily based on the durability of natural earthen materials used to construct these measures. Natural earthen materials such as clay and rock are extremely durable and, with minimal maintenance and repair over time, are expected to remain effective for decades or centuries. As discussed above, the design of the cover systems for the ROD-selected remedy and the "complete rad removal" with on-site disposal alternative were determined to be effective at limiting exposures to projected gamma radiation and radon levels after 1,000 years of radioactive decay using only the performance of those natural earthen components. The potential effects of erosion of the landfill cover by precipitation, disruption of the landfill cover by possible intrusion by woody vegetation, or potential human actions that could affect the cover system necessitate regular and ongoing inspections and maintenance to ensure that the cover system continues to remain effective over time.

The engineering measures implemented under each alternative would be augmented and supported by maintenance of the existing institutional controls at the site and implementation of additional institutional controls as necessary. Institutional controls would limit future uses of the land and resources at the site so as to eliminate or restrict potential exposure to the wastes or contaminated media, and to reduce the potential for future land uses to impact or reduce the effectiveness of the engineered measures. Areas 1 and 2 currently are solid waste disposal units and would remain in this use status under all of the remedial alternatives. Institutional controls would be necessary to restrict future land uses that could interfere with the landfill closure at Areas 1 and 2 regardless of the presence of RIM.

7.2.2 Reduction of Toxicity, Mobility or Volume through Treatment

This criterion addresses the statutory preference to select remedial actions that employ treatment technologies which permanently and significantly reduce toxicity, mobility, or volume of hazardous substances as their principal element.

None of the alternatives include treatment technologies that would reduce the toxicity, mobility, or volume of the waste material through treatment. Treatment technologies are generally not applicable to solid waste landfills due to the overall large volume of wastes. For the RIM interspersed within the solid waste at this site, the radionuclides are naturally occurring elements which cannot be neutralized or destroyed by treatment. Occurrences of radionuclides within Areas 1 and 2 are dispersed within soil material that is further dispersed throughout the overall, heterogeneous matrix of municipal refuse, construction and demolition debris, and other nonimpacted soil materials. Consequently, ex-situ treatment techniques are considered impracticable. In addition, the heterogeneous nature of the solid waste materials and the dispersed nature of the radionuclide occurrences within the overall solid waste matrix make in-situ treatment techniques equally impracticable.

Under all of the alternatives, no treatment processes would be employed on-site or at an off-site disposal facility for soil or debris containing only radiologically-impacted materials. Therefore, there would not be any reduction in toxicity, mobility, or volume through treatment for RIM.

The potential exists to reduce the volume of materials handled as RIM (but not the overall total volume of waste materials in Areas 1 and 2) through use of physical separation processes such as shredding and sorting. For example, revolving cylindrical Trommel sieve screens have been used in conjunction with landfill mining and reclamation (LFMR) projects to separate materials by size, with the soil fraction passing through the screen. While not specifically a “treatment” process, this physical separation process could potentially be employed to reduce the volume of RIM that would be transported to an off-site disposal facility under the “complete rad removal” with off-site disposal alternative, or to an on-site disposal cell under the “complete rad removal” with on-site disposal alternative. Because such processes have not been applied to a solid waste matrix that contains radiologically-impacted soil, no data exists regarding the potential effectiveness, implementability or cost of such technologies in this context. Therefore, though the potential exists as part of the “complete rad removal” alternatives to reduce the volume of RIM (but not the overall volume of waste materials at the site), the potential viability of this technology cannot be determined based on existing information. Pilot testing of such a physical separation process using excavated materials from Area 1 and/or Area 2 would be necessary in order to evaluate the reduction in volume of RIM as well as the effectiveness, implementability, and cost of the technology. Additional evaluation would be necessary to assess the potential for increased short-term risk to workers and off-site receptors due to additional materials handling associated with pilot testing, or full-scale operating of any physical separation process.

To the extent that hazardous wastes or mixed wastes are encountered under any of the alternatives, such wastes would be shipped off-site and would be treated at the disposal facility in accordance with the hazardous waste regulations (e.g., EPA's Land Disposal Restrictions (LDR) program and Universal Treatment Standards (UTS)) and in accordance with the receiving facility's permits and standard operating procedures. Examples of treatment processes for hazardous wastes or mixed wastes include solidification/stabilization of soil and micro- or macro-encapsulation of debris. To the extent that treatment of the hazardous waste or mixed waste would be required for off-site disposal, stabilization or encapsulation treatment would result in a reduction of the mobility of the hazardous waste or the radiological components of the waste. Toxicity and volume would not be reduced by these technologies but may be reduced by other technologies potentially applicable to hazardous wastes that do not contain RIM, such as incineration of drummed solvents if such wastes were encountered during implementation of remedial action at the site.

7.2.3 Short-Term Effectiveness

This criterion addresses the effects that would occur during construction and implementation of the alternatives prior to achievement of the site remedial action objectives (RAOs). Factors considered in the evaluation of this criterion include protection of the community during the remedial action, protection of workers, environmental impacts, and the time until the RAOs are met. As discussed below, the "complete rad removal" alternatives present a greater potential risk to both the community and site workers as compared to the ROD-selected remedy.

7.2.3.1 Protection of the Community

The greatest potential risks to the community are associated with the "complete rad removal" with off-site disposal alternative. These risks arise largely from the much greater number of truck trips associated with off-site disposal which result in greater traffic congestion on St. Charles Rock Road and other nearby highways, and the associated potential for traffic accidents and fatalities, greater greenhouse gas emissions, and greater noise impacts. The projected incidence of traffic accidents is 140% for the "complete rad removal" with off-site disposal alternative, compared to 61% and 79% for the ROD-selected remedy and the "complete rad removal" with on-site disposal alternative, respectively. (Note: If it were feasible to extend a rail spur onto to the West Lake Landfill site such that RIM could be directly loaded into rail cars for transport to an off-site disposal facility, the projected incidence of traffic accidents for the "complete rad removal" with off-site disposal alternative may be reduced; however, even if the trains were only transferred at night, an at-grade rail crossing would still represent a safety issue for traffic on St. Charles Rock Road.) The "complete rad removal" with off-site disposal alternative is the only alternative that includes the potential for an off-site release resulting from potential vehicle accidents or other losses of vehicle or container integrity during material transport, handling and transfer activities. Projected carbon dioxide (greenhouse gas) emissions are also substantially greater for the "complete rad removal" with off-site disposal alternative; 35,400 tons of carbon dioxide compared to 8,350 tons and 17,900 tons for the ROD remedy and the "complete rad removal" with on-site disposal alternative, respectively.

In addition, potential carcinogenic risks to off-site residents resulting from fugitive dust emissions during project construction (assuming no mitigation measures are employed or the mitigation measures prove ineffective) are greatest for the "complete rad removal" alternatives (2.0×10^{-5} and 2.1×10^{-5} for the on-site and off-site alternatives, respectively), compared to those associated with the ROD-selected remedy (3.3×10^{-6}). However, the potential carcinogenic risks to off-site residents for all three alternatives are within EPA's range of acceptable risks (10^{-4} to 10^{-6}).

In contrast to the ROD-selected remedy which only includes regrading, the two "complete rad removal" alternatives require excavation of large portions of Areas 1 and 2. Excavation of RIM from Areas 1 and 2 would require removal of the existing landfill cover, non-RIM overburden over Areas 1 and 2, RIM above cleanup levels in Areas 1 and 2, and portions of adjacent areas of landfill at OU-2. Excavation of overburden and RIM would create depressions in the landfill areas during the period of time required to remove the RIM and regrade and cover the remaining landfill wastes. Precipitation that falls on the landfill while such depressions are open would potentially flow into and accumulate in the depressions. Any accumulation of precipitation in depressions created during waste excavation could result in infiltration of precipitation runoff through the underlying waste materials, which could result in leaching of VOCs or other soluble contaminants from the waste materials. (Accumulation could be significant during a heavy rainstorm as the maximum historical 24-hour rainfall for the St. Louis area ranges from a low of 3.7 inches in November to a high of 8.8 inches in August (NOAA, 2011)). Such leaching could contaminate the underlying groundwater and create a plume of non-radiological contamination that could flow off-site, potentially exposing receptors who are not currently exposed and who would not be expected to be exposed in the future under the ROD-selected remedy.

During construction, consideration would be given to minimizing the area of excavation that would be open and exposed to waste materials at any given time, though the ability to accomplish this for the "complete rad removal" alternatives may be limited. Application of daily soil cover or placement of tarps over areas of exposed waste at the end of each work day would be employed to reduce the potential for infiltration of precipitation. Stormwater best management practices including temporary diversion berms would also be constructed above the open excavation areas to divert precipitation runoff and attempt to prevent the runoff from contacting uncovered waste materials. Precipitation that would contact uncovered waste materials would flow into the low point of the excavation and be pumped out of the excavation into temporary storage tanks using portable gas-driven pumps. Samples from each tank would be collected and sent to a laboratory for analysis. The stored water would be directly discharged on-site or treated and disposed off-site based on the analytical results.

7.2.3.2 Worker Protection

The greatest potential risks to on-site workers are also associated with the two "complete rad removal" alternatives. The projected incidence of industrial accidents is greater for the two "complete rad removal" alternatives (7.6 and 9 for the off-site and on-site alternatives respectively) compared to those for the ROD-selected remedy (4.7). The potential risks to workers from exposure to carcinogenic substances and gamma radiation is two to three times greater for the "complete rad removal" alternatives. The projected carcinogenic risk to the maximally exposed individual worker are 7.6×10^{-4} and 7.4×10^{-4} for the off-site and on-site "complete rad removal" alternatives respectively, compared to 7.2×10^{-5} for the ROD-selected remedy. The projected gamma exposure to a site worker is projected to be 260 and 260 mrem/year for the off-site and on-site "complete rad removal" alternatives respectively, compared to 50 mrem/year for the ROD-selected remedy. The "complete rad removal" alternatives pose the greatest risks to workers due to the greater amount of handling of RIM required for these alternatives. In addition, as the two excavation remedies require longer to implement than the ROD-selected remedy, the two "complete rad removal alternatives would subject workers to gamma exposures over a longer time period. Finally, the projected incidence of industrial accidents to on-site workers is greater for the two "complete rad removal" alternatives (9 and 7.6 accidents estimated to occur over the course of construction for the off-site and on-site alternatives, respectively) compared to those for the ROD-selected remedy (4.7 accidents estimated to occur over the course of construction). The "complete rad removal" alternatives pose the greatest risks to on-site workers due to the greater amount (both in degree and duration) of handling of waste materials generally, and RIM specifically, required for these removal alternatives.

For all of the alternatives, workers would be instructed and trained in safe work practices, work practices at hazardous waste sites, work practices in extreme temperatures, use and care of personal protective equipment and monitoring devices, and other measures to reduce worker exposures and the potential for accidents. Risks and doses to workers from exposure to RIM can be controlled by limiting exposure durations. Fiscally-constraining project implementation to an annual expenditure of $10 million would increase risks to workers and the public due to the increased duration of the construction activities. As discussed further below, impacts to the project schedules resulting from constraining annual expenditures would most greatly affect the construction schedules for the two "complete rad removal" alternatives.

7.2.3.3 Environmental Impacts

No measurable long-term impacts to plants or animals in surrounding ecosystems are expected to occur from any of the alternatives. No wetlands are located within the on-site construction footprint of the alternatives and no endangered species were identified in the site area. Excavating and regrading Areas 1 and 2 and constructing new landfill covers over these areas would affect the wildlife and plant life on those portions of the landfill. Disturbance of the landfill surface would occur under all of the alternatives and would destroy those portions of the habitats that currently exist on the surface of Areas 1 and 2, forcing wildlife to migrate to other areas. This disruption would be temporary and would last for the period of active construction. Vegetative cover would be placed on the site and the landfill would be allowed to return to an early-stage field ecosystem with periodic mowing and maintenance.

7.2.3.4 Time to Achieve Remedial Action Objectives (RAOs)

The short-term effectiveness of the alternatives would be assessed by monitoring performed during, at the completion of, and after construction. Monitoring performed during construction would include perimeter and work space air monitoring and health and safety monitoring of workers. For the “complete rad removal” alternatives, measurements, sampling and laboratory analyses would be performed to guide the excavation activities and verify that all of the RIM above cleanup levels was removed. Construction quality control monitoring would be performed as part of all of the alternatives to document that remedy construction was completed in accordance with the design specifications.

For the ROD-selected remedy, measurements of gamma radiation levels and radon flux would be made on and around Areas 1 and 2 after construction is complete to provide for final quantification of the cover effectiveness. For the “complete rad removal” with on-site disposal alternative, measurements of gamma radiation levels and radon flux would be made on and around the new engineered on-site disposal cell after construction is complete to provide for final quantification of the cover effectiveness.

All of the alternatives include long-term groundwater and landfill gas monitoring along the perimeter of Areas 1 and 2 and, if necessary, at off-site locations. For the “complete rad removal” with on-site disposal alternative, monitoring of leachate generation within and groundwater quality around the new on-site engineered disposal cell would be performed to document the effectiveness of the liner components, and subsurface occurrences of landfill gas and radon would be measured to ensure that off-site migration of these gases is not occurring.

Because RIM and solid wastes would remain in Areas 1 and 2 under the ROD-selected remedy, and solid wastes would remain in these areas under the “complete rad removal” alternatives, engineering measures and institutional controls intended to address the presence of solid wastes would be required for all of the alternatives. Engineering measures and institutional controls to address the presence of RIM would also be required for the ROD-selected remedy and the new engineered cell under the “complete rad removal” with on-site disposal alternative; however, these are the same types of measures that would be used to address the solid waste materials remaining in Areas 1 and 2 under the “complete rad removal” alternatives, with certain enhancements to address the presence of RIM.

The RAOs would be achieved upon completion of construction, which is estimated to be finished within the following time frames after notice to proceed with remedial design is issued (see also Table 10 and Appendix J):

- approximately 3 years for the ROD-selected remedy,

- approximately 4 years for the "complete rad removal" with off-site disposal alternative, and

- approximately 6 years for the "complete rad removal" with on-site disposal alternative.

These estimated durations assume that remedial design for each alternative can be completed and approved within one year of remedy approval and authorization to begin the RD phase, and that construction of the remedy is not fiscally constrained. Under a fiscally constrained approach in which annual project expenditures are limited to $10 million, the estimated time frames for remedial design construction completion increase to 5 years for the ROD-selected remedy, 29 years for the "complete rad removal" with offsite disposal alternative, and 13 years for the "complete rad removal" with on-site disposal alternative.

The estimated schedules for construction of the "complete rad removal" alternatives are highly dependent upon the amount of expansion (the swell factor) the waste materials experience during excavation, handling and loading for shipment. It is likely that the actual volume expansion swell factor could be greater than what has been assumed in this SFS, and unlikely that it would be less. To the extent that the swell factor is greater than what has been assumed during preparation of this SFS, the schedules for completion of construction and consequently the costs and risks would increase.

The schedule for completion, costs and risks for the "complete rad removal" with off-site disposal alternative are also sensitive to the number of rail cars that can be delivered, loaded and shipped per day. It is unlikely that the actual number of rail cars would be greater than the value (15 per day) assumed for preparation of this SFS and is possible that the actual number could be less, thereby increasing the time required to construct, the costs and the risks for the "complete rad removal" with off-site disposal alternative. Similarly, the schedule, costs and risks for the "complete rad removal" with on-site disposal alternative are sensitive to the rates at which soil and RIM can be re-located on-site, which will be a function of the capacity of the internal roads and road intersections and the demands of the on-site truck traffic generated by the existing transfer station, trucking, and concrete/asphalt plant operations. It is possible that the number of off-road haul truck trips assumed for purposes of preparing this SFS may not be achievable, and unlikely that the number assumed could be greater. Consequently, the actual duration required for construction of the "complete rad removal" with on-site disposal alternative could be greater than that assumed in this SFS, again also increasing both costs and risks.

7.2.4 Implementability

This criterion addresses the technical and administrative implementability of each alternative and the availability of the various services and materials required to implement each alternative.

Installation of upgraded landfill covers to promote runoff and minimize infiltration, excavation and off-site disposal of waste materials, construction of lined/covered engineered landfill cells, filling and compaction of waste materials in a cell, and implementation of institutional controls are all technically feasible, reliable, and established technologies that have been implemented and proven at CERCLA landfill sites. Monitoring of landfill cover surfaces, landfill gas, radon, groundwater, and surface water are proven methods for demonstrating the long-term effectiveness of a covered landfill and/or landfill cell and are easily implemented.

Under all three alternatives, regrading and contouring the existing overburden and waste materials in Areas 1 and 2 in order to achieve final grades will require re-compaction of the regraded materials to minimize the potential for differential settlement over time that could affect the integrity of the covers. Placement of additional fill material to achieve the final slope requirements and for construction of the landfill covers over Areas 1 and 2 may result in compaction of the existing waste materials, depending upon the nature, age, and amount of prior degradation of the materials. Long-term maintenance, including inspection and repair, is typically required to address the potential for differential settlement or surface erosion of a cover over time and is anticipated to be part of all alternatives. The level of effort for inspection and repair of the cover surfaces over Areas 1 and 2 would be the same for all alternatives. If the "complete rad removal" with on-site disposal alternative would be implemented at the site, additional effort would be necessary to inspect and repair the site landfill cover surfaces because of the added presence of a new engineered on-site cell.

Monitoring of the Area 1 and 2 cover surfaces and landfill gas, as well as groundwater and surface water quality, would be required for all three alternatives in order to demonstrate the effectiveness of the remedy. For the "complete rad removal" with on-site disposal alternative, additional monitoring would be required for the new on-site cell, including monitoring of the covered surface of the cell, landfill and radon gas, and groundwater and surface water quality. Future groundwater monitoring activities could require acquisition and maintenance of access to off-site properties if off-site groundwater monitoring was required as part of the remedy. All of the monitoring activities are implementable.

For the ROD-selected remedy, proximity to adjacent property constraints exist in Areas 1 and 2 such that the cover could not be constructed to achieve the desired slopes by placement of additional fill material alone. Regrading and contouring a limited amount of existing waste materials would be necessary in some areas. This would require considerably less overburden excavation and waste movement than either of the "complete rad removal" alternatives because the "complete rad removal" alternatives would entail removal and stockpiling of substantial amounts of overburden, removal of substantial amounts of RIM, and replacement of the overburden material.

For the two "complete rad removal" alternatives, there are questions regarding the ability to remove all of the RIM from Area 2 due to the depth of the RIM and proximity to the OU-2 closed construction and demolition waste landfill and the OU-2 inactive solid waste landfill. Excavation of RIM would also present significant implementability concerns associated with the excavation and handling of contaminated materials; management of fugitive dust and potential odors; mitigation of bird hazards; management and treatment of stormwater exposed to RIM during excavation; management of RIM that fails the paint filter liquids test; and the identification, segregation, and disposal off-site of any hazardous wastes or regulated asbestos containing materials that may be encountered during RIM excavation. Directing and controlling the RIM excavation process using radiological scanning and sampling techniques would greatly impact (i.e., decrease) overburden and RIM excavation production rates.

Implementability concerns specific to the "complete rad removal" with off-site disposal alternative, include the following:

- If a truck-to-rail transloading facility at an off-site rail spur location were to be used, a suitable location would have to be identified and a long-term lease secured with the land owner.

- If a rail spur were to be extended onto the West Lake Landfill property, (1) land located across St. Charles Rock Road would either need to be purchased or long-term leases would be needed with landowners, (2) it would be necessary to obtain state and local government, private landowner, facility occupant and community approval to construct a rail spur across private property located to the east of St. Charles Rock Road, across St. Charles Rock Road, and along the access roads which serve the existing solid waste transfer station and asphalt and concrete batch plant operations located at the site, (3) the long-term leases of the asphalt plant, concrete batch plant, trucking company, and potential other tenants who lease land south of the solid waste transfer facility would need to be renegotiated or otherwise acquired, and (4) the facilities of the current site tenants would need to be relocated.

- Switching of gondola railcars either at a truck-to-rail transloading facility spur or an on-site rail spur would need to be coordinated with the railroad company that would be hauling the railcars to the off-site disposal facility. The capacity to switch rail cars could affect the rate at which RIM could be excavated and removed from the site.

- Because of the high traffic volume on St. Charles Rock Road during the day, dropping off empty and picking-up loaded railcars would likely be possible only during late nighttime and early morning hours if a rail spur could be extended onto the West Lake Landfill property. The rail spur crossing at St. Charles Rock Road would need to meet appropriate state and local safety requirements.

- The EPA Region where the off-site disposal facility is located would need to be contacted every 60 days to obtain a compliance determination as to whether the disposal facility currently meets the criteria under the CERCLA Off-Site Rule. If during RIM excavation the contracted off-site disposal facility was found not to be in compliance for a period of time, excavation and transportation would need to cease until the facility became compliant, or RIM would need to be transported to another facility that EPA determined to be in compliance with all permit and regulatory requirements. Besides schedule delays, temporary stoppage of construction would present significant technical implementability concerns regarding open excavation areas.

- If RIM were to be disposed at the Clean Harbors Deer Trail, CO facility, an application would have to be submitted to and accepted by the Rocky Mountain Low Level Radioactive Waste Compact.

Implementability concerns associated with the "complete rad removal" with on-site disposal alternative include the following:

- There is only one available location outside of the geomorphic floodplain in the West Lake Landfill property that could be evaluated for constructing an on-site cell. Geological and geotechnical field investigations and piezometric surface data collection to determine whether the site is suitable would need to be completed as pre-design studies during remedial design. If the results of these studies indicate that the location is not suitable, then the "complete rad removal" with on-site disposal alternative would not be implementable.

- The estimated bottom grades, and therefore available volume, for the on-site cell conceptual design presented in this SFS are based on extrapolated piezometric surface information. If the measured piezometric surface elevation is higher than the elevation assumed or if the RIM volume excavated is greater than the RIM volume estimated in this SFS, some RIM would have to be disposed off-site, triggering many of the implementability issues associated with the off-site disposal alternative (and also likely increasing the cost of this alternative).

- Construction of an overpass over the access road between the landfill entrance and the solid waste transfer station may be necessary so that off-road trucks transporting RIM from Area 2 to the on-site cell would not interrupt traffic. Such an overpass would require the approval of the land owner and potentially MDNR if footings needed to be constructed in the waste material within the Bridgeton Sanitary Landfill which is currently undergoing closure under MDNR supervision. If an overpass is not feasible, a stop-light controlled crossing would have to be constructed, but the associated delays in each transit of the site could extend the time for completion of the remedy.

- Absent a constructed overpass, even use of, design, and construction of, a gravel access road on the top of the existing cover at the Bridgeton Sanitary Landfill "North Quarry Pit" for off-road trucks transporting RIM from Area 2 to the on-site cell would require the approval of the site owner and MDNR.

- Use of the current OU-2 on-site soil borrow and stockpile area as the location of the new on-site cell, as well as excavating the stockpiled soil from the current OU-2 on-site soil borrow and stockpile area and relocating the soil material onto other portions of the site, would require the approval of the property owners and other operators.

- The Negative Easement and Restrictive Covenant recorded against the majority of the West Lake Landfill property, including the only area available for an on-site engineered disposal cell, provides that there shall be no new or additional depositing or dumping of putrescible waste at the property. This Restrictive Covenant runs to the benefit of the City of St. Louis as owner of Lambert-St. Louis International Airport, and is waivable by the City at its sole and absolute discretion. Based on the positions stated by the Airport Authority at the September 2010 meeting and in its September 20, 2010 letter to EPA, it is not expected that the City would waive the Restrictive Covenant and therefore the implementability of this alternative is unlikely. If waiver/release from the obligations of the Restrictive Covenant is required in order to construct a new landfill cell within the area of prohibition, that waiver/release may have to be compelled which could increase costs.

- The relocation and disposal of excavated RIM material containing putrescible waste within 10,000 feet of the westernmost runway of the Lambert Airport, as would occur during excavation of the RIM in Areas 1 and 2 and subsequent placement in the only potentially suitable location for an on-site engineered disposal cell, would be limited by the site selection criteria of the Missouri solid waste regulations and the FAA Advisory Circular that strongly recommend against allowing waste disposal operations which have the potential to attract wildlife that could threaten air traffic.

- Missouri solid waste regulations prohibit the disposal in a solid waste cell of radioactively-contaminated material resulting from cleanup of radioactively-contaminated sites, making the on-site disposal cell scoped by this SFS unlikely to be implementable.

Because Areas 1 and 2 exist within a larger area in an existing landfill, the following activities impact one or more of the three alternatives and would require coordination with the landfill owner and operator:

- Regrading of Areas 1 and 2 and installation of an upgraded landfill cover under the ROD-selected remedy will need to be integrated with the grading and covers present or to be constructed on the adjacent OU-2 landfill units;

- Use of areas outside of Areas 1 and 2 to stockpile cover materials in order to facilitate cover construction under all three alternatives would need to be integrated with ongoing site operations and/or implementation of remedial actions for OU-2;

- The flow of vehicles associated with remedy construction would need to be coordinated with the flow of vehicles associated with the on-site solid waste transfer station, concrete and asphalt batch plant operations, and trucking company;

- Excavation of RIM material and regrading and installation of an upgraded landfill cover over Areas 1 and 2 under both "complete rad removal" alternatives would need to be coordinated with stormwater management and remedial actions being performed for OU-2;

- Truck hauling of RIM off-site to a truck-to-rail transloading facility for the "complete rad removal" with off-site disposal alternative would need to be coordinated with vehicle activity associated with the existing site operations;

- Loading of railcars with RIM and switching of railcars if a rail spur could be extended onto the West Lake Landfill property for the "complete rad removal" with off-site disposal alternative would need to be coordinated with the site owners and existing operations at the site; and

- Truck delivery of rock, clay, and soil materials for cover construction over Areas 1 and 2 under all three alternatives, and for the new disposal cell liner and cover construction for the "complete rad removal" with on-site disposal alternative would need to be coordinated with vehicle traffic associated with the existing site activities.

Specialized personnel, equipment, and materials are readily available to implement the cover systems, institutional controls, and monitoring components of the alternatives. The implementability and potential costs for all three alternatives will be influenced by the availability and location of clean fill materials and/or off-site soil borrow sources at the time the selected alternative is implemented. Potential vendors of rock, clay and soil were contacted during the development of the FS and during preparation of the Remedial Design Work Plan for the ROD-selected remedy. These vendors indicated that rock, clay, and soil material were readily available from sources close to the site. However, if these local sources become exhausted prior to remedy implementation, cover materials would have to be obtained from suppliers at greater distances from the site.

Materials, equipment and personnel required for excavation of the RIM and transport of RIM to an off-site disposal facility or a new engineered on-site cell are readily available. For the "complete rad removal" with off-site disposal alternative, only a limited number of off-site disposal facilities that can accept excavated RIM from the West Lake Landfill have been identified, and all three facilities currently have available capacity to accept the estimated volume of RIM from the site. Capacity at one or more of these facilities may not be available in the future if the "complete rad removal" with off-site disposal alternative were to be selected by EPA. At this time it is difficult to evaluate the long-term availability of the number of disposal facilities that could accept wastes from the West Lake Landfill as well as their respective available capacities. The volumetric rate of acceptance for all off-site disposal facilities would be limited by the number of gondola railcars that could be loaded at or near the site, as well as the number of railcars that could be unloaded at or near the disposal facility. If a "complete rad removal' alternative were to be selected, the identified facilities are also permitted to (1) accept liquid wastes, should any stormwater accumulated in excavations during RIM excavation become contaminated and require disposal off-site, (2) accept mixed wastes if mixed wastes are encountered during excavation, and (3) treat soil and/or debris that contains hazardous or mixed waste.

7.2.5 Cost

The final primary criterion is cost. Table 9 presents a summary of the anticipated costs associated with each alternative. Detailed information regarding the cost estimates for each alternative are presented in Appendix K.

- The ROD-selected remedy would result in the lowest overall capital (design, construction and environmental monitoring during construction) costs all of the alternatives at $41 million, with estimated annual OM&M costs ranging from $42,000 to $414,000.

- Implementation of the "complete rad removal" with off-site disposal alternative would result in incurrence of the highest total capital cost at $259 to $415 million depending upon which off-site disposal facility is used, with estimated annual operations, maintenance and monitoring costs of $40,000 to $412,000.

- Capital costs for construction of the "complete rad removal" with on-site disposal alternative are projected to be $117 million with estimated annual operations, maintenance and monitoring costs of $52,000 to $604,000.

The cost estimates summarized above and provided elsewhere in this SFS are feasibility level cost estimates; that is they were developed to a level of accuracy such that the actual costs incurred to implement the alternatives should fall within a range bounded by 50% above and 30% below these estimates.

The ranges in values for the annual OM&M costs cited above result from variations in the specific activities that occur each year (e.g., higher costs for years with additional environmental monitoring, years when landfill cover repairs may occur, and years when five year reviews are conducted).

Based on the Office of Management and Budget's current value (2011 value issued in December 2010) of 2.3% for the 30-year discount rate, the 30-year present worth costs of the alternatives are estimated to be:

- $43 million for the ROD-selected remedy,

- $250 million to $401 million for the "complete rad removal" with off-site disposal alternative, and

- $112 million for the "complete rad removal" with on-site disposal alternative.

Finally, the total non-discounted costs over the same 30 year period for the three alternatives are estimated to be:

- $45 million for the ROD-selected remedy,

- $262 million to $419 million for the "complete rad removal" with off-site disposal alternative, and

- $121 million for the "complete rad removal" with on-site disposal alternative.

Due to the limited number of off-site disposal facilities that could accept the waste materials, the greatest degree of uncertainty with the capital costs are associated with the "complete rad removal" with off-site disposal option. There also are uncertainties regarding the specification and cost of the rock that would be used for the bio-intrusion layer included in the ROD-selected remedy and the "complete rad removal" with on-site disposal alternative. There are uncertainties associated with the source and unit costs for acquisition and delivery of the clay and soil to be used to construct the clay and vegetative layers of the final landfill covers over Areas 1 and 2 that are included in all of the alternatives, and the liner and final cover for a new engineered cell that is included in the scope of the "complete rad removal" with on-site disposal alternative.

A 20% bid contingency was included in the capital costs for all of the alternatives to address unknowns that might occur after a construction contract is awarded. The ROD-selected remedy is not expected to have the potential for significant cost growth after construction begins because it is a demonstrated technology with fewer uncertainties in cost-determining factors. In contrast, the "complete rad removal" alternatives have the potential for significant cost growth due to the unknowns associated with excavation of the RIM including, among other factors: the configuration and volume of the RIM; the swell resulting from RIM excavation; the amount of overburden; potential occurrences of hazardous wastes or RACM; and actual production rates of excavation and disposal activities especially under different weather conditions.

As an example, DOE awarded a contract using $30 million of 2005 Congressionally-appropriated funds to excavate wastes from the OU-1 Landfill Area at the Mound CERCLA site in Miamisburg, OH. From January 2007 through January 2008, approximately 60,500 cubic yards of landfilled contaminated soil/debris that contained radionuclides were excavated from five waste priority areas and transported to several off-site facilities, including the Energy*Solutions* facility in Clive, UT, for treatment and/or disposal. Contrary to the plan, the $30 million in approved funding was not sufficient to fund removal of all of the Mound OU-1 Landfill Area wastes. Another $25 million in 2009 American Recovery and Reinvestment Act (ARRA) economic stimulus money was directed by DOE to complete the excavation of the remaining waste priority areas in OU-1 (USEPA, 2010 and ARC, 2010). This also may have been insufficient to fund the removal, because the final actual cost for removal of wastes and backfill/capping of the Mound OU-1 Landfill Area is reported to be approximately $65 million (Fischer, 2011 and Lucas, 2011). Review of available documents (ARC, 2009 and ARC, 2010) and discussions with regulatory agency representatives for this project indicate that one reason for the significant increase in costs was that "variations with respect to waste location and waste type from those modeled by the project team in the original Remedial Action Work Plan were encountered during excavation" (ARC, 2009). Specific factors that resulted in the increased costs included:

- Uncertainty regarding the locations, extents, depths, configurations, volumes, types, and characteristics of the waste deposits;

- No or only limited characterization data for the waste materials prior to initiation of the removal action;

- The presence of unanticipated and undocumented waste materials and waste types including but not limited to mercury, PCBs, previously unidentified VOCs, Pu-239, and Am-241;

- The presence of a substantial amount of mixed radioactive and hazardous wastes/debris, and hazardous waste/debris, with both the hazardous wastes/debris and the mixed wastes requiring off-site incineration and chemical oxidation;

- The necessity of transporting materials to four different off-site disposal or waste processing facilities rather than only one facility as anticipated during project planning because of the variability in types of wastes encountered;

- The impacts of weather (heat, cold, rain, lightning) on implementability, employee productivity rates, equipment operation, and progress of the excavation activities;

- Excessive water ponding in trenches and limited operations during backfilling activities caused by severe precipitation; and

- Delayed and complicated backfill and soil cover compaction due to excessive precipitation and frozen soil.

Excavation of waste materials from OU-1 Areas 1 and 2 is likely to encounter many of the same complications encountered at the Mound OU-1 Landfill Area. In addition to the cost overrun issues listed above, experience with waste excavation at other landfill sites indicates that the following additional factors could also contribute to increased costs for either or both of the "complete rad removal" alternatives:

- Unanticipated variations in the volume-weight relationships for the wastes that could result in variability in costs charged on either a volumetric or weight based unit price;

- Increased fuel and resultant transportation costs over time;

- Loss of the availability of one or more of the currently available off-site disposal facilities in the future;

- Potential increases in the off-site transportation and disposal pricing over time;

- Potential for encountering leachate containing hazardous substances that may require treatment;

- Potential for stormwater accumulation in depressions created by waste excavation and resultant potential for generation of contaminated stormwater requiring treatment; and

- Decreased availability and/or increased pricing for local fill material required to regrade Areas 1 and 2 to 5% slopes upon completion of the waste excavation activities.

The nature of the activities and the longer duration required for implementation of the "complete rad removal" alternatives, in particular the off-site disposal alternative, significantly increases the potential for occurrence of cost increases over time.

Fiscally-constraining the project would not materially affect the cost or schedule for construction of the ROD remedy, but would significantly increase the time required for construction of the "complete rad removal" alternatives. The increased schedule under a fiscal constrained approach would increase the fixed costs, such as environmental monitoring and project, construction, and site management, associated with the two "complete rad removal" alternatives. Fiscally-constraining the project would also increase the uncertainty associated with the costs to construct the "complete rad removal" alternatives, especially the alternative that includes off-site disposal, by increasing the potential for future increases in fuel, transportation, and disposal costs. Fiscally-constraining the "complete rad removal" with off-site disposal alternative would effectively make this alternative infeasible as it would limit construction work to only a few weeks per year requiring significant additional costs for repeated mobilization and demobilization, site management and environmental monitoring. It is also highly questionable whether any contractor would bid on a project that would only allow for construction activities for a few weeks per year over an approximately 29-year period. Hiring or contracting with qualified equipment operators, environmental technicians and other specialists for such short durations over such a protracted period of time greatly increases the degree of difficulty in implementation.

7.3 Modifying Criteria

The two NCP modifying criteria are: (1) state acceptance; and (2) community acceptance. Comparison of these alternatives with respect to modifying criteria will be performed by EPA as part the SFS review and decision process .

8 REFERENCES

Accelerated Remediation Company (ARC), 2009, Operable Unit 1 Closeout Report, DOE Contract No. DE-AM09-05SR22399, Prepared for USDOE, April.

Agency for Toxic Substances and Disease Registry (ATSDR), 2006, Health Consultation, Hurricane Response Sampling Assessment for Old Inger Oil Refinery, Ascension parish, Louisiana, EPA Facility ID: LAD980745533, October 11.

ARC, 2010, Operable Unit 1 Landfill Area Closeout Report, Final, DOE Contract No. DE-AM09-05SR22399, Prepared for USDOE, October 12.

AutoCAD Civil 3D (Version 2010) [Computer software], San Rafael, CA: Autodesk.

Auxier & Associates, Inc. (Auxier), 2000, Baseline Risk Assessment (Appendix A to Remedial Investigation Report), West Lake Landfill Operable Unit 1, April 24.

Belant, J.L., 1997, Gulls in Urban Environments: Landscape-Level Management to Reduce Conflict, U.S. Department of Agriculture, National Wildlife Research Center, Sandusky, Ohio, Landscape and Urban Planning 38 (1997) 245-258.

Caterpillar, Inc, 2008, Caterpillar Performance Handbook, Edition 38, January.

Engineering Management Support, Inc. (EMSI), 2010b Supplemental Feasibility Study West Lake Landfill OU-1, DRAFT, July 23.

EMSI, 2010a, Work Plan for Supplemental Feasibility Study – Radiological-Impacted Material Excavation Alternatives Analysis, West Lake Landfill Operable Unit 1, June 4.

EMSI, 2008, Remedial Design Work Plan, West Lake Landfill Operable Unit 1, November 25.

EMSI, 2006, Feasibility Study Report, West Lake Landfill Operable Unit 1, May 8.

EMSI, 2000b, Technical Memorandum: Evaluation of Potential “Hot Spot” Occurrences and Removal for Radiologically Impacted Soil, West Lake Landfill OU-1, September.

EMSI, 2000, Remedial Investigation Report, West Lake Landfill Operable Unit 1, April 10.

Federal Aviation Administration (FAA), 2007, Advisory Circular AC 150/5200-33B, “Hazardous Wildlife Attractants On or Near Airports”, August 28.

FAA, 2006, Advisory Circular AC 150/5200-34B, “Construction or Establishment of Landfills Near Public Airports”, January 26.

FAA, 2002, Memorandum of Agreement Between the Federal Aviation Administration, the U.S. Air Force, the U.S. Army, the U.S. Environmental Protection Agency, the U.S. Fish and Wildlife Service, and the U.S. Department of Agriculture to Address Aircraft-Wildlife Strikes, December 17.

Federal Remediation Technologies Roundtable (FRTR), 2002, Remediation Technologies Screening Matrix and Reference Guide, Version 4.0: Chemical Extraction http://www.frtr.gov/matrix2/section4/4-15.html, Separation http://www.frtr.gov/matrix2/section4/4-18.html, and Phytoremediation http://www.frtr.gov/matrix2/section4/4-3.html

Federal Emergency Management Agency (FEMA), 1995, FIRM Flood Insurance Rate Map, St. Louis County, Missouri and Incorporated Areas, Panel 39 of 420, Map Number 29189C0039 H, August 2.

Fischer, Timothy, 2011, USEPA Region 5 Remedial Project Manager for USDOE Mound Plant, Personal Communication, March 23.

Foth & Van Dyke, 1989, Letter from Rodney Bloese to Joseph Homsy re: West Lake Landfill CERCLA, dated December 12, 1989.

Gnanapragasam, C. Yu, Biwer, B.M., Kamboj, S., Cheng, J.-J, Klett, T., LePoire, D., Zielen, A.J., Chen, S.Y., Williams, W.A., Wallo, A., Domotor, S., Mo, T. and Schwartzman, A., 2007, User's Manual for RESSRAD-Offsite Version 2, Environmental Science Division, Argonne National Laboratory, ANL/EVS/TM/07-1, DOE/HS-0005, NUREG/CR-6937, June.

Golder Associates, 1996, Physical Characterization Technical Memorandum for the West Lake Landfill Operable Unit 2, Bridgeton, Missouri.

Herst & Associates, Inc., 2005, Remedial Investigation Report, West Lake Operable Unit 2, Bridgeton, Missouri, September 2005.

Lee, Chris, 2010, Vice President of Government Business Development – Energy Solutions, Personal communication, June 28.

Louisiana Department of Environmental Quality (LDEQ), 2005, Facility Inspection Reports for AI Nos. 75963, 72223, 71650, 70923, 3335, 1260, 71167, 77198, and 20872, September 27.

Lucas, Paul, 2011, USDOE Office of Environmental Management, Miamisburg, OH, Personal Communication, March 25.

McLaren/Hart, 1996, Soil Boring/Surface Sample Investigation Report, West Lake Landfill Radiological Areas 1 and 2, Bridgeton, Missouri

Missouri Department of Natural Resources (MDNR), 2010, Electronic mail dated February 18, 2010 from Shawn Muenks, MDNR to Paul Rosasco, EMSI re: WLL OU-1 SFS WP – MDNR comments with attachment titled Missouri Department of Natural Resources Comments on the West Lake Landfill Operable Unit 1 Work Plan for Supplemental Feasibility Study.

MDNR, 2007, Solid Waste Management Program (SWMP) Fact Sheet *Design and Construction of Landfill Gas Monitoring Wells,* January.

MDNR, 2006, SWMP Technical Bulletin *Sampling of Landfill Gas Monitoring Wells,* June.

MDNR, 1998, Solid Waste Regulations, 10 CSR 80-3.010, July 31.

National Oceanic and Atmospheric Administration (NOAA), 2011, August-Saint Louis Weather Calendar at http://www.crh.noaa.gov/lsx/climate/normals/aug.php.

National Wildlife Research Center (NWRC), 2008, New Technologies to Deter Wildlife from Airports and Aircraft, USDA Animal and Plant Health Inspection Service.

National Wildlife Research Center and CSU Libraries, undated, AgNIC Wildlife Damage Management, Frightening Devices, USDA Wildlife Services.

National Wildlife Services, 2010, Safer Skies: For Birds and People, USDA Animal and Plant Health Inspection Service.

Nuclear Regulatory Commission (NRC), 1988, Radioactive Material in the West Lake Landfill – Summary Report, NUREG 1308 – Rev. 1, June

NRC, 1984, Radon Attenuation Handbook for Uranium Mill Tailings Cover Design, NUREG/CR-3533.

NRC, 1976, Office of Inspection and Enforcement, IE Inspection Report No. 76-01.

Peck, R. B., Hanson, W.E., and Thornburn, T.H., 1974, *Foundation Engineering*, 2^{nd} Edition, John Wiley & Sons, New York.

Pivetz, B., 2001, Ground Water Issue: Phytoremediation of Contaminated Soil and Ground Water at Hazardous Waste Sites, Prepared for U.S. EPA, Office of Solid Waste and Emergency Response, EPA/540/S-01 /500, February.

Radiation Management Corporation (RMC), 1982, Radiological Survey of the West Lake Landfill, St. Louis County, Missouri, NUREG/CR-2722, May.

RMC, 1981, Report on Site Visit – West Lake Landfill, St. Louis County, Missouri.

RAECOM web calculator used in this evaluation is hosted at http://www.wise-uranium.org/ctc.html (March 21, 2011.

Richtel, Steve, 2010, Program Manager, Closed Sites Management Group – Waste Management, Personal communication, June 28.

Rogers, V.C., Nielson, K.K., and Kalkwarf, D.R., 1984, Radon Attenuation Handbook for Uranium-Mill Tailings Cover Design, prepared for the U.S. Nuclear Regulatory Commission, Washington, D.C., NUREG/CR-3533." Battelle Pacific Northwest Labs., Richland, WA. PNL-4878, April 1984.

"RS Means CostWorks Online." *RSMeans Costworks Online Construction Cost Data - Reliable Construction Cost Estimating from RSMeans*. Reed Construction Data Inc. http://www.meanscostworks.com Data for 2011 Q1.

RS Means, 2010, Heavy Construction Cost Data, 24th Annual Edition.

Schroeder, P.R., Lloyd, C. M., and Zappi, P. A., 1994, "The Hydrologic Evaluation of Landfill Performance (HELP) Model: User's Guide for Version 3," EPA/600/R-94/168a, September 1994, U.S. Environmental Protection Agency Office of Research and Development, Washington, D.C.

Solman, V.E., 1994, Gulls, Canadian Wildlife Service, Ottawa, Ontario – reprinted for Prevention and Control of Wildlife Damage, Cooperative Extension Division, Institute of Agriculture and Natural Resources, University of Nebraska – Lincoln. E49-E52.

terra technologies, 2004, Letter to Ms. Cheryle Micinski, USEPA from David Heinze, terra technologies re: Clarifications to Information Request, West Lake Landfill Site, September 10, 2004.

TetraTech EM, Inc., 2009, Cost Evaluation for Excavation Remedial Alternative, Revision 01, West Lake Landfill Site, Bridgeton, Missouri, Operable Unit 1, START 3 Contract No, EP-S7-06-01, Task Order No. 0142, September 3.

U..S. Army Corps of Engineers (USACE), 2010, Final, Five-Year Review Report, Second Five-Year Review Report for Formerly Used Sites Remedial Action Program (FUSRAP) St. Louis Sites, St. Louis Missouri, U.S. Army Corps of Engineers, St. Louis District Office, September 22.

United States Department of Agriculture (USDA), 2008, Innovative Solutions to Human-Wildlife Conflicts, National Wildlife Research Center Accomplishments, Miscellaneous Publication No. 1603.

United States Department of Energy (DOE), 2007, RESRAD-OFFSITE A Tool for Evaluating Radiation Doses and Risks to Humans, HS-20-IB-2007-5, Office of Nuclear Safety and Environment, United States Department of Energy, August.

DOE, 1999, Cost and Performance Report: Thermo NUtech's Segmented Gate System, Sandia National Laboratories, ER Site 16, Albuquerque, N.M. Prepared by Sandia National Laboratories, January.

DOE, 1998, Technology Deployment: Segmented Gate System (SGS), Accelerated Site Technology Deployment Program, August.

United States Environmental Protection Agency (EPA), 2010g, Letter from Daniel Gravatt, EPA Region 7 to Paul Rosasco, EMSI, re: Missouri Department of Natural Resources' Comments on the Revision 1 Work Plan for Supplemental Feasibility Study, Radiological-Impacted Material Excavation Alternative Analysis, for West Lake Landfill Operable Unit 1, March 29, 2010, May 21.

EPA, 2010f, NPL Fact Sheet, Mound Plant (USDOE), EPA ID# OH6890008984, May 19.

EPA, 2010e, Letter from Daniel Gravatt, EPA Region 7 to Paul Rosasco, EMSI, re: Revision 1 Work Plan for Supplemental Feasibility Study, Radiological-Impacted Material Excavation Alternative Analysis, for West Lake Landfill Operable Unit 1, March 29, 2010, April 29.

EPA, 2010d, Letter from Dan Wall, EPA Region 7 to Paul Rosasco, EMSI, re: Draft Work Plan for Supplemental Feasibility Study Radiological-Impacted Material Excavation Alternative Analysis, for West Lake Landfill Operable Unit 1, January 28, 2010, March 9.

EPA, 2010c, Electronic mail dated February 19, 2010 from Daniel Gravatt, EPA Region 7 to Paul Rosasco, EMSI, re: EPA comments on draft Supplemental FS Workplan for Westlake Landfill, with attached letter from Daniel Wall EPA Region 7 to Paul Rosasco, EMSI re: Draft Work Plan for Supplemental Feasibility Study, Radiological-Impacted Material Excavation Alternatives Analysis, for West Lake Landfill Operable Unit-1, January 28, 2010

EPA, 2010b, Statement of Work for Supplemental Feasibility Study, West Lake Landfill Site (attachment to EPA's January 11, 2010 letter).

EPA, 2010a, Letter from Cecilia Tapia, Region 7 Director Superfund Division to Michael Hockley (Spencer Fane Britt & Browne, LLP), Charlotte Neitzel (Holme, Roberts & Owen, LLP), and Christina Richmond (U.S. Department of Justice) Re: West Landfill Site, Bridgeton, Missouri Administrative Order on Consent, Docket No.: 93-F-0005, January 11.

EPA, 2009c, Office of Superfund Remediation and Technology Innovation (OSTRI) Memorandum from Elizabeth Sutherland to Cecilia Tapia re: West Lake Landfill Site: Recommendations, May 21, 2009.

EPA, 2009b, A Citizen's Guide to Radon, EPA 402/K-09/001, January.

EPA, 2009a, National Oil and Hazardous Substances Pollution Contingency Plan (NCP) at 40 CFR § 300.440.

EPA, 2008b, Second Amendment to Administrative Settlement Agreement and Administrative Order on Consent, Docket No. VII-93-F-0005, filed March 3.

EPA, 2008a, Record of Decision – West Lake Landfill Site, Bridgeton, Missouri, Operable Unit 1, May.

EPA, 2007a, Technology Reference Guide for Radioactively Contaminated Media, EPA 402 R-07-004, October.

EPA, 2007b, Second Five-Year Report for the Dutchtown Treatment Plant Superfund Site, Dutchtown, Ascension Parish, Louisiana, September.

EPA, 2006a, Proposed Plan – West Lake Landfill Site Operable Units 1 and 2, Bridgeton, Missouri, June.

EPA, 2006b, Hurricane Katrina Evaluation Report, Bayou Bonfouca Superfund Site, St. Tammamy parish, Louisiana, February 6.

EPA, 2005a, EPA Superfund Record of Decision: St. Louis Airport/Hazelwood Interim Storage/Futura Coatings Co., EPA ID: MOD980633176 OU 1, St. Louis, MO, EPA/ROD/R07-05/045, September 2.

EPA, 2005b, Emission Facts: Average Carbon Dioxide Emissions Resulting from Gasoline and Diesel Fuel," US EPA Office of Transportation and Air Quality, EPA420-F-05-001 February.

EPA, 2003, Superfund Innovative Technology Evaluation Program, Technology Profiles, Eleventh Edition, EPA/540/R-03/009.

EPA, 2002, Role of Background in the CERCLA Cleanup Program, OSWER 9285.6-07P, April 26.

EPA, 2000, A Guide to Developing and Documenting Cost Estimates During the Feasibility Study, EPA 540-R-00-002, OSWER 9355.0-75, July.

EPA, 1998a, Memorandum: Use of Soil Cleanup Criteria in 40 CFR Part 192 as Remediation Goals for CERCLA Sites, OSWER Directive no. 9200.4-25, February 12.

EPA, 1998b, Superfund Record of Decision, St. Louis Airport/Hazelwood Interim Storage/Futura Coatings Co., EPA ID: MOD980633176 OU 2, St. Louis, MO, EPA/ROD/R07-98/169, August 27.

EPA, 1997a, Memorandum: Establishment of Cleanup Levels for CERCLA Sites with Radioactive Contamination, OSWER Directive no. 9200.4-18, August 22.

EPA, 1997b, First Amendment to Administrative Order on Consent, Docket No. VII-93-F-0005, July 16.

EPA, 1996, Application of the CERCLA Municipal Landfill Presumptive Remedy to Military Landfills, EPA 540/F-96/020, OERR Directive No. 9355.0-67FS, December.

EPA, 1995, Contaminants and Remedial Options at Selected Metal-Contaminated Sites, EPA/540/R-95/512.

EPA, 1994, Seminar Publication – Design, Operation, and Closure of Municipal Solid Waste Landfills, EPA/625/R-94/008, September.

EPA, 1993d, Solid Waste Disposal Facility Criteria, EPA 530-R-93-017, November.

EPA, 1993c, Administrative Order on Consent for Remedial Investigation/Feasibility Study, Docket No. VII-93-F-0005, filed March 3.

EPA, 1993b, Presumptive Remedy for CERCLA Municipal Landfill Sites, Office of Solid Waste and Emergency Response Directive 9355.0-49FS, EPA 540-F-93-035, September.

EPA, 1993a, Memorandum: Revisions to OMB Circular A-94 on Guidelines and Discount Rates for Benefit-Cost Analysis, OSWER Directive No. 9355.3-20, June 25.

EPA, 1992, Engineering Bulletin: Slurry Walls, EPA/540/S-92/008.

EPA, 1991b, A Guide to Principal Threat and Low Level Threat Wastes, Office of Solid Waste and Emergency Response Superfund Publication 9380.3-06FS, November.

EPA, 1991a, Conducting Remedial Investigation/Feasibility Studies for CERCLA Municipal Landfill Sites, EPA/540/P-91/001, February.

USEPA, 1990, National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 CFR 300, Federal Register 55:8666, March 8.

USEPA, 1989, Risk Assessment Guidance for Superfund Volume 1 Human Health Evaluation Manual (Part A) Interim Final, EPA/540/1-89/002, December.

EPA, 1988a, Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, EPA/540/6-08/004, OSWER Directive 9355.3-01, October.

EPA, 1988b, Technological Approaches to the Cleanup of Radiologically Contaminated Superfund Sites, EPA/540/2-88/002.

EPA, 1986, "Radon Flux Measurements on Gardinier and Royster Phosphogypsum Piles Near Tampa and Mulberry, Florida", EPA 520/5-85-029, January.

EPA, 1972, Sanitary Landfill Design and Operation, SW-287.

EPA, DOE, NRC, DOD, 1997, Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), Final, NUREG-1575, EPA 402-R-97-016, December.

USEPA Region 5, 2010, NPL Fact Sheet, Mound Plant (USDOE), EPA ID # OH6890008984, May 19.

Union Pacific Railroad (UPRR), 2007, Environmental Facts.

TABLES

Table 1: Summary Comparision of Results from Proximately Located RI and NRC Soil Borings

RI Boring	NRC Boring	Distance Between (ft)	RI Downhole Log Peak Depth (ft)	RI Downhole Log Peak Intensity (cpm)	RI Soil Sample Results Depth (ft)	RI Soil Sample Results Ra226 (pCi/g)	RI Soil Sample Results Th230 (pCi/g)	NRC Downhole Log Peak Depth (ft)	NRC Downhole Log Peak Intensity (cpm)	NRC Soil Values[1] Depth (ft)	NRC Soil Values[1] Ra226 (pCi/g)	RI Re-Log of NRC Borings Peak Depth (ft)	RI Re-Log of NRC Borings Intensity (cpm)
AREA 1													
WL-112	PVC-38	80	6.5	10,000	5	4.66	84.4	7	5,000	None		8	17,000
WL-113	PVC-27	50	4	14,000	5 +dup	0.97/1.06	0.33/0.58	2	1,800	None		No peak	≤6,000
WL-115	PVC-25	45	No peak	≤6,000	5	1.00	0.84	7	19,000	None		9	72,000
WL-114	PVC-26	80	5	16,000	5	109	7,853	5	19,000	None		5	86,000
WL-118	PVC-26	80	No peak	≤6,000	5	18.4	425	5	19,000	None		5	86,000
WL-117	PVC-24	90	6.5	16,000	10	36.58	3.15	8	1,800	None		No peak	≤6,000
WL-117	PVC-36	115	6.5	16,000	10	36.58	3.15	7	5,000	None		8	17,000
AREA 2													
WL-209	PVC-4	25	0.5	744,000	0	3,720	29,240	0 - 2	>50,000	1	2,500	1	1,290,000
WL-209	PVC-7	60	0.5	744,000	0	3,720	29,240	0 - 2	>50,000	None		3	1,386,000
WL-222	PVC-34	60	No peak	≤6,000	0	2.94	131	1	2,600	None		1	22,000
WL-223	PVC-20	65	4	15,000	5	1.73	9.16	1	23,000	1	76	1.5	127,000
WL-226	PVC-19	70	10.5	370,000	10	1.4	14.1	8	>50,000	8	340	8	332,000
WL-227	PVC-40	45	No peak	≤6,000	5	1.32	20.4	2	26,000	None		2.5	120,000
WL-234	PVC-11	95	7	1,104,000	10	3,060	57,300	0 - 3	>50,000	2	13,000	2.5	2,286,000
WL-241	PVC-9	70	5.5	46,000	5	12.9	343	2	22,000	2	55	5	22,000

1. The NRC studies did not include laboratory analyses of soil samples for Ra-226 but are based on the results of an in-situ gamma measurement system consisting of an intrinsic germanium (IG) detector coupled with a multi-channel analyzer to make qualitative and quantitative field analyses (NRC, 1982)

Table 2: Summary of Thorium-230 Decay and Radium-226 In-Growth Over Time

Time (years)	Thorium-230 pCi/g	From Initial Ra_{226} (pCi/g)	Radium -226 Ingrowth from Th_{230} (pCi/g)	Total (pCi/g)
0	2,140	189	0	189
30	2,139	187	28	214
100	2,138	181	91	272
200	2,136	173	177	351
500	2,131	152	415	568
1,000	2,122	123	748	871
2,000	2,103	80	1,227	1,307
3,000	2,085	52	1,531	1,583
5,000	2,049	22	1,840	1,862
7,000	2,014	9	1,950	1,959
10,000	1,962	2	1,974	1,976
15,000	1,879	0	1,914	1,915
20,000	1,800	0	1,836	1,836
30,000	1,650	0	1,684	1,684
40,000	1,513	0	1,544	1,544
50,000	1,388	0	1,416	1,416
80,000	1,070	0	1,092	1,092

Constants	half life (y)	lambda (1/y)	Specific Mass to Activity (µg/pCi)
Th_{230} Half-Life	80,000	8.664E-06	4.95E-05
Ra_{226} Half-Life	1,602	4.327E-04	1.01E-06

Initial Values (from the RI report Appendix A Table A.2-5)

Thorium 230	2140	pCi/g	Average activity level for Area 2
Radium-226	189	pCi/g	Average activity level for Area 2

Th-230(pCi/g) = Initial_Th230(pCi/g)*EXP[-Lambda_Th(1/y)*Time(y)]

Ra-226(pCi/g) = {Initial_Ra226(pCi/g) x EXP[-Lambda_Ra(1/y) x Time(y)]} + {[Lambda_Ra(1/y) x Initial_Th230(pCi/g)] / [Lambda_Ra(1/y) - Lambda_Th(1/y)]} x {EXP[-Lambda_Th(1/y) x Time(y)] - EXP[-Lambda_Ra(1/y) x Time(y)])}

Table 3: Summary Comparison of Soil Sample Results to RCRA Toxicity Characteristic Regulatory Levels

EPA HW No.	Contaminant	Regulatory Level (mg/L)	x DAF of 100	Maximum concentration in soil (mg/kg) [1]	Location and Depth (ft)
D004	Arsenic	5.0	500	220	WL-114 @ 0
D005	Barium	100.0	10,000	NA	
D006	Cadmium	1.0	100	7.9	WL-114 @ 0
D007	Chromium	5.0	500	**890**	Wl-208 @ 20
D008	Lead	5.0	500	**2,200**	WL-210 @ 0
D009	Mercury	0.2	20	0.27	WL-209 @ 0
D010	Selenium	1.0	100	**250**	WL-114 @ 0
D011	Silver	5.0	500	ND	
D012	Endrin	0.02	2	0.18	WL-218 @ 25
D013	Lindane (gamma BHC)	0.4	40	ND	
D014	Methoxychlor	10.0	1,000	0.0057	WL-227 @ 40
D015	Toxaphene	0.5	50	ND	
D016	2,4-D	10.0	1,000	NA	
D017	2,4,5-TP (Silvex)	1.0	100	NA	
D018	Benzene	0.5	50	**120 J**	Wl-208 @ 20
D019	Carbon tetrachloride	0.5	50	ND	ND
D020	Chlordane	0.03	3	0.015	WL-104 @ 25
D021	Chlorobenzene	100.0	10,000	180	WL-230 @ 16
D022	Chloroform	6.0	600	**890**	Wl-208 @ 20
D023	o-Cresol (2-Methylphenol)	200.0	20,000	0.17 J	WL-213 @ 25
D024	m-Cresol (3-Methylphenol)	200.0	20,000	NA	NA
D025	p-Cresol (4-Methylphenol)	200.0	20,000	5.8 JY	WL-210 @ 15
D026	Cresol	200.0	20,000	NA	NA
D027	1,4-Dichlorobenzene	7.5	750	530 Y *	WL-230 @ 16
D028	1,2-Dichloroethane	0.5	50	ND	ND
D029	1,1-Dichloroethylene	0.7	70	ND	ND
D030	2,4-Dinitrotoluene	0.13	13	ND	
D031	Heptachlor (and its epoxide)	0.008	0.8	ND	
D032	Hexachlorobenzene	0.13	13	ND	
D033	Hexachlorobutadiene	0.5	50	ND	
D034	Hexachloroethane	3.0	300	ND	
D035	Methyl ethyl ketone (2-butanone)	200.0	20,000	52	WL-208 @ 15
D036	Nitrobenzene	2.0	200	ND	
D037	Pentachlorophenol	100.0	10,000	0.085 J	WL-208 @ 28
D038	Pyridine	5.0	500	NA	
D039	Tetrachloroethylene	0.7	70	ND	
D040	Trichloroethylene	0.5	50	6.0 JY	WL-210 @ 15
D041	2,4,5-Trichlorophenol	400.0	40,000	ND	
D042	2,4,6-Trochlorophenol	2.0	200	ND	
D043	Vinyl chloride	0.2	20	ND	

Notes 1 Bolded maximum concentrations indicate that the measured contaminant concentration is greater than the Regulatory Level times a Dilution-Attenuation Factor (DAF) of 100.

J - Estimated value, as result was below laboratory reporting limit.

Y - Estimated value, as all surrogate compounds were diluted beyond detection limits.

* Result is from EPA Method 8270. A result of 2,100 Y was obtained from the EPA Method 8260 analysis of this sample.

Table 4: Summary of Calculated Risks for Current and Future Potential Receptors

Potential Receptor	Location	Radionuclide Cancer Risk	Chemical Cancer Risk	Total Cancer Risks	Hazard Quotient
Current Scenarios					
Grounds keeper adjacent to Area 1	Onsite	1×10^{-5}	NE	1×10^{-5}	NE
Grounds keeper adjacent to Area 2	Onsite	4×10^{-5}	NE	4×10^{-5}	NE
Ford property grounds keeper	Onsite	6×10^{-7}	NE	6×10^{-7}	NE
Future Scenarios					
Area 1 grounds keeper	Onsite	6×10^{-5}	2×10^{-7}	6×10^{-5}	0.0059
Area 2 grounds keeper	Onsite	2×10^{-4}	3×10^{-8}	2×10^{-4}	0.0022
Area 1 Adjacent Building User	Onsite	1×10^{-5}	NE	1×10^{-5}	NE
Area 2 Adjacent Building User	Onsite	4×10^{-5}	NE	4×10^{-5}	NE
Area 1 Storage Yard Worker	Onsite	1×10^{-4}	NE	1×10^{-4}	NE
Area 2 Storage Yard Worker	Onsite	4×10^{-4}	NE	4×10^{-4}	NE
Ford property grounds keeper	Offsite	2×10^{-6}	NE	2×10^{-6}	NE

NE = No exposure anticpated because a complete exposure pathway does not exist.

Table 5 : Preliminary Identification of Potential Chemical-Specific ARARs and TBC Criteria

Citation	Chemical	Medium	Requirement	Preliminary Determination	Remarks
Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings (40 CFR 192), Subpart A, Standards for the Control of Residual Radioactive Material from Inactive Uranium Processing Sites	Radon-222	Air	The annual average release rate of radon-222 to the atmosphere applied over the entire surface of a disposal site should not exceed 20 pCi/m2-s, and the annual average concentration of radon-222 in air at or above any location outside the disposal site should not be increased by more than 0.5 pCi/L.	Not applicable but potentially relevant and appropriate	The West Lake Landfill OU-1 Site is not a designated Title I uranium mill tailings site; therefore, this requirement would not be applicable. The radiologically impacted materials at the West Lake site are a small fraction of an overall matrix of municipal solid waste, debris and fill materials. Therefore, the waste materials at West Lake Site are not similar to uranium mill tailings. These regulations are applicable to uncontrolled areas whereas the current and future uses of Areas 1 and 2 are restricted. As these regulations address radon emissions, which is an issue for OU-1, they are considered potentially relevant and appropriate to the ROD-selected remedy and for a new engineered disposal cell included as part of the "complete rad removal" with on-site disposal alternative.
Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings (40 CFR 192), Subpart A, Standards for the Control of Residual Radioactive Material from Inactive Uranium Processing Sites	Radium, Uranium, and trace metals	Ground-water	Establsihes maximum concentration for groundwater protection Maximum constituent concentration Combined Ra_{226} and Ra_{228} — 5 pCi/l Combined U_{234} and U_{238} — 30 pCi/l Gross alpha (excluding radon & urnaium) — 15 pCi/l Arsenic — 0.05 mg/L Barium — 1.0 mg/L Cadmium — 0.01 mg/L Chromium — 0.05 mg/L Lead — 0.05 mg/L Mercury — 0.002 mg/L Selenium — 0.01 mg/L Silver — 0.05 mg/L Nitrate (as N) — 10 mg/L Molybdenum — 0.1 mg/L	Not applicable but potentially relevant and appropriate	The West Lake Landfill OU-1 Site is not a designated Title I uranium mill tailings site; therefore, this requirement would not be applicable. As potential leaching of radionuclides and trace metals from the radiologically impacted materials at West Lake is a possible issue of concern, these standards are potentially relevant and appropriate to the ROD-selected remedy and for a new engineered disposal cell included as part of the "complete rad removal" with on-site disposal alternative.

Table 5 : Preliminary Identification of Potential Chemical-Specific ARARs and TBC Criteria

Citation	Chemical	Medium	Requirement	Preliminary Determination	Remarks
Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings (40 CFR 192), Subpart B, Standards for Cleanup of Land and Buildings Contaminated with Residual Radioactive Materials from Inactive Uranium Processing Sites	Radium-226 (Radium-228)	Soil	Residual concentrations of radium-226 in soil at a designated uranium processing site should not exceed background by more than 5 pCi/g in the top 15 cm of soil or 15 pCi/g in each 15 cm layer below the top layer, averaged over an area of 100 m^2. (Similar limits are indirectly indicated for radium-228 in Subpart E, which addresses thorium by-product material.)	Neither applicable nor relevant and appropriate to Areas 1 & 2 Potentially relevant and appropriate for radiologically impacted soil on buffer zone/ Crossroad prop.	The West Lake Landfill OU-1 Site is not a designated Title I uranium mill tailings site; therefore this requirement would not be applicable. The radiologically impacted materials at the West Lake site are a small fraction of an overall matrix of municipal solid waste, debris and fill materials. Therefore, the waste materials at West Lake are not similar to uranium mill tailings. These regulations are applicable to uncontrolled areas whereas current and future uses of Areas 1 and 2 are restricted. Consequently, these regulations are not relevant and appropriate to Areas 1 and 2. They are potentially relevant and appropriate for impacted soil on the buffer/Crossroad properties
Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings (40 CFR 192), Subpart D, Standards for Management of Uranium Byproduct Materials Pursuant to Section 84 of the Atomic Energy Act of 1954, as amended; Subpart E, Standards for Management of Thorium Byproduct Materials Pursuant to Section 84 of the Atomic Energy Act of 1954, as amended	Radiation	Any	Processing operations during and prior to the end of the closure period at a facility managing uranium and thorium by-product materials should be conducted in a manner that provides reasonable assurance that the annual dose equivalent does not exceed 25 mrem to the whole body, 75 mrem to the thyroid, and 25 mrem to any other organ of any member of the public as a result of exposures to the planned discharge of radioactive material to the general environment (excluding radon-222, radon-220, and their decay products).	Neither applicable but potentially relevant and appropriate	The West Lake Landfill OU-1 Site is not a designated Title I uranium mill tailings site; therefore, this requirement would not be applicable. The radiologically impacted materials at the West Lake site are a small fraction of an overall matrix of municipal solid waste, debris and fill materials. Therefore, the waste materials at West Lake Site are not similar to uranium mill tailings. As alpha and gamma radiation is a potential exposure route for OU-1, these regaulations are considered to be potentially relevant and appropriate.
National Emissions Standards for Hazardous Air Pollutants (40 CFR 61), Subpart T, National Emissions Standards for Radon Emissions from disposal of Uranium Mill Tailings	Radon-222	Air	Radon-222 emissions to ambient air from uranium mill tailings piles that are no longer operational should not exceed 20 pCi/m^2-s.	Potentially relevant and appropriate	The West Lake Landfill OU-1 Site is not a designated uranium mill tailings site, so this requirement would not be applicable; however it could be considered relevant and appropriate because a portion of the waste materials at the Site do emit radon.

Table 5 : Preliminary Identification of Potential Chemical-Specific ARARs and TBC Criteria

Citation	Chemical	Medium	Requirement			Preliminary Determination	Remarks
National Primary Drinking Water Regulations 40 CFR Part 141	Various	Water	Establishes standards including maximum contaminant levels (MCLs) and maximum contaminant level goals (MCLGs) for public drinking water systems			Potentially relevant and appropriate	These standards are only applicable to public drinking water systems; however, MCLs and non-zero MCLGs may potentially be relavent and appropriate standards for groundwater.
			Contaminant	MCL (mg/l)	MCLG (mg/l)		
			Trace metals				
			Antimony	0.006	0.006		
			Asbestos	7 x 10^6 fibers/liter	7 mfl		
			Barium	2	2		
			Beryllium	0.004	0.004		
			Cadmium	0.005	0.005		
			Chromium (total)	0.001	0.001		
			Copper	1.3	1.3		
			Cyanide	0.2	0.2		
			Fluoride	4.0	4.0		
			Lead	0.015	zero		
			Mercury (inorganic)	0.002	0.002		
			Nitrate (as N)	10	10		
			Nitrite (as N)	1	1		
			Selenium	0.05	0.05		
			Thallium	0.002	0.0005		
			Organic Chemicals				
			Alachlor	zero	0.002		
			Atrazine	0.003	0.003		
			Benzene	zero	0.005		
			Benzo(a)pyrene (PAHs)	zero	0.0002		
			Carbofuran	0.04	0.04		
			Carbon tetrachloride	zero	0.005		
			Chlordane	zero	0.002		
			Chlorobenzene	0.1	0.1		
			2,4-D	0.07	0.07		
			Dalapon	0.2	0.2		
			1,2-Dibromo-3-chloropro	zero	0.0002		
			o-Dichlorobenzene	0.6	0.6		
			p-Dichlorobenzene	0.075	0.075		

Table 5 : Preliminary Identification of Potential Chemical-Specific ARARs and TBC Criteria

Citation	Chemical	Medium	Requirement			Preliminary Determination	Remarks
National Primary Drinking Water Regulations 40 CFR Part 141 (cont.)			1,2-Dichloroethane	zero	0.005		
			1,1-Dichloroethylene	0.007	0.007		
			cis-1,2-Dichloroethylene	0.07	0.07		
			trans-1,2-Dichloroethylen	0.1	0.1		
			Dichloromethane	zero	0.005		
			1,2-Dichloropropane	zero	0.005		
			Di(2-ethylhexyl) adipate	0.4	0.4		
			Di(2-ethylhexyl) phthalat	zero	0.006		
			Dinoseb	0.007	0.007		
			Dioxin (2,3,7,8-TCDD)	zero	3E-08		
			Diquat	0.02	0.02		
			Endothall	0.1	0.1		
			Endrin	0.002	0.002		
			Ethylbenzene	0.7	0.7		
			Ethylene dibromide	zero	0.00005		
			Glyphosate	0.7	0.7		
			Heptachlor	zero	0.0004		
			Heptachlor epoxide	zero	0.0002		
			Hexachlorobenzene	zero	0.001		
			Hexachlorocyclopentadie	0.05	0.05		
			Lindane	0.0002	0.0002		
			Methoxychlor	0.04	0.04		
			Oxamyl (Vydate)	0.2	0.2		
			Polychlorinated biphenyls	zero	0.0005		
			Pentachlorophenol	zero	0.001		
			Picloram	0.5	0.5		
			Simazine	0.004	0.004		
			Styrene	0.1	0.1		
			Tetrachloroethylene	zero	0.005		
			Toluene	1	1		
			Toxaphene	zero	0.003		
			2,4,5-TP (Silvex)	0.05	0.05		
			1,2,4-Trichlorobenzene	0.07	0.07		
			1,1,1-Trichloroethane	0.2	0.2		
			1,1,2-Trichloroethane	0.003	0.005		

Table 5 : Preliminary Identification of Potential Chemical-Specific ARARs and TBC Criteria

Citation	Chemical	Medium	Requirement			Preliminary Determination	Remarks
National Primary Drinking Water Regulations 40 CFR Part 141 (cont.)			Trichloroethylene	zero	0.005		
			Vinyl chloride	zero	0.002		
			Xylenes (total)	10	10		
			Radionuclides (picocuries per liter [pCi/l])				
			Alpha particles (pCi/l)		15		
			Beta particles and photon emitters (millirems per year)		4		
			Radium 226 and Radium 228 (combined) (pCi/l)		5		
			Uranium (ug/l)	zero	30		
Missouri Radiation Regulations; Protection Against Ionizing Radiation (19 CSR 20-10.040), Maximum Permissible Exposure Limits	Radiation	Any	For persons inside a controlled area, the maximum permissible whole-body dose due to all external sources of radiation within a controlled area is limited to 5 rems/year and 3 rems per quarter for the whole body, head and trunk, major portion of the bone marrow, gonads or lens of eye; 30 rems/year and 10 rems/quarter for the shin; and 75 rems/yr and 25 rems/quarter for the hands/forearms and feet/ankles. (Note: a controlled area is an area that requires control of access, occupancy, and working conditions for radiation protection purposes.)			Potentially applicable	As these regulations address sources of ionizing radiation, they are potentially applicable as they provide standards for protection from radiation for workers inside Areas 1 and 2 during any remedial actions that may be undertaken.
Missouri Radiation Regulations; Protection Against Ionizing Radiation (19 CSR 20-10.040), Maximum Permissible Exposure Limits	Radiation	Any	For persons outside a controlled area, the maximum permissible whole-body dose due to sources in or migrating from the controlled area is limited to 2 mrem in any 1 hour, 0.1 rem in any 7 consecutive days, and 0.5 rem in any 1 year. (Notes: a controlled area is an area that requires control of access, occupancy, and working conditions for radiation protection purposes; 0.5 rem = 500 mrem.)			Potentially applicable	As these regulations address sources of ionizing radiation, they are potentially applicable for protection of workers and the public outside of Areas 1 and 2 during any remedial actions that may be taken.
Missouri Radiation Regulations; Protection Against Ionizing Radiation (19 CSR 20-10.040),	Specific radionuclides (see table)	Air	The concentrations above natural background of radionuclides in air ouside a controlled area, averaged over any calendar quarter, should not exceed the following limits:			Potentially applicable	These requirements would be applicable to protection of the public during implementation of any remedial action. Specifically, these

Table 5 : Preliminary Identification of Potential Chemical-Specific ARARs and TBC Criteria

Citation	Chemical	Medium	Requirement			Preliminary Determination	Remarks
Maximum Permissible Exposure Limits				Concentration Limit (uCi/mL)			regulations potentially may require perimeter monitoring to be undertaken during any activities that may expose or disturb the radiologically-impacted materials at the Site.
			Isotope	Soluble	Insoluble		
			Actinium-227	8 x 10-14	9 x 10-13		
			Lead-210	4 x 10-12	8 x 10-12		
			Protactinium-231	4 x 10-14	4 x 10-12		
			Radium-226	1 x 10-12	6 x 10-9		
			Radium-228	2 x 10-12	1 x 10-12		
			Radon-222	1 x 10-9	NA		
			Thorium-230	8 x 10-14	3 x 10-13		
			Thorium-232	7 x 10-14	4 x 10-13		
			Uranium-235	2 x 10-11	4 x 10-12		
			Uranium-238	3 x 10-12	5 x 10-12		
			NA = not applicable because radon-222 is a gas.				
Missouri Water Quality Standards 10 CSR 20-7.031(5)	Inorganics Trace metals Organics Pesticides Man-made Volatiles PAHs Phthalates Others	Ground-water	Water contaminants shall not cause or contribute to an exceedance of the following (Table A) standards				These standards are only applicable to public drinking water systems; however, these standards may potentially be relavent and appropriate standards for groundwater.
			Inogranics (mg/l)				
			Fluoride		4		
			Nitrate		10		
			Trace metals (ug/l)				
			Atimony		6		
			Arsenic		50		
			Barium		2,000		
			Beryllium		4		
			Boron		2,000		
			Cadmium		5		
			Chromium III		100		
			Cobalt		1,000		
			Copper		1,300		
			Iron		300		
			Lead		15		
			Manganese		50		
			Mercury		2		

Table 5 : Preliminary Identification of Potential Chemical-Specific ARARs and TBC Criteria

Citation	Chemical	Medium	Requirement		Preliminary Determination	Remarks
Missouri Water Quality Standards 10 CSR 20-7.031(5) (cont.)			Nickel	100		
			Selenium	50		
			Silver	50		
			Thallium	2		
			Zinc	5,000		
			Organics (ug/l)			
			Acrolein	320		
			Bis-2-chloroisopropyl ether	1,400		
			2, chlorophenol	0.1		
			2,4-dichlorophenol	93		
			2,4-dinitrophenol	70		
			2,4-dimethylphenol	540		
			2,4,5-trichlorophenol	2,600		
			2,4,6-trichlorophenol	2		
			2-methyl-4,6-dinitrophenol	13		
			Ethylbenzene	700		
			Hexachlorocyclopentadiene	50		
			Isophorone	36		
			Nitrobenzene	17		
			Phenol	300		
			Dichloropropene	87		
			Para(1,4)-dichlorobenzene	75		
			Other Dichlorobenzenes	600		
			1,2,4-trichlorobenzene	70		
			1,2,4,5-tetrachlorobenzene	2.3		
			pentachlorobenzene	3.5		
			1,1,1-trichloroethane	200		
			1,1,2-trichloroethane	0.04		
			2,4-dinitrotoluene	0.04		
			1,2-diphenylhydrazine	400		
			di (2-ethylhexyl) adipate	5		
			Pesticides (ug/l)			
			2,4-D	70		
			2,4,5-TP	50		
			Alachlor	2		

Table 5 : Preliminary Identification of Potential Chemical-Specific ARARs and TBC Criteria

Citation	Chemical	Medium	Requirement	Preliminary Determination	Remarks
Missouri Water Quality Standards 10 CSR 20-7.031(5) (cont.)			Atrazine	3	
			Carbofuran	40	
			Dalapon	200	
			Dibromochloropropane	0.2	
			Dinoseb	7	
			Diquat	20	
			Endothall	100	
			Ethylene dibromide	0.05	
			Oxamyl (vydate)	200	
			Picloram	500	
			Simazine	40	
			Glyphosate	700	
			Bioaccumulatie Anthropogenic Toxics (ug/l)		
			PCBs	0.000045	
			DDT	0.00059	
			DDE	0.00059	
			DDD	0.00083	
			Endrin	2	
			Endrin aldehyde	0.75	
			Aldrin	0.00013	
			Dieldrin	0.00014	
			Heptachlor	0.4	
			Heptachlor epoxide	0.2	
i			Methoxychlor	40	
			Toxaphene	3	
			Lindane (gamma-BHC)	0.2	
			Alpha,beta,delta-BHC	0.0022	
			Chlordane	2	
			Benzidine	0.00012	
			2,3,7,8-TCDD (dioxin)	1.3E-08	
			Pentachlorophenol	1	
			Anthropogenic Carcinogens (ug/l)		
			Acrylonitrile	0.058	
			Hexachlorobenzene	1	
			Bis (2-chloroethyl) ether	0.03	

Table 5 : Preliminary Identification of Potential Chemical-Specific ARARs and TBC Criteria

Citation	Chemical	Medium	Requirement		Preliminary Determination	Remarks
Missouri Water Quality Standards 10 CSR 20-7.031(5) (cont.)			Bis (chloromethyl) ether	0.00013		
			Hexachloroethane	1.9		
			3,3'-dichlorobenzidine	0.04		
			Hexachlorobutadiene	0.456		
			n-nitrosodimethylamine	0.0007		
			Volatile Organic Compounds (ug/l)			
			Chlorobenzene	100		
			Carbon Tetrachloride	5		
			Trihalomethanes	80		
			Bromoform	4.3		
			Chlorodibromomethane	0.41		
			Dichlorobromomethane	0.56		
			Chloroform	5.7		
			Methyl Bromide	48		
			Methyl Chloride	5		
			Methylene Chloride	4.7		
			1,2-dichloroethane	5		
			1,1,2,2-tetrachloroethane	0.17		
			1,1-dichloroethylene	7		
			1,2-trans-dichloroethylene	100		
			1,2-cis-dichloroethylene	70		
			Trichloroethylene	5		
			Tetrachloroethylene	0.8		
			Benzene	5		
			Toluene	1,000		
			Xylenes (total)	10,000		
			Vinyl chloride	2		
			Styrene	100		
			1,2-dichloropropane	0.52		
			Polynuclear Aromatic Hydrocarbons (ug/l)			
			Anthracene	9,600		
			Fluoranthene	300		
			Fluorene	1,300		
			Pyrene	960		
			Benzo(a)pyrene	0.2		

Table 5 : Preliminary Identification of Potential Chemical-Specific ARARs and TBC Criteria

Citation	Chemical	Medium	Requirement		Preliminary Determination	Remarks
Missouri Water Quality Standards 10 CSR 20-7.031(5) (cont.)			other polynuclear aromatic hydrocarbons*	0.0044		
			Acenaphthene	1,200		
			Phthalate Esters (ug/l)			
			Bis(2-ethylhexyl) phthalate	6		
			Butylbenzyl phthalate	3,000		
			Diethyl phthalate	23,000		
			Dimethyl phthalate	313,000		
			Di-n-butyl phthalate	2,700		
			Health Advisory Levels (ug/l0			
			Ametryn	60		
			Baygon	3		
			Bentazon	20		
			Bis-2-chloroisopropyl ether	300		
			Bromacil	90		
			Bromochloromethane	90		
			Bromomethane	10		
			Butylate	350		
			Carbaryl	700		
			Carboxin	700		
			Chloramben	100		
			o-chlorotoluene	100		
			p-chlorotoluene	100		
			Chlorpyrifos	20		
			DCPA (dacthal)	4,000		
			Diazinon	0.6		
			Dicamba	200		
			Diisopropyl methylphosphonate	600		
			Dimethyl methylphosphonate	100		
			1,3-dinitrobenzene	1		
			Diphenamid	200		
			Diphenylamine	200		
			Disulfoton	0.3		
			1,4-dithiane	80		
			Diuron	10		
			Fenamiphos	2		

Table 5 : Preliminary Identification of Potential Chemical-Specific ARARs and TBC Criteria

Citation	Chemical	Medium	Requirement		Preliminary Determination	Remarks
Missouri Water Quality Standards 10 CSR 20-7.031(5) (cont.)			Fluometron	90		
			Fluorotrichloromethane	2,000		
			Fonofos	10		
			Hexazinone	200		
			Malathion	200		
			Maleic hydrazide	4,000		
			MCPA	10		
			Methyl parathion	2		
			Metolachlor	70		
			Metribuzin	100		
			Naphthalene	20		
			Nitroguanidine	700		
			p-nitrophenol	60		
			Paraquat	30		
			Pronamide	50		
			Propachlor	90		
			Propazine	10		
			Propham	100		
			2,4,5-T	70		
			Tebuthiuron	500		
			Terbacil	90		
			Terbufos	0.9		
			1,1,1,2-Tetrachloroethane	70		
			1,2,3-trichloropropane	40		
			Trifluralin	5		
			Trinitroglycerol	5		
			Trinitrotoluene	2		
Missouri Public Drinking Water Program - Contaminant Levels and Monitoring (10 CSR 60-4)	Inorganics, Synthetic Organic Compounds, Radionuclides, Secondary Contaminants,		Maximum contaminant levels for public water systems.		Not applicable Potentially relevant and appropriate	These standards apply to public water systems and therefore are not applicable to the West Lake Landfill. As these standards provide for maximum concentrations in drinking water and the alluvial aquifer could be used for drinking water outside of the West Lake landfill boundaries; these standards are potentially relevant and appropriate for
			<u>Maximum Contaminant Levels</u>			
			<u>Inorganics</u>			
			Antimony	0.006 mg/L		
			Arsenic	0.01 mg/L		
			Asbestos	7×10^6 fibers/L		
			Barium	2 mg/L		

Table 5 : Preliminary Identification of Potential Chemical-Specific ARARs and TBC Criteria

Citation	Chemical	Medium	Requirement		Preliminary Determination	Remarks
Missouri Public Drinking Water Program - Contaminant Levels and Monitoring (10 CSR 60-4) (cont.)	and Volatile Organic Compounds		Beryllium	0.004 mg/L		groundwater at the Site.
			Cadmium	0.005 mg/L		
			Chromium	0.1 mg/L		
			Cyanide	0.2 mg/L		
			Fluoride	4.0 mg/L		
			Mercury	0.002 mg/L		
			Nitrate (as N)	10 mg/L		
			Nitrite (as N)	1 mg/L		
			Total Nitrate + Nitrite (as N)	10 mg/L		
			Selenium	0.01 mg/L		
			Thallium	0.002 mg/L		
			Synthetic Organic Compounds			
			Alachlor	0.002 mg/L		
			Atrazine	0.003 mg/L		
			Benzo(a)pyrene	0.0002 mg/L		
			Carbonfugran	0.04 mg/L		
			Chlordane	0.002 mg/L		
			Dalapon	0.2 mg/L		
			Di(2-ethylhexyl) adipate	0.4 mg/L		
			Dibromochloropropane (DBCP)	0.0002 mg/L		
			Di(2-ethylhexyl) phthalate	0.006 mg/L		
			Dinoseb	0.007 mg/L		
			Diquat	0.02 mg/L		
			Endothall	0.1 mg/L		
			Endrin	0.002 mg/L		
			2,4-D	0.07 mg/L		
			Ethylene dibromide (EDB)	0.00005 mg/L		
			Glyphosoate	0.7 mg/L		
			Heptachlor	0.0004 mg/L		
			Heptachlor Epoxide	0.0002 mg/L		
			Hexachlorobenzene	0.001 mg/L		
			Hexachlorocyclopentadiene	0.05 mg/L		
			Lindane	0.0002 mg/L		
			Methoxychlor	0.04 mg/L		
			Oxamyl (Vydate)	0.2 mg/L		

Table 5 : Preliminary Identification of Potential Chemical-Specific ARARs and TBC Criteria

Citation	Chemical	Medium	Requirement		Preliminary Determination	Remarks
Missouri Public Drinking Water Program - Contaminant Levels and Monitoring (10 CSR 60-4) (cont.)			Picloram	0.5 mg/L		
			Polychlorinated biphenyls (PCBs)	0.0005 mg/L		
			Pentachlorophenol	0.001 mg/L		
			Simazine	0.004 mg/L		
			Toxaphene	0.003 mg/L		
			2,3,7,8-TCDD (Dioxin)	0.00000003 mg/L		
			2,4,5-TP (Silvex)	0.05 mg/L		
			Radionuclides			
			Combined Ra_{226} and Ra_{228}	5 pCi/l		
			Gross alpha (excluding radon & urnaium)	15 pCi/l		
			Uranium	30 ug/L		
			Secondary Contaminants			
			Aluminum	0.05 - 0.2 mg/L		
			Chloride	250 mg/L		
			Copper	1.0 mg/L		
			Fluoride	2.0 mg/L		
			Iron	0.3 mg/L		
			Manganese	0.05 mg/L		
			Silver	0.1 mg/L		
			Sulfate	250 mg/L		
			Total Dissolved Solid (TDS)	500 mg/L		
			Zinc	5 mg/L		
			Volatile Organic Compounds			
			Benzene	0.005 mg/L		
			Carbon tetrachloride	0.005 mg/L		
			1,2-dichloroethane	0.005 mg/L		
			1,1-dichloroethylene	0.007 mg/L		
			para-dichlorobenzene	0.075 mg/L		
			1,1,1-thrichloroethane	0.2 mg/L		
			Trichloroethylene	0.005 mg/L		
			Vinyl chloride	0.002 mg/L		
			cis-1,2-dichloroethylene	0.07 mg/L		
			Dichloromethane	0.005 mg/L		
			1,2-dichloropropane	0.005 mg/L		
			Ethylbenzene	0.7 mg/L		

Table 5 : Preliminary Identification of Potential Chemical-Specific ARARs and TBC Criteria

Citation	Chemical	Medium	Requirement	Preliminary Determination	Remarks
			Monodichlorobenzene 0.1 mg/L o-dichlorobenzene 0.6 mg/L Styrene 0.1 mg/L Tetrachloroethylene 0.005 mg/L Toluene 1 mg/L 1,2,4-Trichlorobenzene 0.07 mg/L 1,1,2-Trichloroethane 0.005 mg/L trans-1,2-dischloroethylene 0.1 mg/L Xylenes (total) 10 mg/L		
OSWER Directive No. 9200.4-25	Radium-226 Radium-228 Thorium-230 Throium-228	Soil	Clarifies EPA's position on the use of the soil cleanup criteria in 40 CFR Part 192 at CERCLA sites with radioactive contamination. In particular it clarifies the intent of 40 CFR Part 192 in setting remediation levels for subsurface soil, Also, Thorium-230 and Thorium-232 should be cleaned up to the same concentrations as their radium progeny. (5 and 15 pCi/g). Radium 226 +228 5 pCi/g plus background Thorium 230 +232 5 pCi/g plus background	Not an ARAR but potentially a TBC for the buffer zone/ Crossroad prop.	As this is only guidance, it is not an ARAR. As 40 CFR 192 is considered to be potentially relevant and appropriate for the radiologically-impacted soil on the buffer zone/Crossroad property, this guidance would be a TBC for alternatives that include excavation of soil from these properties.

Table 6 : Preliminary Identification of Potential Location-Specific ARARs and TBC Criteria

Citation	Location	Requirement	Preliminary Determination	Remarks
Archeological and Historic Preservation Act (16 USC 469; PL 93-291; 88 Stat. 174)	Land	Data recovery and preservation activities should be conducted if prehistoric, historical, and archaelogical data might be destroyed as a result of a federal, federally assisted, or federally licensed activity or program.	Potentially applicable	No destruction of such data is expected to result from remedial action. The site has been considerably disturbed by past human activities and is therefore not expected to contain any such data. However, if these data were affected, e.g., at any potential off-site borrow area, the requirement would be applicable.
Endangered Species Act, as amended [16 USC 1531-1543; 50 CFR 17.402; 40 CFR 6.302(h)]	Any	Federal agencies should ensure that any action authorized, funded, or carried out by the agency is not likely to jeopardize the continued existence of any threatened or endangered species or destroy or adversely modify any critical habitat.	Potentially applicable	No critical habitat has been identified in the affected area, and no adverse impacts to threatened or endangered species are expected to result from any remedial action. However, if such species were affected, the requirement would be applicable. An assessment of the potential for occurrences of threatened or endangered species was performed during the RI. No federal listed or proposed threatened and endangered species or their habitats were identified at or in the vicinity of the site.
Missouri Wildlife Code (1989) (RSMo. 252.240;3 CSR 10-4.111), Endangered Species	Any	Endangered species, i.e., those designated by the U.S. Department of the Interior and the Missouri Department of Conservation as threatened or endangered (see1978 Code, RSMo. 252.240), should not be pursued, taken, possessed, or killed.	Potentially applicable	No critical habitat has been identified in the affected area, and no adverse impacts to threatened or endangered species are expected to result from any remedial action. However, if such species were affected, the requirement would be applicable.
Floodplain Management [Executive Order 11988; 40 CFR 6.302(b)]	Floodplain	Federal agencies should avoid, to the maximum extent possible, any adverse impacts associated with direct and indirect development of a floodplain.	Potentially applicable	This requirement may be applicable to any remedial action for the Ford Property. Mitigative measures would be taken to minimize any adverse impacts.

Table 6 : Preliminary Identification of Potential Location-Specific ARARs and TBC Criteria

Citation	Location	Requirement	Preliminary Determination	Remarks
Governor's Executive Order 82-19	Floodplain	Potential effects of actions taken in a floodplain should be evaluated to avoid adverse impacts.	Potentially applicable	This requirement may be applicable to any remedial action for the Ford Property. Mitigative measures would be taken to minimize any adverse impacts.
Clean Water Act (33 USC 1251-1376); Disposal Sites, Specifications(40 CFR 230), Dredged or Fill Material Discharges (Section 404 Program); Definitions, Exempt Activities Not Requiring Permits (40 CFR 232); State Program Regulations (40 CFR 233); General Regulatory Policies (33 CFR 320); Nationwide Permits (33 CFR 330)	Wetland	Dredge or fill material is not to be dischared into a wetland (as defined by the U.S. Army Corps of Engineers) without a permit.	Potentially applicable	This requirement could be applicable to any off-site borrow area if the location selected contained any wetlands or if the borrow activities could indirectly impact wetlands. No wetlands have been identified on-site.
Farmland Protection Policy Act (7 USC 4201 et seq.) Farmland Protection [7 CRF 658; 40 CFR 6.302(c)]	Farmland (prime, unique, or of state and local impor-tance)	Federal agencies should take steps to ensure that federal actions do not cause U.S. farmland to be irreversibly converted to nonagricultural uses in cases in which other national interests do not override the importance of the protection of farmland or otherwise outweigh the benefits of maintaining farmland resources. Criteria developed by the U.S. Soil Conservation Service are to be used to identify and take into account the adverse effects of federal programs on farmland preservation. Federal agencies should consider alternative actions that could lessen adverse effects and should ensure that programs are compatible with state and local government and private programs and policies to protect farmland.	Potentailly applicable	This requirement would be applicable for any potential soil borrow area off-site. Mitigative measures and restoration activities would also be conducted at any off-site borrow area, as appropriate, to minimize any adverse impacts to farmland.
RCRA Subtitle D (40 CFR Part 258 Subpart B) and MDNR Solid Waste	Proximity of solid waste	Requires new or existing municipal solid waste landfills or lateral expansions that are located within 10,000 ft of any airport runway	Not applicable to ROD-remedy	As the OU-1 portion of the West Lake landfill closed in the 1970's this requirement is not

Table 6 : Preliminary Identification of Potential Location-Specific ARARs and TBC Criteria

Citation	Location	Requirement	Preliminary Determination	Remarks
Regulations (10 CSR 80-3.010 (4)(B)(1)) RCRA Subtitle D (40 CFR Part 258 Subpart B) and MDNR Solid Waste Regulations (10 CSR 80-3.010 (4)(B)(1)) (cont.)	landfills to the end of runways used for turbojet aircraft	end used by turbojet aircraft to demonstrate that the units are designed and operated so that the MSWLF unit does not pose a bird hazard to aircraft.	Applicable to new on-site cell Potentially relevant and appropriate to ROD remedy and "complete rad removal" alternatives	applicable to Areas 1 and 2. This requirement would be applicable to a new engineered disposal cell. Both the ROD-remedy and the "complete rad removal" alternatives include regrading of existing solid waste in Areas 1 and 2. This requirement may potentially be relevant and apporpriate to all of the alternatives.
RCRA Subtitle D (40 CFR Part 258 Subpart B) and MDNR Solid Waste Regulations (10 CSR 80-3.010 (4)(B))	Landfill site selection	Sets forth criteria for site selection for new landfills and horizontal expansions of existing sanitary landfills and requirements for design and operation plans for sanitary landfills. Site selection criteria include (1) proximity to airport runways (see discussion above), floodplains, wetlands, seismic zones and faults, and unstable areas. Also sets out required demonstrations for liners placed near the depth of groudnwater.	Potentally applicable to to siting and design of a new, engineered disposal cell	A new engineered disposal cell included within the scope of the "complete rad removal" alternative would represent a new sanitary landfill and therefore these requirements are potentially applicable.
Missouri Guidance for Conducting and Reporting Detailed Geologic and Hydrogeologic Investigations at a Proposed Solid-Waste Disposal Area 10 CSR 80-2.015 Appendix A	Landfill site selection	Provides general procedures for characterization of potential solid-waste landfill sites	Substantive requirements of the guidance may potentially be a TBC for characteization of conditions at a new disposal cell	A new engineered disposal cell included within the scope of the "complete rad removal" alternative would represent a new sanitary landfill cell and therefore the substantive requirements may be a potential "to-be considered" criteria for characterization of site conditions at the new cell location.

Table 7 : Preliminary Identification of Potential Action-Specific ARARs and TBC Criteria

Citation	Action	Medium	Requirement	Preliminary Determination	Remarks
Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings (40 CFR 192), Subpart A, Standards for the Control of Residual Radioactive Materials from Inactive Uranium Processing Sites	Radioactive waste disposal		Control of residual radioactive materials at designated uranium processing or depository sites should be designed to be effective for at least 200 years and up to 1,000 years, to the extent reasonably achievable. In addition, the control should be designed such that releases of radon-222 from the residual radioactive material would not exceed an average rate of 20 pCi/m2-s or increase the annual average concentration in air outside the disposal site by more than 0.5 pCi/L. Because this standard applies to design, monitoring after disposal is not required to demonstrate compliance.	Not applicable but potentially relevant and appropriate in part for ROD-remedy and on-site disposal alterantive	The West Lake Landfill OU-1 Site is not a designated Title I uranium mill tailings site; therefore, this requirement would not be applicable. These regulations are applicable to uncontrolled areas whereas the current and future uses of Areas 1 and 2 are restricted. As OU-1 does contain radiologically impacted materials, these requirements may potentially be relevant; however, the radiologically impacted materials at the West Lake site are a small fraction of an overall matrix of municipal solid waste, debris and fill materials. Although the waste materials are not similar to uranium tailings, the wastes do contain radium and thorium; therefore the longevity standard is potentially relevant and appropriate. As the radiologically-impacted materials do emit radon, the radon standard is potentially relevant and appropriate. For the ROD-remedy and on-site option, radiologically-impacted materials will remain past the post-closure period for a solid waste landfill and longevity considerations should be factored into the cover design.
Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings (40 CFR 192), Subpart D, Standards for Management of Uranium Byproduct Materials Pursuant to Section 84 of the U.S. Atomic Energy Act of 1954, as amended; Subpart E, Standards for Management of Thorium Byproduct Materials Pursuant to Section 84 of the U.S. Atomic Energy Act of 1954, as amended.	Radioactive waste disposal		Disposal areas for uranium and thorium by-product materials should be designed to be effective for at least 200 years and up to 1,000 years, to the extent reasonably achievable. In addition the control should be designed so that releases of radon-222 and radon-220 from these materials (i.e., excluding the cover) would not exceed an average of 20 pCi/m2-s. The standard applies to design, so monitoring for radon after inatallation of an appropriately designed cover is not required. (This requirement does not apply to any portion of the site that contains residual surface and subsurface concentrations of radium-226 and radium-228 at or below those identified in Subparts B and E, respectively, which were described under chemical-specific ARARs and TBCs.)	Not applicable but potentially relevant and appropriate in part for ROD-remedy and on-site disposal alternative	The West Lake Landfill OU-1 Site is not a designated Title I uranium mill tailings site; therefore, this requirement would not be applicable. These regulations are applicable to uncontrolled areas whereas the current and future uses of Areas 1 and 2 are restricted. As OU-1 does contain radiologically impacted materials, these requirements may potentially be relevant; however, the radiologically impacted materials at the West Lake site are a small fraction of an overall matrix of municipal solid waste, debris and fill materials. Although the waste materials at West Lake Site are not similar to uranium mill tailings, the wastes do contain radium . and thorium; therefore the longevity standard is potentially relevant and appropriate. As the radiologically impacted materials will remain on-site beyond the 30-year post-closure period for a solid waste landfill, the 200/1000 year period, this standard is considered to be potentially relevant and appropriate.

Table 7 : Preliminary Identification of Potential Action-Specific ARARs and TBC Criteria

Citation	Action	Medium	Requirement	Preliminary Determination	Remarks
Resource Conservation and Recovery Act (RCRA) Subtitle C	Hazardous waste management		Establishes standards for identification of and treatment, storage and disposal of hazardous wastes including hazardous wastes disposed in landfills. Standards for Identification of hazardous wastes (40 CFR 261) Standards for Generators of hazardous wastes (40 CFR 262) Standards for Transporters of hazardous wastes (40 CFR 263) Use and Management of Containers (40 CFR 264 Subpart I) Land Disposal Restrictions (40 CFR 264 Subpart N) Staging Piles (40 CFR 264.554)	Possibly applicable in the event that hazardous wastes or materials that potentially could be hazardous wastes are encountered during remedy implementation	The radiologically impacted materials in Areas 1 and 2 do not meet the criteria for classification as hazardous wastes; however, other waste materials in Areas 1 or 2 may meet these criteria and as such these rquirements may be applicable. The Subtitle D standards are considered to be the appropriate criteria for final cover design.
Solid Waste Disposal Act, as amended (42 USC 6901, et seq.); Criteria for Municipal Solid Waste Landfills (40 CFR 258), Subpart F, Closure and Post-Closure Care	Solid waste disposal		Criteria for closure of a landfill unit and post-closure care requirements are specified. Cover system design requirements at closure include (1) an infiltration layer constructed of a minimum of 18 in. of earthen material with a permeability less than or equal to the permeability of the bottom liner system or no greater than 1 x 10-5 cm/s, whichever is less, and (2) an erosion protectin layer of earthen material capable of supporting native plant growth; or equivalents approved by the director of an approved state program. Post-closure care requires maintenance of the integrity of the final cover system, the leachate collection system, ground-water monitoring, and gas monitoring for a period of 10 years or as necessary to protect human health and the envrionment. Management of the leachate may be terminated if the owner/ operator demonstrates that leachate no longer poses a threat to human health and the environment	Neither applicable nor relevant and appropriate	Neither applicable nor relevant and appropriate as solid waste landfills in Missouri are regulated by the Missouri solid waste regulations.
Missouri Radiation Regulations; Protection Against Ionizing Radiation (19 CSR 20-10.090), Disposal of Radioactive Wastes	Radioactive waste disposal		Radioactive waste material should not be disposed of by dumping or burial in soil, except at sites approved by and registered with the Missouri Department of Health; a permit should be obtained holding and preparation of such material prior to disposal; and no releases to air or water should cause exposure of any person above the limits specified in 10-CSR 20-10.041.	Potentially applicable to offsite disposal and on-site disposal alternatives	Certain of these requirements would be applicable to the offsite disposal and on-site disposal alternatives if one of these alternatives were to be implemented
Missouri Radiation Regulations; Protection Against Ionizing Radiation (19 CSR 20-10.070), Storage of Radioactive Materials	Radioactive waste storage		Radioactive materials should be stored in a manner that will not result in the exposure of any person, during routine access to a controlled area, in excess of the limits identified in 19 CSR 20-10.040 (see related discussion for contaminant-specific requirements); a facility used to store materials that may emit radioactive gases or airborne particulate matter should be vented to ensure that the concentration of such substances in air does not constitute a radiation hazard; and provisions should be made to minimize hazards to emergency workers in the event of a fire, earthquake, flood, or windstorm.	Potentially applicable	These requirements would be applicable to the temporary storage of radiologically-impacted soils that might be generated during any remedial action.

Table 7 : Preliminary Identification of Potential Action-Specific ARARs and TBC Criteria

Citation	Action	Medium	Requirement	Preliminary Determination	Remarks
Missouri Solid Waste Rules (10 CSR 80), Chapter 3, Sanitary Landfills, 3.010(17), Cover	Solid waste disposal		The landfill should be covered to minimize fire hazard, infiltration of precipitation, odors and blowing litter; control gas venting and vectors; discourage scavenging; and provide a pleasing appearance. Final slope of the top shall be a minimum of 5%. No slopes shall ever exceed 33 1/3 % and slopes shall not exceed 25% without a detailed slope stability analysis. The final cover should be at least 2 ft of compacted clay with a permeability of 1 x 10^{-5} cm/sec or less overlain by 1 ft of soil capable of supporting vegetative growth.	Only applicable if Areas 1 or 2 are re-opened to accept additional solid wastes. Potentially relevant and appropriate for design of a new landfill cover.	These requirements are not applicable as they only apply to landfills in operation after 10-9-91. These requirements would be applicable to design of a new engineered disposal cell and to regrading of Areas 1 and 2 after removal of radiologically-impacted material under the two "complete rad removal" alternatives. These regaulations would also be applicable to the final slopes and cover design for Areas 1 and 2 under the ROD-selected remedy except that the slopes would be a minimum of 2% (seee discussion in text).
Missouri Solid Waste Rules (10 CSR 80), Chapter 4, Demolition Landfills, 4.010(17), Cover	Solid waste disposal		The landfill should be covered to minimize fire hazard, infiltration of precipitation, odors and blowing litter; control gas venting and vectors; discourage scavenging; and provide a pleasing appearance. Final slope of the top shall be a minimum of 5%. No slopes shall ever exceed 33 1/3 % and slopes shall not exceed 25% without a detailed slope stability analysis. The final cover should be at least 2 ft of compacted clay with a permeability of 1 x 10^{-5} cm/sec or less overlain by 1 ft of soil capable of supporting vegetative growth.	Only applicable if Areas 1 or 2 are re-opened to accept additional solid wastes. Potentially relevant and appropriate for design of a new landfill cover.	These requirements are not applicable as they only apply to landfills in operation after 10-9-91. These requirements would be applicable to design of a new engineered disposal cell and to regrading of Areas 1 and 2 after removal of radiologically-impacted material under the two "complete rad removal" alternatives. These regaulations would also be applicable to the final slopes and cover design for Areas 1 and 2 under the ROD-selected remedy except that the slopes would be a minimum of 2% (seee discussion in text).
Noise Control Act, as Amended; Noise Pollution and Abatement Act	Construction activities		The public should be protected from noises that jeopardize human health or welfare.	Potentially applicable	These requirements would be applicable to any remedial action.
CERCLA Offsite Rule 40 CFR 300.440	Off-site disposal		Wastes can only be disposed at offsite facilities operationg in compliance with applicable regulations as verified by EPA.	Applicable to off-site disposal	These requirements would be applicable to the "complete rad removal" with off-site disposal alternative.
DOT and NRC regulations for shipment of radioactive materials 49 CFR 171-180 and 10 CFR 71	Off-site disposal		Specifies requirements for shipment of radioactive materials including hazard communications, labeling, manifests, security, emergency response, and planning.	Applicable to off-site disposal	These requirements would be applicable to the "complete rad removal" with off-site disposal alternative.
Offsite disposal Waste Acceptance Criteria	Off-site disposal		Lists the types of materials and activity levels of waste materials that can be accepted by off-site disposal facilities.	Applicable to off-site disposal	These requirements would be applicable to the "complete rad removal" with off-site disposal alternative.
National Emissions Standards for Hazardous Air Pollutants - Asbestos 40 CFR Part 61	Asbestos management	Waste	Requirements for management of regulated asbestos containing materials (RACM)	Potentially applicable if RACM are encountered during remedy implementation	Standards for demolition and renovation may be applicable in the event that RACM is encountered during remedy implementation.
National Ambient Air Quality Standards 40 CFR 50	Radionuclides Radon and Particulates	Air	Air quality standards	Potentially applicable	Potential standards for air emissions during remedy implementation

Table 7 : Preliminary Identification of Potential Action-Specific ARARs and TBC Criteria

Citation	Action	Medium	Requirement	Preliminary Determination	Remarks
PCB Spill Cleanup Policy 40 CFR 761 Subpart G Cleanup Site Characterization Sampling for PCB Remediation Waste 40 CFR 761 Subpart N Sampling to Verify Completion of Self-Implementing Cleanup and On-Site Disposal of Bulk PCB Remediation Waste and Porous Surfaces 40 CFR 761 Subpart O Sampling Non-Porous Surfaces for Measurement-Based Use, Reuse and On-Site or Off-Site Disposal 40 CFR 761 Subpart P Sampling Non-Liquid, Non-Metal PCB Bulk Product Waste for Purposes of Characterization for PCB Disposal and Sampling PCB Remediation Waste Destined for Off-Site Disposal 40 CFR 761 Subpart R Double Wash/Rinse Method for Decontaminating Non-Porous Surfaces 40 CFR 761 Subpart S	PCB cleanup and management	Soil or waste	Requirements for cleanup of PCB wastes	Potentially applicable if PCBs are encountered during remedy implementation	Sets out procedures for cleanup of PCB wastes
Missouri Storm Water Regulations 10 CSR 20-6.200		Storm water	Requirements for control of storm water runoff	Potentially applicable	Substantive requirements are potentially applicable for control of storm water runoff during and after remedy construction
De Minimus Emissions Levels 10 CSR 10-6.020(3)(A)	PM-10 Non-methane organic compounds (NMOC)		Air quality standards	Potentially applicable	Potential standards for air emissions during remedy implementation
Sampling Methods for Air Pollution Sources 10 CSR 10-6.030		Air	Stack emissions sampling procedures	Potentially applicable	Poteintally applicable if a landfill gas flare is constructed an operated as part of the remedy
Controlling Emissions During Episodes of High Air Pollution Potential 10 CSR 10-6.130		Air	Requirements for controlling emissions during air pollution events	Potentially applicable	Potentially could require shut down of remedy implementation construction operations during a purple or maroon air quality event
Restriction of Particulate Matter to the Ambient Air Beyond the Premises of Origin 10 CSR-6.170	Particulate Matter	Air	Requirements for controlling emissions	Potentially applicable	Potentially applicable to the control of fugitive dust emissions during remedy construction activities
Closure and Post-Closure Plan Laidlaw Waste Systems (Bridgeton), Inc. Sanitary Landfill, December 1996, Revised September 1997	Landfill cover		Sets out closure and post-closure procedures for the West Lake Landfill, in particluar, the final cover, grading and vegetation plan.	Potential TBC	Sets out the procedures to be used at the landfill to comply with the MDNR Solid Waste Regulations. This document should be considered in the design and construction of any cover system or drainage

Table 7 : Preliminary Identification of Potential Action-Specific ARARs and TBC Criteria

Citation	Action	Medium	Requirement	Preliminary Determination	Remarks
Closure and Post-Closure Plan Laidlaw Waste Systems (Bridgeton), Inc. Sanitary Landfill, December 1996, Revised September 1997 (cont.)					improvements that may be constructed for Areas 1 and 2 or if aditional waste materials are placed in these areas as part of a remedial action. This docment will also need to be considered if any regrading and/or landfill cover improvements are implemented for Areas 1 or 2.

Table 8: Comparison of USEI Waste Acceptance Criteria (WAC) to Projected OU-1 RIM Concentrations

	WAC Criteria		OU-1 RIM Concentrations		
Radionuclide	Maximum Concentration of Source Material	Sum of Concentrations of Parents and all Progeny	Mass Concentration (ppm)	Activity Concentration (pCi/g)	pCi/g - all progeny + parent
Natural uranium in equilibrium with progeny	<500 ppm/167 pCi/g (^{238}U activity)	≤3,000 pCi/g	8.3	2.8	39.2
^{230}Th	0.1 ppm/ ≤2,000 pCi/g	NA	0.068	1,384	NA
Natural thorium (^{232}Th + ^{228}Th)	<500 ppm/ 110 pCi/g	≤2,000 pCi/g	8.9	1.96	19.6
^{226}Ra w/progeny in bulk form	500 pCi/g	≤4,500 pCi/g	NA	113	1,017
Mixture of Thorium and Uranium	Sum of ratios ≤1	≤2,000 pCi/g	Sum of ratios = 0.7	NA	58.6

Notes:
Based on this information, all WAC criteria are acceptable.
NA = not applicable

Table 9: Summary of Estimated Costs

Estimated Cost	Alternative: ROD-Selected Remedy	Alternative: "Complete Rad Removal" with Off-site Disposal (low)	Alternative: "Complete Rad Removal" with Off-site Disposal (high)	Alternative: "Complete Rad Removal" with On-site Disposal	Alternative (Fiscally-Constrained to $10 million/year): ROD-Selected Remedy	Alternative (Fiscally-Constrained to $10 million/year): "Complete Rad Removal" with Off-site Disposal (low)	Alternative (Fiscally-Constrained to $10 million/year): "Complete Rad Removal" with Off-site Disposal (high)	Alternative (Fiscally-Constrained to $10 million/year): "Complete Rad Removal" with On-site Disposal
Capital ($M)	41.4	259	415	116.6	46.2	286	*NE*	137
Operation, Maintenance, and Monitoring ($1,000)	42 - 414	40 - 412		52 - 604	42 - 433	412		52 - 707
30 year:								
Present Worth* ($M)	43	250	401	112	46	211	*NE*	121
Non-discounted Total ($M)	45	262	419	121	49	286	*NE*	141
200 year:								
Present Worth* ($M)	45	252	*NE*	114	48	213	*NE*	124
Non-discounted Total ($M)	61	278	*NE*	143	65	303	*NE*	162
1,000 year:								
Present Worth* ($M)	45	252	*NE*	114	48	213	*NE*	124
Non-discounted Total ($M)	137	352	*NE*	245	141	377	*NE*	264

** i = 2.3%*
NE - not estimated

Note: These cost estimates are feasibility level cost estimates; that is they were developed to a level of accuracy such that the actual costs incurred to implement the alternatives should fall within a range bounded by 50% above and 30% below these estimates.

Table 10: Comparative Analysis of Alternatives

Evaluation Criteria	**ROD-Selected Remedy**	**"Complete Rad Removal" with Off-site Disposal**	**"Complete Rad Removal" With On-site Disposal**
Threshold Criteria			
Overall Protection of Human Health and the Environment	All of the alternatives would be protective of human health and the environment. All alternatives eliminate or reduce potential exposures to (1) external gamma radiation, (2) radon emissions, (3) inhalation or ingestion of contaminated soil or wastes, (4) dermal contact with contaminated soil or waste, and (5) dispersal of contaminants in fugitive dust. All of the alternatives would reduce potential infiltration of precipitation into the waste and thereby reduce the potential for leaching to groundwater. All alternatives include institutional controls to ensure that only land and resource uses that are consistent with the remedy and protective of human health and the environment are allowed in the future.		
Compliance with ARARs			
Compliance with Chemical-Specific ARARs	All of the alternatives would comply with chemical-specific ARARs including (1) uranium mill tailing standards for radon emissions, maximum concentrations for groundwater protection, and cleanup of contaminated land (Buffer Zone and Crossroad Property), (2) radon NESHAP, (3) Missouri radiation protection standards, and (4) Missouri maximum contaminant levels (MCLs).		
Compliance with Location-Specific ARARs	Would meet location-specific ARARs including solid waste regulation standards relative to 100-year floodplain and proximity to airport runways.	Would meet location-specific ARARs including solid waste regulation standards relative to 100-year floodplain and proximity to airport runways.	Would meet location-specific ARARs including solid waste regulation site selection standards relative to airport runways, 100-year floodplain, wetlands, seismic zones, and unstable ground. May not meet all FAA requirements (TBCs) relative to airport runways because location of on-site cell is within 8,000 feet of end of westernmost runway at Lambert-St. Louis International Airport.
Compliance with Action-Specific ARARs	Would meet action-specific ARARs including Missouri solid waste regulations closure and post-closure standards and uranium mill tailing standards for longevity of disposal facilities.	Would meet action-specific ARARs including Missouri solid waste regulation closure and post-closure standards, DOT and NRC standards for shipment of radioactive wastes, and disposal facility waste acceptance criteria.	Would meet action-specific ARARs including Missouri solid waste regulations for design, operation, closure and post-closure of a solid waste landfill and uranium mill tailing standards for longevity of disposal facilities. Would NOT comply with Missouri solid waste prohibition on disposal of radioactive contaminated material in solid waste disposal cell.

Table 10: Comparative Analysis of Alternatives (continued)

Evaluation Criteria	ROD-Selected Remedy	"Complete Rad Removal" with Off-site Disposal	"Complete Rad Removal" With On-site Disposal
Primary Balancing Criteria			
Long-Term Effectiveness and Permanence			
Magnitude of residual risks	Highest long-term risk that would remain upon completion of the remedial action (1.3 x 10^{-6}) is within EPA's target risk range of 1 x 10^{-6} to 1 x 10^{-4}.	Highest long-term risk that would remain upon completion of the remedial action (<1 x 10^{-7}) is less than EPA's target risk range of 1 x 10^{-6} to 1 x 10^{-4}.	Highest long-term risk that would remain upon completion of the remedial action (1.5 x 10^{-6}) is within EPA's target risk range of 1 x 10^{-6} to 1 x 10^{-4}.
Adequacy and reliability of controls	Engineering measures including construction, inspection and maintenance of a final cover would be the primary methods used to control waste materials that remain on site. These types of measures have been demonstrated to be effective at numerous solid waste and NCP sites. Conceptual design of the new landfill covers is based on established designs for solid waste disposal sites, augmented to limit increased gamma radiation and radon emissions expected to occur over a 1,000 period from decay of thorium. Includes rip-rap armor along toe of Area 2 to provide protection against flooding in the unlikely event of failure of the Earth City Flood Control levees or stormwater management systems. Engineering measures would be augmented and supported by existing and additional institutional controls which also have been used at numerous solid waste and NCP sites.	Includes excavation and removal of radiologically-impacted materials above levels which would allow for unrestricted use relative to radiological contamination to an off-site disposal site, and thus is potentially more reliable than the other alternatives. Engineering measures including construction, inspection and maintenance of a final cover would be the primary methods used to control waste materials that remain on site. These types of measures have been demonstrated to be effective at numerous solid waste and NCP sites. Engineering measures would be augmented and supported by existing and additional institutional controls which also have been used at numerous solid waste and NCP sites.	Engineering measures including construction and closure of a new engineered waste disposal cell and construction, inspection and maintenance of a final cover would be the primary methods used to control waste materials that remain on site. These types of measures have been demonstrated to be effective at numerous solid waste and NCP sites. Engineering measures would be augmented and supported by existing and additional institutional controls which also have been used at numerous solid waste and NCP sites. Conceptual design of the new landfill cell is based on established designs for solid waste disposal sites, augmented to limit increased gamma radiation and radon emissions expected to occur over a 1,000 period from decay of thorium.

Table 10: Comparative Analysis of Alternatives (continued)

Evaluation Criteria	ROD-Selected Remedy	"Complete Rad Removal" with Off-site Disposal	"Complete Rad Removal" With On-site Disposal
Primary Balancing Criteria (cont.)			
Reduction of Toxicity, Mobility or Volume through Treatment	None of the alternatives include treatment technologies that would reduce the toxicity, mobility or volume of waste material through treatment as a primary component. Treatment technologies are generally not applicable to the site wastes due to the nature and overall large volume of wastes, combined with the fact that radionuclides are naturally occurring elements that cannot be neutralized or destroyed by treatment. All of the alternatives include off-site treatment and disposal of hazardous wastes in accordance with the RCRA regulations if any such wastes are encountered during implementation of the remedy.		
Short-Term Effectiveness			
Protection of the community during any remedial action	Lowest potential for impacts to the community: Transportation accident incidence:0.61 Carcinogenic risk to residents:$3.3x10^{-6}$ Carbon dioxide emissions: 8,350 tons	Highest potential for impacts to the community: Transportation accident incidence:1.4 Carcinogenic risk to residents:$2.1x10^{-5}$ Carbon dioxide emissions: 35,400 tons	Lower potential for impacts to the community: Transportation accident incidence:0.79 Carcinogenic risk to residents:$2.0x10^{-5}$ Carbon dioxide emissions: 17,900 tons
		Excavation of RIM would create depressions in the waste where precipitation could accumulate increasing the potential for infiltration, leaching and creation of a plume of contamination in groundwater.	Excavation of RIM would create depressions in the waste where precipitation could accumulate increasing the potential for infiltration, leaching and creation of a plume of contamination in groundwater.
	This alternative poses the least potential for increased bird strikes to aviation operations at nearby Lambert-St. Louis International Airport.	This alternative poses potential for increased bird strikes to aviation operations at nearby Lambert-St. Louis International Airport.	This alternative poses greatest potential for increased bird strikes to aviation operations at nearby Lambert-St. Louis International Airport.
Protection of workers during remedial actions	Lowest potential for impacts to workers Industrial accident incidence – 4.7 Carcinogenic risk – 7.2×10^{-5} Worker dose (TEDE) – 50 mrem/yr	Greater potential impacts to workers from increased handling of RIM Industrial accident incidence – 7.6 Carcinogenic risk – 7.6×10^{-4} Worker dose (TEDE) – 260 mrem/yr	Greater potential impacts to workers due to increased handling of RIM Industrial accident incidence – 9.0 Carcinogenic risk – 7.4×10^{-4} Worker dose (TEDE) – 260 mrem/yr
Environmental impacts of any remedial action	No measurable long-term impacts to plants or animals are expected to occur from any of the alternatives. No wetlands are present on-site and no endangered species were identified in the site area. Regrading and/or excavating Area 2 would disturb the landfill surface and destroy the habitat that currently exists in this area, but this would be replaced by vegetative cover equivalent to an early stage field succession.		

Table 10: Comparative Analysis of Alternatives (continued)

Evaluation Criteria	ROD-Selected Remedy	"Complete Rad Removal" with Off-site Disposal	"Complete Rad Removal" With On-site Disposal
Primary Balancing Criteria (cont.)			
Short-Term Effectiveness (cont.)			
Time until RAOs are achieved	Implementation of institutional controls is included as part of all of the alternatives and would take approximately 1 year to implement. Potential threats would be addressed upon implementation of institutional controls. No potential threats would remain after implementation of any of the alternatives. Note: NTP for entries below is notice to proceed with RD.		
	RAOs would be achieved upon completion of construction 3 yrs after NTP w/ no fiscal constraint 5 yrs after NTP if fiscal constraint	RAOs would be achieved upon completion of construction 4 yrs after NTP w/ no fiscal constraint 29 yrs after NTP if fiscal constraint	RAOs would be achieved upon completion of construction 6 yrs after NTP w/ no fiscal constraint 13 yrs after NTP if fiscal constraint
Implementability			
Technical Feasibility	All of the alternatives are constructible.		
		There is uncertainty regarding the actual volumes of RIM that would need to be removed and the volume of daily cover that would be added resulting in uncertainty the actual disposal volume. The ability to remove deeper occurrences of RIM from Area 2 is a technical difficulty with this alternative and might result in schedule delays. The ability to locate a rail spur near the site or to construct a rail spur to and on the site is a technical difficulty that could limit the performance and schedule of this alternative. Reductions in the number of rail cars or the frequency of exchange of full and empty rail cars could impact the schedule for this alternative.	There is uncertainty regarding the actual volumes of RIM that would need to be removed and the volume of daily cover that would be added resulting in uncertainty the actual disposal volume. The ability to remove deeper occurrences of RIM from Area 2 is a technical difficulty with this alternative that might result in schedule delays. Construction and operation of a new engineered disposal cell is a common technology that has been demonstrated to be reliable. Only one possible location for a new disposal cell could be identified due to the Missouri river geomorphic floodplain. Subsurface conditions at this location are unknown and could affect technical feasibility and/or capacity of a new disposal cell.

Table 10: Comparative Analysis of Alternatives (continued)

Evaluation Criteria	ROD-Selected Remedy	"Complete Rad Removal" with Off-site Disposal	"Complete Rad Removal" With On-site Disposal
Primary Balancing Criteria (cont.)			
Implementability (cont.)			
Technical Feasibility (cont.)	Landfill cover systems have been used extensively and with proper inspection and maintenance have been demonstrated to be reliable. Stormwater controls and environmental monitoring are commonly used techniques that have been demonstrated to be reliable.	Excavation and offsite disposal is a common and reliable technology. Landfill cover systems have been used extensively and with proper inspection and maintenance have been demonstrated to be reliable. Stormwater controls and environmental monitoring are commonly used and demonstrated reliable techniques. Per the FAA, the reliability of most bird mitigation technologies are questionable.	Landfill cover systems have been used extensively and with proper inspection and maintenance have been demonstrated to be reliable. Stormwater controls and environmental monitoring are commonly used and demonstrated reliable techniques. Per the FAA, the reliability of most bird mitigation technologies are questionable.
	The only future actions anticipated to be required for all of the alternatives are ongoing inspection, monitoring, maintenance and, if needed, repair of the final landfill covers which should be easily implemented. All of the alternatives include a provision for a contingent landfill gas control system in the event the monitoring of subsurface occurrences of landfill gas or radon indicates a need for such a system.		
	Performance of all the alternatives can be monitored and potential risk of exposure in the event of failure of any of the alternatives would be low.		
Administrative Feasibility	Requires coordination and permitting with MSD for disposal of leachate and stormwater during construction. Requires access to Crossroad Property for investigation/removal of soil. Requires coordination with Earth City Flood Control district for design and operation of long-term stormwater management systems. May require preparation and approval of a traffic control plan for St. Charles Rock Road.	Implementation would require approval and verification of current acceptability for off-site disposal from EPA. Use of the Clean Harbors facility for disposal would require approval by the Rocky Mountain Low Level Radioactive Waste Compact. Construction of a rail spur would require leasing/acquisition of property located on the east side of St. Charles Rock Rd. and permission to construct a rail crossing over St. Charles Rock Rd.	Requires approval of City of St. Louis (unlikely based on prior discussions) to temporarily remove its Negative Easement and Restrictive Covenant against additional landfilling at the site and resultant impacts to airport safety. Requires coordination with and possible approval by the FAA for construction and operation a new disposal cell within 10,000 ft of the end of the westernmost runway at Lambert-St. Louis International Airport.

Table 10: Comparative Analysis of Alternatives (continued)

Evaluation Criteria	ROD-Selected Remedy	"Complete Rad Removal" with Off-site Disposal	"Complete Rad Removal" With On-site Disposal
Primary Balancing Criteria (cont.)			
Implementability (cont.)			
Administrative Feasibility (cont.)		Requires coordination and permitting with MSD for disposal of leachate and stormwater during construction. Requires access to Crossroad Property for investigation/removal of soil. Requires coordination with Earth City Flood Control district for design and operation of long-term stormwater management systems. May require development and approval of a traffic control plan for St. Charles Rock Road.	Requires MDNR approval to construct haul roads over previously closed portions of the permitted landfill. Requires coordination and permitting with MSD for disposal of leachate and stormwater during construction. Requires access to Crossroad Property for investigation/removal of soil. Requires coordination with Earth City Flood Control district for design and operation of long-term stormwater management systems. May require preparation and approval of a traffic control plan for St. Charles Rock Road.
Availability of Services and Materials	Preliminary discussions with MSD indicate that it is willing and has sufficient capacity to accept leachate or stormwater that may be generated during construction. Alternatively, off-site disposal facilities are available to accept these materials if necessary	Only 2 or possibly 3 off-site disposal facilities are available that could accept the types of wastes in Areas 1 and 2. Preliminary discussions with MSD indicate that it is willing and has sufficient capacity to accept leachate or stormwater that may be generated during construction. Alternatively, off-site disposal facilities are available to accept these materials if necessary.	Preliminary discussions with MSD indicate that it is willing and has sufficient capacity to accept leachate or stormwater that may be generated during construction and leachate that may accumulate in the new on-site disposal cell. Alternatively, off-site disposal facilities are available to accept these materials if necessary.
	Adequate equipment, materials, and specialists necessary to implement this alternative are anticipated to be available.		

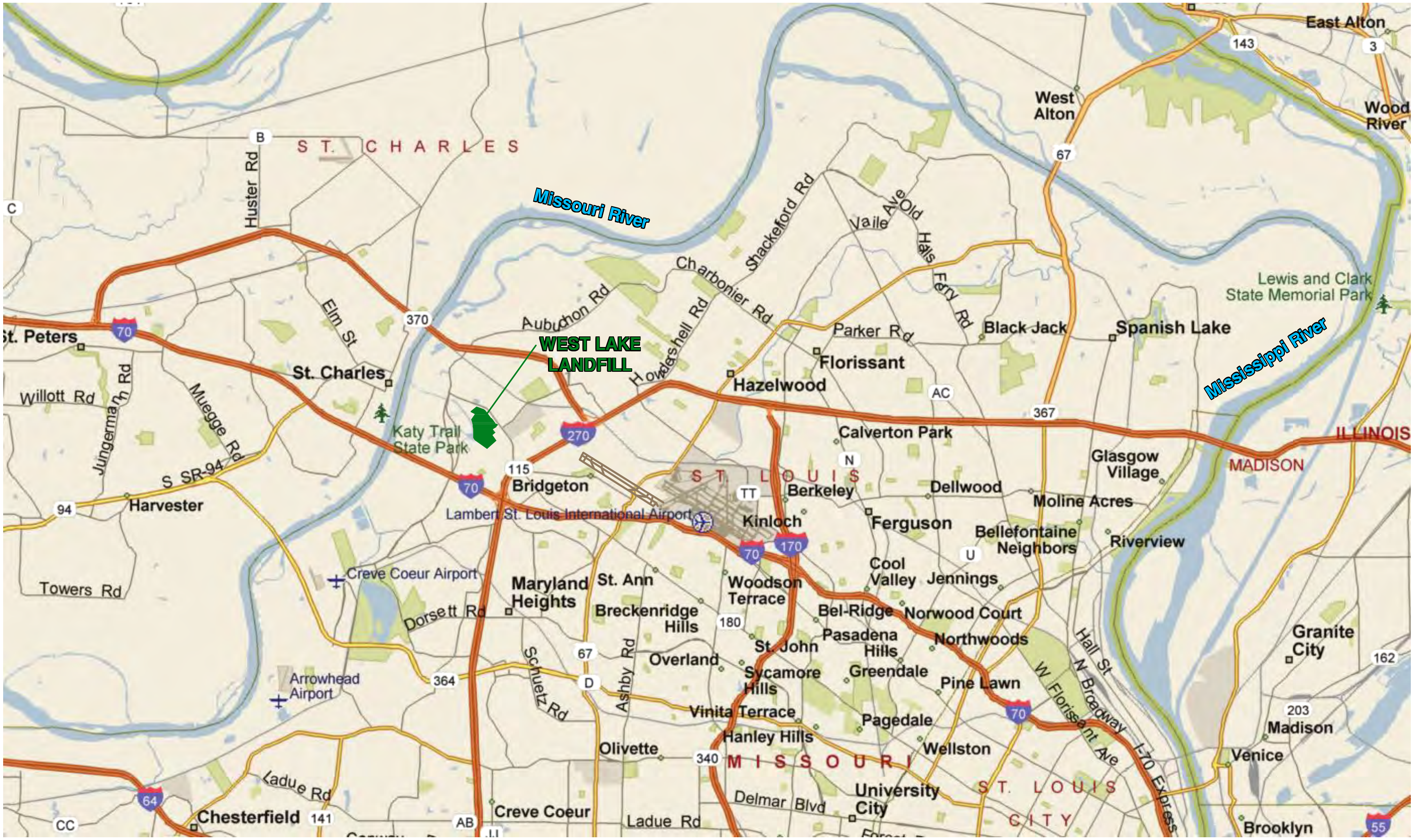
Table 10: Comparative Analysis of Alternatives (continued)

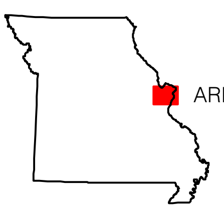
Evaluation Criteria	ROD-Selected Remedy	"Complete Rad Removal" with Off-site Disposal	"Complete Rad Removal" With On-site Disposal
Primary Balancing Criteria (cont.)			
Implementability (cont.)			
Availability of Services and Materials (cont.)	Technologies included as part of this alternative are generally available and sufficiently demonstrated. No prospective technologies are anticipated as part of this alternative.	Technologies included as part of this alternative are generally available and sufficiently demonstrated. No prospective technologies are anticipated as part of this alternative. Use of physical separation techniques could, if effective, reduce the overall cost of this alternative; however, the potential effectiveness, implementability, risks and cost of such techniques cannot be determined from available information. An on-site pilot-scale test would be necessary to make such determinations.	Technologies included as part of this alternative are generally available and sufficiently demonstrated. No prospective technologies are anticipated as part of this alternative.
Cost			
Capital cost	$41,400,000	$259,000,000 - $415,000,000	$117,000,000
O&M costs	$42,000 - $414,000	$40,000 - $412,000	$52,000 - $604,000
Total costs (30 years):			
No fiscal constraint			
Present worth	$43,000,000	$250,000,000 - $401,000,000	$112,000,000
Total (non-discounted)	$45,000,000	$262,000,000 - $419,000,000	$121,000,000
Fiscally constrained ($10M/yr):			
Present worth	$46,000,000	$211,000,000 – *Not Estimated*	$121,000,000
Total (non-discounted)	$49,000,000	$286,000,000 – *Not Estimated*	$141,000,000

The cost estimates summarized above and provided elsewhere in this SFS are feasibility level cost estimates; that is, they were developed to a level of accuracy such that the actual costs incurred to implement the alternatives should fall within a range bounded by 50% above and 30% below these estimates.

FIGURES

M:\clients\EMSI\westlake\2011\Final-SFS\WL-Fig-1-gen-loc.dwg plotted: 08/31/2011





0 3
SCALE IN MILES

N

Figure 1

General Location Map

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

Source: MyTopo.com Date of Photograph 8/9/2007

0 1000
SCALE IN FEET

N

Figure 2

Site and Surrounding Properties

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

M:\clients\EMSI\westlake\2011\Final-SFS\WL-Fig-2-Site.dwg plotted: 11/15/2011

Source: MyTopo.com Date of Photograph 8/9/2007

Figure 3

Site Features

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

M:\clients\EMSI\westlake\2011\Final-SFS\WL-Fig-3-Site Features.dwg plotted: 09/20/2011

M:\CLIENTS\EMSI\WESTLAKE\2011\FINAL-SFS\WL-FIG-4-SITE TOPOGRAPHY.DWG-LAYOUT2 11/15/2011 12:44PM

Figure 4
Site Topography

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

Parcels from ArcGIS Server "http://maps.stlouisco.com/arcgis/services".

Legend

Approximate Landfill Boundary

Parcel Outline

10O520084 - Parcel Number
Laidlaw .... - Parcel Owner

0 300 600
Scale In Feet
1 inch = 600 feet

N

Figure 5

Site Ownership In Vicinity of West Lake Landfill

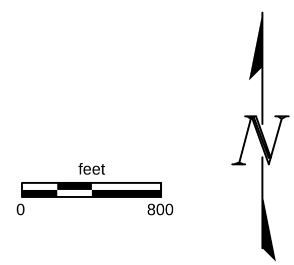
West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support , Inc.

LEGEND

B-4	General commercial district
M-1	Manufacturing district, limited
M-3g	Planned manufacturing district Northwest Industrial Park
M-3n	Planned manufacturing district West Lake Quarry Tract
NU	Non-Urban
R-1	One family dwelling district
R-3	One family dwelling district

Source: Golder Associates, 1996 Physical Characterization Technical Memorandum, Figure 1-5



Note: Deed restrictions were recorded in June, 1997 against the entire landfill area prohibiting residential use and groundwater use. A supplemental deed restriction was recorded in January, 1998 against Areas 1 and 2 prohibiting the placement of buildings and restricting the installation of underground utilities, pipes, and/or excavation.

Figure 6

Landfill and Surrounding Area Zoning

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

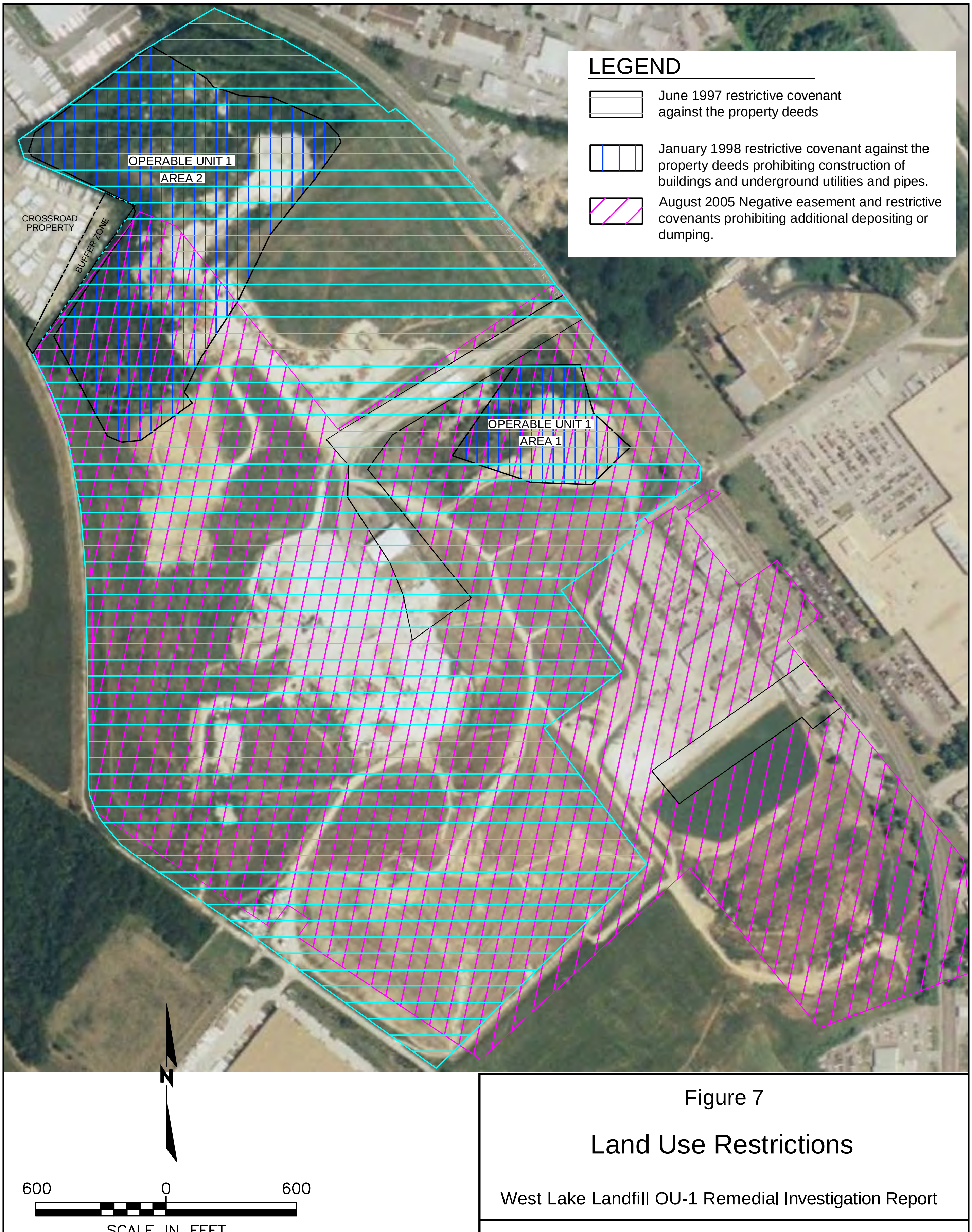


Figure 7

Land Use Restrictions

West Lake Landfill OU-1 Remedial Investigation Report

EMSI Engineering Management Support, Inc.

M:\clients\EMSI\westlake\2011\Final-SFS\WL-Fig-7-Easements.dwg plotted: 09/20/2011

M:\clients\EMSI\westlake\2011\Final-SFS\WL-Fig-8-Airport-Setbacks.dwg plotted: 10/07/2011

Source: Google Earth

Legend

West Flow Radar Tracks (From Lambert-St Louis International Airport 14 CFR Part 150 Study)

East Flow Radar Tracks (To Lambert-St Louis International Airport 14 CFR Part 150 Study)

0 1600

SCALE IN FEET

N

Figure 8

Setback From Airport Runway

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

M:\CLIENTS\EMSI\WESTLAKE\2011\FINAL-SFS\WL-FIG-9-GEO.DWG-LAYOUT1 09/20/2011 5:34PM

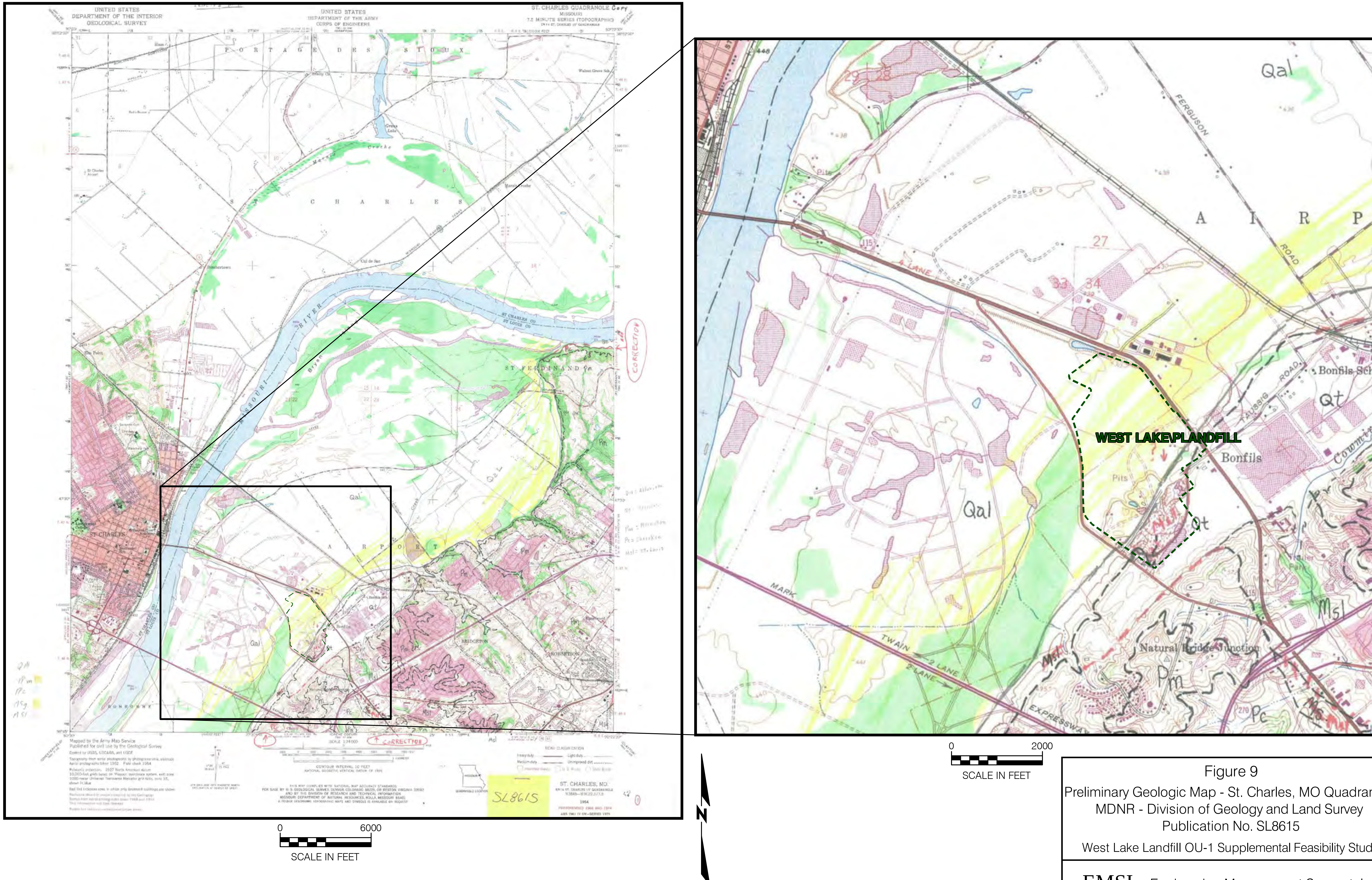
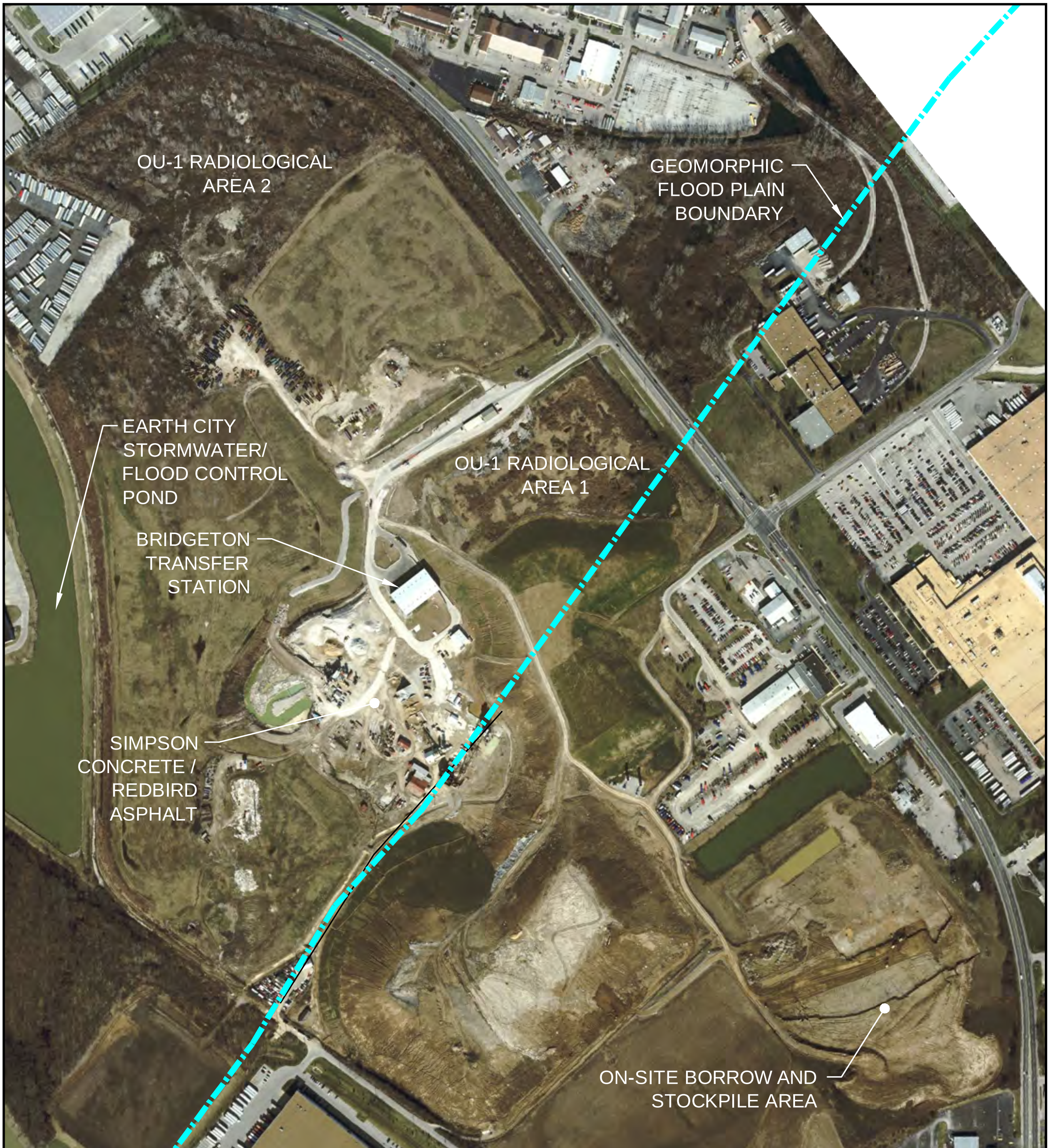


Figure 9

Preliminary Geologic Map - St. Charles, MO Quadrangle
MDNR - Division of Geology and Land Survey
Publication No. SL8615

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.



LEGEND

Southeast limit of Missouri River Geomorphic Flood Plain

0 600
SCALE IN FEET

N

Figure 10

Missouri RiverGeomorphic Flood Plain

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

M:\clients\EMSI\westlake\2011\Final-SFS\WL-Fig-10-Flood-Plain.dwg plotted: 09/28/2011

M:\clients\EMSI\westlake\2011\Final-SFS\WL-Fig-11-Entent of Rad-Mat.dwg plotted: 09/20/2011

RIM Extents Depths Generally 0-17 Ft. Below Ground Surface In Area 1 and 0-31 Ft. Below Ground Surface In Area 2

RIM Extents Depths Generally 17-49.5 Ft. Below Ground Surface (Variable)

N

0 200 400

SCALE IN FEET

Figure 11

Extent of Radiologically Impacted Material

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

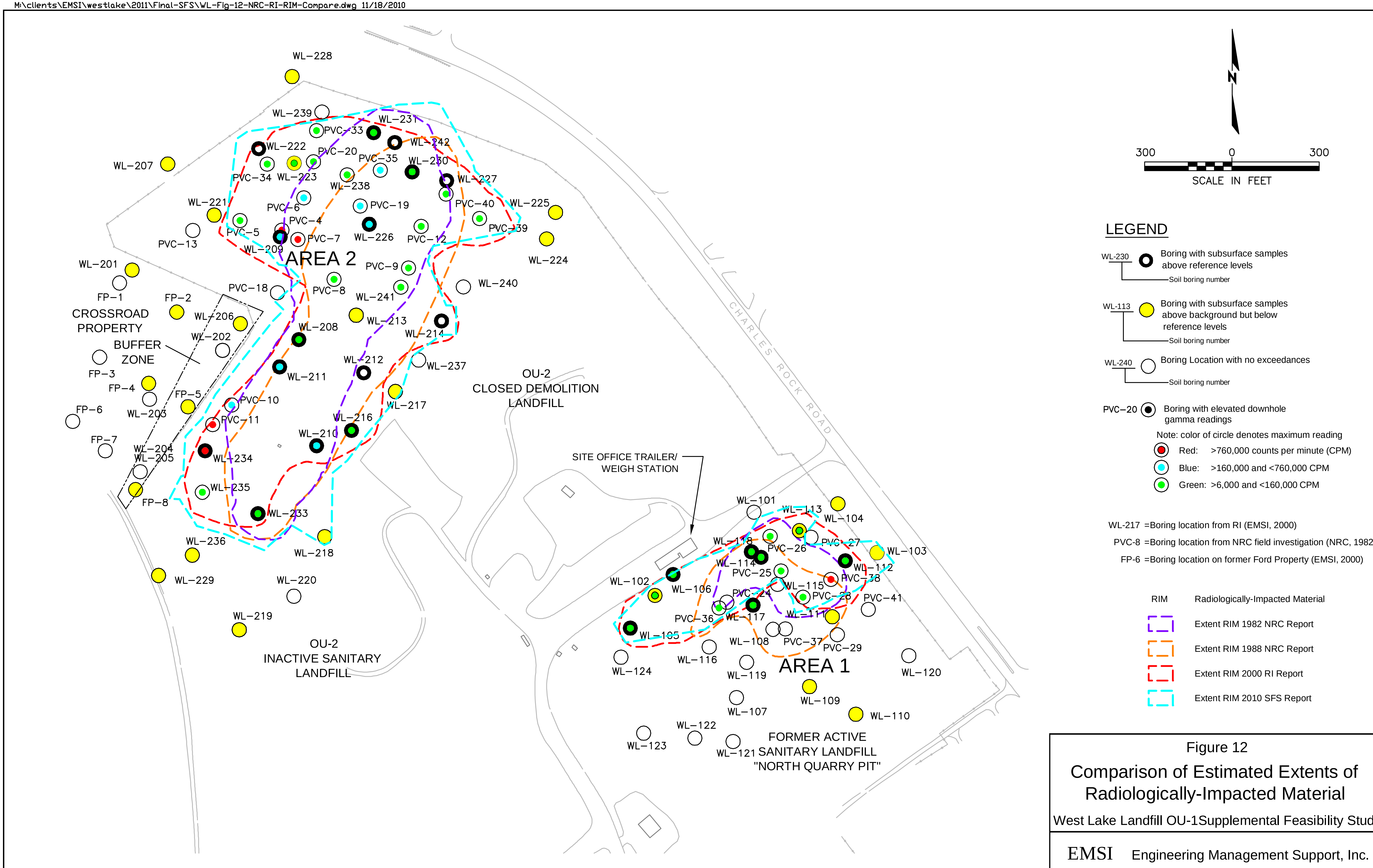


Figure 12

Comparison of Estimated Extents of Radiologically-Impacted Material

West Lake Landfill OU-1Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

M:\clients\EMSI\westlake\2011\Final-SFS\WL-Fig-13-NRC and RI Soil Boring.dwg 11/18/2010

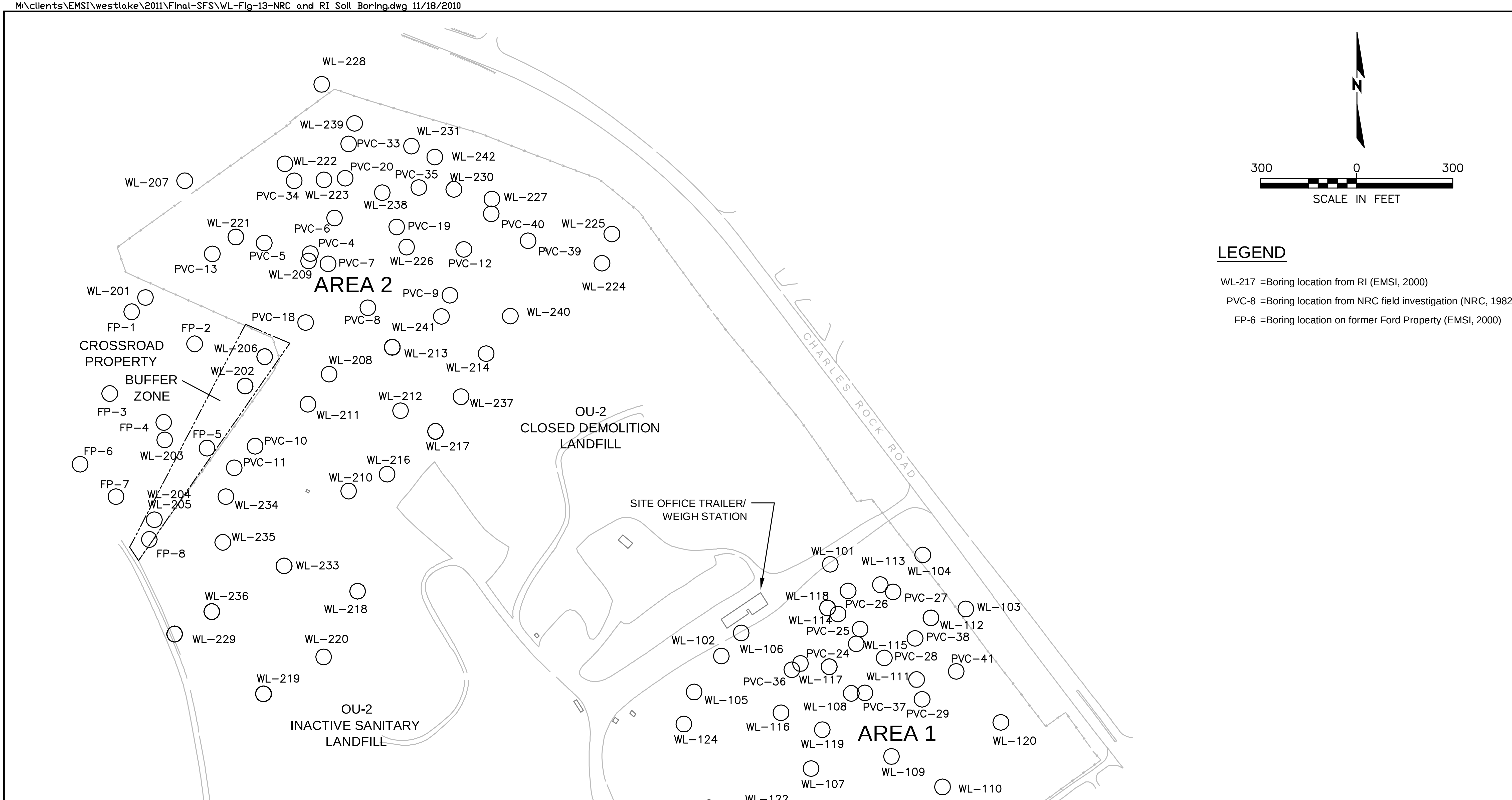


Figure 13

NRC and RI Soil Borings

West Lake Landfill OU-1Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

M:\clients\EMSI\westlake\2011\Final-SFS\WL-Fig-14-Buffer Zone.dwg plotted: 09/28/2011

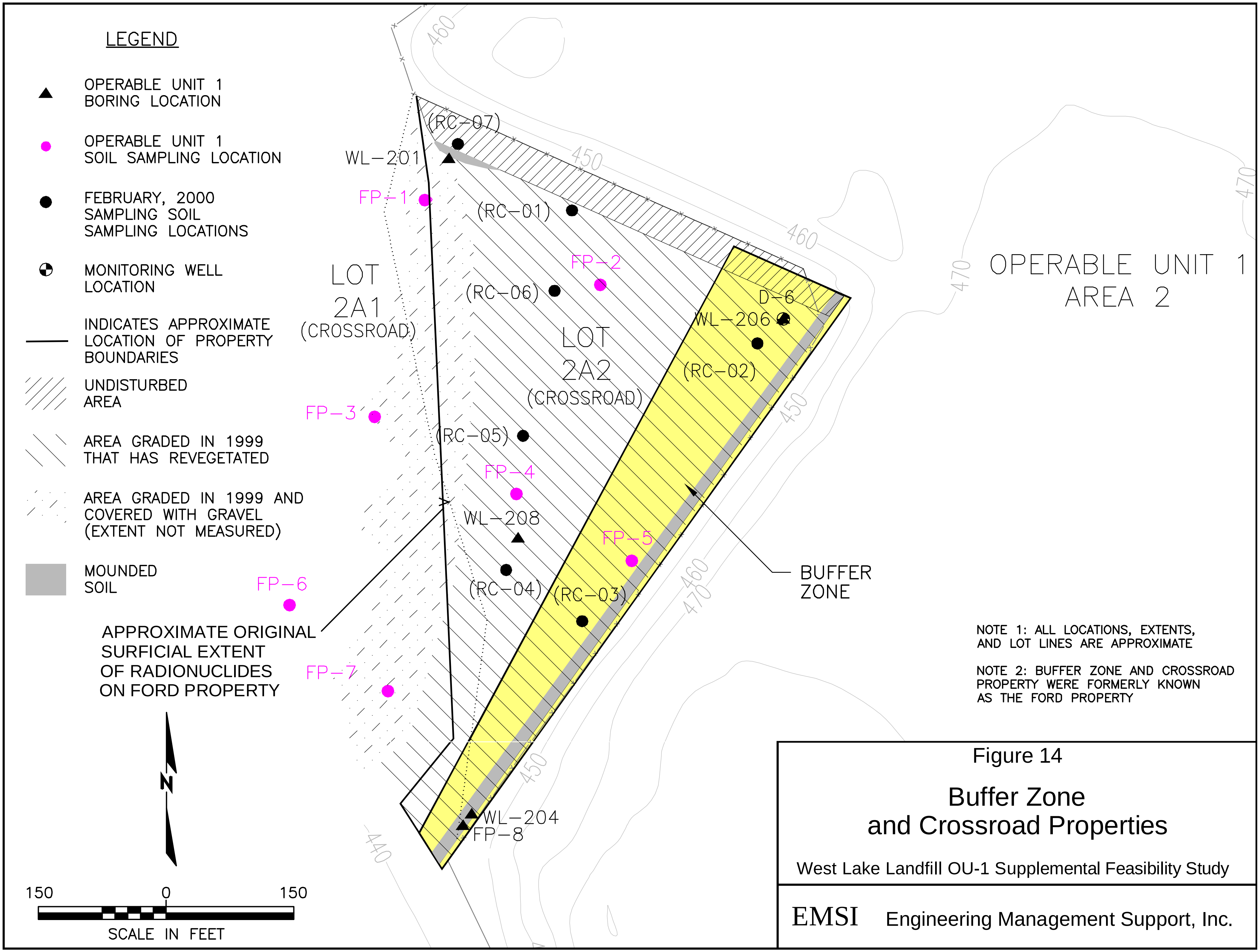


Figure 14

Buffer Zone and Crossroad Properties

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

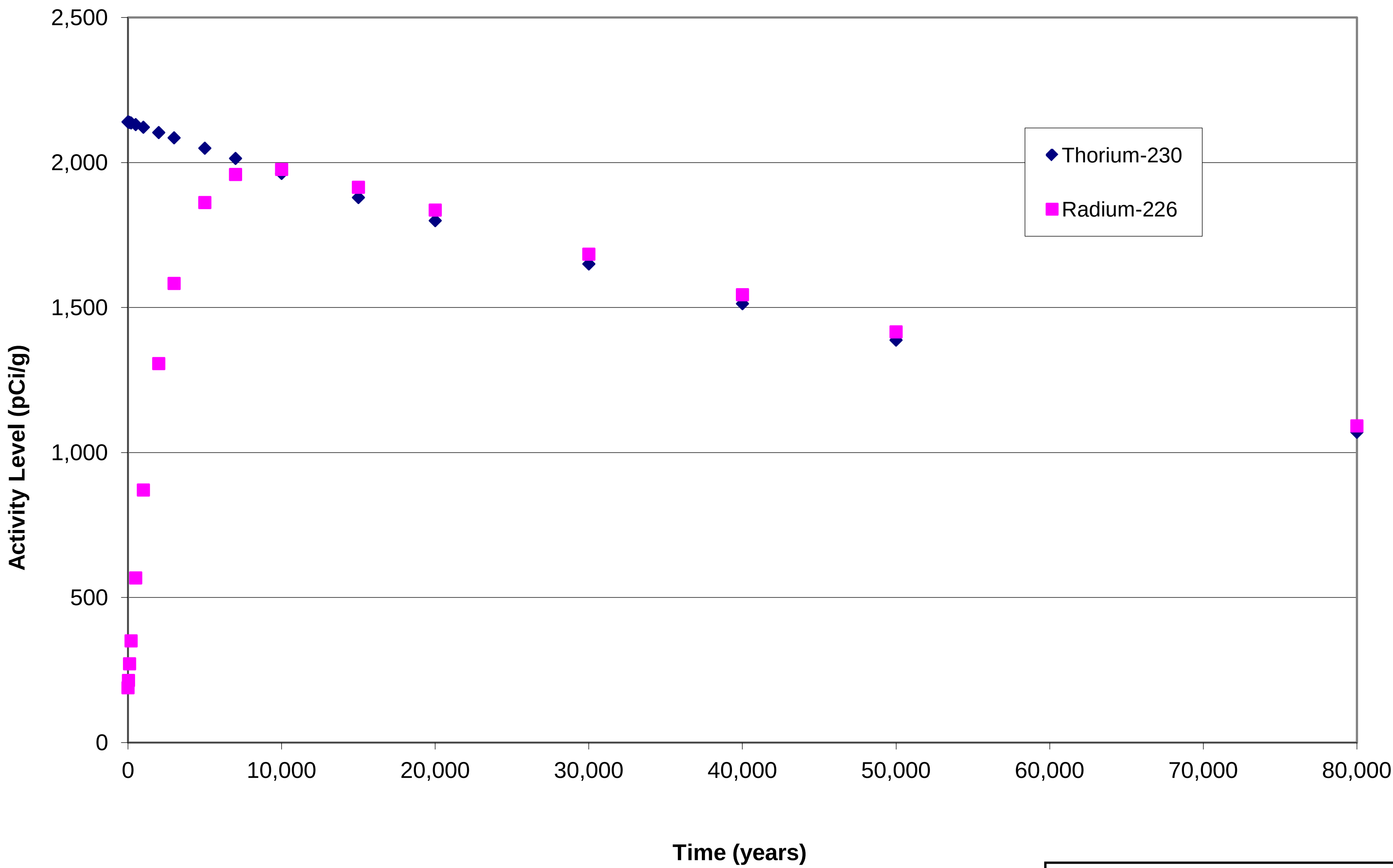


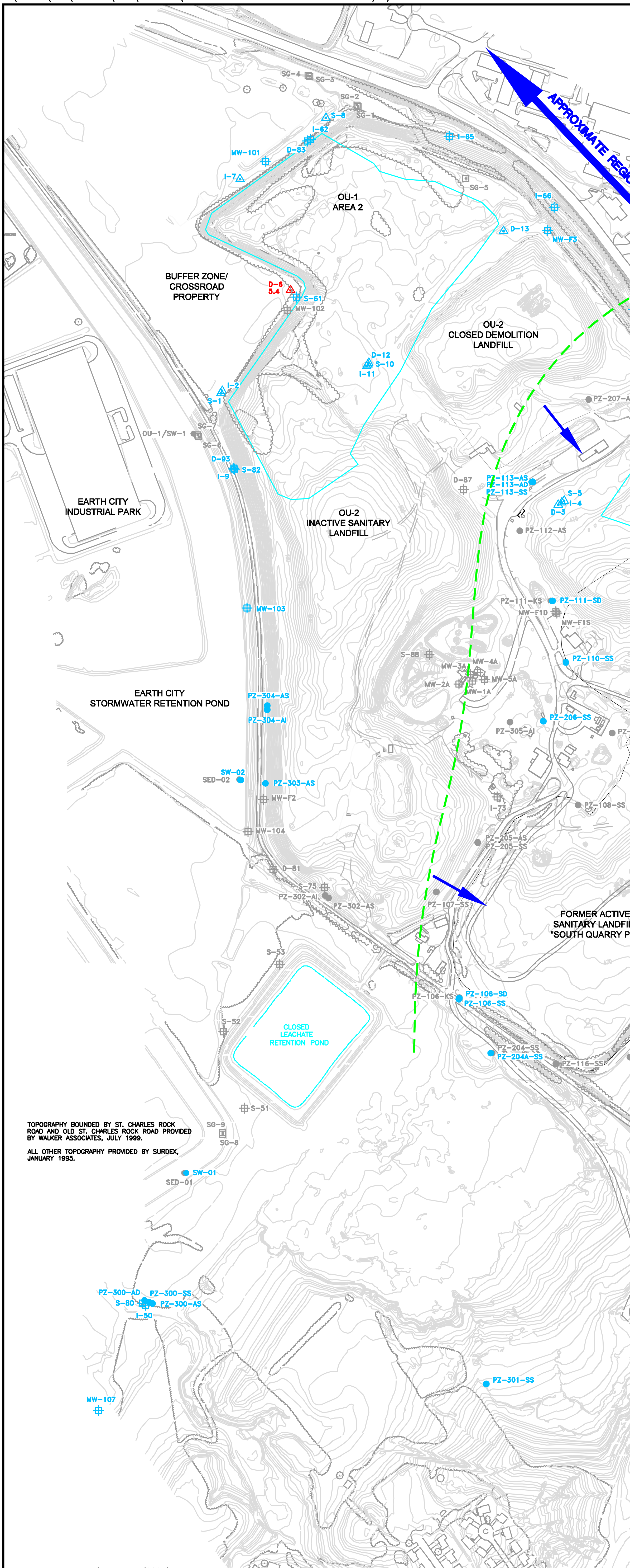
Figure 15

Thorium-230 Decay and Radium-226 Ingrowth Over Time

Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

M:\CLIENTS\EMSI\WESTLAKE\2011\FINAL-SFS\WL-FIG-16-RAD-DIS.DWG-HERST STD 17X11 09/21/2011 3:42PM



LOCATION NOT SAMPLED

LOCATION SAMPLED, DISSOLVED RADIUM BELOW MAXIMUM CONTAMINANT LEVEL (5 pCi/L)

LOCATION SAMPLED, DISSOLVED RADIUM ABOVE MAXIMUM CONTAMINANT LEVEL (5 pCi/L)

5.4 DISSOLVED RADIUM CONCENTRATION (pCi/L)*

GROUNDWATER FLOW DIRECTION

APPROXIMATE EXTENT OF INWARD HYDRAULIC GRADIENT

EMSI HAS CONCLUDED THAT D-14 RESULTS ARE NOT VAILD DUE TO EXTREME VARIATIONS BETWEEN FILTERED AND UNFILTERED RESULTS AND EXTREME VARIATIONS AMONG SAMPLING EVENTS.

OU-1 WELLS SAMPLED MAY 1996/1997

OU-2 WELLS SAMPLED DECEMBER 1995/FEBRUARY 1997

D: DEEP WELL
I: INTERMEDIATE WELL
PZ: PIEZOMETER / MONITORING WELL
S: SHALLOW WELL
SED: SEDIMENT SAMPLING POINT
SG: STAFF GAUGE LOCATION
SW: SURFACE WATER SAMPLING POINT
AS: SHALLOW ALLUVIAL WELL
KS: KEOKUK FORMATION WELL
SD: SALEM FORMATION WELL
SS: ST. LOUIS FORMATION WELL

* MOST RECENT SAMPLE RESULT FROM EITHER OU-1 RI (EMSI, 2000), OU-2 RI (HERST & ASSOCIATES, 2000), OR MARCH 2004 DATA FOR OU-1 FS EFFORT.

Figure 16

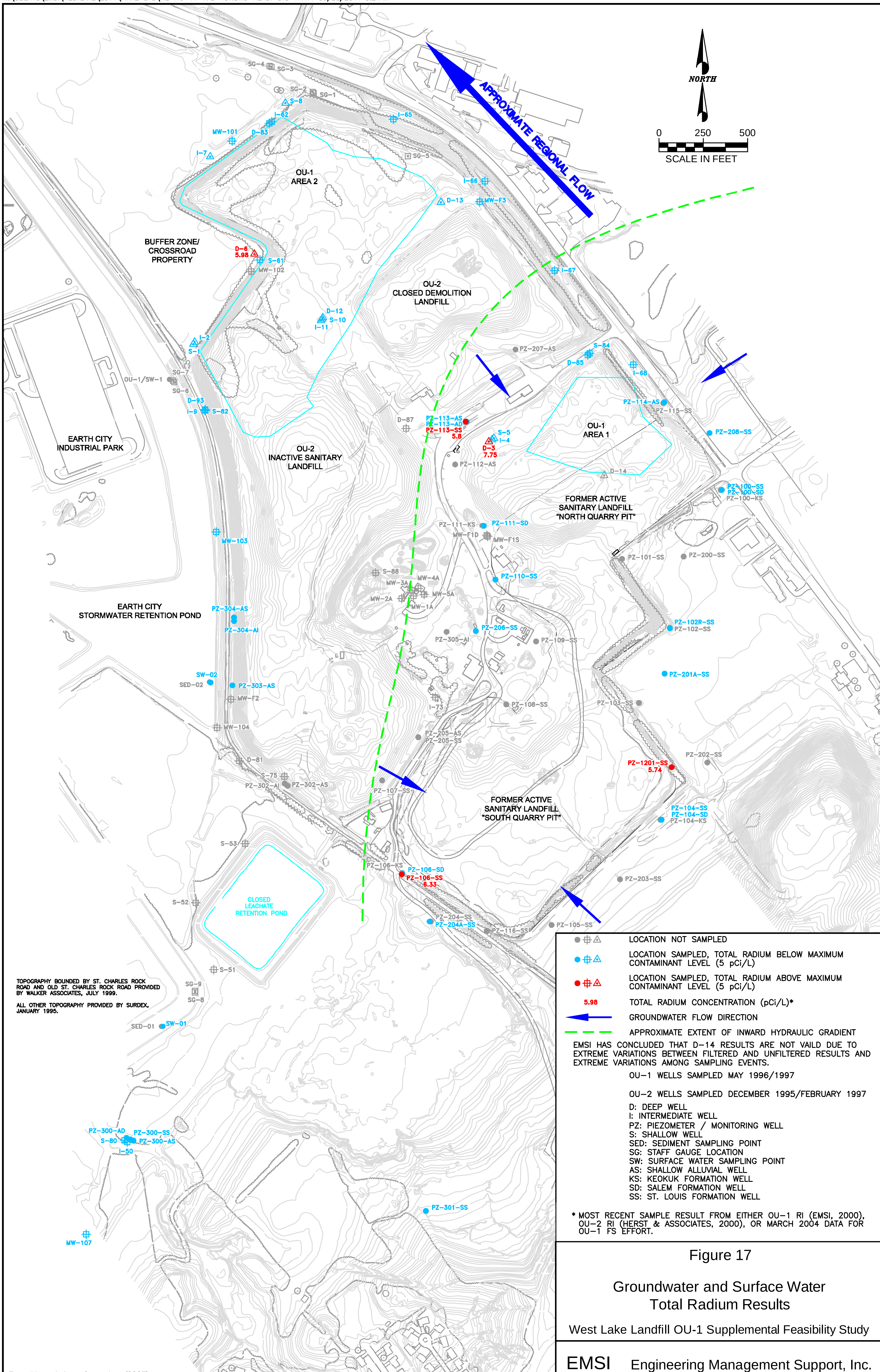
Groundwater and Surface Water Dissolved Radium Results

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

From Herst & Associates, Inc. (2007)

M:\CLIENTS\EMSI\WESTLAKE\2011\FINAL-SFS\WL-FIG-17-RAD-TOT.DWG-HERST STD 17X11 09/28/2011 9:27AM



LOCATION NOT SAMPLED

LOCATION SAMPLED, TOTAL RADIUM BELOW MAXIMUM CONTAMINANT LEVEL (5 pCi/L)

LOCATION SAMPLED, TOTAL RADIUM ABOVE MAXIMUM CONTAMINANT LEVEL (5 pCi/L)

5.98 TOTAL RADIUM CONCENTRATION (pCi/L)*

GROUNDWATER FLOW DIRECTION

APPROXIMATE EXTENT OF INWARD HYDRAULIC GRADIENT

EMSI HAS CONCLUDED THAT D-14 RESULTS ARE NOT VAILD DUE TO EXTREME VARIATIONS BETWEEN FILTERED AND UNFILTERED RESULTS AND EXTREME VARIATIONS AMONG SAMPLING EVENTS.

OU-1 WELLS SAMPLED MAY 1996/1997

OU-2 WELLS SAMPLED DECEMBER 1995/FEBRUARY 1997

D: DEEP WELL
I: INTERMEDIATE WELL
PZ: PIEZOMETER / MONITORING WELL
S: SHALLOW WELL
SED: SEDIMENT SAMPLING POINT
SG: STAFF GAUGE LOCATION
SW: SURFACE WATER SAMPLING POINT
AS: SHALLOW ALLUVIAL WELL
KS: KEOKUK FORMATION WELL
SD: SALEM FORMATION WELL
SS: ST. LOUIS FORMATION WELL

* MOST RECENT SAMPLE RESULT FROM EITHER OU-1 RI (EMSI, 2000), OU-2 RI (HERST & ASSOCIATES, 2000), OR MARCH 2004 DATA FOR OU-1 FS EFFORT.

Figure 17

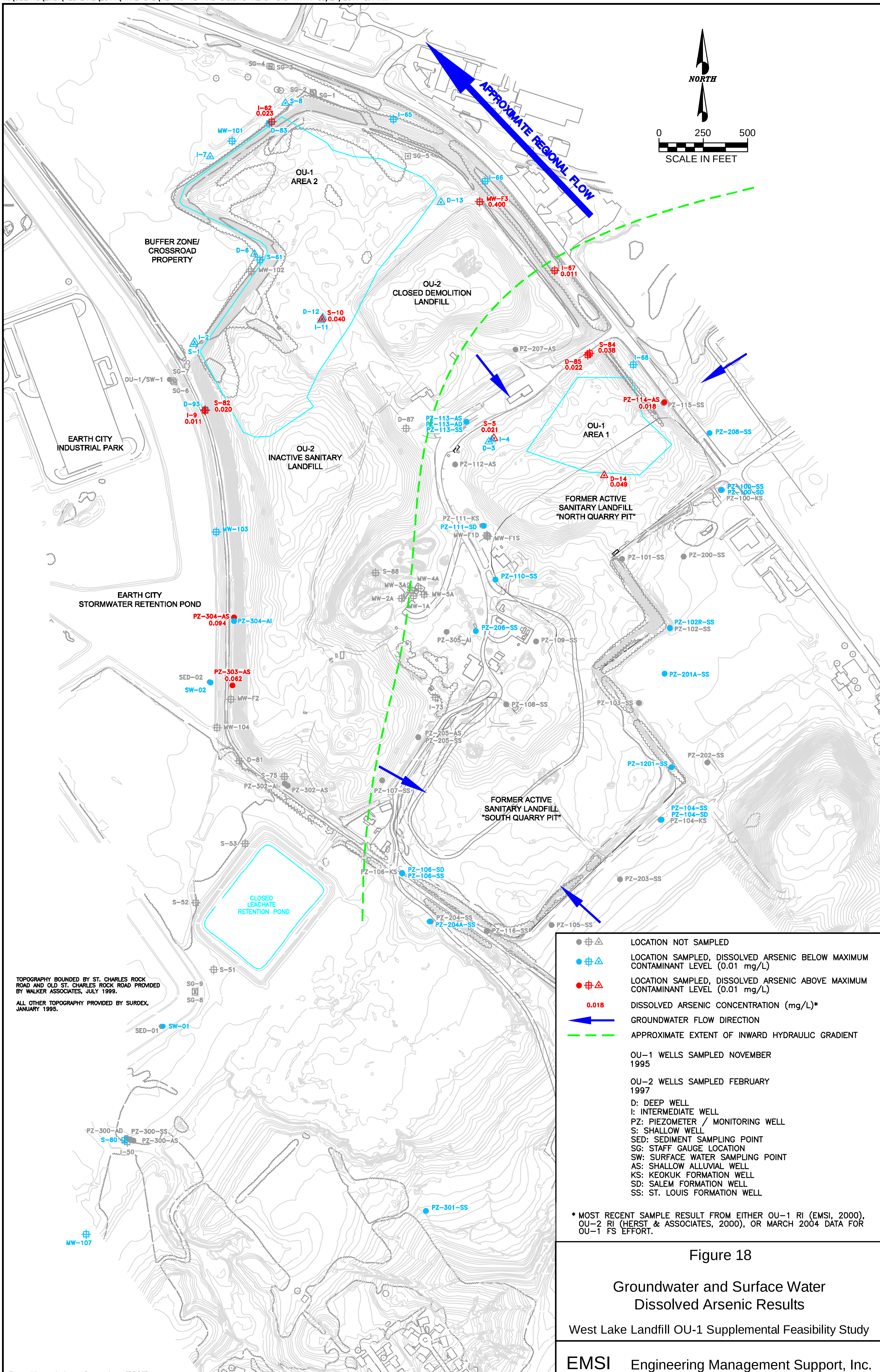
Groundwater and Surface Water Total Radium Results

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

From Herst & Associates, Inc. (2007)

M:\CLIENTS\EMSI\WESTLAKE\2011\FINAL-SFS\WL-FIG-18-ARS-DIS.DWG-HERST STD 17X11 09/21/2011 3:44PM



LOCATION NOT SAMPLED

LOCATION SAMPLED, DISSOLVED ARSENIC BELOW MAXIMUM CONTAMINANT LEVEL (0.01 mg/L)

LOCATION SAMPLED, DISSOLVED ARSENIC ABOVE MAXIMUM CONTAMINANT LEVEL (0.01 mg/L)

0.018 DISSOLVED ARSENIC CONCENTRATION (mg/L)*

GROUNDWATER FLOW DIRECTION

APPROXIMATE EXTENT OF INWARD HYDRAULIC GRADIENT

OU-1 WELLS SAMPLED NOVEMBER 1995

OU-2 WELLS SAMPLED FEBRUARY 1997

D: DEEP WELL
I: INTERMEDIATE WELL
PZ: PIEZOMETER / MONITORING WELL
S: SHALLOW WELL
SED: SEDIMENT SAMPLING POINT
SG: STAFF GAUGE LOCATION
SW: SURFACE WATER SAMPLING POINT
AS: SHALLOW ALLUVIAL WELL
KS: KEOKUK FORMATION WELL
SD: SALEM FORMATION WELL
SS: ST. LOUIS FORMATION WELL

* MOST RECENT SAMPLE RESULT FROM EITHER OU-1 RI (EMSI, 2000), OU-2 RI (HERST & ASSOCIATES, 2000), OR MARCH 2004 DATA FOR OU-1 FS EFFORT.

Figure 18

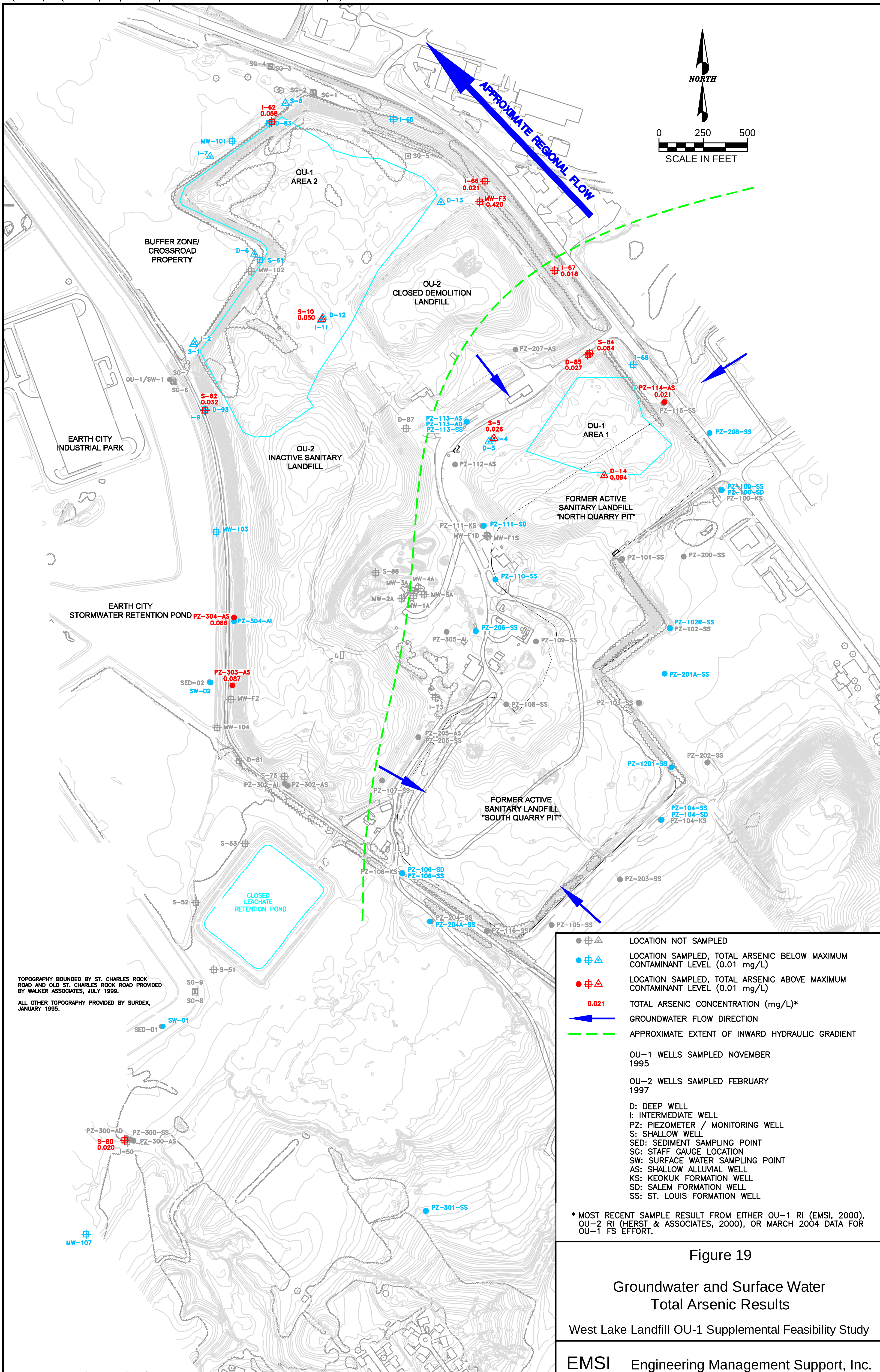
Groundwater and Surface Water Dissolved Arsenic Results

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

From Herst & Associates, Inc. (2007)

M:\CLIENTS\EMSI\WESTLAKE\2011\FINAL-SFS\WL-FIG-19-ARS-TOT.DWG-HERST STD 17X11 09/21/2011 3:45PM



LOCATION NOT SAMPLED

LOCATION SAMPLED, TOTAL ARSENIC BELOW MAXIMUM CONTAMINANT LEVEL (0.01 mg/L)

LOCATION SAMPLED, TOTAL ARSENIC ABOVE MAXIMUM CONTAMINANT LEVEL (0.01 mg/L)

0.021 TOTAL ARSENIC CONCENTRATION (mg/L)*

GROUNDWATER FLOW DIRECTION

APPROXIMATE EXTENT OF INWARD HYDRAULIC GRADIENT

OU-1 WELLS SAMPLED NOVEMBER 1995

OU-2 WELLS SAMPLED FEBRUARY 1997

D: DEEP WELL
I: INTERMEDIATE WELL
PZ: PIEZOMETER / MONITORING WELL
S: SHALLOW WELL
SED: SEDIMENT SAMPLING POINT
SG: STAFF GAUGE LOCATION
SW: SURFACE WATER SAMPLING POINT
AS: SHALLOW ALLUVIAL WELL
KS: KEOKUK FORMATION WELL
SD: SALEM FORMATION WELL
SS: ST. LOUIS FORMATION WELL

* MOST RECENT SAMPLE RESULT FROM EITHER OU-1 RI (EMSI, 2000), OU-2 RI (HERST & ASSOCIATES, 2000), OR MARCH 2004 DATA FOR OU-1 FS EFFORT.

Figure 19

Groundwater and Surface Water Total Arsenic Results

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

From Herst & Associates, Inc. (2007)

M:\CLIENTS\EMSI\WESTLAKE\2011\FINAL-SFS\WL-FIG-20-LEAD-DIS.DWG-HERST STD 17X11 09/28/2011 9:25AM

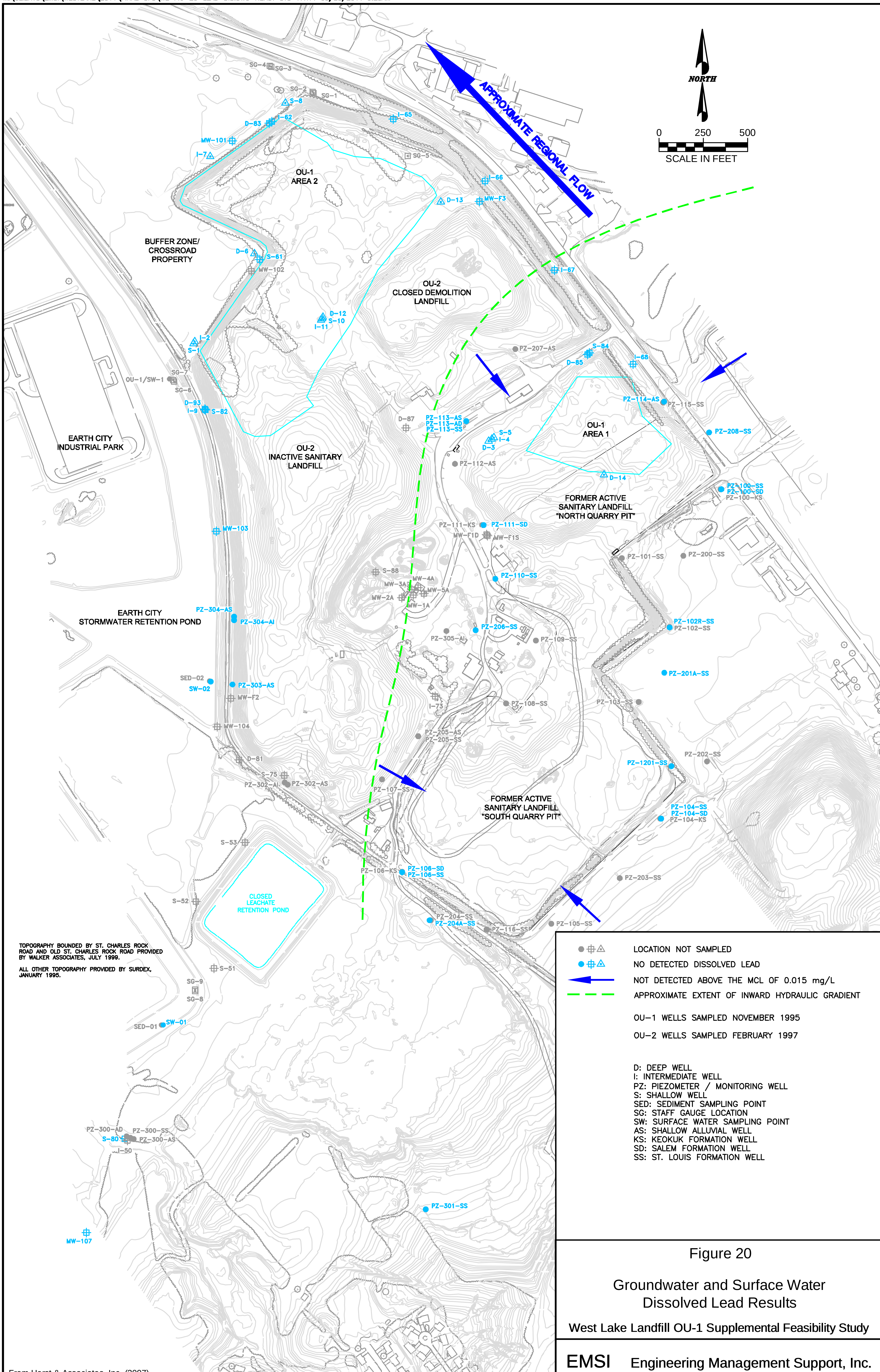


Figure 20

Groundwater and Surface Water Dissolved Lead Results

West Lake Landfill OU-1 Supplemental Feasibility Study

M:\CLIENTS\EMSI\WESTLAKE\2011\FINAL-SFS\WL-FIG-21-LEAD-TOT.DWG-HERST STD 17X11 09/21/2011 3:47PM

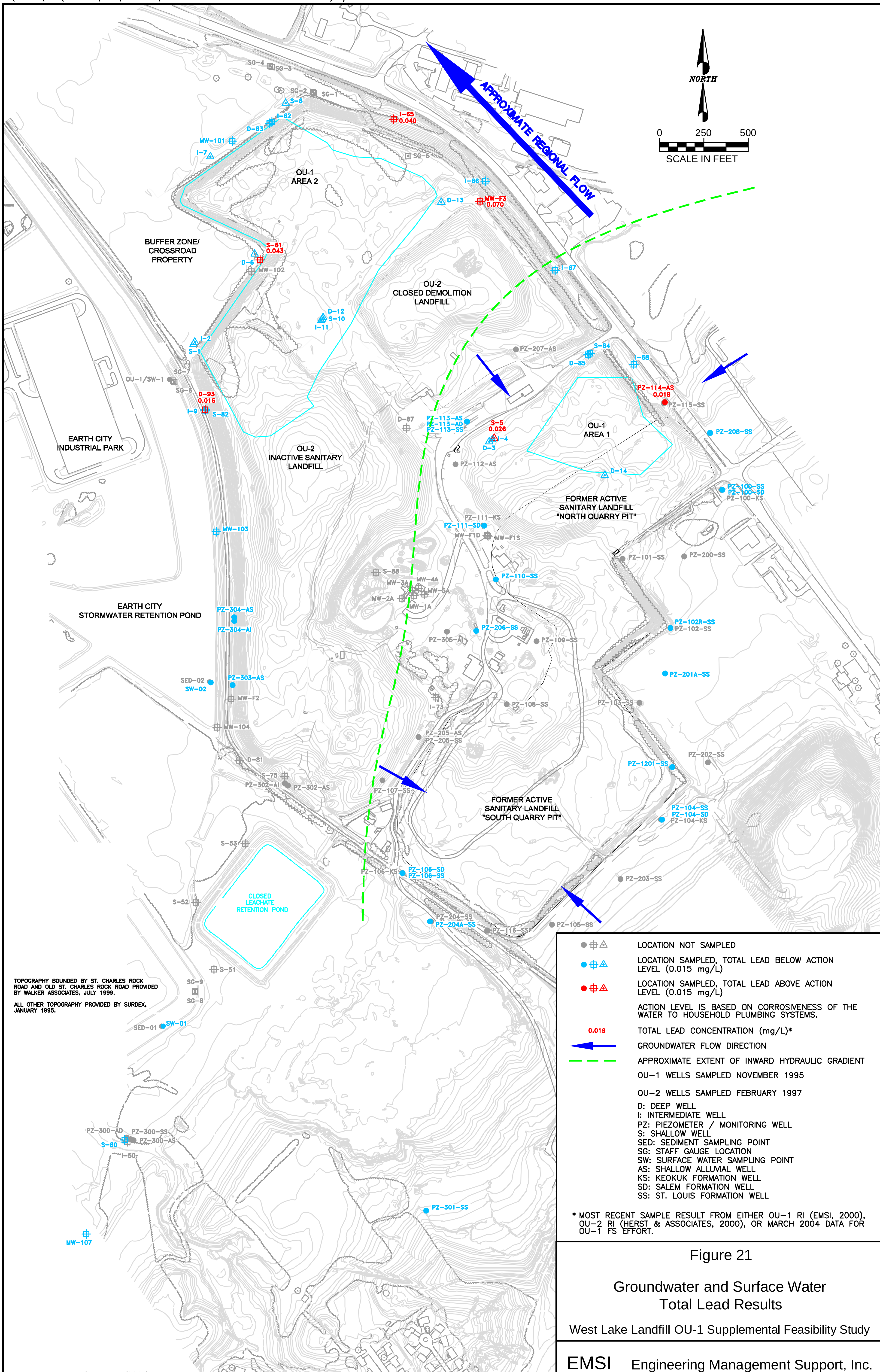


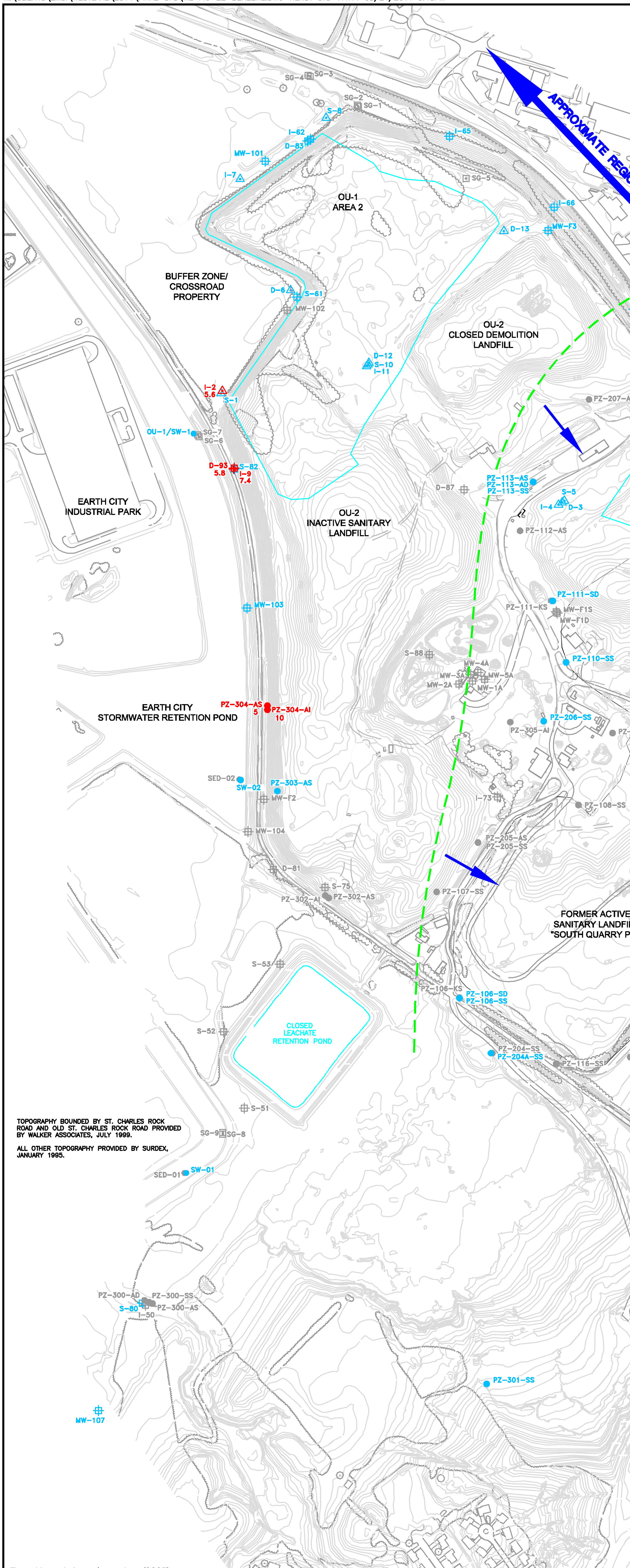
Figure 21

Groundwater and Surface Water Total Lead Results

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

M:\CLIENTS\EMSI\WESTLAKE\2011\FINAL-SFS\WL-FIG-22-BENZENE.DWG-HERST STD 17X11 09/21/2011 3:48PM



LOCATION NOT SAMPLED

LOCATION SAMPLED, BENZENE NOT DETECTED

LOCATION SAMPLED, BENZENE DETECTED > 5 µg/L MCL

10 BENZENE CONCENTRATION (µg/L)*

GROUNDWATER FLOW DIRECTION

APPROXIMATE EXTENT OF INWARD HYDRAULIC GRADIENT

OU-1 WELLS SAMPLED FEBRUARY 1996

OU-2 WELLS SAMPLED FEBRUARY 1997

D: DEEP WELL
I: INTERMEDIATE WELL
PZ: PIEZOMETER / MONITORING WELL
S: SHALLOW WELL
SED: SEDIMENT SAMPLING POINT
SG: STAFF GAUGE LOCATION
SW: SURFACE WATER SAMPLING POINT
AS: SHALLOW ALLUVIAL WELL
KS: KEOKUK FORMATION WELL
SD: SALEM FORMATION WELL
SS: ST. LOUIS FORMATION WELL

* MOST RECENT SAMPLE RESULT FROM EITHER OU-1 RI (EMSI, 2000), OU-2 RI (HERST & ASSOCIATES, 2000), OR MARCH 2004 DATA FOR OU-1 FS EFFORT.

Figure 22

Groundwater and Surface Water Benzene Results

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

From Herst & Associates, Inc. (2007)

M:\CLIENTS\EMSI\WESTLAKE\2011\FINAL-SFS\WL-FIG-23-CLORO-BENZENE.DWG-HERST STD 17X11 09/21/2011 3:51PM

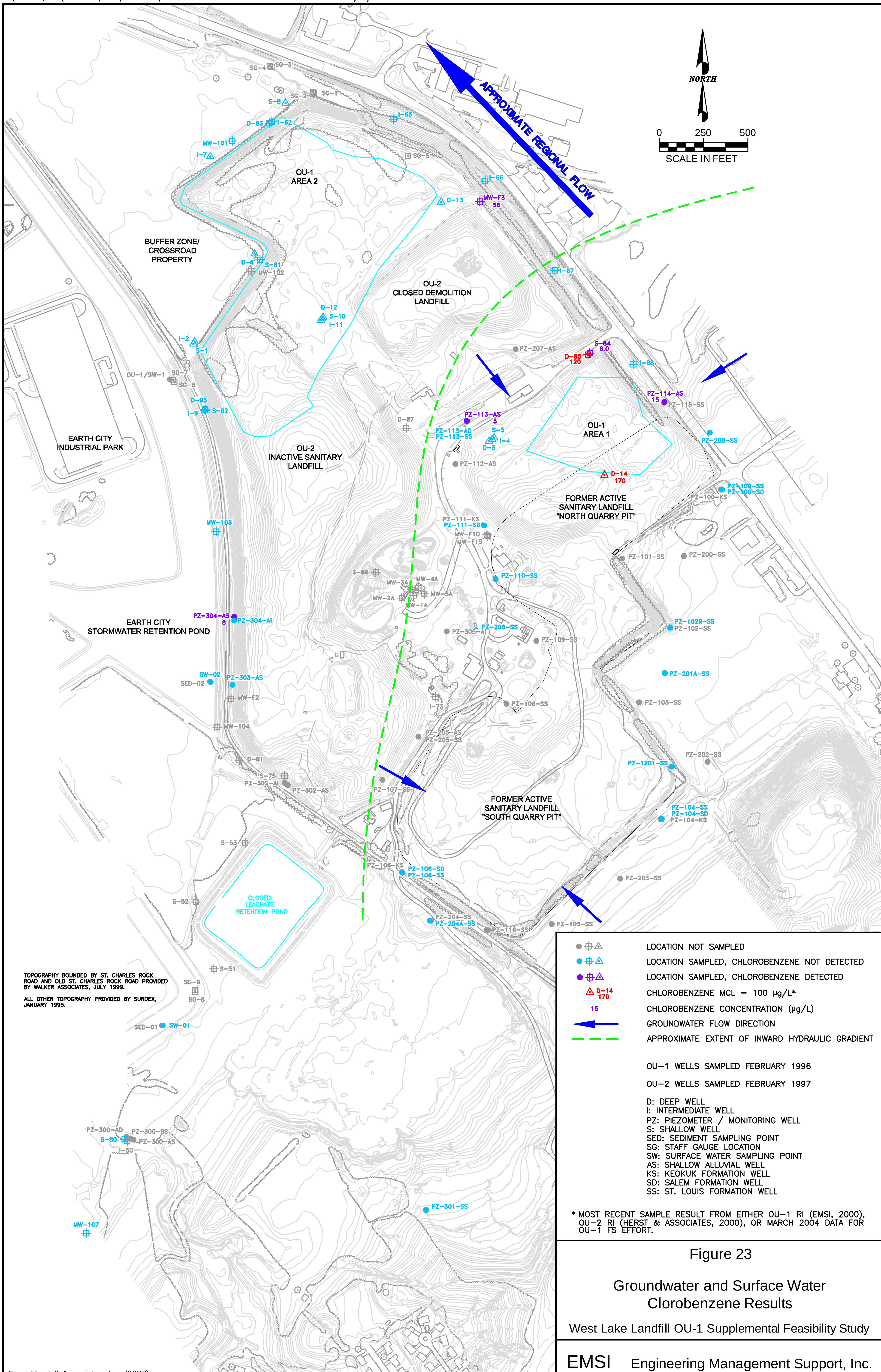


Figure 23

Groundwater and Surface Water Clorobenzene Results

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

From Herst & Associates, Inc. (2007)

GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTIONS	DESCRIPTION	IMPLEMENTABILITY SCREENING COMMENTS
No Action	See Figure 4-1 in FS			
Institutional Controls[1]	See Figure 4-1 in FS			
Monitoring	Long-term performance monitoring	Groundwater, surface water, sediment, landfill gas, and radon gas monitoring	Monitoring to evaluate site conditions over time and/or remedial action performance.	Potentially applicable.
	Short-term monitoring during construction	Perimeter environmental media air monitoring	Monitoring station contains low volume air sampler to collect airborne particulates and organic vapor samples for analysis of VOCs and radionuclide activity; continuous radon monitor; and radiation dosimeter. Data to be collected pre-, during, and post-remedial action.	Potentially applicable. Would be required during construction of any remedy to monitor doses, activities, and concentrations at the fenceline and areas where workers will frequent, to assure that non-remediation workers present in other portions of the landfill site are not exposed, and to assure that remediation workers are not exposed to unnecessary radiation exposure.
		Work zone monitoring	Site workers would participate in medical and dosimetry monitoring programs. Breathing zone samplers might be assigned to selected workers to evaluate intake of airborne particulates and radon. Equipment and workers leaving radiologically-controlled area will be surveyed and decontaminated, if necessary.	Potentially applicable. Would be required during construction of any remedy.
		Excavation guidance/ clearance monitoring	Use of walkover field radiological survey equipment and solids sampling to identify impacted materials above cleanup levels to guide excavation equipment. Final walkover radiological scans of exposed faces and base of excavated areas and sampling of soil/trash at base of excavation to document that RIM have been removed.	Potentially applicable. Would be required during construction of any remedy if RIM were to be relocated.
		Waste acceptance monitoring	If excavated RIM were to be disposed off-site, each load of material removed from the site would be scanned to ensure that the radiological Waste Acceptance Criteria of the facility where the RIM would disposed would be met.	Potentially applicable. Would be required if RIM is to be disposed off-site.
		Post cover construction radon flux monitoring	Use of Large Area Activated Charcoal Canisters (LAACCs) to measure radon flux of the cover surface after construction is complete.	Potentially applicable. Would be required during construction of any remedy if radionuclides remain under the cover.

[1] Indicates that General Response Action or remedial technology is component of presumptive remedy for CERCLA municipal landfill sites (USEPA, 1993)

[2] Treatment technology or remedial technology specified in Technology Reference Guide for Radioactively Contaminated Media, EPA 402-R-07-004, October 2007.

(hatched box) Technology and/or Process Option screened out on the basis of technical implementability.

Figure 24

Technical Implementability Screening of Remediation Technologies and Process Options

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

M:\clients\EMSI\westlake\2011\Final-SFS\WL-Fig-24_9-11.dwg plotted: 09/28/2011

GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTIONS	DESCRIPTION	IMPLEMENTABILITY SCREENING COMMENTS
Containment	See Figure 4-1 in FS for Surface Controls/Diversions, Surface Water/Sediment Control/Barriers, and Dust Controls			
	Capping and Covers [1,2]	Soil, clay, and vegetation; asphalt or concrete; synthetic membrane material; and multilayer, multimedia material	Capping can limit contaminant mobility and mitigate potential migration via air, surface water, and groundwater by attenuating radon emissions and controlling particulate resuspension, storm water run-on and runoff, and precipitation-enhanced percolation and leaching. These processes can be implemented with conventional equipment.	Potentially applicable.
	Land Encapsulation [2]	On-site: New Cell [2]	New cell would be constructed in area of the site outside geomorphic flood plain. Cell would consist of engineered liner and a final cover consistent with both MDNR solid waste regulations and UMTRCA requirements.	EPA has requested that this be evaluated as potentially applicable. Bird nuisance mitigation would be required during filling of new cell with waste.
		Off-site Licensed Facility [2]	This option would involve incorporation of removed material at an existing acceptable permitted commercial disposal facility. Land based disposal can reduce the mobility of contaminated material and mitigate potential exposures and migration by controlling the contaminant source. In addition to engineering requirements, constraints include issues such as transportation routes and risks, costs for off-site disposal and regulatory community acceptance.	EPA has requested that this be evaluated as potentially applicable. Waste Acceptance Criteria of disposal facility must be met for all material prior to the material being transported. Wastes hauled offsite to an offsite licensed facility must be shipped in appropriate containers and USDOT requirements for shipping must be met.
	Cryogenic Barriers [2] (screened out)	Subsurface Cryogenic Barrier [2] (screened out)	Provides containment and reduces the mobility of radionuclide contaminants by freezing contaminated subsurface soils to create an ice barrier around a contaminated zone. Rows of freeze pipes are inserted in an array outside and beneath the contaminated zone and the array of pipes connected to a refrigeration plant. Coolants typically consist of salt water, propylene glycol or calcium chloride.	Soil moisture content of 14 to 18% is considered optimal. Thorough subsurface characterization including identification of all subsurface structures is needed for proper design. Because containment by other barrier methods such as slurry walls and grout curtains becomes more cost effective after 8 or 9 years of operation, cryogenic barriers might be more applicable to containment of short-lived radionuclides such as tritium. Large volume of RIM in three areas would need to be refrigerated and soils containing radionuclides are comingled with municipal solid waste and construction debris. Consequently, this option was eliminated from further consideration.

MATCH A

[1] Indicates that General Response Action or remedial technology is component of presumptive remedy for CERCLA municipal landfill sites (USEPA, 1993)

[2] Treatment technology or remedial technology specified in Technology Reference Guide for Radioactively Contaminated Media, EPA 402-R-07-004, October 2007.

(hatched box) Technology and/or Process Option screened out on the basis of technical implementability.

Figure 24

Technical Implementability Screening of Remediation Technologies and Process Options

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTIONS	DESCRIPTION	IMPLEMENTABILITY SCREENING COMMENTS
MATCH A				
	Vertical Barriers[2]	Slurry Wall[2]	Mixture of soil and bentonite is used to construct a low conductivity wall that is typically keyed-into bedrock or an impermeable hydrostratigraphic layer. Wall is normally installed by introducing bentonite slurry into a trench as the trench is excavated to hydraulically shore the trench to prevent collapse. Soil from the excavation is mixed above ground with bentonite and the mixture is placed back into the trench, displacing the slurry.	Would be difficult to implement in landfill containing municipal solid waste and construction and demolition debris. Consequently, this option was eliminated from further consideration.
		Grout curtain[2]	Grout is injected into the natural formation in-situ to fill interstitial void spaces and significantly reduce the hydraulic conductivity of the soil, forming a vertical barrier to groundwater flow.	Only applicable to low permeable zones. Would be difficult to implement in landfill containing municipal solid waste and construction and demolition debris. Consequently, this option was eliminated from further consideration.
		Sheet Pile Cutoff Wall[2]	Sheet piling barriers are constructed by driving individual sections of interlocking steel sheets into the ground using impact or vibratory hammers to form an impermeable barrier. Joints between individual sheet piles can be filled with grout to provide a better seal.	Would be difficult to implement in landfill containing municipal solid waste and construction and demolition debris. Consequently, this option was eliminated from further consideration.
	Solidification/ Stabilization[2]	Cement Solidification/ Stabilization[2]	The cement solidification/stabilization process involves the addition of agents including Portland cement, gypsum and pozzolanic-based materials such as fly ash, blast furnace slag, kiln dust, and pumice with a waste to form a densified and hardened soil mass that limits the solubility or mobility of the waste constituents. It is conducted either in-situ by injecting a cement-based agent into the contaminated materials or ex-situ by excavating the materials, machine-mixing them with a cement-based agent, and depositing the solidified mass in a designated area. Is best suited to fine-grained soil with small pores.	Potentially applicable for use at an off-site licensed disposal facility if hazardous wastes are encountered that need to undergo solidification/stabilization or encapsulation at the off-site facility prior to disposal.
		Chemical Solidification/ Stabilization[2]	Similar to solidification/stabilization process as cement solidification/stabilization except agents include thermoplastic polymers, thermosetting polymers, and other proprietary additives. Is best suited to highly porous, coarse-grained, low-level radioactive waste in permeable matrices.	Potentially applicable for use at an off-site licensed disposal facility if hazardous wastes are encountered that need to undergo solidification/stabilization or encapsulation at the off-site facility prior to disposal.
MATCH B				

[1] Indicates that General Response Action or remedial technology is component of presumptive remedy for CERCLA municipal landfill sites (USEPA, 1993)

[2] Treatment technology or remedial technology specified in Technology Reference Guide for Radioactively Contaminated Media, EPA 402-R-07-004, October 2007.

(hatched box) Technology and/or Process Option screened out on the basis of technical implementability.

Figure 24

Technical Implementability Screening of Remediation Technologies and Process Options

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

M:\clients\EMSI\westlake\2011\Final-SFS\WL-Fig-24_9-11.dwg plotted: 09/28/2011

MATCH B

GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTIONS	DESCRIPTION	IMPLEMENTABILITY SCREENING COMMENTS
Physical/Chemical Treatment	Chemical Separation[2] (screened out)	Solvent/Chemical Extraction[2] (screened out)	An ex-situ chemical separation technology that separates hazardous contaminants from soils, sludges, and sediments using solvent/chemical extraction to reduce the volume of waste that must be subsequently treated or disposed. Solvents that have been used to remove radionuclide contaminants include complexing agents such as EDTA; inorganic salts; organic solvents; and sulfuric, hydrochloric, and nitric mineral acids. When contaminants have been sufficiently extracted, solvent is separated from the soil and distilled or removed by precipitation. Distilled vapor consists of relatively pure solvent that is recycled into the extraction process. The liquid residue containing concentrated contaminants undergoes further treatment or disposal. If multiple radionuclides or metals are targeted for removal, multiple solvent extraction steps may be required using multiple solvents.	To be considered for potential removal of radionuclides from the soil component of the RIM, would require pilot-testing of a dry soil separation technology to remove comingled municipal solid waste and debris greater than 2.4 inches in diameter to obtain representative soil samples for bench- and pilot-testing. Since multiple radionuclides would be targeted for removal, multiple solvent extraction steps would be required using multiple solvents, each requiring treatability testing. Removal percentages cited in the literature for uranium, radium-226, and thorium-232 would not meet the criteria that would allow for unrestricted use. Consequently, this option was eliminated from further consideration.
	Physical Separation[2]	Dry Soil Separation[2]	Dry soil separation involves screening and sieving soils to separate finer fractions, such as silt and clay, from coarser fractions of the soil. Since contaminants tend to bind to the fine fraction of a soil, the purpose of solids separation processes is to concentrate the contaminants to a smaller volume of soil that would subsequently be treated or disposed. Large debris would be removed and rocks, concrete, and asphalt would be crushed before fixed, vibrating, or rotation (trommel) screening. The segmented gate technology uses conveyor belts and gamma radiation detectors to separate dry materials. Shredders may be employed prior to screening.	Data are not available to assess potential effectiveness, implementability or cost at this time. Full-scale pilot testing would be required using representative material from Areas 1 and/or 2 to assess the degree to which the radiologically-impacted soil fraction of RIM can be separated from the overall matrix of landfilled refuse, debris and fill materials, and unimpacted soil and quarry spoils. Potentially applicable for reducing the volume of RIM that needs to be addressed under the two "complete rad removal" alternatives if results of pilot-testing indicate that the separated non-soil fraction of RIM does not exhibit radionuclide concentrations exceeding the levels that would allow for unrestricted use. It may be difficult to identify soil with a thorium-230 concentration that would allow for unrestricted use using gamma radiation detectors. Worker exposures, dust creation, and bird nuisance potential would increase.
		Soil Washing[2] (screened out)	A process in which water, with or without surfactants, is mixed with contaminated soil and debris to produce a slurry feed that is scrubbed to remove contaminated fine soil particles (silts and clays) from granular soil particles. Clean soil (sands and gravels) is returned to the excavation area, while remaining smaller volume of contaminated soil fines and process water are further treated and/or disposed.	Despite many bench- and pilot-scale tests, soil washing has not been fully demonstrated as a technology for reducing the volume of radionuclide-contaminated soil. Consequently, this option was eliminated from further consideration.

MATCH C

MATCH C

[1] Indicates that General Response Action or remedial technology is component of presumptive remedy for CERCLA municipal landfill sites (USEPA, 1993)

[2] Treatment technology or remedial technology specified in Technology Reference Guide for Radioactively Contaminated Media, EPA 402-R-07-004, October 2007.

(hatched box) Technology and/or Process Option screened out on the basis of technical implementability.

Figure 24

Technical Implementability Screening of Remediation Technologies and Process Options

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

M:\clients\EMSI\westlake\2011\Final-SFS\WL-Fig-24_9-11.dwg plotted: 09/28/2011

GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTIONS	DESCRIPTION	IMPLEMENTABILITY SCREENING COMMENTS
MATCH C		MATCH C		
Physical/Chemical Treatment	Physical Separation [2]	Flotation [2]	Radionuclide-contaminated soil is pretreated to remove coarse material and separated fine silt and clay soil particles are mixed with water to form a slurry. Flotation agent is added to the slurry. Small air bubbles passed upward through the slurry adhere to the floating particles, transport them to the surface, producing a foam containing the radionuclide-contaminated soil particles that is mechanically skimmed from the surface and further treated in a subsequent process to remove the radionuclides.	Flotation is most effective at separating soil particles in the very fine 0.0004 to 0.004 inch size range. For soils that include a wider range of particle sizes, flotation would need to be combined with other treatment processes. Has been employed extensively in the mining industry to segregated metal-containing fines, but has not been fully demonstrated for reducing the volume of radionuclide-contaminated soil. Consequently, this option was eliminated from further consideration.
	Virtrification [2]	In-situ Vitrification [2]	Vitrification involves heating contaminated media to extremely high temperatures, then cooling to form a dense, glassified solid mass, trapping and greatly reducing the mobility of radioactive contaminants. In-situ vitrification uses a square array of 4 graphite electrodes that allows a melt width of approximately 20 to 40 ft; the array is lowered progressively, as the melt grows, to the desired treatment depth. Offgas treatment may be required, depending on the amount/types of organics and metals that may volatilize.	Void volumes and percentages of metals, rubble, and combustible organics (e.g., methane in landfill gas) in contaminated media need to be considered - soils and waste containing greater than 55% inorganic debris and/or rubble are difficult to treat. Should not be used on contaminated soils with organic contents higher than 10%. Soils should have greater that 30% glass-forming materials (i.e., SiO2) to effectively immobilize radionuclides. RIM volume not expected to have greater than 30% glass-forming materials. Consequently, this option was eliminated from further consideration.
		Ex-situ Vitrification [2]	In the ex-situ vitrification configuration, waste is fed to a furnace (e.g., joule-process heating; plasma; electric arc; microwave; and coal-, gas-, or oil-fired cyclone furnace) on either a batch or continuous feed basis.	Not retained, see in-situ vitrification.
Biological Treatment	Phytoremediation [2]	Phytoextraction [2]	Phytoextraction is the uptake of contaminants by plant roots and the translocation/accumulation of contaminants in plant shoots and leaves. Plants are subsequently harvested from the growing area, dried, and disposed. Will produce harvested biomass residual waste that will require further treatment and/or disposal. Based on bench and field-testing, most promising candidates for phytoextraction are cesium and strontium.	Treatment technology is limited to shallow soils and sediments. RIM in Areas 1 and 2 is present at depths greater than 20 feet and is comingled with municipal solid waste and construction debris. Will not be effective year-round because of limited growing season. Little full-scale operating experience and technology not effective for removal of uranium and thorium radionuclides. Consequently, this option was eliminated from further consideration.
		MATCH D		

[1] Indicates that General Response Action or remedial technology is component of presumptive remedy for CERCLA municipal landfill sites (USEPA, 1993)

[2] Treatment technology or remedial technology specified in Technology Reference Guide for Radioactively Contaminated Media, EPA 402-R-07-004, October 2007.

(Hatched box) Technology and/or Process Option screened out on the basis of technical implementability.

Figure 24

Technical Implementability Screening of Remediation Technologies and Process Options

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

M:\clients\EMSI\westlake\2011\Final-SFS\WL-Fig-24_9-11.dwg plotted: 09/28/2011

GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTIONS	DESCRIPTION	IMPLEMENTABILITY SCREENING COMMENTS
MATCH D				
Biological Treatment	Phytoremediation[2]	Phytostabilization[2]	Phytostabilization is the production of chemical compounds by plants to immobilize contaminants at the interface of roots and soil.	Treatment technology is limited to shallow soils and sediments. RIM in Areas 1 and 2 is present at depths greater than 20 feet and is comingled with municipal solid waste and construction debris. Will not be effective year-round because of limited growing season. Little full-scale operating experience. Technology not effective for removal of uranium and thorium radionuclides. Consequently, this option was eliminated from further consideration.
Removal	Excavation	Backhoe, bulldozer, scraper and front-end loader	Excavation can limit contaminant mobility and mitigate potential exposures at the affected area by removing the contaminant source. This technology can be implemented with conventional equipment.	Potentially applicable.
	Storm Water Management	Implement Best Management Practices to route runon around working areas.	Involves use of diversion ditches, earthern berms, culverts, sumps, and pumps if necessary.	Potentially applicable.
		Implement Best Management Practices to minimize waste exposure to direct precipitation.	Involves use of selective excavation, staging, daily soil cover, and tarps.	Potentially applicable.
		Enclose excavation within temporary structure to minimize waste exposure to direct precipitation	Involves use of rigid-frame structure with fabric roofing that can be constructed over the excavation area and moved as work progresses. Maximum width of available structures is 200 feet, but reasonable max width is 140 feet. Length is added in 15-foot segments and is unlimited. Frame height can accommodate arm-height of heavy equipment. Building ends can be open or equipped with access doors. Ventilation can be provided to remove landfill emissions, engine exhaust, and ambient heat. Structure can be segmented such that it can be partially disassembled, lifted by crane to a new location, and reassembled. Foundation must be supported with piers or grade beam. Structures are designed for flat or uniform grade not to exceed 6% along length. Foundation width (side-to-side) must be level, or beam leg height must be adjusted so building does not lean.	Not practical because surface topography of landfills undulates and slope exceeds 6% in some areas. Considerable regrading would be needed to accommodate foundation, exposing organic waste to precipitation. Width of RIM in Areas 1 and 2 plus layback for overburden ranges from 250 to 1,050 feet. Thus, structure would need to be moved several times, overlapping excavated and backfilled areas every time. Even if the available structures could be partially disassembled, relocated, and reassembled, sufficient foundation beams and/or piers would be required to support the new locations. That would necessitate over-excavating soils and trash and/or installing foundation piers on 15-foot centers through base of landfills. Overall timeframe for remediation would be lengthened. Consequently, this option was eliminated from further consideration.
MATCH E		MATCH E		

Hatched boxes (Phytoremediation[2]; Phytostabilization[2]; Enclose excavation within temporary structure to minimize waste exposure to direct precipitation) = Technology and/or Process Option screened out on the basis of technical implementability.

[1] Indicates that General Response Action or remedial technology is component of presumptive remedy for CERCLA municipal landfill sites (USEPA, 1993)

[2] Treatment technology or remedial technology specified in Technology Reference Guide for Radioactively Contaminated Media, EPA 402-R-07-004, October 2007.

Technology and/or Process Option screened out on the basis of technical implementability.

Figure 24

Technical Implementability Screening of Remediation Technologies and Process Options

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

M:\clients\EMSI\westlake\2011\Final-SFS\WL-Fig-24_9-11.dwg plotted: 09/28/2011

GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTIONS	DESCRIPTION	IMPLEMENTABILITY SCREENING COMMENTS
Removal (MATCH E)	Storm Water Management (MATCH E)	Implement Best Management Practices to collect, detain, treat, and release runoff.	Involves use of sumps, pumps, pipelines, lined impoundments or temporary storage tanks, outlet structures to regulate discharge rate to design storm flow, and flow and water quality monitoring. If treatment is necessary, conventional processes such as gravity precipitation and/or filtration may be used and NPDES permit or discharge to a POTW would be necessary.	Potentially applicable.
	Bird Nuisance Mitigation	Implement Best Management Practices	Involves use of selective excavation techniques to minimize exposure of in-place waste, temporarily staging excavated waste in as small an area as practical, daily cover of waste material with soil or tarp, and rapid recovering of exposed waste whenever practicable.	Particularly applicable to landfill regrading projects.
		Enclose excavation within temporary structure (screened out)	Involves use of rigid-frame structure with fabric roofing that can be constructed over the excavation area and moved as work progresses. Maximum width of available structures is 200 feet, but reasonable max width is 140 feet. Length is added in 15-foot segments and is unlimited. Frame height can accommodate arm-height of heavy equipment. Building ends can be open or equipped with access doors, but if left open, birds will enter. Ventilation can be provided to remove landfill emissions, engine exhaust, and ambient heat. Structure can be segmented such that it can be partially disassembled, lifted by crane to a new location, and reassembled. Foundation must be supported with piers or grade beam. Structures are designed for flat or uniform grade not to exceed 6% along length. Foundation width (side-to-side) must be level, or beam leg height must be adjusted so building does not "lean".	Not practical because surface topography of landfills undulates and slope exceeds 6% in some areas. Considerable regrading would be needed to accommodate foundation, exposing organic waste to birds in the process. Width of RIM in Areas 1 and 2 plus layback for overburden ranges from 250 to 1,050 feet. Thus, structure would need to be moved several times, overlapping excavated and backfilled areas every time. Even if the available structures could be partially disassembled, relocated, and reassembled, sufficient foundation beams and/or piers would be required to support the new locations. That would necessitate over-excavating soils and trash and/or installing foundation piers on 15-foot centers through base of landfills. Overall timeframe for remediation would be lengthened. Consequently, this option was eliminated from further consideration.
		Erect wire or monofilament grids over exposed refuse	Involves use of stainless steel wire, monofilament, or Kevlar lines placed in parallel, or in spoke configurations to prevent bird access. Parallel spacings of between 10 and 50 feet should be effective for most birds near site. Lines must be placed above the maximum height of working equipment. Line length would depend on strength of the wire/filament used, poles and pole anchors, and available space for poles.	Potentially applicable. The size of open excavations may limit the constructability of wire or monofilament grids.

MATCH F

[1] Indicates that General Response Action or remedial technology is component of presumptive remedy for CERCLA municipal landfill sites (USEPA, 1993)

[2] Treatment technology or remedial technology specified in Technology Reference Guide for Radioactively Contaminated Media, EPA 402-R-07-004, October 2007.

(hatched box) Technology and/or Process Option screened out on the basis of technical implementability.

Figure 24

Technical Implementability Screening of Remediation Technologies and Process Options

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

M:\clients\EMSI\westlake\2011\Final-SFS\WL-Fig-24_9-11.dwg plotted: 09/28/2011

GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTIONS	DESCRIPTION	IMPLEMENTABILITY SCREENING COMMENTS
		MATCH F		
	Bird Nuisance Mitigation	Use of visual deterrents such as predator birds or effigies of predator birds	Involves use of predator birds and/or visual devices such as statues, flags, and kites of predator hawks, eagles, or owls as deterrents for birds.	Potentially applicable. Visual deterrents can be successful short-term, but not long term because birds habituate to the deterrent. Frequent relocation of predatory birds and predator effigies may help, but long-term effectiveness in not assured.
		Use of auditory “frightening” devices such as pyrotechnics, exploders, bird alarm calls, or sound generators.	Involves use of big “bang” devices such as pyrotechnics, cracker shells, racket bombs, screamer shells, whistle bombs, propane exploders, and recordings of bird distress calls. All can be successful short-term to frighten birds away, but over time, birds habituate to the deterrent.	Potentially applicable except for loud “bang” noises that will be a nuisance to nearby land owners, including the Airport Authority. Frequent repositioning and/or altering the timing of auditory activation may help, but long-term effectiveness in not assured.
		Use of EPA-registered chemical frightening agents or toxicants. (hatched: screened out)	Involves use of EPA-registered gull toxicant DRC-1339 and/or Avitrol® . DRC-1339 is applied to bread baits and causes renal failure, killing birds within days of ingestion. Avitrol® is a chemical frightening agent that causes birds to fly erratically and emit distress calls, frightening unaffected birds. Affected birds typically die within 4 hours. Avitrol® has not been formally evaluated for dispersing gulls.	Not likely applicable because killing or disorienting birds does not address the concern about congregating birds within the flight path of aircraft. Consequently, this option was eliminated from further consideration.
Transportation	Hauling of waste material	Truck	Includes off-road haul trucks that would move materials within a large construction or mining site; semi-trailer bottom-, end-, and side-dump trucks; standard dump; and transfer truck and pup vehicles for transporting loose material such as sand, gravel, asphalt, soil or waste materials on roads and highways.	Potentially applicable. If waste materials were to be transported to an off-site disposal facility, trucks can be used as the sole method of transportation to the facility, or alternatively to transfer materials to another transportation method such as rail. If hauled offsite, wastes with radionuclides must be placed in appropriate containers and USDOT requirements for shipping must be met.
		Rail	Bulk waste material is placed directly into 90-100 ton gondola rail cars if a rail spur is extended on-site; or a truck-to-rail transloading operation is used. Truck-to-rail involves loading of rail cars at a non-shared dedicated rail spur or siding. For loading of bulk material, a back-on transloading ramp is located perpendicular to the rail cars and end dump trucks discharge material into the gondolas after backing onto the ramp. After filling, covers are bolted onto the gondolas to keep the bulk material in-place in route to a disposal facility. Alternatively, end-dump truck trailers can be lined with IP-1 DOT bags, filled with bulk waste material, the bags “zippered” shut, and the bags dumped into a gondola car at the transloading ramp. Another transloading operation involves loading bulk waste material into intermodal containers, hauling the containers on a flat-bed truck to the truck-to-rail transloading station, and stacking multiple intermodal containers on a flat railcar for rail transportation to the disposal facility.	Potentially applicable. Wastes hauled offsite to an offsite licensed facility must be shipped in appropriate containers and USDOT requirements for shipping must be met. Would require lease of nearby rail spur and a truck-to-rail transloading facility as spur does not exist on-site. Extension of a rail spur on-site would be difficult to implement. Number of rail cars per day would be constrained by the length of spur and railroad switching limitations.

[1] Indicates that General Response Action or remedial technology is component of presumptive remedy for CERCLA municipal landfill sites (USEPA, 1993)

[2] Treatment technology or remedial technology specified in Technology Reference Guide for Radioactively Contaminated Media, EPA 402-R-07-004, October 2007.

(hatched box) Technology and/or Process Option screened out on the basis of technical implementability.

M:\clients\EMSI\westlake\2011\Final-SFS\WL-Fig-24_9-11.dwg plotted: 09/28/2011

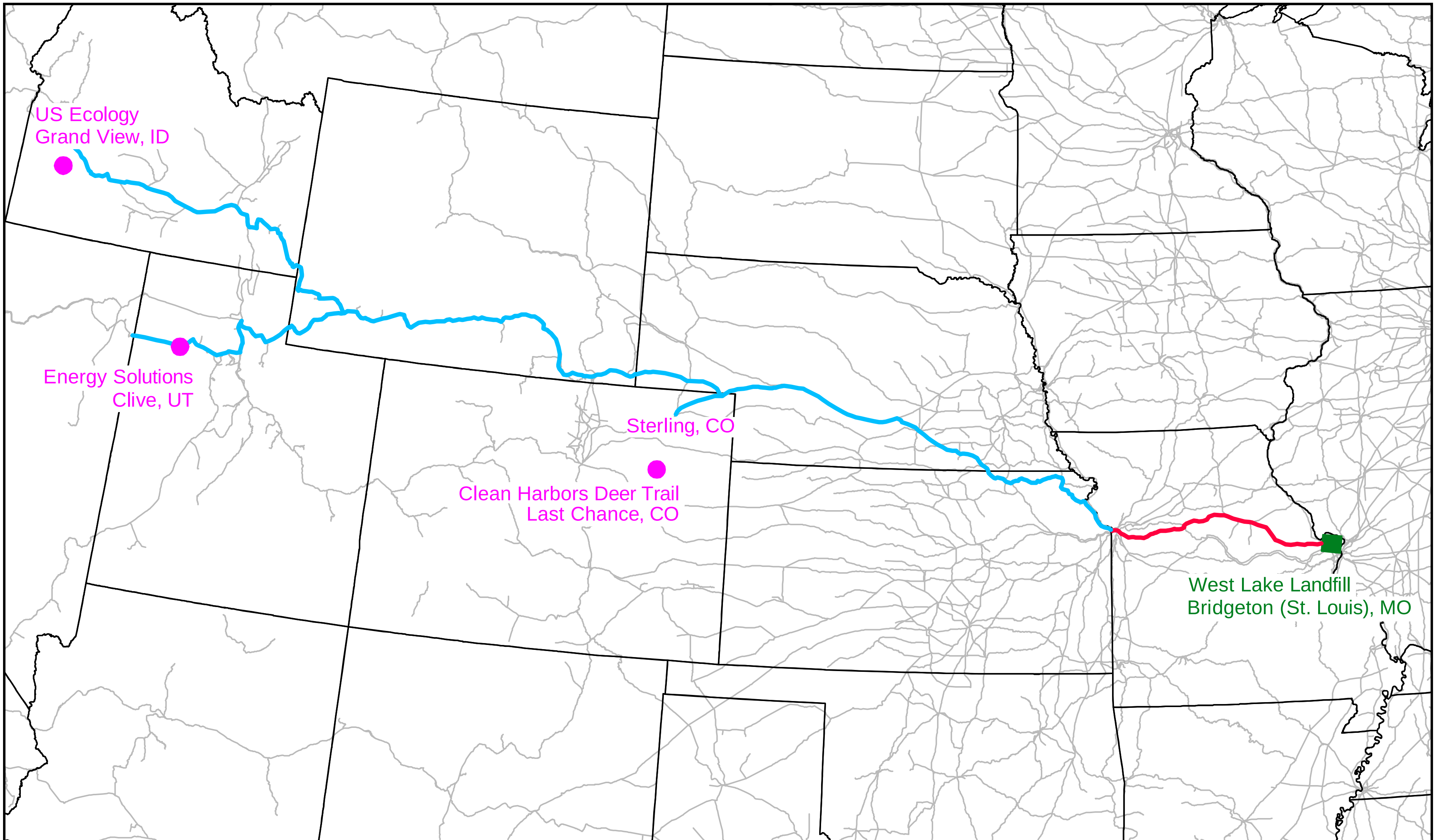
Figure 24

Technical Implementability Screening of Remediation Technologies and Process Options

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

M:\clients\EMSI\westlake\2011\Final-SFS\WL-Fig-25-Potential Off-site Disposal.dwg plotted: 09/28/2011



Legend

- Disposal Facility
- Railroad Line
- Norfolk Southern or BNSF Railroad
- Union Pacific Railroad

N

0 75 150

APPROXIMATE SCALE IN MILES

Figure 25

Locations of Potential Off-Site Disposal Facilities and Rail Points

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

Legend

MSW Municipal Solid Waste

C & D Construction and Demolition

NOT TO SCALE

Figure 26

Waste Volume/Size Reduction and Separation Equipment

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTIONS	EFFECTIVENESS	IMPLEMENTABILITY	COST	SCREENING COMMENTS
No Action	See Figure 4-2 in FS					
Institutional Controls	See Figure 4-2 in FS					
Monitoring	Long-term performance monitoring	Groundwater, surface water, sediment, landfill gas, and radon gas monitoring	Effective at determining whether there is any migration of contamination from soil or landfilled areas to groundwater, surface water, and sediment as well as verifying if any remedy is performing as required.	Easily implemented; resources are readily available.	Low capital and low to moderate O&M costs.	Would be implemented under monitoring program.
		Perimeter environmental media air monitoring	For airborne particulates, volatile organics, and radon, effective at documenting background conditions prior to, during, and after remedy implementation. Multiple monitoring stations may be required.	Easily implemented; resources are readily available.	Relatively high capital costs to establish power at monitoring station. Can be high O&M costs depending on parameters requiring analyses in off-site laboratory.	Would be implemented under monitoring program.
		Work zone monitoring	Effective at monitoring exposures of workers to radionuclides and contaminants that may be in airborne particulates.	Easily implemented using various portable, hand-held, passive and breathing zone monitoring devices and equipment. Worker participation in medical monitoring program may be required.	Low capital for dosimeter badges. Most other equipment can be rented.	Would be implemented under monitoring program.
	Short-term monitoring during construction	Excavation guidance/ clearance monitoring	For radionuclides and indirectly for volatile organics, effective for assessing presence of, location/extent, and relative concentration of waste materials. Provides real-time information for decisions during waste excavation projects. Monitoring for metals and semi-volatile organics would require analysis at off-site laboratory and delay excavation.	Easily implemented. Real-time monitoring and sampling equipment and supplies are readily available.	High capital costs for some portable radionuclide survey equipment and on-site laboratory, if needed. Low O&M costs.	Would be implemented under monitoring program.

MATCH A

[1] Indicates that General Response Action or remedial technology is component of presumptive remedy for CERCLA municipal landfill sites (USEPA, 1993)

[2] Treatment technology or remedial technology specified in Technology Reference Guide for Radioactively Contaminated Media, EPA 402-R-07-004, October 2007.

Figure 27

Evaluation of Remediation Technologies and Process Options

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTIONS	EFFECTIVENESS	IMPLEMENTABILITY	COST	SCREENING COMMENTS
		MATCH A				
	Short-term monitoring during construction	Waste acceptance monitoring	Effective at assessing whether a container of waste meets off-site disposal facility acceptance criteria before waste material is shipped off-site. Results of field monitoring devices may need to be verified with samples analyzed in off-site laboratory.	Easily implemented with standard, readily-available equipment. Will require profile sampling and preparation/signature of waste manifests prior to shipment.	Low capital and O&M costs (unless laboratory confirmation required).	Would be implemented under monitoring program.
		Post cover construction radon flux monitoring	Effective at measuring radon flux of the cover surface of tailings piles and landfills.	Easily implemented with Large Area Activated Charcoal Canisters (LAACCs).	No capital and low O&M. LAACCs are rented from the analytical laboratory.	Would be implemented under monitoring program.
Containment	See Figure 4-2 in FS for Surface Controls/Diversions, Surface Water/Sediment Control/Barriers, and Dust Controls					
	Capping and Covers [1,2]	Soil, clay, and vegetation; asphalt or concrete; synthetic membrane material; and multilayer, multimedia material	Caps and covers can effectively limit airborne emissions (including radon) and external gamma radiation, and they can also reduce precipitation-enhanced percolation and leaching.	Can be easily implemented with conventional equipment and procedures. Resources are readily available. Consideration must be given to settlement of filled materials in OU-1 after a cover is placed. Surface depressions must be filled-in.	Moderate to high capital costs, depending on type of cover. Low maintenance and monitoring costs.	Soil, clay and vegetation layer covers retained. Asphalt or concrete covers screened-out because of potential settlement concerns if a cover were to be placed over Areas 1 and 2. Synthetic membrane and multilayer/multimedia material covers screened out because they are inconsistent with the existing landfill cover requirements.
	Land Encapsulation [2]	On-site: New Cell [2]	Effective at containing waste materials. Cell liner and cap would passively limit potential contaminant migration and human/ecological exposures for an indefinite period.	Potentially implementable if siting criteria are satisfied and a suitable site is identified. Materials, equipment, and personnel are readily available to construct cell. Excavation and handling of waste materials to place in cell, management of fugitive dust, bird nuisance, and potential odor during placement, and management/treatment of stormwater generated during waste placement in a cell would present implementability challenges. Would require cooperation/coordination with landowner where cell would be located.	High capital costs. Moderate maintenance and monitoring costs.	Associated with Excavation and Transportation.
		MATCH B				

[1] Indicates that General Response Action or remedial technology is component of presumptive remedy for CERCLA municipal landfill sites (USEPA, 1993)

[2] Treatment technology or remedial technology specified in Technology Reference Guide for Radioactively Contaminated Media, EPA 402-R-07-004, October 2007.

Figure 27

Evaluation of Remediation Technologies and Process Options

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTIONS	EFFECTIVENESS	IMPLEMENTABILITY	COST	SCREENING COMMENTS
	(MATCH B) Land Encapsulation [2]	Off-site Licensed Facility [2]	Can effectively remove the source of contamination to limit contaminant mobility and volume at the affected area and reduce related exposures.	Difficult to implement; potentially only three facilities in U.S. will accept wastes. Will require construction of an on-site rail spur or truck-to-railcar transfer facility. Will require transportation of radiologically-impacted materials by truck and railroad and the attendant risks.	High	Associated with Excavation and Transportation.
Physical/Chemical Treatment	Solidification/ Stabilization [2]	Cement Solidification/ Stabilization [2]	Effective at reducing mobility of hazardous and radioactive contaminants.	Cement solidification/stabilization is best suited to highly porous, coarse-grained, permeable soils. Would be difficult to implement in-situ because of the nature of the matrix of landfilled refuse, debris and fill materials, soil, and quarry spoils. Easily implemented ex-situ at permitted off-site disposal facility prior to disposal of hazardous or mixed wastes if hazardous wastes encountered during excavation of RIM in Areas 1 and 2.	Moderate capital costs.	Would only be relevant if hazardous wastes were encountered during surface regrading or excavation of RIM in Areas 1 and 2.
		Chemical Solidification/ Stabilization [2]	Effective at reducing mobility of hazardous and radioactive contaminants.	Chemical solidification/stabilization best suited to fine-grained soil with small pores. Macroencapsulation is used for immobilizing low-level radioactive and mixed debris waste with dimensions greater than or equal to 2.5 inches while microencapsulation used to solidify wastes with smaller particles. Would be difficult to implement in-situ because of the nature of the matrix of landfilled refuse, debris and fill materials, soil, and quarry spoils. Easily implemented ex-situ at permitted off-site disposal facility prior to disposal of hazardous or mixed wastes if hazardous wastes encountered during excavation of RIM in Areas 1 and 2.	Moderate capital costs.	Would only be relevant if hazardous wastes were encountered during surface regrading or excavation of RIM in Areas 1 and 2.

MATCH B

MATCH C

[1] Indicates that General Response Action or remedial technology is component of presumptive remedy for CERCLA municipal landfill sites (USEPA, 1993)

[2] Treatment technology or remedial technology specified in Technology Reference Guide for Radioactively Contaminated Media, EPA 402-R-07-004, October 2007.

Figure 27

Evaluation of Remediation Technologies and Process Options

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

MATCH C

GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTIONS	EFFECTIVENESS	IMPLEMENTABILITY	COST	SCREENING COMMENTS
Physical/Chemical Treatment						
	Physical Separation[2]	Dry Soil Separation[2]	Could potentially be effective at reducing volume of RIM by separating the soil materials containing radionuclides from the overall matrix of landfilled refuse, debris and fill materials, and unimpacted soil and quarry spoils if full-scale pilot-testing indicates that radionuclide concentrations in samples of the non-soil fraction of RIM that is discharged from the screening process would allow for unrestricted use of the non-soil fraction. If soil materials containing radionuclides remain adhered to the segregated refuse because of moisture content or other reasons, a separation process would not be effective. The effectiveness and degree of separation that may be achieved is uncertain until pilot-testing results are obtained. RIM matrix may require drying to improve separation effectiveness.	Pilot-testing using representative material from Areas 1 and/or 2 would be needed to determine the site-specific implementability. Equipment is readily available. Shear shredding pretreatment step prior to separation screening would be required. In maintaining the separation screening equipment, workers would be exposed to increased radiation emitted by RIM that adheres to the screen. Inclusion of a solids separation step as part of a process used for excavation and disposal of the RIM could become a factor relative to the daily production rates and project duration. Use of separation equipment could extend the overall project schedule and increase the potential or amounts of stormwater accumulation, airborne (dust) emissions, and bird or other vector impacts due to a possible increase in the overall schedule.	High capital cost. High operating costs.	Full-scale pilot-testing using representative material from Areas 1 and/or 2 would need to be conducted as a pre-design study early in the Remedial Design schedule.
Removal	Excavation	Backhoe, bulldozer, scraper and front-end loader	Can effectively remove the source of contamination to limit contaminant mobility and volume at the affected area and reduce related exposures.	Can be implemented with conventional equipment and procedures, and resources are available. Consideration must be given to type and composition of material to be excavated and excavations at depths greater than 25 feet, as special excavation equipment may be required.	Cost dependent on material properties. Moderate if shallow. High if deep.	None.
	Storm Water Management	Implement Best Management Practices to route runon around working areas.	Effective in the short-term and long-term.	Easily implementable. Relies on use of conventional construction equipment and materials.	Low capital and O&M cost.	Would be implemented as part of RA and O&M.
		Implement Best Management Practices to minimize waste exposure to direct precipitation.	Would be effective during excavation if the RIM was being removed and/or placed in the on-site cell.	Easily implementable. Relies on use of conventional construction equipment and materials.	Moderate O&M cost.	Would be implemented as part of RA.

MATCH D

MATCH D

[1] Indicates that General Response Action or remedial technology is component of presumptive remedy for CERCLA municipal landfill sites (USEPA, 1993)

[2] Treatment technology or remedial technology specified in Technology Reference Guide for Radioactively Contaminated Media, EPA 402-R-07-004, October 2007.

Figure 27

Evaluation of Remediation Technologies and Process Options

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

M:\clients\EMSI\westlake\2011\Final-SFS\WL-Fig-27_9-11.dwg plotted: 09/28/2011

GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTIONS	EFFECTIVENESS	IMPLEMENTABILITY	COST	SCREENING COMMENTS
MATCH D	MATCH D					
Removal	Storm Water Management	Implement Best Management Practices to collect, detain, treat, and release runoff.	Effective during excavation while the RIM is being removed and/or placed in the on-site cell.	Easily implementable. Relies on use of conventional construction equipment and materials.	Moderate capital and O&M cost.	Would be implemented as part of RA.
	Bird Nuisance Mitigation	Implement Best Management Practices	Effective means to minimize waste exposure opportunity for birds.	Can be implemented as part of an excavation program.	Low-moderate cost, depending on size of waste area to be covered.	Potentially effective.
		Erect wire or monofilament grids over exposed refuse.	May be effective deterrent with adequate grid spacing and pole placement.	Can be implemented with parallel spacings of between 10 and 50 feet. Line height can be 10-15 feet above the starting grade for Areas 1 and 2 if scrapers are used to strip overburden. Line length depends on strength of the wire/filament used and available space for poles and pole anchors. Should be able to implement with conventional wire, poles, construction equipment, and labor.	Cost dependent on wire/monofilament used, grid spacing, and height. Moderate capital cost if parallel spacings >15 feet and pole height <15 feet.	More effective if combined with visual and/or auditory deterrents.
		Use of visual deterrents such as predator birds or effigies of predator birds	May be effective short-term in one position, but long-term (greater than several months) effectiveness will require frequent repositioning.	Can be implemented with commercially-available effigies of predator birds mounted on poles and/or onsite buildings.	Low capital and O&M cost.	More effective if combined with auditory deterrents and/or overhead wire grid.
		Use of auditory "frightening" devices such as pyrotechnics, screamer whistles, and bird distress calls.	May be effective short-term in one position, but long-term (greater than several months) effectiveness will require frequent repositioning and altering of timing of activation.	Can be implemented with commercially-available sound devices that can be mobilized to new locations.	Low capital and O&M cost.	More effective if combined with visual deterrents and/or overhead wire grid.

Figure 27

Evaluation of Remediation Technologies and Process Options

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

M:\clients\EMSI\westlake\2011\Final-SFS\WL-Fig-27_9-11.dwg plotted: 09/28/2011

GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTIONS	EFFECTIVENESS	IMPLEMENTABILITY	COST	SCREENING COMMENTS
Transportation	Hauling of waste material	Truck	With the numerous types of trucks available, effective for hauling of waste materials over all types of terrain and distances.	Easily implemented. Can be mobilized quickly. Depending on the characteristics of the waste material, truck beds may require lining or the waste may need to be transported in special containers. Federal, State, and local laws limit weight that can be carried on roads (depending on type of truck and characteristics of road).	Relatively cost-effective, plenty of competition available. Truck hauling is typically the only option to haul materials short distances. Not cost-effective for hauling large volumes/weights of materials long distances.	Eliminated for hauling of radiologically-impacted materials to off-site disposal facilities because of long distances.
		Rail	Effective for hauling of waste materials over long distances or heavy volumes locally.	Difficult to implement. Would require truck-to-rail transfer and lease of nearby rail spur or extension of a rail spur onto the Site. Construction of new spur on-site would require land purchase or lease and coordination with local agencies and the railroad. Rate of waste transport via rail would be dependent on length of rail spur, number of switches provided by the railroad per week, and availability of specialty railcars for waste transport.	Cost-effective for hauling large volumes/weights long distances.	None.

[1] Indicates that General Response Action or remedial technology is component of presumptive remedy for CERCLA municipal landfill sites (USEPA, 1993)

[2] Treatment technology or remedial technology specified in Technology Reference Guide for Radioactively Contaminated Media, EPA 402-R-07-004, October 2007.

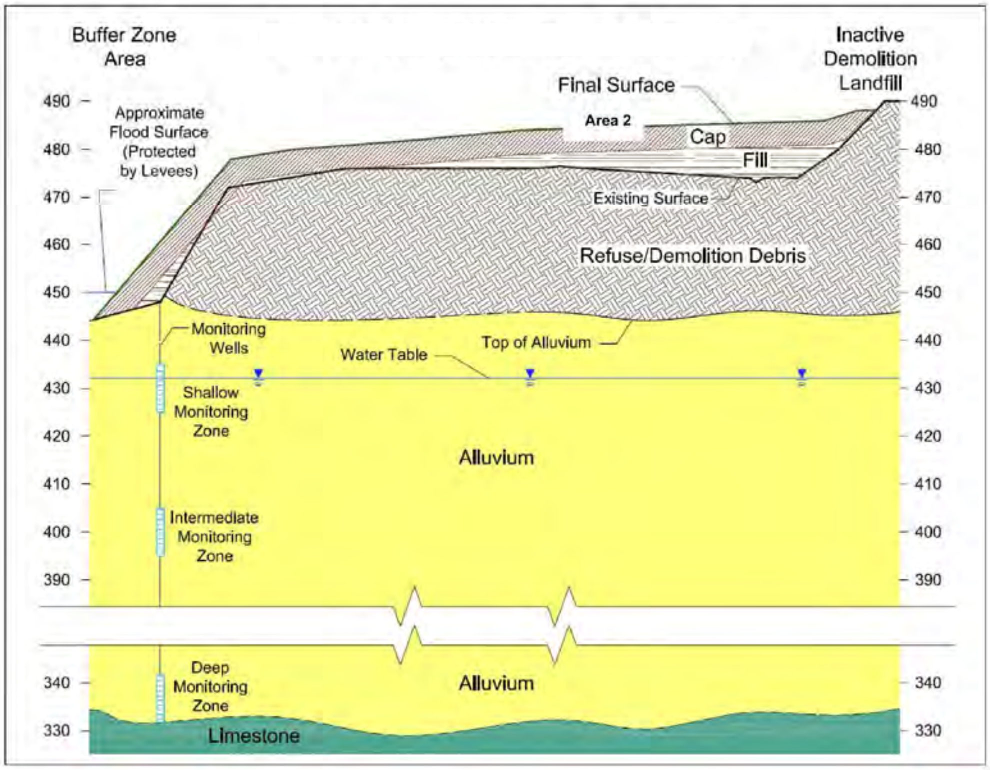
Figure 27

Evaluation of Remediation Technologies and Process Options

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

M:\clients\EMSI\westlake\2011\Final-SFS\WL-Fig-27_9-11.dwg plotted: 09/28/2011



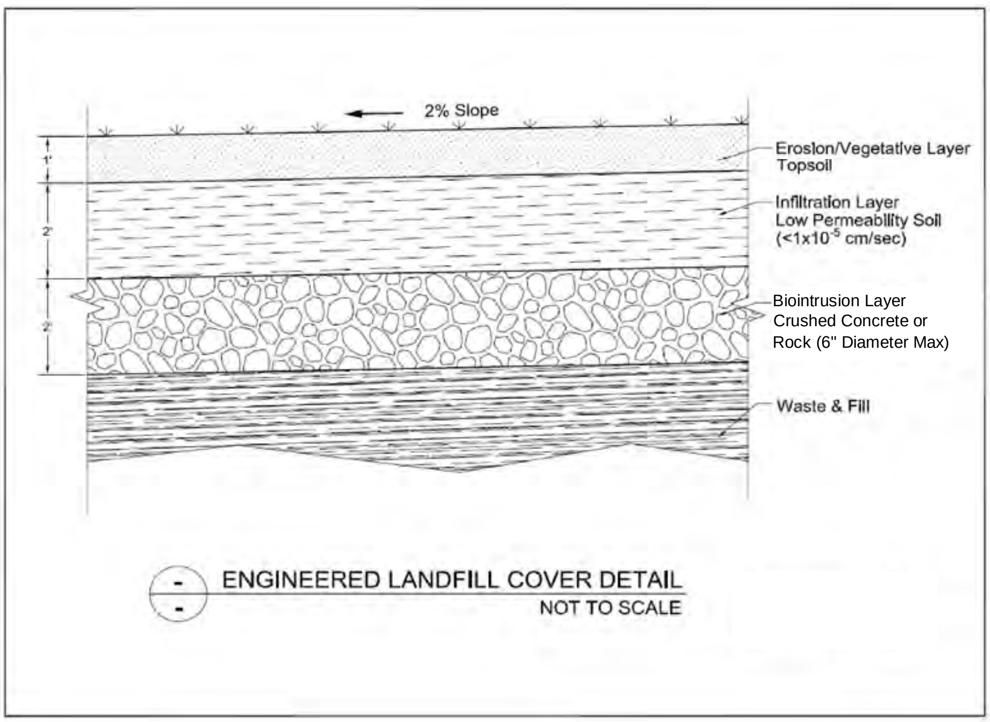


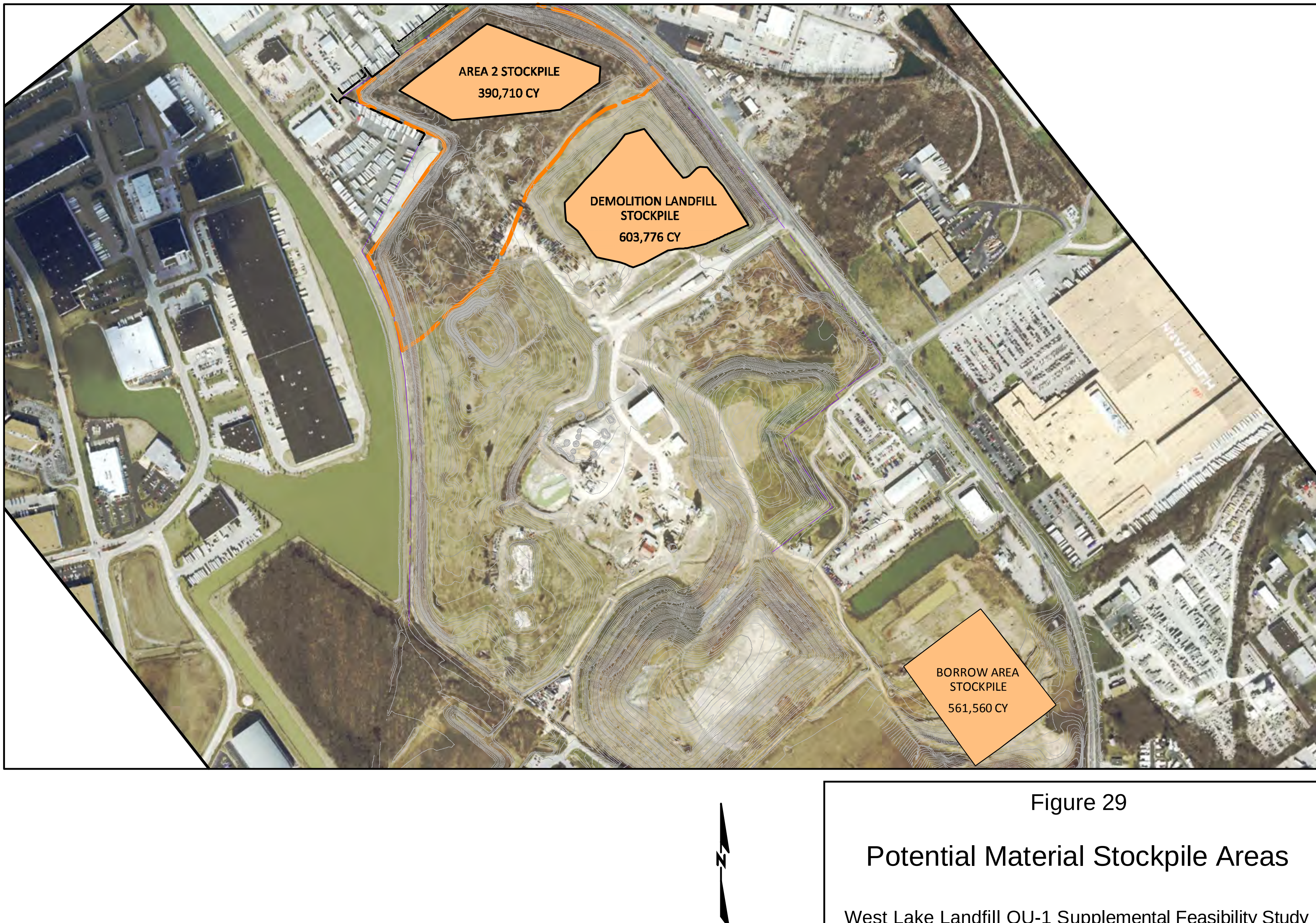
Figure 28
Conceptual Cross-Section of the ROD Remedy

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

M:\clients\EMSI\westlake\2011\Final-SFS\WL-Fig-28-Concept-Xsec.dwg plotted: 09/28/2011

M: \clients\EMSI\westlake\2011\Final-SFS\WL-Fig-29-Pot-Stkpile-areas.dwg plotted: 09/29/2011



FROM FEEZER ENGINEERING 2011

Figure 29

Potential Material Stockpile Areas

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

M:\clients\EMSI\westlake\2011\Final-SFS\WL-Fig-30-Onsite-Treat-SW.dwg plotted: 09/28/2011

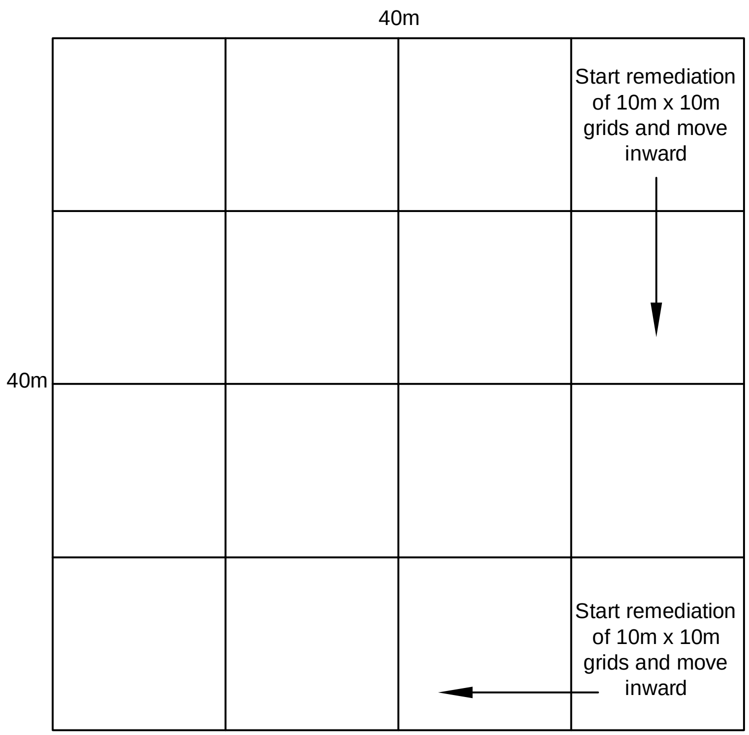
Figure 30

On-Site Treatment of Contact Stormwater and Leachate

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

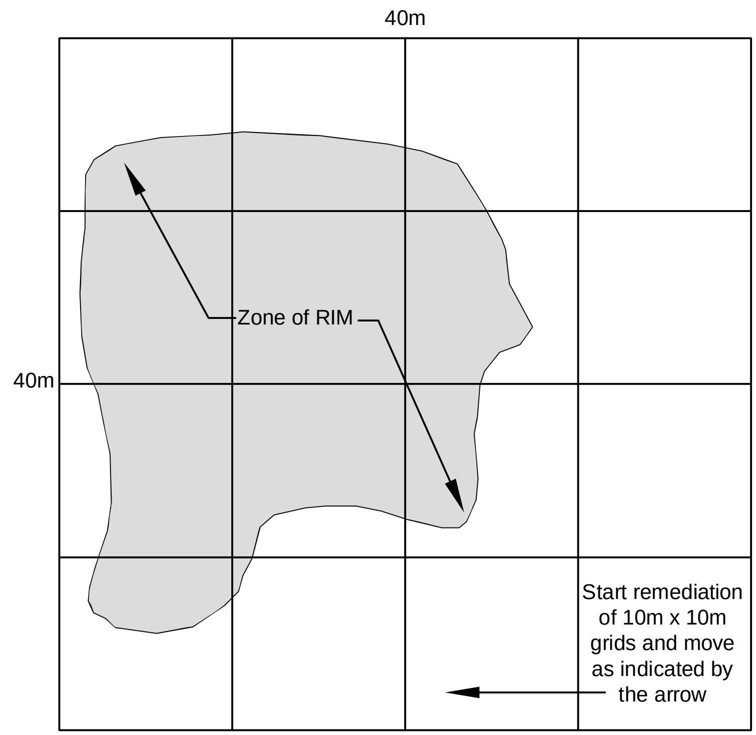
Example Affected Area (@ 1,618 m^2)



The soil would be excavated from the boundary inward, allowing movement of the hauling equipment closer to the excavator to try to increase efficiency and prevent the spread of contamination.

Example of Excavation Plan Logistics

Example Affected Area (@ 1,618 m^2)



Continue Excavation Along Edges of RIM

Figure 31

RIM Excavation Sequencing

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

M:\clients\EMSI\westlake\2011\Final-SFS\WL-Fig-32-Concept-Align-RR.dwg plotted: 09/28/2011

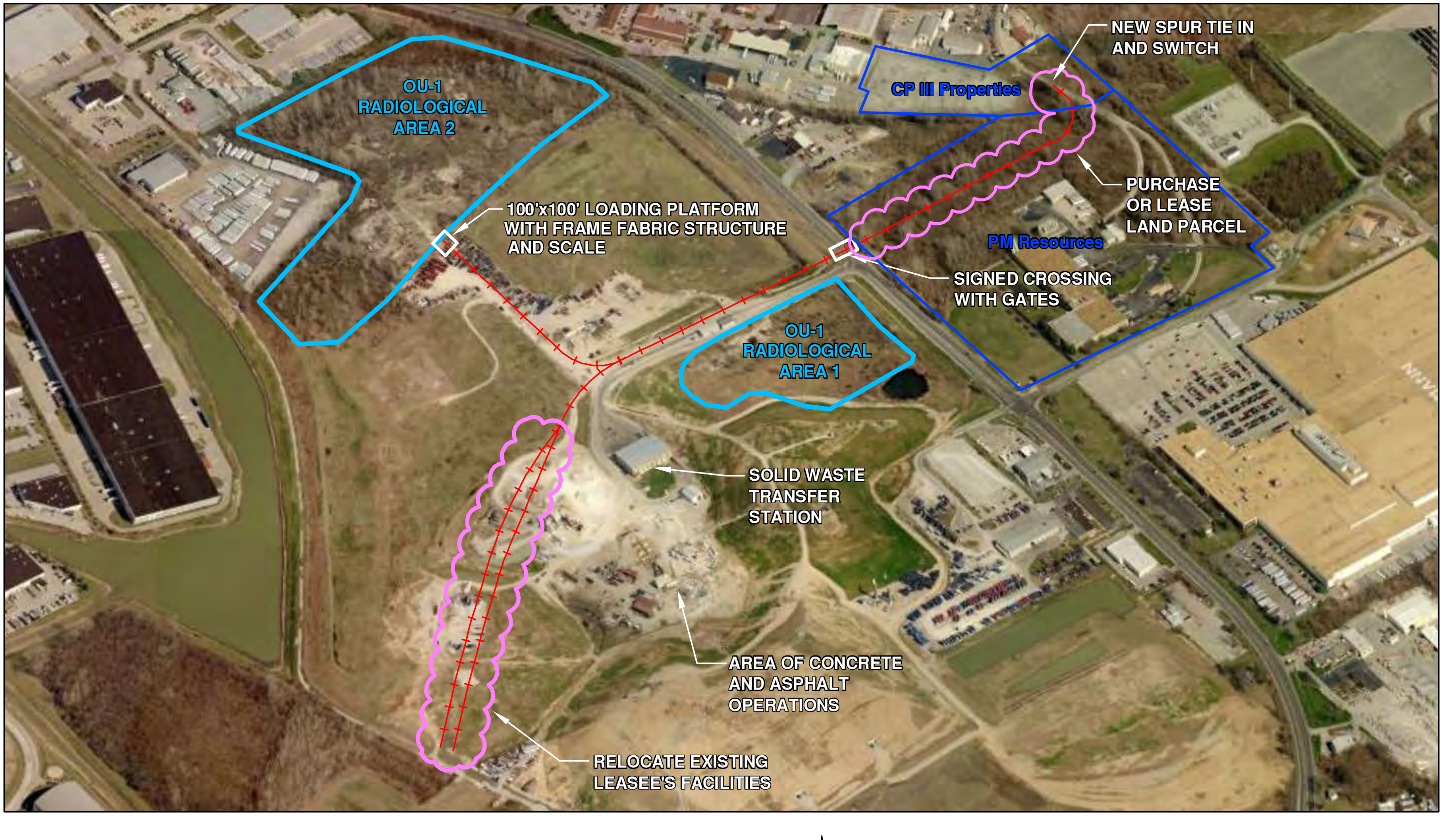


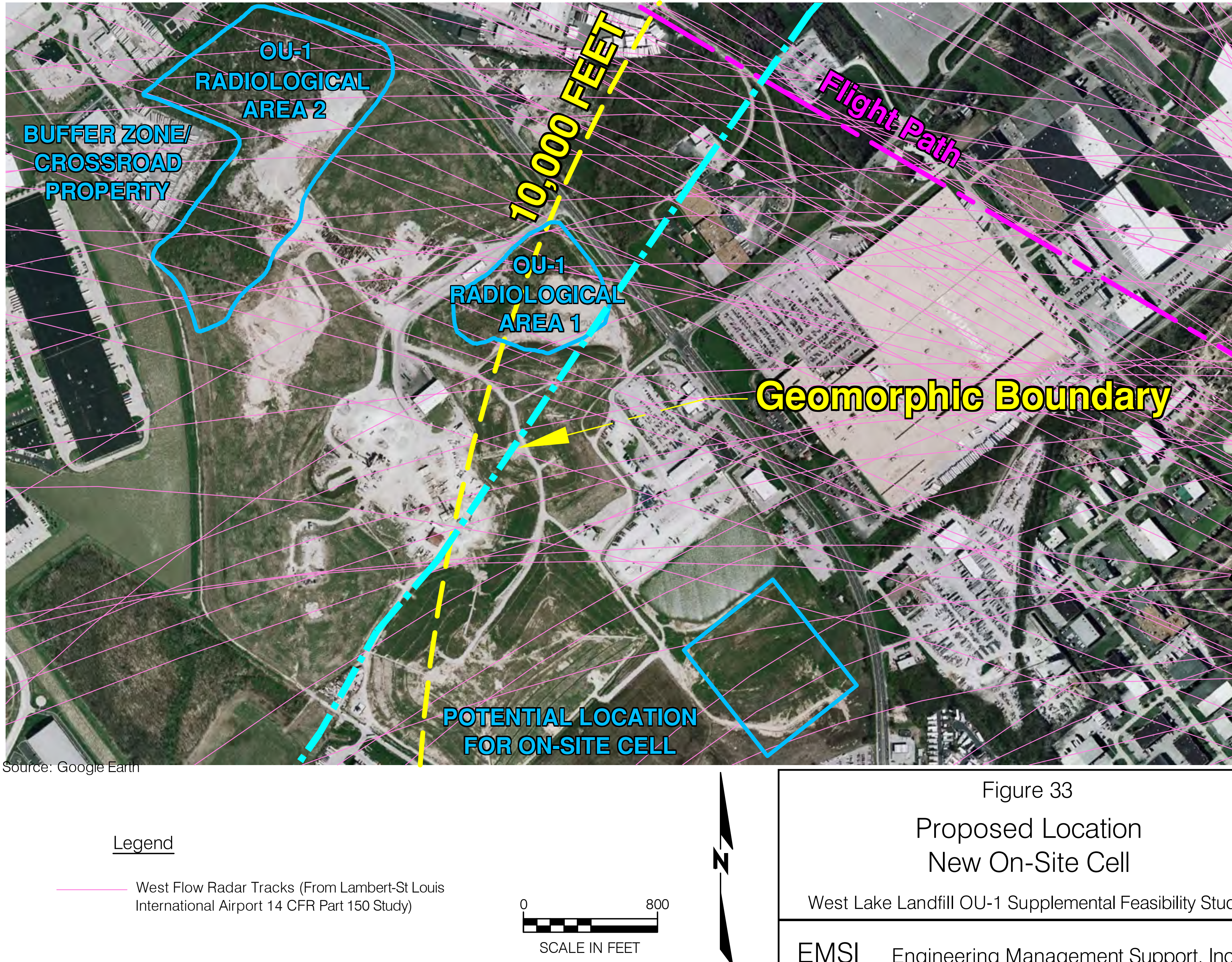
Figure 32

Conceptual Alignment of On-Site Rail Spur

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

M:\clients\EMSI\westlake\2011\Final-SFS\WL-Fig-33-Prop-Loc-OS-Cell.dwg plotted: 09/28/2011



Source: Google Earth

Legend

West Flow Radar Tracks (From Lambert-St Louis International Airport 14 CFR Part 150 Study)

Figure 33

Proposed Location
New On-Site Cell

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

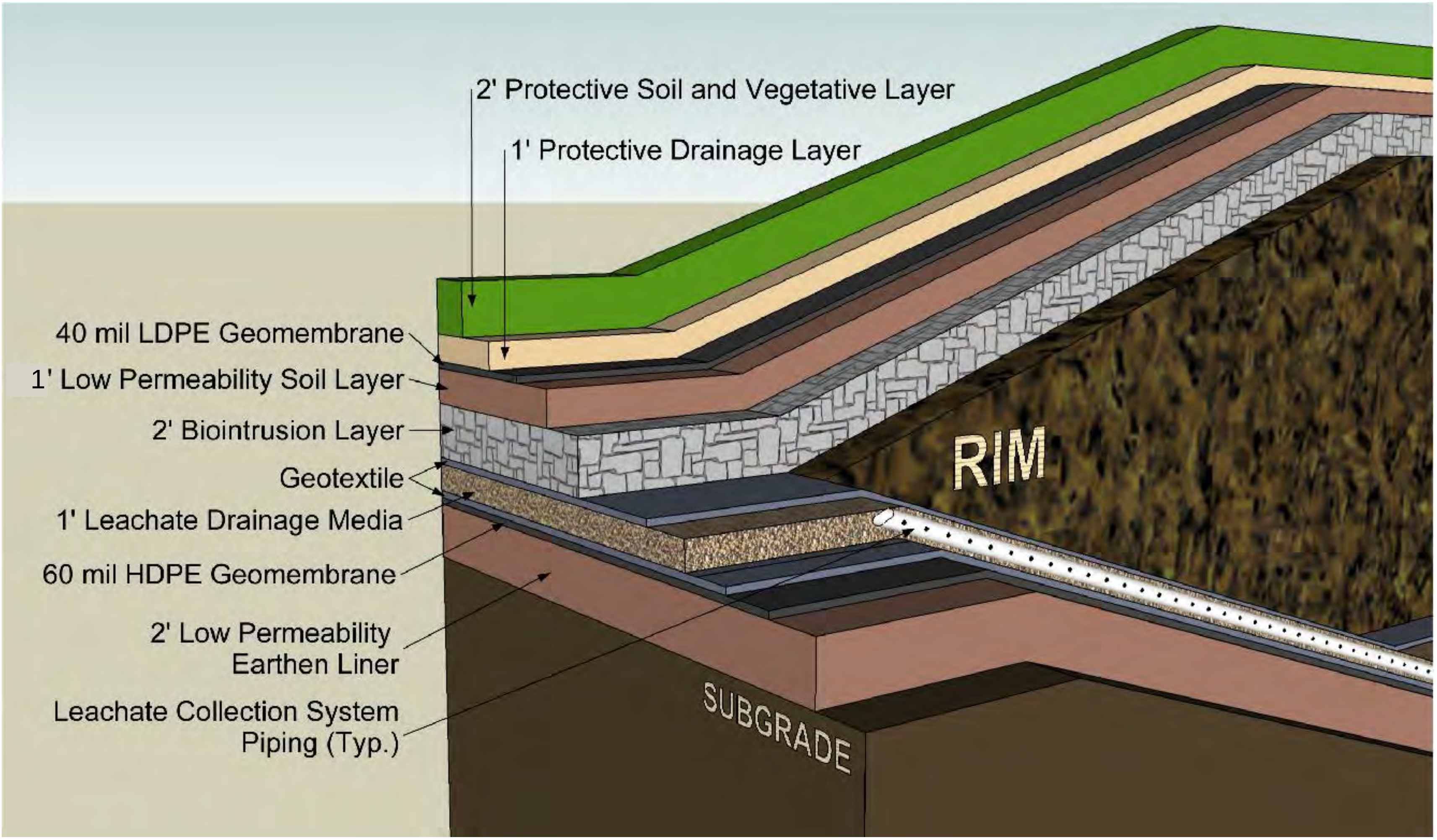


Figure 34

Profile of On-site Disposal Cell Liner and Cover

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

Figure 35

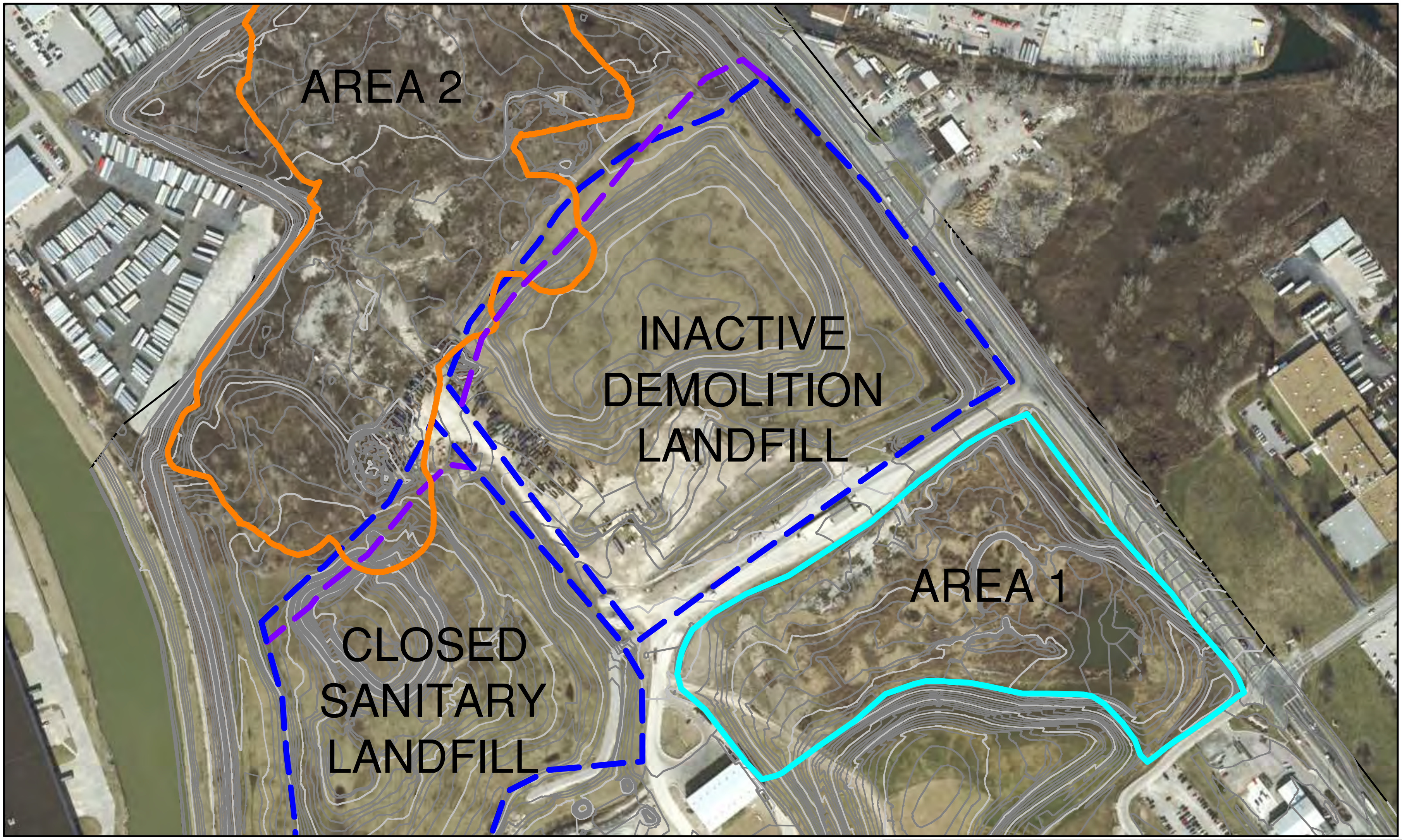
Final Closed Topography
Areas 1 and 2

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

M:\CLIENTS\EMSI\WESTLAKE\2011\FINAL-SFS\WL-FIG-35-FINAL-TOPOGRAPHY.DWG-LAYOUT4 11/15/2011 11:12AM

M: \clients\EMSI\westlake\2011\Final-SFS\WL-36-OU2 overlap 2-17 Plan.dwg plotted: 09/28/2011



LEGEND

- A2 EXCAVATION
- OU-1 BOUNDARY
- OU-2 BOUNDARY
- OU-2 BOUNDARY ADJUSTED
- 2005 10' CONTOUR
- 2005 2' CONTOUR

FROM FEEZER ENGINEERING 2011

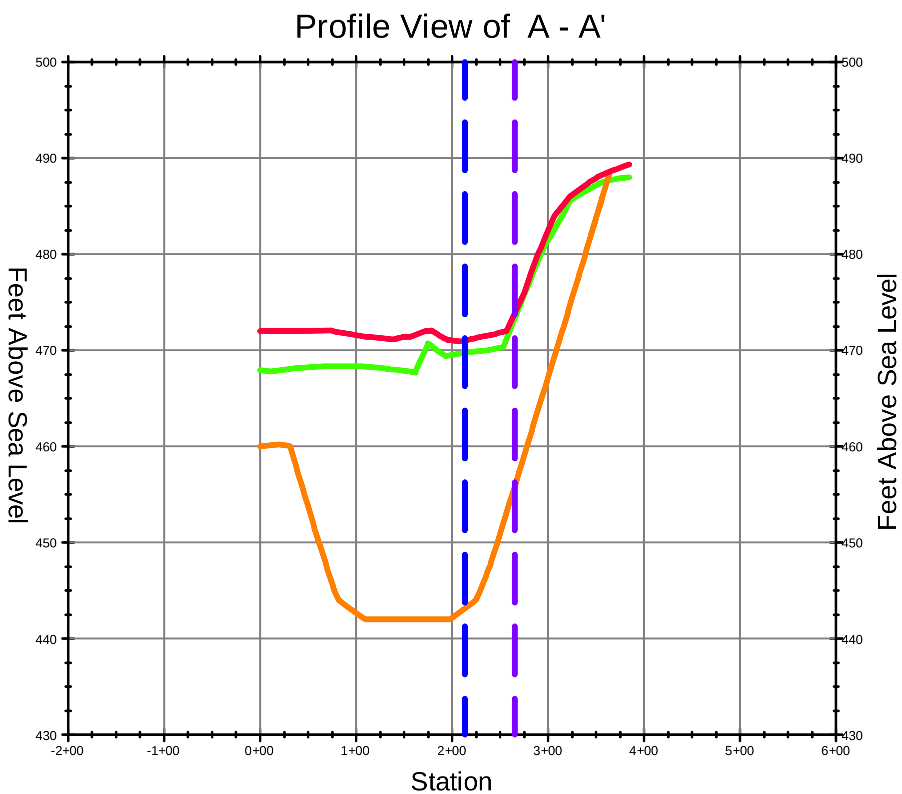
0 400
SCALE IN FEET

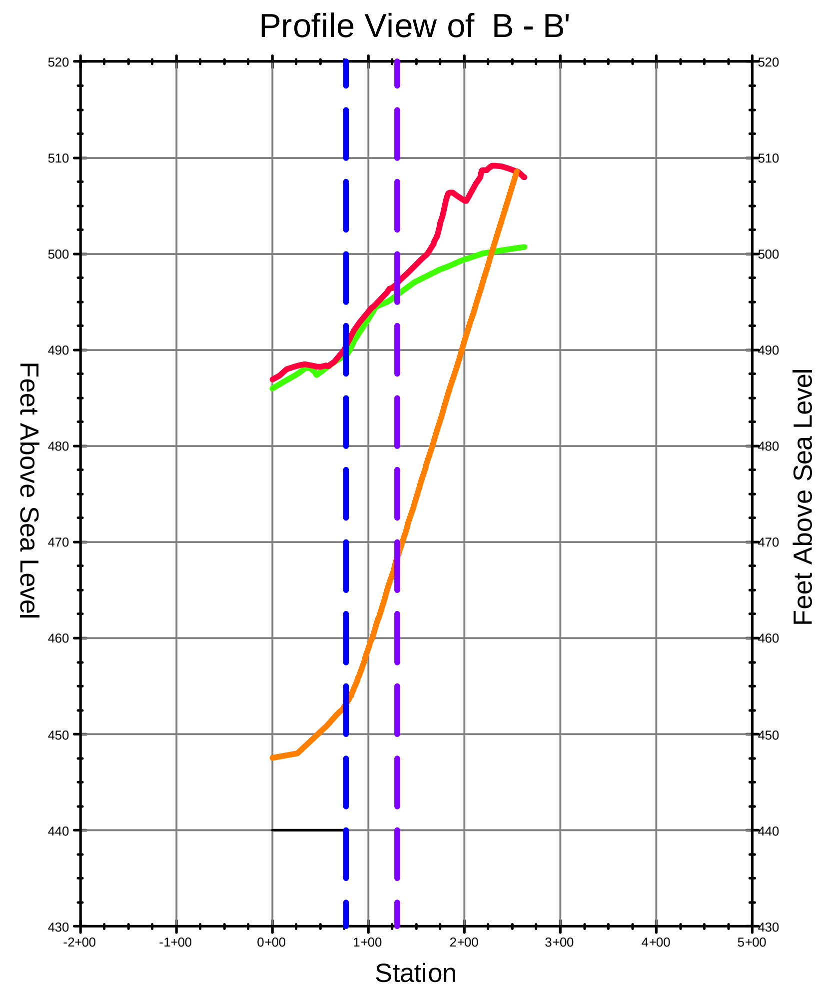
Figure 36

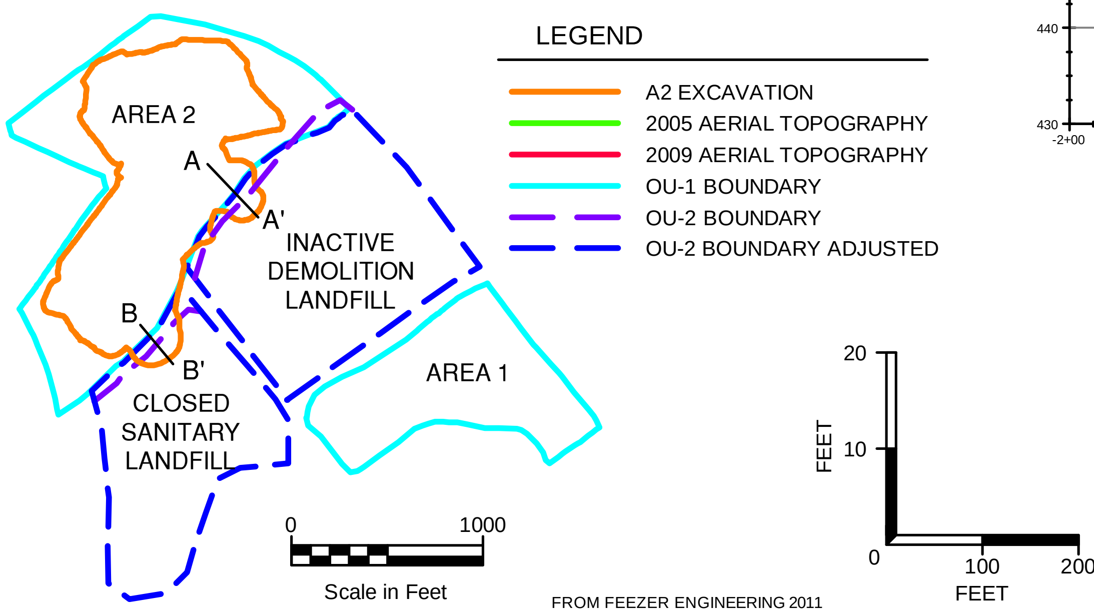
Area 2 Waste Excavation Intersection with OU-2 Boundaries

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.







LEGEND

- A2 EXCAVATION
- 2005 AERIAL TOPOGRAPHY
- 2009 AERIAL TOPOGRAPHY
- OU-1 BOUNDARY
- OU-2 BOUNDARY
- OU-2 BOUNDARY ADJUSTED

Figure 37

Profile of Area 2 Waste Excavation Intersection with OU-2 Boundaries

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

APPENDICES

APPENDIX A:

A-1: Existing Institutional Controls

A-2: City of St. Louis - Negative Easement and Restrictive Covenants on West Lake Landfill

A-3: Federal Aviation Administration
Record of Decision
Memorandum of Understanding
Advisory Circulars

A-4: Meeting Notes
September 7, 2010 Meeting with
St. Louis Airport Authority

A-5: St. Louis Airport Authority
September 20, 2010 Letter

Appendix A-1:

Existing Institutional Controls

SPENCER FANE BRITT & BROWNE LLP
ATTORNEYS AND COUNSELORS AT LAW

MICHAEL D. HOCKLEY
DIRECT DIAL (816) 292-8233
mdh@spencerfane.com

File No. 2741000/1

July 30, 1997

David A. Hoefer, Esq.
Assistant Regional Counsel
Office of Regional Counsel
U.S. Environmental Protection Agency
Region VII
726 Minnesota Avenue
Kansas City, Kansas 66101

Re: West Lake Landfill Site, Declaration of Covenants and Restrictions

Dear David:

With this letter I enclose copies of the following documents:

1. Declaration of Covenants and Restrictions executed by West Lake Quarry and Material Company, recorded with the St. Louis County Recorder of Deeds on June 30, 1997 at Book 11208, Page 2499;

2. Declaration of Covenants and Restrictions executed by Rock Road Industries, Inc., recorded with the St. Louis County Recorder of Deeds on June 30, 19997 at Book 11208, Page 2508;

3. Declaration of Covenants and Restrictions executed by Laidlaw Waste Systems (Bridgeton) Inc., recorded with the St. Louis County Recorder of Deeds on June 30, 1997 at Book 11208, Page 2515.

By recording these Declarations of Covenants and Restrictions, future use of the area encompassed by the West Lake Superfund Site has been limited and cannot include residential use. To change such use, the Environmental Protection Agency, the Missouri Department of Natural Resources, and the owner of the affected premises would have to agree to such changes. Therefore, the West

212540.1

1000 WALNUT STREET, SUITE 1400
KANSAS CITY, MISSOURI 64106-2140
(816) 474-8100 FAX (816) 474-3216
OVERLAND PARK, KANSAS WASHINGTON, D.C.

Lake Landfill Site Respondents believe that the only reasonable future use that should be considered for risk assessment purposes is a non-residential use.

Sincerely,

Michael D. Hockley

MDH:nrl

cc: Mr. Doug Borro
William R. Werner, Esq.
Charlotte L. Neitzel, Esq.
Mr. James W. Wagoner II
Mr. Paul V. Rosasco, P.E.
(All via mail, w/enclosure)

BP11208/2499

[redacted]

1997063000829

DANIEL T. O'LEARY
RECORDER OF DEEDS
ST. LOUIS COUNTY MISSOURI
41 SOUTH CENTRAL
CLAYTON, MO 63105

RECORDER OF DEEDS DOCUMENT IDENTIFICATION & CERTIFICATION SHEET

TYPE OF INSTRUMENT	GRANTOR	TO	GRANTEE
RESTR	WEST LAKE QUARRY AND MATERIAL CO ETAL		

PROPERTY DESCRIPTION: YOSTI PARTITION LOT PT 1 2 3 & 4

Lien Number	Notation	Document Number	Locator
		829	

STATE OF MISSOURI)
SS.
COUNTY OF ST. LOUIS)

I, the undersigned Recorder of Deeds for said County and State, do hereby certify that the following and annexed instrument of writing, which consists of 8 pages, (this page inclusive), was filed for record in my office on the 30 day of June 1997 at 02:30 PM and is truly recorded in the book and at the page shown at the top and/or bottom of this page.

In witness whereof I have hereunto set my hand and official seal the day, month and year aforesaid.

Recorder of Deeds
St. Louis County, Missouri

Deputy Recorder

SEAL OF THE RECORDER OF DEEDS FOR ST. LOUIS COUNTY, MO

RECORDING FEE $36.32

7

DECLARATION OF COVENANTS AND RESTRICTIONS

WEST LAKE QUARRY AND MATERIAL COMPANY

West Lake Quarry and Material Company, a Missouri corporation ("Declarant"), hereby (a) imposes the provisions of this Declaration upon the Premises (as defined below), (b) publishes and declares that the following terms, conditions, restrictions and obligations shall (i) affect and encumber the Premises, (ii) run with and be a burden upon and a benefit to the Premises, and (iii) be fully binding upon Declarant and all other persons or entities acquiring the Premises or any part thereof or interest therein whether by descent, devise, purchase or otherwise, and (c) declares that any person or entity, by the acceptance of title to the Premises or any part thereof or interest therein, shall thereby agree and covenant to abide by and be bound by the following terms, conditions, restrictions and obligations.

RECITALS

A. Declarant is the owner of certain real property (located in the City of Bridgeton, County of St. Louis, State of Missouri), legally described on Exhibit A, attached hereto and incorporated herein by this reference, which real property is herein referred to as the "Premises".

B. The Premises and nearly all real property in the immediate vicinity of the Premises have been used exclusively for more than 40 years for non-residential uses, primarily for commercial and industrial uses and in some cases, for agricultural uses.

C. Such uses have included, but have not been limited to, quarrying operations, demolition and sanitary landfill operations, asphalt and concrete batch plant operations, and vehicle maintenance, repair and body shop operations.

D. Such uses, and the character and nature of the land uses in the vicinity of the Premises, make the Premises unsuitable for any future residential use.

E. The United States Environmental Protection Agency ("EPA") has entered into an Administrative Order on Consent (the "Consent Order") with Cotter Corporation (N.S.L.), Laidlaw Waste Systems (Bridgeton) Inc., Rock Road Industries, Inc., and the United States Department of Energy.

F. The Consent Order, among other things, (i) provides for the investigation of the nature and extent of contamination and any threat to the public health, welfare, or the environment caused by the release or threatened release of hazardous substances at or from two isolated areas either on or in the vicinity of the Premises and which have been designated as Radiological Areas 1 and 2 in the Consent Order, and which contain low-level radioactive waste materials, and (ii) has been filed with the Regional Hearing Clerk, EPA, Region VII, 726 Minnesota Avenue, Kansas City, Kansas, Docket No. VII-93-F-0005.

G. Declarant desires to prohibit the present and future use of the Premises for any residential purpose in accordance with the terms and provisions of this Declaration.

DECLARATION

Declarant hereby states and declares as follows:

1. Neither the Premises, nor any portion thereof, shall be used now or hereafter for any residential purpose, or for any day care, preschool or other educational use.

2. This Declaration shall not unlawfully restrict and shall not be used to violate any federal law, rule, or regulation regarding the use of real estate, including, but not limited to, the Fair Housing Act.

3. No water well for drinking water use shall be installed on the Premises.

4. This Declaration shall be recorded in the office of the Recorder of Deeds for the County of St. Louis, State of Missouri.

5. Any deed or other instrument of conveyance for the Premises or any portion thereof shall be subject to this Declaration.

6. Each of EPA (or its successor), the Missouri Department of Natural Resources ("MDNR") (or its successor) and the owner of any portion of the Premises shall have the right to sue for and obtain an injunction, prohibitive or mandatory, to prevent the breach, or to enforce the observance, of this Declaration. This right shall be in addition to any other action available at law or in equity. The failure to enforce any covenant or restriction herein at the time of its violation shall not constitute a waiver of the right to do so later.

7. The provisions of this Declaration shall continue in full force and effect until the fiftieth anniversary of the date of this Declaration and thereafter for successive twenty-year periods unless, prior to the expiration of the then current term, a written notice of termination of this Declaration, executed by each of the then owners of the Premises and by authorized representatives of EPA (or its successor) and MDNR (or its successor), has been filed with the office of the Recorder of Deeds for St. Louis County, State of Missouri. A notice of termination of this Declaration may be filed at any time after the effective date of this Declaration, and the Declaration shall terminate on the date the notice of termination is filed with the Recorder of Deeds.

IN WITNESS WHEREOF, West Lake Quarry and Material Company has caused this instrument to be executed this 27th day of May, 1997.

WEST LAKE QUARRY AND MATERIAL COMPANY
a Missouri corporation

By: ______________________
William E. Whitaker
President

ACKNOWLEDGEMENT

STATE OF MISSOURI)
) ss
County OF ST. LOUIS)

On this 27th day of May, 1997, before me, a notary public, personally appeared William E. Whitaker, to me known, who, being by me duly sworn, did say that he is the President of West Lake Quarry and Material Company, a Missouri corporation, and that said instrument was signed on behalf of said corporation by authority of its Board of Directors, and said person acknowledged said instrument to be the free act and deed of said corporation.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my official seal in the County and State aforesaid, the day and year first above written.

Margaret G. Cusumano
Notary Public

My Commission Expires:

November 5, 1998

MARGARET G CUSUMANO
NOTARY PUBLIC STATE OF MISSOURI
ST. LOUIS COUNTY
MY COMMISSION EXP. NOV. 5,1998

MARGARET G. CUSUMANO NOTARY PUBLIC NOTARY SEAL STATE OF MISSOURI

GRANTOR'S PROPERTY

A tract of land in part of Lots 1,2,3, and 4 of the Yosti Partition in U.S. Survey 131, part of Lot 21, of the St. Charles Ferry ;pany Tract in U.S. Survey 47 and 1934, part of U.S. Survey 131, a..d part of U.S. Survey 47 in Townships 46 and 47 North, Range 5 East of the 5th Principal Meridian, St. Louis County Missouri, described as follows:

Beginning at the most easterly corner of Lot 1 of the Yosti Partition in U.S. Survey 131, being a point in the centerline of Taussig Avenue; thence South 43 degrees 34 minutes 53 seconds East, along the northeasterly line of Lot 4 of the Yosti Partition, a distance of 99.92; thence South 6 degrees 41 minutes 15 seconds West, a distance of 68.96 feet; thence South 23 degrees 21 minutes 55 seconds West, a distance of 154.73 feet; thence South 26 degrees 49 minutes 07 East, a distance of 55.27 feet; thence South 14 degrees 32 minutes 36 seconds West, a distance of 143.63 feet; thence South 34 degrees 03 minutes 12 seconds West, a distance of 220.86 feet; thence North 55 degrees 41 minutes 34 seconds West, a distance of 127.00 feet; thence South 88 degrees 59 minutes 19 seconds West, a distance of 62.24 feet; thence South 54 degrees 43 minutes 18 seconds West, a distance of 240.50 feet; thence South 26 degrees 44 minutes 32 seconds West, a distance of 450.91 feet; thence South 8 degrees 25 minutes 49 seconds West, a distance of 224.01 feet; thence South 17 degrees 14 minutes 43 seconds East, a distance of 28.63 feet; thence South 47 degrees 09 minutes 44 seconds East, a distance of 61.27 feet; thence South 24 degrees 34 minutes 10 seconds East, a distance of 73.64 feet; thence South 0 degrees 07 minutes 21 seconds West, a distance of 107.37 feet to the northeasterly right of way line of the St. Charles Rock Road, 60 foot wide; thence North 61 degrees 07 minutes 11 seconds West, along said right of way line, a distance of 99.72 feet to the centerline of Taussig Avenue; thence North 28 degrees 07 minutes 01 seconds East, along said centerline, a distance of 100.00 feet to the intersection of said centerline and the southeasterly prolongation of the northeasterly line of a tract of land conveyed to American Telephone and Telegraph Company of Missouri by deed recorded in Book 1719 on Page 170; thence North 61 degrees 07 minutes 11 seconds West, along said line, a distance of 120.00 feet to the most northerly corner of said tract; thence South 28 degrees 07 minutes 01 seconds West, along the northwesterly line of said tract and its southwesterly extension, a distance of 130.00 feet to the centerline of the St. Charles Rock Road; thence North 61 degrees 07 minutes 11 seconds West, along said centerline a distance of 252.27 feet; thence North 51 degrees 56 minutes 32 seconds East, a distance of 311.60 feet; thence North 26 degrees 44 minutes 32 seconds East, a distance of 644.89 feet; thence North 56 degrees 34 minutes 13 seconds West, a distance of 296.04 feet; thence North 49 degrees 02 minutes 55 seconds West, a distance of 174.81 feet; thence North 7 degrees 43 minutes 38 seconds West, a distance of 65.61 feet; thence South 82 degrees 16 minutes 22 seconds West, a distance of 106.78 feet; thence around a curve to the right, having a radius of 150.00 feet and a chord bearing North 47 degrees 50 minutes 16 seconds West, a chord distance of 229.44 feet to a point of compound curve; thence around a curve to the right, having a radius of 450.00 feet and a chord bearing North 30 degrees 29 minutes 30 seconds East, a chord distance of 428.61 feet to its point of tangency; thence North 58 degrees 55 minutes 53 seconds East. a distance of 277.03 feet: thence North 2 degrees 03 minutes 23 seconds West, a distance of 332.12 feet; thence North 43 degrees 55 minutes 12 seconds West, a distance of 444.12 feet; thence North 39 degrees 22 minutes 26 seconds East, a distance of 463.83 feet; thence North 53 degrees 20 minutes 34 second East, a distance of 126.98 feet; thence South 50 degrees 18 minutes 12 seconds East, a distance of 205.86 feet; thence North 75 degrees 52 minutes 00 seconds East, a distance of 426.11 feet; thence North 51 degrees 12 minutes 40 seconds East, a distance of 277.46 feet to the southwesterly right of way line of Highway 40; also known as St. Charles Rock Road; thence South 43 degrees 53 minutes 31 seconds East, along said right of way line, a distance of 137.18 feet; thence leaving said right of way, South 51 degrees 12 minutes 40 seconds West, a distance of 1023.23 feet; thence South 25 degrees 58 minutes 41 seconds West, a distance of 181.33 feet to the northeasterly line of Lot 1 of the Yosti Partition of U.S. Survey 131; thence South 43 degrees 34 minutes 53 seconds East, along said northeasterly line, a distance of 971.20 feet to the Point of Beginning.

Excepting from the above the following:

A tract of land being part of Lots 1, 3, and 4 of the "Yosti Partition in U.S. Survey 131, townships 46 and 47 north, range 5 east of the Fifth Principal Meridian, St. Louis County, Missouri, more particularly described as follows:

Commencing at the intersection of the northwesterly line of U.S. Survey 131 and the southwesterly right of way line of Highway 40, also known as "St. Charles Rock Road;" thence South 37 degrees 11 minutes 39 seconds East, along said south right of way line, 209.98 feet; thence exiting said right of way line, South 57 degrees 54 minutes 32 seconds West, 1023.23 feet; thence South degrees 40 minutes 33 seconds West, 181.33 feet to the northeasterly line of said lot 1; thence South 36 degrees 53 minutes 01 seconds East, along said northeasterly line of lot 1, a distance of 591.05 feet to the point of beginning of the tract described herein; thence continuing along the northeasterly line of said lot 1 and along the northeasterly line of said lot 4, South 36 degrees 53 minutes 01 seconds East, 480.07 feet; thence exiting said northeasterly line, South 13 degrees 23 minutes 07 seconds West, 68.96 feet; thence South 30 degrees 03 minutes 47 seconds West, 154.73 feet; thence South 20 degrees 07 minutes 14 seconds East; 55.27 feet; thence South 21 degrees 14 minutes 28 seconds West, 143.63 feet; thence South 40 degrees 45 minutes 05 seconds West, 220.86 feet; thence North 48 degrees 59 minutes 42 seconds West, 127.00 feet; thence North 84 degrees 18 minutes 49 seconds West, 62.24 feet; thence South 61 degrees 25 minutes 10 seconds West, 240.50 feet; thence South 33 degrees 26 minutes 24 seconds West, 450.91 feet; thence South 15 degrees 07 minutes 41 seconds West, 224.01 feet; thence South 10 degrees 32 minutes 51 seconds East, 28.63 feet; thence South 40 degrees 27 minutes 52 seconds East, 61.27 feet; thence South 17 degrees 52 minutes 18 seconds East, 73.64 feet; thence South 06 degrees 49 minutes 13 seconds West, 107.37 feet to the north right of way line of "Old St. Charles Rock Road;" thence North 54 degrees 25 minutes 19 seconds West, along said right of way line, 99.72 feet; thence North 34 degrees 48 minutes 53 seconds East, 100.00 feet; thence exiting said west line, North 54 degrees 25 minutes 19 seconds West, 120.00 feet; thence North 21 degrees 27 minutes 09 seconds East, 153.52 feet; thence North 00 degrees 02 minutes 46 seconds West, 37.43 feet; thence North 56 degrees 33 minutes 36 seconds West, 70.00 feet; thence North 33 degrees 26 minutes 24 seconds East, 624.89 feet; thence South 49 degrees 52 minutes 21 seconds East, 56.85 feet; thence North 67 degrees 30 minutes 55 seconds East, 06.05 feet; thence North 08 degrees 48 minutes 44 seconds East, 158.15 feet; thence South 59 degrees 03 minutes 26 seconds East, 82.21 feet; thence North 33 degrees 28 minutes 55 seconds East, 321.44 feet; thence North 55 degrees 02 minutes 11 seconds West, 158.34 feet; thence North 01 degrees 10 minutes 17 seconds East, 342.38 feet to the point of beginning.

BP11208/2507

[redacted]

1997063000830

DANIEL T. O'LEARY
RECORDER OF DEEDS
ST. LOUIS COUNTY MISSOURI
41 SOUTH CENTRAL
CLAYTON, MO 63105

RECORDER OF DEEDS DOCUMENT IDENTIFICATION & CERTIFICATION SHEET

TYPE OF INSTRUMENT	GRANTOR	TO	GRANTEE
RESTR	ROCK ROAD INDUSTRIES INC ETAL		

PROPERTY DESCRIPTION: SUR 131 T 47 R 5 W/O/P

Lien Number	Notation	Document Number	Locator
		830	

STATE OF MISSOURI)
SS.
COUNTY OF ST. LOUIS)

I, the undersigned Recorder of Deeds for said County and State, do hereby certify that the following and annexed instrument of writing, which consists of 7 pages, (this page inclusive), was filed for record in my office on the 30 day of June 1997 at 02:30 PM and is truly recorded in the book and at the page shown at the top and/or bottom of this page.

In witness whereof I have hereunto set my hand and official seal the day, month and year aforesaid.

SEAL OF THE RECORDER OF DEEDS FOR ST. LOUIS COUNTY, MO

Recorder of Deeds
St. Louis County, Missouri

Deputy Recorder

RECORDING FEE $33.32

(Paid at the time of Recording)

V

DECLARATION OF COVENANTS AND RESTRICTIONS

ROCK ROAD INDUSTRIES, INC.

Rock Road Industries, Inc., a Missouri corporation ("Declarant"), hereby (a) imposes the provisions of this Declaration upon the Premises (as defined below), (b) publishes and declares that the following terms, conditions, restrictions and obligations shall (i) affect and encumber the Premises, (ii) run with and be a burden upon and a benefit to the Premises, and (iii) be fully binding upon Declarant and all other persons or entities acquiring the Premises or any part thereof or interest therein whether by descent, devise, purchase or otherwise, and (c) declares that any person or entity, by the acceptance of title to the Premises or any part thereof or interest therein, shall thereby agree and covenant to abide by and be bound by the following terms, conditions, restrictions and obligations.

RECITALS

A. Declarant is the owner of certain real property (located in the City of Bridgeton, County of St. Louis, State of Missouri), legally described on Exhibit A, attached hereto and incorporated herein by this reference, which real property is herein referred to as the "Premises".

B. The Premises and nearly all real property in the immediate vicinity of the Premises have been used exclusively for more than 40 years for non-residential uses, primarily for commercial and industrial uses and in some cases, for agricultural uses.

C. Such uses have included, but have not been limited to, quarrying operations, demolition and sanitary landfill operations, asphalt and concrete batch plant operations, and vehicle maintenance, repair and body shop operations.

D. Such uses, and the character and nature of the land uses in the vicinity of the Premises, make the Premises unsuitable for any future residential use.

E. The United States Environmental Protection Agency ("EPA") has entered into an Administrative Order on Consent (the "Consent Order") with Cotter Corporation (N.S.L.), Declarant, Laidlaw Waste Systems (Bridgeton) Inc., and the United States Department of Energy.

F. The Consent Order, among other things, (i) provides for the investigation of the nature and extent of contamination and any threat to the public health, welfare, or the environment caused by the release or threatened release of hazardous substances at or from two isolated areas either on or in the vicinity of the Premises and which have been designated as Radiological Areas 1 and 2 in the Consent Order, and which contain low-level radioactive waste materials, and (ii) has been filed with the Regional Hearing Clerk, EPA, Region VII, 726 Minnesota Avenue, Kansas City, Kansas, Docket No. VII-93-F-0005.

G. Declarant desires to prohibit the present and future use of the Premises for any residential purpose in accordance with the terms and provisions of this Declaration.

DECLARATION

Declarant hereby states and declares as follows:

1. Neither the Premises, nor any portion thereof, shall be used now or hereafter for any residential purpose, or for any day care, preschool or other educational use.

2. This Declaration shall not unlawfully restrict and shall not be used to violate any federal law, rule, or regulation regarding the use of real estate, including, but not limited to, the Fair Housing Act.

3. No water well for drinking water use shall be installed on the Premises.

4. This Declaration shall be recorded in the office of the Recorder of Deeds for the County of St. Louis, State of Missouri.

5. Any deed or other instrument of conveyance for the Premises or any portion thereof shall be subject to this Declaration.

6. Each of EPA (or its successor), the Missouri Department of Natural Resources ("MDNR") (or its successor) and the owner of any portion of the Premises shall have the right to sue for and obtain an injunction, prohibitive or mandatory, to prevent the breach, or to enforce the observance, of this Declaration. This right shall be in addition to any other action available at law or in equity. The failure to enforce any covenant or restriction herein at the time of its violation shall not constitute a waiver of the right to do so later.

7. The provisions of this Declaration shall continue in full force and effect until the fiftieth anniversary of the date of this Declaration and thereafter for successive twenty-year periods unless, prior to the expiration of the then current term, a written notice of termination of this Declaration, executed by each of the then owners of the Premises and by authorized representatives of EPA (or its successor) and MDNR (or its successor), has been filed with the office of the Recorder of Deeds for St. Louis County, State of Missouri. A notice of termination of this Declaration may be filed at any time after the effective date of this Declaration, and the Declaration shall terminate on the date the notice of termination is filed with the Recorder of Deeds.

IN WITNESS WHEREOF, Rock Road Industries, Inc. has caused this instrument to be executed this 27th day of May, 1997.

ROCK ROAD INDUSTRIES, INC.
a Missouri corporation

By: ______________________
William E. Whitaker
President

ACKNOWLEDGEMENT

STATE OF MISSOURI)
) ss
County OF ST. LOUIS)

On this 27th day of March, 1997, before me, a notary public, personally appeared William E. Whitaker, to me known, who, being by me duly sworn, did say that he is the President of Rock Road Industries, Inc., a Missouri corporation, and that said instrument was signed on behalf of said corporation by authority of its Board of Directors, and said person acknowledged said instrument to be the free act and deed of said corporation.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my official seal in the County and State aforesaid, the day and year first above written.

Margaret G. Cusumano
Notary Public

My Commission Expires:

November 5, 1998

MARGARET G CUSUMANO
NOTARY PUBLIC STATE OF MISSOURI
ST. LOUIS COUNTY
MY COMMISSION EXP. NOV. 5,1998

MARGARET G. CUSUMANO NOTARY PUBLIC NOTARY SEAL STATE

EXHIBIT "A"

AREA 1

A tract of land in part of U.S. Survey 131, Township 47 North, Range 5 East of the 5th Principal Meridian, St. Louis County, Missouri, described as follows:

Commencing at the intersection of the northwesterly line of U.S. Survey 131 and the southwesterly right of way line of Highway 40, also known as St. Charles Rock Road; thence South 43 degrees 53 minutes 31 seconds East, along said right of way line, a distance of 729.68 feet; thence South 40 degrees 49 minutes 32 seconds West, a distance of 92.54 feet to the Point of Beginning of the following described tract; thence continuing South 40 degrees 49 minutes 32 seconds West, a distance of 288.61 feet; thence South 89 degrees 29 minutes 50 seconds West, a distance of 241.41 feet; thence North 79 degrees 05 minutes 44 seconds West, a distance of 390.43 feet; thence North 29 degrees 48 minutes 55 seconds East, a distance of 499.73 feet; thence North 84 degrees 45 minutes 59 seconds East, a distance of 248.68 feet; thence South 32 degrees 24 minutes 17 seconds East, a distance of 201.28 feet;thence South 56 degrees 18 minutes 22 seconds East, a distance of 251.78 feet to the Point of Beginning.

AREA 2

A tract of land in part of Lot 20, of the St. Charles Ferry Company Tract in U.S. Survey 47 and 1934 and in part of U.S. Survey 47 Township 47 North, Range 5 East of the 5th Principal Meridian, St. Louis County, Missouri, described as follows:

Commencing at the intersection of the centerline of St. Charles Rock Road and the northwesterly line of Lot 20 of the St. Charles Ferry Company Tract; thence North 28 degrees 53 minutes 11 seconds East, along said northwesterly line, a distance of 148.48 feet of the Point of Beginning of the following described tract; thence continuing North 28 degrees 53 minutes 11 seconds East, along said line, a distance of 676.08 feet to the northwest corner of said Lot 20; thence North 72 degrees 46 minutes 42 seconds West, along the northerly line of Lot 19 of the St. Charles Ferry Company tract, a distance of 674.79 feet;thence North 47 degrees 43 minutes 02 seconds East, a distance of 906.64 feet; thence South 64 degrees 46 minutes 52 seconds East, a distance of 389.58 feet; thence South 76 degrees 30 minutes 26 seconds East, a distance of 245.51 feet; thence South 60 degrees 07 minutes 01 seconds East, a distance of 283.36 feet; thence South 31 degrees 26 minutes 39 seconds West, a distance of 1136.42 feet; thence South 33 degrees 08 minutes 25 seconds West, a distance of 109.40 feet; thence South 34 degrees 54 minutes 38 seconds East, a distance of 149.81 feet; thence South 44 degrees 29 minutes 33 seconds West, a distance of 267.70 feet; thence North 78 degrees 25 minutes 41 seconds West, a distance of 241.02 feet; thence North 34 degrees 31 minutes 30 seconds West, a distance of 351.19 feet to the Point of Beginning.

[redacted]

[illegible]

1997063000831

DANIEL T. O'LEARY
RECORDER OF DEEDS
ST. LOUIS COUNTY MISSOURI
41 SOUTH CENTRAL
CLAYTON, MO 63105

RECORDER OF DEEDS DOCUMENT IDENTIFICATION & CERTIFICATION SHEET

TYPE OF INSTRUMENT	GRANTOR	TO	GRANTEE
RESTR	LAIDLAW WASTE SYSTEMS BRIDGETON INC ETAL		

PROPERTY DESCRIPTION: YOSTI PARTITION LOT PT 1 2 & 3

Lien Number	Notation	Document Number	Locator
		831	

STATE OF MISSOURI)
SS.
COUNTY OF ST. LOUIS)

I, the undersigned Recorder of Deeds for said County and State, do hereby certify that the following and annexed strument of writing, which consists of 10 pages, (this page inclusive), was filed for record in my office n the 30 day of June 1997 at 02:30 PM and is truly recorded in the book and : the page shown at the top and/or bottom of this page.

In witness whereof I have hereunto set my hand and official seal the day, month and year aforesaid.

Recorder of Deeds
St. Louis County, Missouri

Deputy Recorder

RECORDING FEE $42.32

(Paid at the time of Recording)

9

DECLARATION OF COVENANTS AND RESTRICTIONS

LAIDLAW WASTE SYSTEMS (BRIDGETON) INC.

Laidlaw Waste Systems (Bridgeton) Inc. f/k/a/ West Lake Landfill, Inc., a Missouri corporation ("Declarant"), hereby (a) imposes the provisions of this Declaration upon the Premises (as defined below), (b) publishes and declares that the following terms, conditions, restrictions and obligations shall (i) affect and encumber the Premises, (ii) run with and be a burden upon and a benefit to the Premises, and (iii) be fully binding upon Declarant and all persons or entities acquiring the Premises or any part thereof or interest therein whether by descent, devise, purchase or otherwise, and (c) declares that any person or entity, by the acceptance of title to the Premises or any part thereof or interest therein, shall thereby agree and covenant to abide by and be bound by the following terms, conditions, restrictions and obligations.

RECITALS

A. Declarant is the owner of certain real property (located in the City of Bridgeton, County of St. Louis, State of Missouri), legally described on Exhibit 1, attached hereto and incorporated herein by this reference, which real property is herein referred to as the "Premises".

B. The Premises and nearly all real property in the immediate vicinity of the Premises have been used exclusively for more than 40 years for non-residential uses, primarily for commercial and industrial uses and in some cases, for agricultural uses.

C. Such uses have included, but have not been limited to, quarrying operations, demolition and sanitary landfill operations, asphalt and concrete batch plant operations, and vehicle maintenance, repair and body shop operations.

D. Such uses, and the character and nature of the land uses in the vicinity of the Premises, make the Premises unsuitable for any future residential use.

E. The United States Environmental Protection Agency ("EPA") has entered into an Administrative Order on Consent (the "Consent Order") with Cotter Corporation (N.S.L.), Declarant, Rock Road Industries, Inc., and the United States Department of Energy.

F. The Consent Order, among other things, (i) provides for the investigation of the nature and extent of contamination and any threat to the public health, welfare, or the environment caused by the release or threatened release of hazardous substances at or from two isolated areas either on or in the vicinity of the Premises, which have been designated as Radiological Areas 1 and 2 in the Consent Order, and which contain low-level radioactive waste materials, and (ii) has been filed with the Regional Hearing Clerk, EPA, Region VII, 726 Minnesota Avenue, Kansas City, Kansas, Docket No. VII-93-F-0005.

G. The EPA and Declarant have entered into an additional Administrative Order on Consent, which has been filed with the Regional Hearing Clerk, EPA, Region VII, 726 Minnesota Avenue, Kansas City, Kansas, Docket No. VII-94-F-0025, to investigate the nature and extent of any potential contamination at the Premises (other than Radiological Areas 1 and 2) relating to the historical use of the Premises.

H. Declarant desires to prohibit the present and future use of the Premises for any residential purpose in accordance with the terms and provisions of this Declaration.

DECLARATION

Declarant hereby states and declares as follows:

1. Neither the Premises, nor any portion thereof, shall be used now or hereafter for any residential purpose, or for any day care, preschool, or other educational use.

2. This Declaration shall not unlawfully restrict and shall not be used to violate any federal law, rule, or regulation regarding the use of real estate, including, but not limited to, the Fair Housing Act.

3. No water well for drinking water use shall be installed on the Premises.

4. This Declaration shall be recorded in the office of the Recorder of Deeds for the County of St. Louis, State of Missouri.

5. Any deed or other instrument of conveyance for the Premises or any portion therefor shall be subject to this Declaration.

6. Each of EPA (or its successor), the Missouri Department of Natural Resources ("MDNR") (or its successor), and the owner of any portion of the Premises shall have the right to sue for and

obtain an injunction, prohibitive or mandatory, to prevent the breach, or to enforce the observance, of this Declaration. This right shall be in addition to any other action available at law or in equity. The failure to enforce any covenant or restriction herein at the time of its violation shall not constitute a waiver of the right to do so later.

7. The provisions of this Declaration shall continue in full force and effect until the fiftieth anniversary of the date of this Declaration and thereafter for successive twenty-year periods unless, prior to the expiration of the then current term, a written notice of termination of this Declaration, executed by each of the then owners of the Premises and by authorized representatives of EPA (or its successor) and MDNR (or its successor), has been filed with the office of the Recorder of Deeds for St. Louis County, State of Missouri. A notice of termination of this Declaration may be filed at any time after the effective date of this Declaration, and the Declaration shall terminate on the date the notice of termination is filed with the Recorder of Deeds.

IN WITNESS WHEREOF, Laidlaw Waste Systems (Bridgeton) Inc. has caused this instrument to be executed this 2nd day of June, 1997.

LAIDLAW WASTE SYSTEMS
(BRIDGETON) INC.

By ______________________

ACKNOWLEDGMENT

STATE OF Arizona)
) SS.
COUNTY OF Maricopa)

On this 9th day of June, 1997, before me, a notary public, personally appeared Steven Eklm, to me known, who, being by me duly sworn, did say that he is the Vice President of Laidlaw Waste Systems (Bridgeton) Inc., a Missouri corporation, and that said instrument was signed on behalf of said corporation by authority of its Board of Directors, and said person acknowledged said instrument to be the free act and deed of said corporation.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my official seal in the County and State aforesaid, the day and year first above written.

Mary Deborah Stoup
Notary Public

DEBORAH STOUP NOTARY PUBLIC MARICOPA COUNTY AZ

My commission expires:
5/16/99

EXHIBIT "1"

Landfill Area

Tract 1

tract of land in part of Lots 1,2, and 3 of the Yosti Partition in U.S. Survey 131, part of Lots 20,21, and 22 of the St. Charles Ferry Company Tract in U.S. Survey 47 and 1934, part of U.S. Survey 131, and part of U.S. Survey 47 in Townships 46 and 47 North, Range 5 East of the 5th Principal Meridian, St. Louis County Missouri, described as follows:

Beginning at the intersection of the northwesterly line of U.S. Survey 131 and the southwesterly right of way line of Highway 40, also known as St. Charles Rock Road; thence South 43 degrees 53 minutes 31 seconds East, along said right of way line, a distance of 72.80 feet; thence South 51 degrees 12 minutes 40 seconds West, a distance of 277.46 feet; thence South 75 degrees 52 minutes 00 seconds West, a distance of 426.11 feet; thence North 50 degrees 18 minutes 12 seconds West, a distance of 205.86 feet; thence South 53 degrees 20 minutes 34 seconds West, a distance of 126.98 feet; thence South 39 degrees 22 minutes 26 seconds West, a distance of 463.83 feet; thence South 43 degrees 55 minutes 12 seconds East, a distance of 444.12 feet; thence South 2 degrees 03 minutes 23 seconds East, a distance of 332.12 feet; thence South 58 degrees 55 minutes 53 seconds West, a distance of 277.03 feet; thence around a curve to the left, having a radius of 450.00 feet and a chord bearing South 30 degrees 29 minutes 30 seconds West, a chord distance of 428.61 feet to a point of compound curve; thence around a curve to the left, having a radius of 150.00 feet and a chord bearing South 47 degrees 9 minutes 16 seconds East, a chord distance of 229.44 feet to its point of tangency; thence North 82 degrees 16 minutes 22 seconds East, a distance of 106.78 feet; thence South 7 degrees 43 minutes 38 seconds East, a distance of 65.61 feet; thence South 49 degrees 02 minutes 55 seconds East, a distance of 174.81 feet; thence South 56 degrees 34 minutes 13 seconds East, a distance of 296.04 feet; thence South 26 degrees 44 minutes 32 seconds West, a distance of 644.89 feet; thence South 51 degrees 56 minutes 32 seconds West, a distance of 311.60 feet to the centerline of St. Charles Rock Road; thence along said centerline the following courses and distances: North 61 degrees 07 minutes 11 seconds West, a distance of 739.36 feet; North 5 degrees 58 minutes 11 seconds West, a distance of 997.50 feet; North 11 degrees 22 minutes 11 seconds West, a distance of 477.70 feet; North 17 degrees 07 minutes 11 seconds West, a distance of 348.30 feet; North 31 degrees 34 minutes 11 seconds West, a distance of 349.50 feet; North 38 degrees 50 minutes 11 seconds West, a distance of 22.38 feet to the northwest line of Lot 20 of the St. Charles Ferry Company Tract; thence North 28 degrees 53 minutes 11 seconds East, along said Northwest line, a distance of 824.56 feet to the Northwest corner of said Lot 20; thence North 72 degrees 46 minutes 42 seconds West, along the North line of Lot 19 of the St. Charles Ferry Company Tract, a distance of 674.79 feet; thence North 47 degrees 43 minutes 02 seconds East, a distance of 1137.84 feet to the Southwesterly right of way line of Highway 40 also known as St. Charles Rock Road; thence along said right of way line the following courses and distances; thence South 75 degrees 56 minutes 31 seconds East, a distance of 260.00 feet; thence around a curve to the right, having a radius of 1825.08 feet and a chord bearing South 65 degrees 11 minutes 52 seconds East, a chord distance of 680.49 feet; thence

North 35 degrees 32 minutes 48 seconds East, a distance of 30.00 feet; thence around a curve to the right, having a radius of 1855.08 feet and a chord bearing South 49 degrees 10 minutes 22 seconds East, chord distance of 341.47 feet; thence South 43 degrees 53 minutes 31 seconds East, a distance of 47.91 feet; thence South 46 degress 06 minutes 29 seconds West, a distance of 15.00 feet; thence South 43 degrees 53 minutes 31 seconds East, a distance of 34.28 feet; thence South 55 degrees 55 minutes 28 seconds East, a distance of 95.94 feet; thence South 43 degrees 53 minutes 31 seconds East, a distance of 602.78 feet to the Point of Beginning and containing 111.80 Acres.

Tract 2

A tract of land in part of Lots 1,3, and 4 of the Yosti Partition in U.S. Survey 131, and part of U.S. Survey 131, in Townships 46 and 47 North, Range 5 East of the 5th Principal Meridian, St. Louis County, Missouri, described as follows:

Beginning at the most easterly corner of Lot 1 of the Yosti Partition in U.S. Survey 131, being a point in the centerline of Taussig Avenue; thence South 43 degrees 34 minutes 53 seconds East, along the northeasterly line of Lot 4 of the Yosti Partition, a distance of 99.92 feet; thence South 6 degrees 41 minutes 15 seconds West, a distance of 68.96 feet; thence South 23 degrees 21 minutes 55 seconds West, a distance of 154.73 feet; thence South 26 degrees 49 minutes 07 seconds East, a distance of 55.27 feet; thence South 14 degrees 32 minutes 36 seconds West, a distance of 143.63 feet; thence South 34 degrees 03 minutes 12 seconds West, a distance of 220.86 feet; thence North 55 degrees 41 minutes 34 seconds West, a distance of 127.00 feet; thence South 88 degrees 59 minutes 19 seconds West, a distance of 62.24 feet; thence South 54 degrees 43 minutes 18 seconds West, a distance of 240.50 feet; thence South 26 degrees 44 minutes 32 seconds West, a distance of 450.91 feet; thence South 8 degrees 25 minutes 49 seconds West, a distance of 224.01 feet; thence South 17 degrees 14 minutes 43 seconds East, a distance of 28.63 feet; thence South 47 degrees 09 minutes 44 seconds East, a distance of 61.27 feet; thence South 24 degrees 34 minutes 10 seconds East, a distance of 73.64 feet; thence South 0 degrees 07 minutes 21 seconds West, a distance of 107.37 feet to the northeasterly right of way line of the St. Charles Rock Road, 60 foot wide; thence South 61 degrees 07 minutes 11 seconds East, along said right of way line, a distance of 758.45 feet to the most southerly corner of Lot 4 of said Yosti Partition; thence North 39 degrees 17 minutes 12 seconds East, along the southeasterly line of said Lot 4, a distance of 1349.58 feet to the most easterly corner thereof; thence North 43 degrees 34 minutes 53 seconds West, along the northeasterly line of said lot 4, a distance of 779.68 feet to a point 50.00 feet southeasterly of the most southerly corner of a tract of land conveyed to John Guerra and wife by deed recorded in Book 1642 on Page 263; thence North 46 degrees 24 minutes 31 seconds East, parallel with the southeasterly line of said Guerra tract, a distance of 437.11 feet; thence North 43 degrees 34 minutes 53 seconds West, parallel with the northeasterly line of said Guerra tract, a distance of 486.26 feet to the centerline of Taussig Avenue; thence North 41 degrees 52 minutes 29 seconds East, along said centerline, a distance of 68.21 feet; thence North 47 degrees 48 minutes 29 seconds East, along said centerline, a distance of 340.00 feet; thence North 42 degrees 11 minutes 31 seconds West, a distance of 30.00 feet to the northwesterly right of way line of said Taussig Avenue; thence North 47 degrees 48 minutes

29 seconds East, along said right of way a distance of 312.95 feet; thence North 5 degrees 09 minutes 06 seconds West, continuing along said right of way, a distance of 57.50 feet to the southwesterly ight of way of Highway 40, also known as St. Charles Rock Road; thence North 43 degrees 53 minutes 31 seconds West, along said southwesterly right of way line, a distance of 877.45 feet; thence South 51 degrees 12 minutes 40 seconds West, a distance of 1023.23 feet; thence South 25 degrees 58 minutes 41 seconds West, a distance of 181.33 feet, to the northeasterly line of Lot 1 of the Yosti Partition of U.S. Survey 131; thence South 43 degrees 34 minutes 53 seconds East, along said northeasterly line, a distance of 971.20 feet to the Point of Beginning.

Tract 3

A tract of land being part of Lots 1, 3, and 4 of the "Yosti Partition in U.S. Survey 131, townships 46 and 47 north, range 5 east of the Fifth Principal Meridian, St. Louis County, Missouri, more particularly described as follows:

Commencing at the intersection of the northwesterly line of U.S. Survey 131 and the southwesterly right of way line of Highway 40, also known as "St. Charles Rock Road;" thence South 37 degrees 11 minutes 39 seconds East, along said south right of way line, 209.98 feet; thence exiting said right of way line, South 57 degrees 54 minutes 32 seconds West, 1023.23 feet; thence South 32 degrees 40 minutes 33 seconds West, 181.33 feet to the northeasterly line of said lot 1; thence South 36 degrees 53 minutes 01 seconds East, along said r rtheasterly line of lot 1, a distance of 591.05 feet to the point of nning of the tract described herein; thence continuing along the no. heasterly line of said lot 1 and along the northeasterly line of said lot 4, South 36 degrees 53 minutes 01 seconds East, 480.07 feet; thence exiting said northeasterly line, South 13 degrees 23 minutes 07 seconds West, 68.96 feet; thence South 30 degrees 03 minutes 47 seconds West, 154.73 feet; thence South 20 degrees 07 minutes 14 seconds East, 55.27 feet; thence South 21 degrees 14 minutes 28 seconds West, 143.63 feet; thence South 40 degrees 45 minutes 05 seconds West, 220.86 feet; thence North 48 degrees 59 minutes 42 seconds West, 127.00 feet; thence North 84 degrees 18 minutes 49 seconds West, 62.24 feet; thence South 61 degrees 25 minutes 10 seconds West, 240.50 feet; thence South 33 degrees 26 minutes 24 seconds West, 450.91 feet; thence South 15 degrees 07 minutes 41 seconds West, 224.01 feet; thence South 10 degrees 32 minutes 51 seconds East, 28.63 feet; thence South 40 degrees 27 minutes 52 seconds East, 61.27 feet; thence South 17 degrees 52 minutes 18 seconds East, 73.64 feet; thence South 06 degrees 49 minutes 13 seconds West, 107.37 feet to the north right of way line of "Old St. Charles Rock Road;" thence North 54 degrees 25 minutes 19 seconds West, along said right of way line, 99.72 feet; thence North 34 degrees 48 minutes 53 seconds East, 100.00 feet; thence exiting said west line, North 54 degrees 25 minutes 19 seconds West, 120.00 feet; thence North 21 degrees 27 minutes 09 seconds East, 153.52 feet; thence North 00 degrees 02 minutes 46 seconds West, 37.43 feet; thence North 56 degrees 33 minutes 36 seconds West, 70.00 feet; thence North 33 degrees 26 minutes 24 seconds East, 624.89 feet; thence South 49 degrees 52 minutes 21 conds East, 56.85 feet; thence North 67 degrees 30 minutes 55 seconds East, 6.05 feet; thence North 08 degrees 48 minutes 44 seconds East, 158.15 feet; t nce South 59 degrees 03 minutes 26 seconds East, 82.21 feet; thence North 3 degrees 28 minutes 55 seconds East, 321.44 feet; thence North 55 degrees 02 minutes 11 seconds West, 158.34 feet; thence North 01 degrees 10 minutes 17 seconds East, 342.38 feet to the point of beginning.

Excluding from the above tracts the real property sometimes referred to as Area 1 and Area 2, and more particularly described as follows:

AREA 1

A tract of land in part of U.S. Survey 131, Township 47 North, Range 5 East of the 5th Principal Meridian, St. Louis County, Missouri, described as follows:

Commencing at the intersection of the northwesterly line, of U.S. Survey 131 and the southwesterly right of way line of Highway 40, also known as St. Charles Rock Road; thence South 43 degrees 53 minutes 31 seconds East, along said right of way line, a distance of 729.68 feet; thence South 40 degrees 49 minutes 32 seconds West, a distance of 92.54 feet to the Point of Beginning of the following described tract; thence continuing South 40 degrees 49 minutes 32 seconds West, a distance of 288.61 feet; thence South 89 degrees 29 minutes 50 seconds West, a distance of 241.41 feet; thence North 79 degrees 05 minutes 44 seconds West, a distance of 390.43 feet; thence North 29 degrees 48 minutes 55 seconds East, a distance of 499.73 feet; thence North 84 degrees 45 minutes 59 seconds East, a distance of 248.68 feet; thence South 32 degrees 24 minutes 17 seconds East, a distance of 201.28 feet; thence South 56 degrees 18 minutes 22 seconds East, a distance of 251.78 feet to the Point of Beginning.

AREA 2

A tract of land in part of Lot 20, of the St. Charles Ferry Company Tract in U.S. Survey 47 and 1934 and in part of U.S. Survey 47 Township 47 North, Range 5 East of the 5th Principal Meridian, St. Louis County, Missouri, described as follows:

Commencing at the intersection of the centerline of St. Charles Rock Road and the northwesterly line of Lot 20 of the St. Charles Ferry Company Tract; thence North 28 degrees 53 minutes 11 seconds East, along said northwesterly line, a distance of 148.48 feet of the Point of Beginning of the following described tract; thence continuing North 28 degrees 53 minutes 11 seconds East, along said line, a distance of 676.08 feet to the northwest corner of said Lot 20; thence North 72 degrees 46 minutes 42 seconds West, along the northerly line of Lot 19 of the St. Charles Ferry Company tract, a distance of 674.79 feet; thence North 47 degrees 43 minutes 02 seconds East, a distance of 906.64 feet; thence South 64 degrees 46 minutes 52 seconds East, a distance of 389.58 feet; thence South 76 degrees 30 minutes 26 seconds East, a distance of 245.51 feet; thence South 60 degrees 07 minutes 01 seconds East, a distance of 283.36 feet; thence South 31 degrees 26 minutes 39 seconds West, a distance of 1136.42 feet; thence South 33 degrees 08 minutes 25 seconds West, a distance of 109.40 feet; thence South 34 degrees 54 minutes 38 seconds East, a distance of 149.81 feet; thence South 44 degrees 29 minutes 33 seconds West, a distance of 267.70 feet; thence North 78 degrees 25 minutes 41 seconds West, a distance of 241.02 feet; thence North 34 degrees 31 minutes 30 seconds West, a distance of 351.19 feet to the Point of Beginning.

THE STOLAR PARTNERSHIP
ATTORNEYS AT LAW
THE LAMMERT BUILDING
911 WASHINGTON AVENUE
ST. LOUIS, MISSOURI 63101-1290
(314) 231-2800

TELEFAX: (314) 436-8400

WILLIAM R. WERNER
Email: WRW@TSPSTL.COM

H.M. STOLAR
(RETIRED 1964)

February 5, 1998

David A. Hoefer, Esq.
Office of Regional Counsel
U.S. Environmental Protection
Agency - Region VII
726 Minnesota Ave.
Kansas City, KS 66101

RE: West Lake Landfill Site - Supplemental Declaration of Covenants and Restrictions

Dear David;

Attached for your file is a copy of the Supplemental Declaration of Covenants and Restrictions which was executed on behalf of Rock Road Industries, Inc. subsequent to your review. The Declaration has been recorded with the St. Louis County Recorder of Deeds at the Book and Page number shown on the enclosed copy.

Very truly yours,

William R. Werner

WRW:jvb
Enclosure
cc(w/enc): John Frazier
Angela Foster
Michael Hockley
Charlotte Neitzel
Paul Rosasco
James Wagoner II

[redacted]

1998012001106

DANIEL T. O'LEARY
RECORDER OF DEEDS
ST. LOUIS COUNTY MISSOURI
41 SOUTH CENTRAL
CLAYTON, MO 63105

RECORDER OF DEEDS DOCUMENT IDENTIFICATION & CERTIFICATION SHEET

TYPE OF INSTRUMENT	GRANTOR	TO	GRANTEE
RESTR	**ROCK ROAD INDUSTRIES INC**		

PROPERTY DESCRIPTION: **SUR 131 T 47 R 5 W/O/P**

Lien Number	Notation	Document Number	Locator
		1,106	

STATE OF MISSOURI)
SS.
COUNTY OF ST. LOUIS)

I, the undersigned Recorder of Deeds for said County and State, do hereby certify that the following and annexed instrument of writing, which consists of **6** pages, (this page inclusive), was filed for record in my office on the **20** day of **January** **1998** at **04:27 PM** and is truly recorded in the book and at the page shown at the top and/or bottom of this page.

In witness whereof I have hereunto set my hand and official seal the day, month and year aforesaid.

D. T. O'Leary

5

SUPPLEMENTAL DECLARATION OF COVENANTS AND RESTRICTIONS

ROCK ROAD INDUSTRIES, INC.

Rock Road Industries, Inc., a Missouri corporation ("Declarant"), hereby (a) imposes the provisions of this Supplemental Declaration upon the Premises (as defined below), (b) publishes and declares that the following terms, conditions, restrictions and obligations shall (i) affect and encumber the Premises, (ii) run with and be a burden upon and a benefit to the Premises, and (iii) be fully binding upon Declarant and all other persons or entities acquiring the Premises or any part thereof or interest therein whether by descent, devise, purchase or otherwise, and (c) declares that any person or entity, by the acceptance of title to the Premises or any part thereof or interest therein, shall thereby agree and covenant to abide by and be bound by the following terms, conditions, restrictions and obligations.

RECITALS

A. Declarant is the owner of certain real property (located in the City of Bridgeton, County of St. Louis, State of Missouri), legally described on Exhibit A, attached hereto and incorporated herein by this reference, which real property is herein referred to as the "Premises".

B. The United States Environmental Protection Agency ("EPA") has entered into an Administrative Order on Consent (the "Consent Order") with Cotter Corporation (N.S.L.), Declarant, Laidlaw Waste Systems (Bridgeton) Inc., and the United States Department of Energy for a Remedial Investigation and Feasibility Study.

C. The Consent Order, among other things, (i) provides for the investigation of the nature and extent of contamination and any threat to the public health, welfare, or the environment caused by the release or threatened release of hazardous substances at or from two isolated areas either on or in the vicinity of the Premises and which have been designated as Radiological Areas 1 and 2 in the Consent Order, and which contain low-level radioactive waste materials (the "Environmental Condition"), and (ii) has been filed with the Regional Hearing Clerk, EPA, Region VII, 726 Minnesota Avenue, Kansas City, Kansas, Docket No. VII-93-F-0005.

D. The Premises is subject to a Declaration of Covenants and Restrictions dated May 27, 1997, which is recorded in Book 11208 Page 2507 in the St. Louis County Recorder of Deeds Office (the "May 1997 Declaration").

E. In addition to the restrictions contained in the May 1997 Declaration, Declarant desires to prohibit in perpetuity (i) the construction or placement upon the Premises of any building for any purpose, and (ii) the installation of underground utilities, pipes and/or excavation upon the Premises, except as set forth herein.

DECLARATION

Declarant hereby states and declares as follows:

1. No building of any kind or nature for any purpose shall be constructed or placed on the Premises, now or at any time in the future, in perpetuity. In addition, no underground utilities or pipes shall be installed at the Premises and no excavation work shall be performed on the Premises, now or at any time in the future, in perpetuity, except such utilities, pipes and/or excavation work, if any, which (a) are approved by EPA in connection with a plan selected by EPA to remediate the Environmental Condition and are performed in accordance with safety regulations applicable to such remedial plan or otherwise required by EPA as a condition of such approval, or (b) are any part of a landfill gas control, leachate collection, or surface water management system installed and operated pursuant to a plan approved by all

applicable Federal, State and/or local authorities exercising jurisdiction over inactive landfill conditions on the Premises or active or inactive landfill operations conducted adjacent to the Premises.

2. This Supplemental Declaration shall not unlawfully restrict and shall not be used to violate any Federal law, rule, or regulation regarding the use of real estate, including, but not limited to, the Fair Housing Act.

3. This Supplemental Declaration shall be recorded in the office of the Recorder of Deeds for the County of St. Louis, State of Missouri.

4. Any deed or other instrument of conveyance for the Premises or any portion thereof shall be subject to this Supplemental Declaration.

5. Each of EPA (or its successor), the Missouri Department of Natural Resources ("MDNR") (or its successor) and the owner of any portion of the Premises shall have the right to sue for and obtain an injunction, prohibitive or mandatory, to prevent the breach, or to enforce the observance, of this Supplemental Declaration. This right shall be in addition to any other action available at law or in equity. The failure to enforce any covenant or restriction herein at the time of its violation shall not constitute a waiver of the right to do so later.

6. The provisions of this Supplemental Declaration shall continue in full force and effect until the fiftieth anniversary of the date of this Supplemental Declaration and thereafter for successive twenty-year periods unless, prior to the expiration of the then current term, a written notice of termination of this Supplemental Declaration, executed by each of the then owners of the Premises and by authorized representatives of EPA (or its successor) and MDNR (or its successor), has been filed with the office of the Recorder of Deeds for St. Louis County, State of Missouri. A notice of termination of this Supplemental Declaration may be filed at any

time after the effective date of this Supplemental Declaration, and this Supplemental Declaration shall terminate on the date the notice of termination is filed with the Recorder of Deeds.

7. The May 1997 Declaration remains in full force and effect, and shall be deemed supplemented, but not amended, by this Supplemental Declaration.

IN WITNESS WHEREOF, Rock Road Industries, Inc. has caused this instrument to be executed this 16th day of January, 1998.

ROCK ROAD INDUSTRIES, INC., a Missouri corporation

By: [signature]
William E. Whitaker
President

ACKNOWLEDGEMENT

STATE OF MISSOURI)
) ss
County OF ST. LOUIS)

On this 16th day of January, 1998, before me, a notary public, personally appeared William E. Whitaker, to me known, who, being by me duly sworn, did say that he is the President of Rock Road Industries, Inc., a Missouri corporation, and that said instrument was signed on behalf of said corporation by authority of its Board of Directors, and said person acknowledged said instrument to be the free act and deed of said corporation.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my official seal in the County and State aforesaid, the day and year first above written.

Margaret G. Cusumano
Notary Public

My Commission Expires:

MARGARET G CUSUMANO
NOTARY PUBLIC STATE OF MISSOURI
ST. LOUIS COUNTY
MY COMMISSION EXP. NOV. 5,1998

EXHIBIT A

AREA 1

A tract of land in part of U.S. Survey 131, Township 47 North, Range 5 East of the 5th Principal Meridian, St. Louis County, Missouri, described as follows:

Commencing at the intersection of the northwesterly line, of U.S. Survey 131 and the southwesterly right of way line of Highway 40, also known as St. Charles Rock Road; thence South 43 degrees 53 minutes 31 seconds East, along said right of way line, a distance of 729.68 feet; thence South 40 degrees 49 minutes 32 seconds West, a distance of 92.54 feet to the Point of Beginning of the following described tract; thence continuing South 40 degrees 49 minutes 32 seconds West, a distance of 288.61 feet; thence South 89 degrees 29 minutes 50 seconds West, a distance of 241.41 feet; thence North 79 degrees 05 minutes 44 seconds West, a distance of 390.43 feet; thence North 29 degrees 48 minutes 55 seconds East, a distance of 499.73 feet; thence North 84 degrees 45 minutes 59 seconds East, a distance of 248.68 feet; thence South 32 degrees 24 minutes 17 seconds East, a distance of 201.28 feet; thence South 56 degrees 18 minutes 22 seconds East, a distance of 251.78 feet to the Point of Beginning.

AREA 2

A tract of land in part of Lot 20, of the St. Charles Ferry Company Tract in U.S. Survey 47 and 1934 and in part of U.S. Survey 47 Township 47 North, Range 5 East of the 5th Principal Meridian, St. Louis County, Missouri, described as follows:

Commencing at the intersection of the centerline of St. Charles Rock Road and the northwesterly line of Lot 20 of the St. Charles Ferry Company Tract; thence North 28 degrees 53 minutes 11 seconds East, along said northwesterly line, a distance of 148.48 feet of the Point of Beginning of the following described tract; thence continuing North 28 degrees 53 minutes 11 seconds East, along said line, a distance of 676.08 feet to the northwest corner of said Lot 20; thence North 72 degrees 46 minutes 42 seconds West, along the northerly line of Lot 19 of the St. Charles Ferry Company tract, a distance of 674.79 feet; thence North 47 degrees 43 minutes 02 seconds East, a distance of 906.64 feet; thence South 64 degrees 46 minutes 52 seconds East, a distance of 389.58 feet; thence South 76 degrees 30 minutes 26 seconds East, a distance of 245.51 feet; thence South 60 degrees 07 minutes 01 seconds East, a distance of 283.36 feet; thence South 31 degrees 26 minutes 39 seconds West, a distance of 1136.42 feet; thence South 33 degrees 08 minutes 25 seconds West, a distance of 109.40 feet; thence South 34 degrees 54 minutes 38 seconds East, a distance of 149.81 feet; thence South 44 degrees 29 minutes 33 seconds West, a distance of 267.70 feet; thence North 78 degrees 25 minutes 41 seconds West, a distance of 241.02 feet; thence North 34 degrees 31 minutes 30 seconds West, a distance of 351.19 feet to the Point of Beginning.

Appendix A-2:

City of St. Louis Negative Easement and Restrictive Covenants

[redacted]

BP16465/1140 BP16465/1140

20050411100245

JANICE M. HAMMONDS, RECORDER OF DEEDS
ST. LOUIS COUNTY MISSOURI
41 SOUTH CENTRAL, CLAYTON, MO 63105

TYPE OF INSTRUMENT	GRANTOR	TO	GRANTEE
AGRMT	BRIDGETON LANDFILL L L C ETAL		

PROPERTY DESCRIPTION: YOSTI PARTITION LOT 1 - 4 PB 3 PG 101 W/O/P

Lien Number	Notation	Locator

NOTE: I, the undersigned Recorder of Deeds, do hereby certify that the information shown on this Certication Sheet as to the **TYPE OF INSTRUMENT**, the **NAMES** of the **GRANTOR** and **GRANTEE** as well as the **DESCRIPTION** of the **REAL PROPERTY** affected is furnished merely as a convenience only, and in the case of any discrepancy of such information between this Certification Sheet and the attached Document, the **ATTACHED DOCUMENT** governs. Only the DOCUMENT NUMBER, the DATE and TIME of filing for record, and the **BOOK** and **PAGE** of the recorded Document is taken from this CERTIFICATION SHEET.

RECORDER OF DEEDS DOCUMENT CERTIFICATION

STATE OF MISSOURI)
SS.
COUNTY OF ST. LOUIS)

Document Number
245

I, the undersigned Recorder of Deeds for said County and State, do hereby certify that the following and annexed instrument of writing, which consists of ~~18~~ 19 pages, (this page inclusive), was filed for record in my office on the 11 day of April 2005 at 09:02 AM and is truly recorded in the book and at the page shown at the top and/or bottom of this page.

In witness whereof I have hereunto set my hand and official seal the day, month and year aforesaid.

JoAnn Reber CB
Deputy Recorder

Janice M. Hammonds
Recorder of Deeds
St. Louis County, Missouri

____ N.P
____ N.P.C
____ N.N.C.
____ N.N.I.

RECORDING FEE $72.00
(Paid at the time of Recording

Mail to:

Destination code: 14 P

B-16465 P-1140/1158

BP16465/1141 BP16465/1141

THE CITY OF ST. LOUIS, MISSOURI

AT

LAMBERT-ST. LOUIS INTERNATIONAL AIRPORT®

NEGATIVE EASEMENT AND DECLARATION OF RESTRICTIVE COVENANTS AGREEMENT

THIS NEGATIVE EASEMENT AND DECLARATION OF RESTRICTIVE COVENANTS AGREEMENT, dated as of April 6, 2005 (the "**Agreement**"), is made and entered into by and among the grantors, whose names and addresses are listed below (collectively referred to herein as the "**Grantors**") and THE CITY OF ST. LOUIS, a municipal corporation of the State of Missouri, as the grantee ("**St. Louis**"), whose address is City Hall, Room 200, 1200 Market Street, St. Louis, Missouri 63103, acting by and through its Board of Estimate and Apportionment and its City Counselor.

GRANTORS' NAMES AND ADDRESSES:

Bridgeton Landfill LLC, a Delaware limited liability company
15880 N. Greenway-Hayden Loop, Ste.100
Scottsdale, AZ 85260

Rock Road Industries, Inc., a Missouri corporation
15880 N. Greenway-Hayden Loop, Ste.100
Scottsdale, AZ 85260

Bridgeton Transfer Station, LLC, a Delaware limited liability company
15880 N. Greenway-Hayden Loop, Ste.100
Scottsdale, AZ 85260

TIA 170270A-SC

165132.2

WITNESSETH THAT:

WHEREAS, the Grantors are the fee simple owners of certain real property located in St. Louis County, Missouri that is more fully described in **EXHIBIT "A"**, which is attached hereto and incorporated herein (the "**Property**");

WHEREAS, St. Louis is the owner and operator of Lambert-St. Louis International Airport® ("**Airport**");

WHEREAS, St. Louis wishes to impose certain limitations and restrictions on the use and enjoyment of the Property in order to reduce or mitigate the potential harm to airport-related activities that could be caused by certain wildlife or birds on or from the Property. Such wildlife may include various species (birds, mammals, reptiles), including feral animals and domesticated animals not under control, that are associated with aircraft strike problems, are capable of causing structural damage to airport facilities, or act as attractants to other wildlife that pose a strike hazard to aircraft; and

WHEREAS, the Grantors and St. Louis recognize that the grant of a negative easement by Grantors to St. Louis, and the declaration of restrictive covenants by Grantors, will assist in reducing or mitigating the potential harm to airport-related activities that could be caused by said wildlife.

NOW, THEREFORE, stating their intention to be legally bound hereby and in consideration of the foregoing, and the promises, covenants, and agreements herein contained, and for other good and valuable consideration, including the sum of FOUR HUNDRED THOUSAND DOLLARS ($400,000.00) in hand paid by St. Louis to Grantors, the receipt and sufficiency of which are hereby acknowledged, Grantors do hereby grant and convey unto St. Louis, its successors in interest and assigns, a negative easement, as more particularly described below, upon, over, in, and to the Property.

The negative easement granted herein and described below shall constitute a binding servitude upon the Property. To that end, Grantors do hereby covenant on behalf of themselves and their heirs, successors in interest and assigns with St. Louis, its successors in interest and assigns, such covenants and provisions being deemed to run with the land as a binding servitude in perpetuity, as provided for below, to do and to refrain from doing upon the Property the following stipulations, which contribute to the public purpose in that they aid in the reduction or mitigation of said potential wildlife or bird hazards on or from the Property, and hereby declare and impose the following restrictions upon the use and enjoyment of the Property:

1. There shall be no new or additional depositing or dumping of municipal waste, organic waste, and/or putrescible waste (municipal waste, organic waste and putrescible waste hereinafter collectively referred to as "Putrescible Waste") above, upon, on, or under the Property beginning as of August 1, 2005 and continuing in perpetuity, unless and until such time as this Agreement is terminated or canceled by St. Louis in accordance with the terms set out in paragraph 4 below. The parties acknowledge and agree that the restriction described in the preceding sentence does not, and shall not, in any way prohibit solid waste transfer station activities or operations conducted on the

Transfer Station site as shown on the drawing attached hereto as Exhibit A (the "Site") as expanded to include any encroachments by solid waste transfer station buildings or improvement extending beyond the boundaries of the Site onto the Property at the time of the execution of this Agreement. For purposes of this Agreement, "**Putrescible Waste**" shall mean solid waste that contains organic matter capable of being decomposed by micro-organisms and of such a character and proportion as to be capable of attracting or providing food for birds. For purposes of this Agreement, "**Putrescible Waste**" shall not include solid waste that qualifies for disposal in a demolition landfill as defined in 10 CSR 8O-2.010(20).

2. At all times after the Effective Date (defined below), the Grantor shall comply with all applicable federal, state and local laws and regulations regarding proper landfill cover.

3. This Agreement shall become effective and binding on the date first written above upon the execution and delivery hereof by St. Louis and the Grantors (the "**Effective Date**"). This Agreement and any companion documents or instruments referred to herein may be executed in any number of counterparts, each of which shall be original, but all of which together shall constitute one document or instrument.

4. The term of this Agreement shall begin on the Effective Date and shall end only if and when St. Louis chooses in its sole and absolute discretion to abandon its negative easement granted herein by terminating or canceling this Agreement in writing and recording such writing with St. Louis County's Recorder of Deeds.

5. Except as provided for herein, Grantors reserve unto themselves all rights, privileges, powers, and immunities in and to the Property including, without limitation, the right of possession and the use and enjoyment of the Property.

6. Representatives and agents of St. Louis shall be permitted at reasonable times, which times shall be established in advance by St. Louis by three (3) days' written notice, to come upon the Property to inspect for violation of any of the promises, covenants, restrictions, or agreements herein ("**Inspections**"), except that if St. Louis has reasonable cause to believe that such violations are occurring or have occurred, St. Louis shall not be obligated to give said three (3) days' written notice or any other notice whatsoever to the Grantors. This right of Inspections is independent of any right-of-entry granted to the St. Louis under any separate agreement. Notwithstanding the foregoing, any representative or agent of St. Louis that comes upon the Property shall enter and exit the Property exclusively through the gate maintained by Grantors for such purpose and shall observe all customary formalities required by Grantors with respect to visitors including, but not limited to, immediately reporting their presence to Grantor's administrative personnel and signing in and signing out on appropriate security logs.

7. St. Louis shall promptly repair any damage it causes to the Property in the course of any Inspections, generally placing the Property and all points of entry in the same general condition as before the Inspections or entry, to the extent reasonably practical, ordinary wear and tear excepted, unless otherwise agreed to in writing by Grantors. All

Inspections, and all repairs to the Property arising from the Inspections, shall be at the sole cost of St. Louis. St. Louis and its representatives and agents shall use their best efforts to minimize damage to the Property and shall not substantially or materially disturb or interfere with the administration and/or operations of the Grantors when conducting its Inspections.

8. St. Louis, to the extent permitted by law, hereby agrees to indemnify, release and hold Grantors and their officers, employees, representatives and agents harmless from and against any and all losses, claims, judgments, actions, suits, cross-claims, counterclaims, third party actions, damages, liabilities, fines, penalties, including all reasonable costs for investigation and defense thereof (including, without limitation, attorneys' fees, court costs, expert fees and litigation expenses) and expenses in connection with loss of life, personal injury, bodily injury or damage to property, to the extent caused by or resulting from this Agreement (including activities conducted thereunder or relating thereto), the operations of the Airport in regard to aircraft bird strikes (provided that the Grantors are in compliance with the terms and provisions of this Agreement and the Right-Of-Entry Agreement dated April 6 2005 between St. Louis and the Grantors), the Inspections or the actions of St. Louis, its employees, contractors, representatives or agents in the course of the Inspections, except to the extent arising out of the negligence or intentional misconduct of the Grantors, or their officers, boards, commissions, employees, contractors, representatives, or agents. In case the Grantors or such other persons or entities shall be made a party to any action or proceeding commenced against St. Louis, to the extent provided in the preceding sentence, St. Louis shall protect and hold such parties harmless and pay all costs, expenses and reasonable attorneys' fees incurred or paid by such parties in connection with such action or proceeding. Grantors shall give to St. Louis reasonable notice of any such claims or actions. St. Louis shall use counsel reasonably acceptable to Grantors in carrying out their obligations hereunder. This indemnity provision shall survive the termination or cancellation of this Agreement, any and all sales or transfers of the Property or any portion thereof, or interest therein and shall be binding on St. Louis and its successors in interest and assigns and shall inure to the benefit of Grantors and their successors in interest and assigns.

9. In the event of a violation or default of any promise, covenant, restriction, stipulation, warranty, agreement, or provision (**"Provision"**) herein by either party, the non-defaulting party shall have all rights and remedies available in law or equity including, without limitation, the right to specific performance and injunctive relief, and the right to institute a suit to enjoin such violation. Notwithstanding the above sentence, Grantors hereby expressly stipulate and agree that Grantors and their heirs, successors in interest and assigns shall not have the right to terminate or cancel this Agreement under any circumstance whether with or without cause. In the event of any dispute regarding any Provision of this Agreement or the rights, obligations, and liabilities of the parties with regard to this Agreement, the prevailing party shall be entitled to recover from the non-prevailing party its reasonable attorneys' fees, court costs, and other litigation costs incurred in connection with such matter.

10. All notices, requests, information or other documents required or permitted hereunder or necessary or convenient in connection with this Agreement shall be in writing and shall be deemed duly given upon receipt if sent by certified mail or by overnight or express mail service, with a return receipt, postage prepaid, and addressed to the parties as set forth below. Notice shall be deemed received at the earlier of actual receipt or two (2) calendar days after deposit with one of the mail services described in this paragraph. Any party may change the person or address to which notices are to be sent to it by giving written notice of such change to the other party in the manner herein provided for giving notice.

<u>If to the Grantors (individually or collectively) to:</u>

Bridgeton Landfill LLC
15880 N. Greenway-Hayden Loop, Ste.100
Scottsdale, AZ 85260
Attn: Jo Lynn White

Rock Road Industries, Inc.
15880 N. Greenway-Hayden Loop, Ste.100
Scottsdale, AZ 85260
Attn: Jo Lynn White

Bridgeton Transfer Station, LLC
15880 N. Greenway-Hayden Loop, Ste.100
Scottsdale, AZ 85260
Attn: Jo Lynn White

with a copy to:

Spencer Fane Britt & Browne LLP
Attn: Michael Hockley
1000 Walnut Street, Suite 1400
Kansas City, MO 64106-2140

<u>If to St. Louis to:</u>

Director of Airports
Task Orders, Agreement and Facility Issues
Lambert-St. Louis International Airport®
10701 Lambert International Boulevard
P.O. Box 10212, Lambert Station
St. Louis, MO 63145
and
Mr. Gerard Slay
Deputy Director of Airports

Lambert-St. Louis International Airport®
Airport Operations
10701 Lambert International Boulevard
P.O. Box 10212, Lambert Station
St. Louis, MO 63145
(314) 426-8023
(314) 890-1844 FAX

with a copy to:

Mr. Donald L. Ruble, R.A.
Assistant Director of Planning and Development
Lambert-St. Louis International Airport®
Airport Planning and Development Office, 4th Floor
13723 Riverport Drive
Maryland Heights, MO 63043
(314) 551-5025
(314) 551-5013 FAX

11. No waiver of any breach of any Provision herein contained shall be deemed, or shall constitute, a waiver of any preceding or succeeding breach thereof of any Provision contained herein. No extension of time for performance of any obligation or act shall be deemed an extension of the time for performance of any other obligation or act. No waiver shall be binding unless executed in writing by the party granting the waiver.

12. The parties hereto covenant and warrant that they have the authority and power to enter into this Agreement, that this Agreement has been authorized by all necessary corporate and municipal actions, and that each party is authorized and empowered to consummate the transaction provided for herein. This Agreement constitutes a legal, binding, valid and enforceable obligation of the parties, and there are no claims or defenses, personal or otherwise, or offsets whatsoever to the enforceability or validity of this Agreement.

13. This Agreement constitutes the entire understanding between the parties hereto with respect to the subject matter hereof and supersedes all prior or contemporaneous agreements, whether verbal or written, between the parties in regard thereto. This Agreement shall not be altered or modified except by an agreement in writing signed by the authorized representatives of the parties hereto, which writing specifically shall refer to this Agreement. It is expressly understood by the parties hereto that the provisions of this Agreement shall in no way affect or impair the provisions or obligations of St. Louis or the Grantors in regard to any other existing, contemporaneous, or prior agreements between the parties.

14. The parties hereto affirm each has full knowledge of the Provisions and requirements contained in this Agreement. Each party hereto acknowledges that such party and its counsel, after negotiation and consultation, have reviewed and revised this

Agreement. As such, the Provisions of this Agreement shall be fairly construed, and the usual rule or construction, if applicable, to the effect that any ambiguities herein should be resolved against the drafting party, shall not be employed in the interpretation of this Agreement or any amendments modifications or exhibits thereto.

15. If for any reason one or more of the Provisions contained in this Agreement shall be held to be invalid, illegal, or unenforceable in any respect, such invalidity, illegality, or unenforceability shall not affect any other Provision of this Agreement and shall be construed as if such invalid, illegal, or unenforceable Provision never had been included in this Agreement, provided the invalidity of such Provision does not materially prejudice either St. Louis or the Grantors in their respective rights and obligations contained in the valid Provisions of this Agreement

16. When the consent, approval, waiver, or certification ("**Approval**") of a party is required under the terms of this Agreement, such Approval must be in writing and signed by the party making the Approval. Whenever the Approval of St. Louis or the Director of Airports is required, the Approval must be from the Director of Airports or his/her authorized or designated representative. Whenever the Approval of the Grantors is required (individually or collectively), the Approval must be from all fee owners of the Property or any portion thereof or their authorized or designated representatives. St. Louis and the Grantors agree that an extension of time of performance may be made with the written mutual consent of St. Louis and Grantors. Whenever the approval of St. Louis, the Director of Airports or the Grantors is required or necessary herein, no such approval shall be unreasonably requested, withheld, conditioned, or delayed.

17. MISCELLANEOUS PROVISIONS:

A. Not An Agent: St. Louis and Grantors acknowledge and agree that nothing herein shall be interpreted or construed to mean that the parties hereto, or their respective officers, contractors, consultants, employees, representatives, or agents are employees or agents of the other party.

B. Dates and Non-Business Days: Whenever a number of days is referred to in this Agreement, days shall mean consecutive calendar days unless otherwise expressly provided. If the last day for giving of notice or for performance of any obligation or condition hereunder is a Saturday, Sunday or federal, state, or city holiday, then such last day shall be extended to the next succeeding business day thereafter. Whenever it is provided in this Agreement that days shall be counted, the first day to be counted shall be the day following the date on which the event causing the period to commence occurs.

C. Other Documents: St. Louis and Grantors agree that, at the request of the other, they will execute, acknowledge, certify, (if appropriate), and deliver whatever additional documents, affidavits, certifications, and records, and perform such other acts in good faith, as may be reasonably required in order to accomplish the intent and purposes of this Agreement.

D. Gender and Number: Whenever the sense of this Agreement so requires, the use of (i) the singular shall be deemed to include the plural, (ii) the masculine gender shall be deemed to include the feminine or neuter gender, and (iii) the neuter gender shall be deemed to include the masculine and feminine gender.

E. Exhibits: All exhibits described herein are fully incorporated into this Agreement by this reference as if fully set out herein. St. Louis and Grantors shall reasonably and in good faith finalize and attach all such exhibits to this Agreement, which may not have been in final form as of the Effective Date, or may require revisions. St. Louis hereby authorizes the Director of Airports to revise or approve said amendments or revisions to the exhibits on behalf of St. Louis.

F. Compliance with Laws and Regulations: This Agreement does not affect such other obligations as the Grantor may have under applicable federal, state, or local laws and regulations including, without limitation, 40 C.F.R 258.10.

TO HAVE AND TO HOLD unto St. Louis and unto its successors in interest and assigns forever. The Provisions of this Agreement and the parties' rights, commitments, and obligations within, shall be binding on the parties hereto, their respective heirs, successors in interest, and assigns. Every party acquiring or holding any interest or estate in any portion of the Property shall take or hold such interest or estate, or the security interest with respect thereto, with notice of this Agreement and of the Provisions of this Agreement. In accepting any interest or estate in, or any security interest with respect to any portion of the Property, such party shall be deemed to have assented to all of the Provisions hereof. The Provisions of this Agreement shall run with the land. To that end, this Agreement shall be deemed incorporated into all deeds and conveyances hereinafter made by Grantors and any heirs, successor in interest or assigns thereto. Grantors, for themselves, their heirs, successors in interest and assigns, hereby acknowledge, stipulate, and agree that the Provisions agreed to and the restrictions imposed, as aforesaid, shall be binding rights and privileges granted hereunder appertaining or belonging to St. Louis, its successors in interest and assigns, and shall continue as a servitude running in perpetuity with the Property, unless abandoned and terminated by St. Louis as provided for in paragraph 4 above.

{Signature pages to follow.}

IN WITNESS WHEREOF, the Grantors and St. Louis have entered into this Negative Easement and Declaration of Restrictive Covenants Agreement on the date first written above.

GRANTORS:

BRIDGETON LANDFILL, LLC

By: Rusty [signature]

Title: Vice President

STATE OF MISSOURI }
}
COUNTY OF ST. LOUIS }

On this 1st day of April 2005, before me appeared Rusty WALDRUP, being by me duly sworn, and did state that he is a Vice President of Bridgeton Landfill, LLC, a Delaware limited liability company; that said instrument was signed and sealed on behalf of Bridgeton Landfill, LLC; and that he acknowledged said instrument to be the free act and deed of Bridgeton Landfill, LLC.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my notarial seal at my office in the County of St. Louis.

NOTARY PUBLIC NOTARY SEAL STATE OF MISSOURI

BRAD R. GEURIN
My Commission Expires
September 21, 2008
St. Louis County

Brad R. Geurin
Notary Public

My commission expires: 9/21/08.

165132.2

NAME OF GRANTOR:
ROCK ROAD INDUSTRIES, INC.

By: [signature]

Title: Vice President

STATE OF MISSOURI }
}
COUNTY OF ST. LOUIS }

On this 1st day of April 2005, before me appeared Rusty Waldrup, being by me duly sworn, and did state that he is a Vice President of Rock Road Industries, Inc, a Missouri corporation; that said instrument was signed and sealed on behalf of said corporation and that he acknowledged said instrument to be the free act and deed of Rock Road Industries, Inc.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my notarial seal at my office in the County of St Louis.

NOTARY PUBLIC NOTARY SEAL STATE OF MISSOURI

BRAD R. GEURIN
My Commission Expires
September 21, 2008
St. Louis County

Brad R Geurin
Notary Public

My commission expires: 9/21/08.

165132.2

NAME OF GRANTOR:
BRIDGETON TRANSFER STATION, LLC

By: *[signature]*

Title: Vice President

STATE OF MISSOURI }
}
COUNTY OF ST. LOUIS }

On this *1st* day of *April* 2005, before me appeared *Rusty Waldrup*, being by me duly sworn, and did state that he is a Vice President of Bridgeton Transfer Station, LLC, a Delaware limited liability company; that said instrument was signed and sealed on behalf of Bridgeton Transfer Station, LLC and that he acknowledged said instrument to be the free act and deed of Bridgeton Transfer Station, LLC.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my notarial seal at my office in the County of *St Louis*.

NOTARY PUBLIC NOTARY SEAL STATE OF MISSOURI

BRAD R. GEURIN
My Commission Expires
September 21, 2008
St. Louis County

Brad R. Geurin
Notary Public

My commission expires: *9/21/08*.

BRAD R. GEURIN NOTARY PUBLIC SEAL

165132.2

ST. LOUIS/GRANTEE:

THE CITY OF ST. LOUIS, MISSOURI, OWNER AND OPERATOR OF LAMBERT-ST. LOUIS INTERNATIONAL AIRPORT®

Pursuant to The City of St. Louis' Ordinance No. 64279, approved March 9, 1998, as amended.

The foregoing Negative Easement and Declaration of Restrictive Covenants Agreement was approved by the Board of Estimate and Apportionment at its meeting on March 16, 2005.

3/17/05

Secretary, Board of Estimate & Apportionment Date

APPROVED BY:

City Counselor, The City of St. Louis

COUNTERSIGNED BY:

3-22-05

Comptroller, The City of St. Louis Date

ATTESTED TO BY:

MAR 22 2005

Register, The City of St. Louis Date

COMPTROLLER'S OFFICE

DOCUMENT # 50337

STATE OF MISSOURI }

CITY OF ST. LOUIS }

On this 3rd day of March 2005, before me appeared ~~Patricia A. Hageman~~ Edward J. Hanlon to me personally known, who being by me duly sworn, did say that she is the City Counselor of The City of St. Louis, Missouri, a municipal corporation, and that the seal affixed to the foregoing instrument is the corporate seal of The City of St. Louis and that said instrument was signed and sealed on behalf of The City of St. Louis pursuant to Ordinance No. 64279, approved March 9, 1998, as amended.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my notarial seal at my office in the City of St. Louis, Missouri.

Notary Public

My commission expires: __________________.

PATRICIA A FLEMING
Notary Public - Notary Seal
STATE OF MISSOURI
ST. LOUIS CITY
MY COMMISSION EXP. AUG. 28,2006

165132.2

STATE OF MISSOURI }
}
CITY OF ST. LOUIS }

On this 17th day of March 2005, before me appeared Yudora T. Mason to me personally known, who being by me duly sworn, did say that she is the Secretary for the Board of Estimate and Apportionment of The City of St. Louis, Missouri, a municipal corporation, and that the foregoing instrument was approved by the Board of Estimate and Apportionment on March 16, 2005, on behalf of The City of St. Louis pursuant to Ordinance No. 64279, approved March 9, 1998, as amended.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my notarial seal at my office in the City of St. Louis, Missouri.

Karen Jackson
Notary Public

My commission expires: April 1, 2008.

Notary Public Notary Seal State of Missouri

KAREN JACKSON
St. Louis City
My Commission Expires
April 1, 2008

Exhibit A
Legal Description of Property
For Negative Easement and Declaration of
Restrictive Covenants Agreement

TRACT I
PROPERTY DESCRIPTION OF
ACTIVE LANDFILL MINUS TRANSFER STATION

A tract of land being part of U.S. Survey 131, all of Lots 1, 2, 3, and 4 of the Yosti Partition as recorded in Survey Record Book 3 Page 101 of the St. Louis City (former County) records, part of Lots 20 and 21 of the St. Charles Ferry Company tract as recorded in Plat Book 7 Pages 98 and 99 of the St. Louis City (former County) records, and being located in U.S. Surveys 131 and 1934, Townships 46 and 47 North, Range 5 East of the Fifth Principal Meridian, City of Bridgeton, St. Louis County, Missouri, and being more particularly described as follows:

Beginning at the most Westerly corner of Lot 3 of the Boundary Adjustment Plat of Lots 1 and 3 of West Lake Acres Plat Two, a subdivision according to the plat thereof recorded in Plat Book 348 Page 667 of the St. Louis County, Missouri Records; thence South 36 degrees 52 minutes 59 seconds East along the Southwesterly line of said Lot 3 and the Southwesterly line of Lot 4 of West Lake Acres Plat Two, a subdivision according to the plat thereof recorded in Plat Book 344 Page 261 of said records a distance of 486.26 feet to a point on the Northwesterly line of last said Lot 4; thence South 53 degrees 06 minutes 26 seconds West along said Northwesterly line 437.11 feet to a point on the Southwesterly line of last said Lot 4; thence South 36 degrees 52 minutes 59 seconds East along last said Southwesterly line 779.68 feet to a point on the Northwesterly line of Lot 13 of Foersters Subdivision, a subdivision according to the plat thereof recorded in Plat Book 10 Page 55 of the St. Louis City (former County) records, thence South 45 degrees 59 minutes 06 seconds West along said Northwesterly line of said Lot 13 and the Northwesterly line of Lot 12 of said Foersters Subdivision 1349.58 feet to the Northerly line of Old St. Charles Rock Road, 60 feet wide, also known as Boenker Lane; thence North 54 degrees 25 minutes 17 seconds West along said Northerly line 858.18 feet to a point on the centerline of Taussig Avenue, 40 feet wide (vacated); thence North 34 degrees 48 minutes 55 seconds East along said centerline 100.00 feet to a point on the Northeasterly line of a tract of land as conveyed to Laidlaw Waste Systems (Bridgeton), Inc. according to the instrument recorded in Book 11082 Page 319 of the St. Louis County Records; thence North 54 degrees 25 minutes 17 seconds West along said Northeasterly line 120.00 feet to a point on the Northwesterly line of above said Laidlaw Waste Systems (Bridgeton), Inc. tract; thence South 34 degrees 45 minutes 34 seconds West along said Northwesterly line 130.00 feet to a point on the centerline of above said Old St. Charles Rock Road (vacated); thence along said centerline the following courses and distances: North 54 degrees 25 minutes 17 seconds West 991.55 feet, North 00 degrees 43 minutes 42 seconds East 997.52 feet, North 04 degrees 40 minutes 18 seconds West 477.70 feet, North 10 degrees 25 minutes 18 seconds West 348.30 feet, North 24 degrees 52 minutes 18 seconds West 349.50 feet; thence North 32 degrees 08 minutes 18 seconds West 22.38 feet to a point on the Southeasterly line of a tract of land as conveyed to Rock Road Industries, Inc. according to the instrument recorded in Book 12868 Page 1159 of the St. Louis County Records; thence North 35 degrees 35 minutes 04 seconds East 824.56 feet to a point on the Southwesterly line of a tract of land as conveyed to Rock Road Industries, Inc. according to the instrument recorded in Book 8356 Page 1807 of said records, and being a point on the common line between U.S. Survey 47 and U.S Survey 1934, Township 47 North, Range 5 East; thence South 66 degrees 04 minutes 54 seconds East along said Southwesterly line and said common line 167.44 feet to a point on the Southwesterly line of said Rock Road Industries, Inc. tract; thence South 36 degrees 52 minutes 59 seconds East along last said Southwesterly line and the Southwesterly line of a tract of land as conveyed to West Lake Landfill, Inc. according to the instrument recorded in Book 5262 Page 311 of above said records, and departing above said common line South 36 degrees 52 minutes 59 seconds East 1221.43 feet to a point on the Southeasterly line of a tract of land as conveyed to above said West Lake Landfill, Inc. tract, and being a point on the common line between U.S. Survey 131 and U.S Survey 47, Township 47 North, Range 5 East; thence North 54 degrees 46 minutes 17 seconds East along said Southeasterly line and said common line 1188.94 feet to a point on the Southwesterly line of Highway 40, also known as St. Charles Rock Road, variable width; thence South 37 degrees 11 minutes 37 seconds East along said Southwesterly line 1087.25 feet; thence departing said Southwesterly line the following courses and distances: South 01 degrees 32 minutes 48 seconds West 57.51 feet, South 54 degrees 30 minutes 23 seconds West 312.95 feet and South 35 degrees 29 minutes 37 seconds East 30.00 feet to a point on the Northwesterly line of above said Lot 3 of the Boundary Adjustment Plat of Lots 1 and 3 of West Lake Acres Plat Two; thence South 54 degrees 30 minutes 23 seconds West along said Northwesterly line 340.00 feet and South 48 degrees 34 minutes 23 seconds West 68.21 feet to the POINT OF BEGINNING and containing 7,119,040 square feet or 163.43 acres more or less according to a survey by Stock & Associates Consulting Engineers, Inc. dated November 19, 2004, and most recently revised February 15, 2005.

AND EXCEPTING THEREFROM the following:

A tract of land being part of Lot 1 of the Yosti Partition as recorded in Survey Record Book 3 Page 101 of the St. Louis City (former County) Records and part of U.S. Survey 131 in Township 47 North, Range 5 East of the Fifth Principal Meridian, City of Bridgeton, St. Louis County, Missouri, and being the same property as described in Ordinance Number 03-26 approved by the City of Bridgeton on June 18, 2003, and being more particularly described as follows:

Commencing at a point on the Southwesterly line of Highway 40, also known as St. Charles Rock Road, variable width, with the intersection of the common line between U.S.

Survey 131 and U.S. Survey 47, Township 47 North, Range 5 East; thence South 37 degrees 11 minutes 37 seconds West along said Southwesterly line 72.80 feet to the POINT OF BEGINNING of the herein described tract; thence continuing along said Southwesterly line South 37 degrees 11 minutes 37 seconds East 137.01 feet; thence departing said Southwesterly line the following courses and distances: South 57 degrees 54 minutes 34 seconds West 1023.24 feet, South 32 degrees 40 minutes 35 seconds West 181.33 feet, South 36 degrees 52 minutes 59 seconds East 771.12, South 53 degrees 07 minutes 01 seconds West 332.71 feet, North 10 degrees 28 minutes 16 seconds West 198.67 feet, North 20 degrees 00 minutes 51 seconds East 166.52 feet, North 30 degrees 50 minutes 21 seconds East 404.44 feet, North 04 degrees 38 minutes 30 seconds East 131.00 feet, North 37 degrees 13 minutes 19 seconds West 153.74 feet, and North 57 degrees 54 minutes 34 seconds East 1260.74 feet to the POINT OF BEGINNING and containing 347,048 square feet or 7.967 acres more or less according to a survey by Stock & Associates Consulting Engineers, Inc. dated November 19, 2004, and most recently revised February 15, 2005.

The above property (less exception) contains 6,771,992 square feet or 155.464 acres more or less according to a survey by Stock & Associates Consulting Engineers, Inc. dated November 19, 2004, most recently revised March 9, 2005 and on file with the City of St. Louis.

TRACT II

All of Lot 4 of West Lake Acres Plat II, according to the plat thereof recorded in Plat Book 344 Page 261 of the St. Louis County Records.

The above property is shown on as parcel 3 on a survey by Stock & Associates Consulting Engineers, Inc. dated November 19, 2004, most recently revised March 9, 2005 and on file with the City of St. Louis.

TRACT III

Part of Lots 12 and 13 of the "Foersters Subdivision" in U.S. Survey 131 in Township 46 North, Range 5 East of the Fifth Principal Meridian, St. Louis County, Missouri, said part being more particularly described as follows:

Beginning at the most southerly corner of Lot 4 of Yosti Partition, being the same as the most westerly corner of said Lot 12 of Foersters Subdivision; thence North 45 degrees 59 minutes 04 seconds East, along the northwesterly line of Lots 12 and 13 of Foersters Subdivision, being the same as the southeasterly line of Lot 4 of Yosti Partition, a distance of 1349.58 feet to a concrete monument which marks the most northerly corner of said Lot 13; thence South 36 degrees 53 minutes 01 seconds East, along the northeasterly line of said Lot 13, a distance of 151.17 feet to its intersection with a line which lies 150 feet southeasterly of and parallel to the northwesterly lines of said Lots 12 and 13 of the Foersters Subdivision; thence South 45 degrees 59 minutes 04 seconds West, along said parallel line, a distance of 1303.26 feet to the northerly right of way line of "Old St. Charles Rock Road"; thence North 54 degrees 25 minutes 19 seconds West, along said right of way line, a distance of 152.51 feet to the Point of Beginning.

The above property is shown on as parcel 4 on a survey by Stock & Associates Consulting Engineers, Inc. dated November 19, 2004, most recently revised March 9, 2005 and on file with the City of St. Louis.

TRACT IV

Lot 3 of the Boundary Adjustment Plat of Lots 1 and 3 of West Lake Acres Plat II, according to the plat thereof recorded in Plat Book 348 Page 657 of the St. Louis County Records.

The above property is shown on as parcel 6 on a survey by Stock & Associates Consulting Engineers, Inc. dated November 19, 2004, most recently revised March 9, 2005 and on file with the City of St. Louis.

TRACT V

All of Lot 5 of West Lake Acres Plat II, according to the plat thereof recorded in Plat Book 344 Page 261 of the St. Louis County Records.

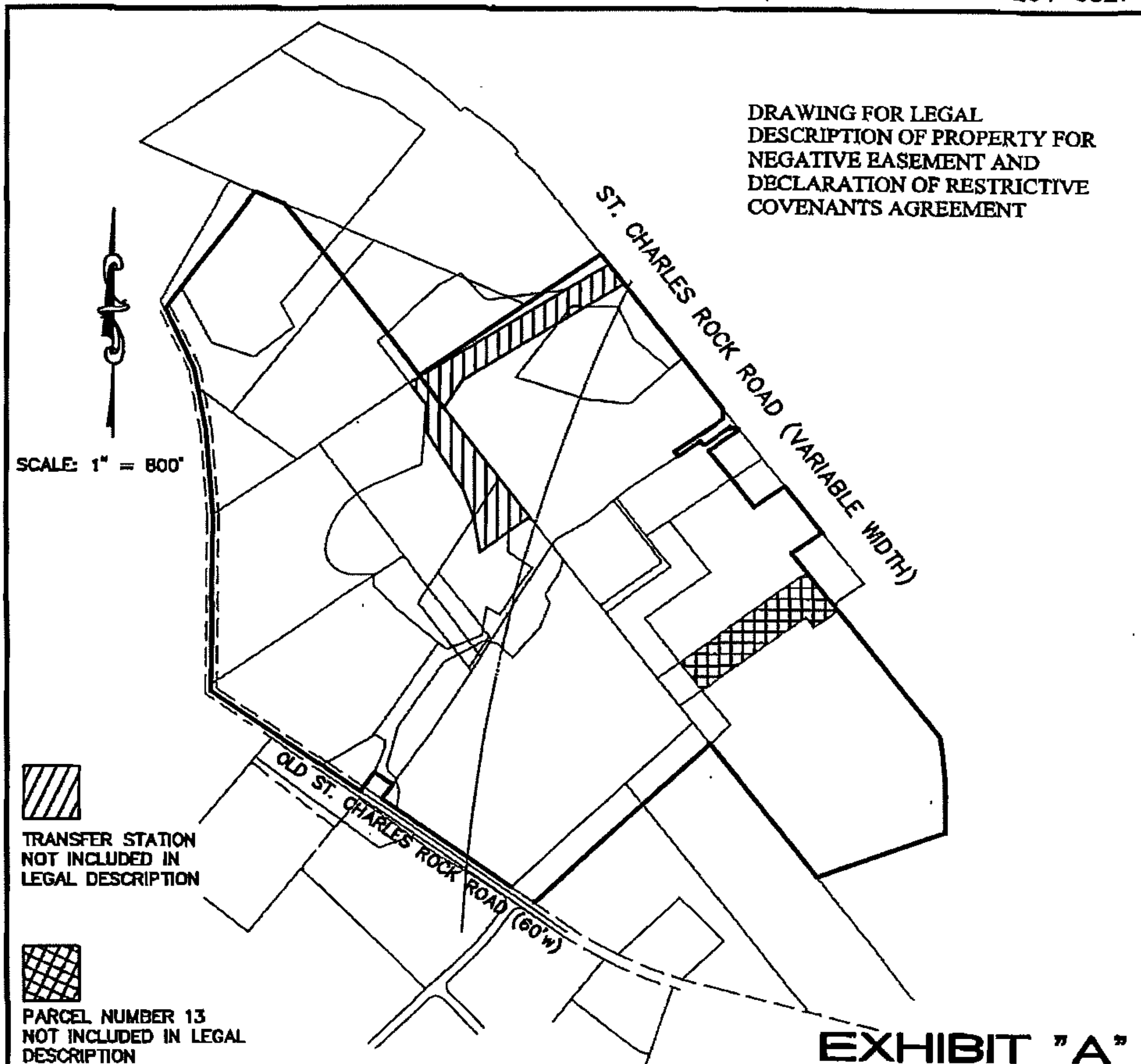
The above property is shown on as parcel 7 on a survey by Stock & Associates Consulting Engineers, Inc. dated November 19, 2004, most recently revised March 9, 2005 and on file with the City of St. Louis.

TRACT VI

Lot 6 of West Lake Acres Plat II, according to the plat thereof recorded in Plat Book 344 Page 261 of the St. Louis County Records.

The above property is shown on as parcel 8 on a survey by Stock & Associates Consulting Engineers, Inc. dated November 19, 2004, most recently revised March 9, 2005 and on file with the City of St. Louis.

DATE 3-9-05 JOB NO. 204-3327



A TRACT OF LAND BEING PART OF WEST LAKE ACRES PLAT II AS RECORDED IN PLAT BOOK 344 PAGE 261, PART OF THE BOUNDARY ADJUSTMENT PLAT OF LOTS 1 AND 3, OF WEST LAKE ACRES PLAT II AS RECORDED IN PLAT BOOK 348 PAGE 667 AND PART OF FOERSTERS SUBDIVISION AS RECORDED IN PLAT BOOK 342 PAGE 68, ALL OF THE ST. LOUIS COUNTY RECORDS; PART OF THE YOSTI PARTITION AS RECORDED IN SURVEY RECORD BOOK 3 PAGE 101 AND PART OF THE ST. CHARLES FERRY COMPANY TRACT AS RECORDED IN PLAT BOOK 7 PAGES 98 AND 99, ALL OF THE ST. LOUIS CITY (FORMER COUNTY) RECORDS AND PART OF US SURVEY 131 LOCATED IN U.S. SURVEYS 47, 131 AND 1934, TOWNSHIPS 46 & 47 NORTH, RANGE 5 EAST OF THE 5TH PRINCIPAL MERIDIAN, CITY OF BRIDGETON, ST. LOUIS COUNTY, MISSOURI

204-3327\SURVEY\3327EXHIBIT.DWG

5

Appendix A-3:

Federal Aviation Administration

Record of Decision

Memorandum of Understanding

Advisory Circulars

U.S. DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration
Central Region
Kansas City, MO

RECORD OF DECISION

For

Lambert-St. Louis International Airport
St. Louis, MO

September 30, 1998

The Federal Aviation Administration has approved Lambert-St. Louis International Airport's proposed airside and landside improvements, commonly known as Alternative W-1W. A Record of Decision (ROD) was signed on September 30, 1998, by FAA Central Region Administrator John E. Turner.

By October 14, 1998, official copies of the ROD may be viewed at the various locations (City Halls, Libraries, FAA and Lambert-St. Louis International Airport) identified in the September 30, 1998, press release *included at the end of this document.*

FEDERAL AVIATION ADMINISTRATION

Record of Decision
Lambert-St. Louis International Airport

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

APPENDICES

1. FAA DECISION

This Record of Decision (ROD) provides final Federal Aviation Administration (FAA) approval for the Federal actions for proposed improvements at Lambert-St. Louis International Airport (Lambert), including construction and operation of a new air carrier length runway (12W/30W). The Federal actions and associated airport development are described in detail in the Final Environmental Impact Statement, Lambert-St. Louis International Airport, dated December 1997 (FEIS). The Federal actions are considered in Section 3, Agency Actions, of this ROD. The FAA's decision is based on the information contained in the FEIS and all other applicable documents available to the FAA and considered by it, which constitute the administrative record.

This ROD is issued in accordance with the requirements of the Council on Environmental Quality (CEQ), 40 CFR 1505.2. The principal features include:

- A statement of the agency's decision;
- An identification of all the alternatives considered by the FAA in reaching its decision, with a specification of the alternative or alternatives that are considered to be environmentally preferable; and
- The means adopted (mitigation measures) to avoid or minimize environmental harm from the alternative selected.

Based on a review of the administrative record and the FEIS approved on December 19, 1997, it is the FAA's final determination that the revised Airport Layout Plan (ALP) for proposed improvements to Lambert, including a new air carrier-length runway, specifically described in Sections 2, 4 and 5 of this ROD, and identified in the FEIS as the "FAA's Preferred Alternative" (Alternative W-1W), is approved. This runway is designated, for planning purposes, as 12W/30W. In addition, the runway is approved as eligible for Federal financial assistance and construction.

These approvals of the ALP and eligibility for Federal funding constitute final approval. The FAA notes that the airport-project sponsor, the St. Louis Airport Authority (STLAA), has agreed to the various conditions of approval, in particular, the conditions requiring mitigation measures.

In reaching this determination, careful consideration has been given to: (a) the needs of Lambert as a part of the national air transportation system and the airport capacity/delay reduction needs through the year 2015; (b) the aviation safety and operational objectives of the project in the light of the various aeronautical factors and judgments presented and (c) the anticipated environmental impacts of the project.

The FAA has carefully considered all reasonable alternatives to the proposed action. Although the “No-Action Alternative” had fewer developmental and environmental impacts than the preferred alternative and was the “environmentally preferred alternative,” it failed to achieve the purposes and needs for this project. The other reasonable development alternative, Alternative S-1, was examined in detail by the FAA and found to provide capacity and delay reduction benefits slightly higher than Alternative W-1W, at higher costs and with greater environmental impacts. Alternative W-1W is more protective than Alternative S-1 of natural resources protected under *49 U.S.C. 47016(c),* park and historic resources protected under Section 303 of the Department of Transportation Act (DOT Section 303, also referred to as Section 4(f)) and Section 6(f) of the Land and Water Conservation Fund Act, and wetlands. For the reasons summarized in this ROD, and supported by detailed discussion in the FEIS, the FAA has determined that the agency’s preferred alternative, Alternative W-1W, is the only possible, prudent and practicable alternative.

A discussion of the leading factors considered by the FAA in reaching this decision follows.

2. BACKGROUND

Over the past decade, the FAA has worked closely with local and regional officials and with the STLAA aviation planning staff to investigate ways to accommodate the increasing passenger and operational activity demands at Lambert. As documented in Section 1.0, Introduction, of the FEIS, the present airport runway configuration, with two closely spaced parallel air carrier runways (12L/30R and 12R/30L), is currently responsible for significant airside delays, particularly during poor weather conditions. It is forecast that this configuration will be responsible for increasing such delays in the future.

The FAA has prepared an FEIS to identify the potential environmental effects associated with the construction and operation of proposed improvements to Lambert. The City of St. Louis, the owner and operator of Lambert, has completed a Master Plan Supplement (MPS) that proposes a comprehensive development program for the expansion of Lambert. The STLAA has submitted an ALP to the FAA for approval and requested from the FAA the Federal environmental approval necessary to proceed with the processing of an application for Federal funds.

AIRPORT DESCRIPTION

Lambert is located 12 miles northwest of the St. Louis central business district. The primary area served by Lambert includes nine counties and the City of St. Louis. This area is referred to as the St. Louis Metropolitan Statistical Area and encompasses approximately 5,340 square miles. Five counties and 24 percent of the service area's population is in Illinois, while four counties, the City of St. Louis, and 76 percent of the service area's population is in Missouri.

Currently, Lambert has two parallel air carrier runways: 12L/30R and 12R/30L. In addition, Lambert has two crosswind runways, Runways 6/24 and 17/35, and Runway 13/31, which is a converted taxiway that is only used for small aircraft in visual daytime conditions. Runway 13/31 will be converted back to a taxiway after the new Runway 12W/30W is operational.

Runway 12R/30L, Lambert's longest runway, is 11,018 feet long, and the parallel Runway 12L/30R is 9,003 feet long. Runways 12R/30L and 12L/30R are separated by 1,300 feet. The airport is reduced to one precision instrument approach during adverse weather conditions because of the minimal separation of the parallel runways.

LAMBERT'S ROLE

Lambert is the primary commercial air carrier airport in the region and is one of the nation's major hub airports. It has consistently been ranked among the top 20 (Airport Council International) most active airports nationally, and in 1996, it ranked 14th in terms of total passengers (enplaned and deplaned) and 8th in total aircraft operations. In 1996, Lambert was served by nine scheduled air carriers, six cargo carriers and six commuter airlines.

Lambert serves as the primary connecting hub for TransWorld Airlines (TWA). In 1996, TWA offered direct service to over 70 cities. Approximately 60 percent of the enplaning passengers at Lambert were connecting passengers.

AIRPORT MASTER PLANNING PROCESS

Lambert-St. Louis International Airport Master Plan

Between the years 1987 and 1993, the STLAA prepared a comprehensive master plan study, the "Lambert-St. Louis International Airport Master Plan" (LAMP). The study developed forecasts of aviation demand through the year 2010 and proposed an airport development plan to enable Lambert to meet future projected demand levels.

The LAMP study culminated with the identification of a preferred airport development plan called Alternative F-4. This alternative proposed to rebuild the entire airfield while the airport continued to operate. Alternative F-4 would have reconfigured and expanded the airfield by rotating the alignment of the airport's main runway system clockwise approximately 10 degrees. This configuration involved the construction of new runways resulting in four parallel Runways (14R/32L, 14L/32R, 13R/31L, and 13L/31R) and the retention of existing crosswind Runway 6/24.

In 1993, a more detailed review of the F-4 concept was accomplished by the STLAA. This review indicated that the costs to construct the proposed F-4 plan would be significantly greater than originally anticipated. There were several problems with this Alternative's "constructability" (e.g., ability to phase and construct the alternative while maintaining continuous 24-hour operations, ability to maintain the hub at Lambert, and ability to operate the terminal and existing runways during construction). In particular, rotation of the airfield and the staging of its development would severely affect the ability of Lambert to operate as a hub for several years. The STLAA determined that it would be prudent to re-examine the development options at Lambert.

Master Plan Supplement

In 1994, the STLAA undertook a review and update to the master planning process at Lambert. This study, called the Master Plan Supplement (previously identified as MPS), re-examined the needs of Lambert. It resulted in the recommended course of development proposed by the STLAA and considered in the FEIS.

Aviation Demand Forecasts

During the development of the MPS, the City of St. Louis developed, refined, and updated aviation activity forecasts for Lambert, which considered the development and growth trends in the region, the aviation growth trends regionally and nationally, and changes in the airline industry. Before facility requirements were determined, the STLAA submitted forecasts representing unconstrained conditions to the FAA for its review and approval. The FAA approved the forecasts representing unconstrained conditions during the development of the MPS. Subsequently, the FAA issued FAA Safety Notice N7110.157, "Wake Turbulence." The Safety Notice has the effect of reducing airport capacity due to the recategorization of certain aircraft types and a resulting increase in separation standards. Taking into consideration the recently published guidelines, the FAA recognized that the unconstrained forecasts for the No-Action Alternative might not be achievable, given the configuration of the current runways. Therefore, the forecasts for the 2015 No-Action Alternative were adjusted to represent a constrained condition.

The MPS revised forecasts indicate that in the year 2015, Lambert has the potential to accommodate approximately 632,000 aircraft operations with the selected action, as compared to 595,000 aircraft operations without the proposed improvements. The FAA's revised 2015 No-Action constrained forecast for Lambert was 532,000 operations. The forecasts used in the FEIS and the FAA's Terminal Area Forecasts (TAF) are within the same range. Although the TAF are slightly higher than the FEIS forecasts, the differences are within a range that FAA considers to be insignificant and within the range of acceptable aviation forecasting.

Facility Requirements and Alternatives Analysis

A facility requirements analysis was accomplished to identify the shortfalls of the existing airport and to identify development items that would enable Lambert to effectively solve the shortfalls and meet projected demand levels. The analysis examined major components of the airport, including runways, airspace, terminals and ground transportation. This evaluation confirmed that Lambert needed an east-west parallel runway system capable of accommodating simultaneous independent Instrument Flight Rules (IFR) approaches.

The MPS included a comprehensive re-evaluation of possible development options, including an analysis of the alternatives studied as part of the previous LAMP. It was determined that the use of a Precision Runway Monitor (PRM) would enable consideration of runway development alternatives, which were rejected in previous studies. PRM is a system comprised of a rapid update radar, an enhanced color graphic monitor, and software package which aids the air traffic controller in more accurately monitoring the position of aircraft on final approach to a runway. PRM is the primary tool that has allowed the FAA to approve simultaneous independent instrument approaches to parallel runways spaced as little as 3,000 feet apart (3,400 feet for straight-in approaches). The PRM allows sufficient runway separation to allow simultaneous independent IFR approaches during marginal visual and instrument meteorological conditions. The alternatives analysis process considered operational, financial and environmental factors. From an initial list of more than 40 development concepts, the STLAA selected the airport development alternative, designated Alternative W-1W, as its preferred alternative.

THE PROPOSED IMPROVEMENTS TO LAMBERT

The STLAA has proposed airside and landside improvements to Lambert to enable the airport to meet projected levels of activity. The City's preferred development alternative, known as W-1W, includes a new parallel runway (12W/30W), 9,000 feet long by 150 feet wide, located at the southwestern side of Lambert in the City of Bridgeton. This runway will be located parallel to and 4,100 feet from existing runway 12L/30R with a staggered threshold of approximately 12,100 feet. This runway has been proposed to improve airfield capacity during both visual meteorological conditions (VMC) and instrument meteorological conditions (IMC).

The two parallel runways at Lambert, which are 1,300 feet apart, are too close together to allow simultaneous independent approaches. With the proposed improvements, the weighted hourly capacity at Lambert will be increased. With the use of a PRM, the separation of the new runway from the existing runways will be of sufficient distance to allow the airport to accommodate simultaneous independent approaches during IMC. Lambert does not currently have this capability. This feature will allow Lambert to reduce delay times, improve adverse weather capabilities, enhance capacity, and continue to accommodate hubbing operations such as the system TWA is now using at Lambert.

Other associated actions include property acquisition, terminal expansion, roadway improvements, and relocation of several airport tenant operations. A summary of the major components of the development plan and the proposed phasing is provided in Section 5, Alternatives Analysis, of this ROD.

EIS PROCESS

On August 17, 1995**,** the FAA began the public phase of the environmental process involving STLAA site-specific development proposals, which included a new runway for Lambert, by announcing in the Federal Register (60 Fed. Reg. 42938) its intent to prepare an Environmental Impact Statement (EIS), and by requesting scoping comments. Scoping meetings were held with the general public and with Federal, state and local agencies on September 6 and 7, 1995. See FEIS Section 7.0, regarding public involvement, and FEIS Appendix J, for a summary of scoping comments.

On October 4, 1996**,** a Notice of Availability of the Draft Environmental Impact Statement (DEIS) was published in the Federal Register (61 Fed. Reg. 51939). Public comments were taken on the DEIS from the date of its release until January 17, 1997. A public hearing was held on October 28, 1996. Appendix V of the FEIS contains a summary of comments and responses on the DEIS, which were received from the public and government agencies during the hearing as well as through the mail.

The FEIS was approved by the FAA on December 19, 1997, and released to the public on December 22, 1997. The FEIS addressed areas of public concern by way of modifications to the DEIS text and specific responses to public comments.

Pursuant to 40 CFR 1506.10, the U.S. Environmental Protection Agency (EPA) published a notice of the availability of the approved FEIS in the Federal Register on January 2, 1998 (63 Fed. Reg. 75). According to CEQ regulations, the FAA was required to wait a minimum of 30 days after the notice of availability of the approved FEIS before issuing its ROD. That 30-day waiting period has passed.

Although the FAA did not solicit public comment on the FEIS, several public agencies, community groups, and citizens submitted written comments for agency consideration. The FAA has to the extent practicable considered all comments received on the FEIS. Appendices A, B, C, D, E and G of the ROD respond to substantive agency and public comments on the FEIS and any new significant issues that have arisen.

3. AGENCY ACTIONS

The Federal actions are:

1. The approval of revisions to the ALP for construction and operation of proposed Runway 12W/30W and associated improvements, listed in full in Section 3.4.3 of the FEIS;

2. The Federal environmental approval necessary to proceed with processing of an application for Federal funding for those development items qualifying under the former Airport and Airway Improvement Act of 1982, as amended and recodified at *49 U.S.C. 47101 et seq.*; and

3. The approval of associated safety actions.

The City of St. Louis may also submit an amendment to its passenger facility charge (PFC) application to the FAA in order to use such PFC revenues for eligible portions of the proposed project. Although future projects other than Runway 12W/30W are depicted on the ALP, the City of St. Louis is requesting final environmental approval only for the runway and associated projects assessed as part of Phase I through the year 2000 and Phase II (2002-2015) in the FEIS. It is recognized that other projects may require additional environmental analysis when ripe for decision at a later date and will only be conditionally approved by the FAA on the ALP at this time.

The U.S. Army Corps of Engineers (COE), a cooperating agency for the FEIS, will be responsible for permitting processes under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act. In addition, the U.S. Air Force (USAF) and the U.S. Navy (Navy) will be preparing separate RODs, when appropriate, for the relocation of their facilities. The necessary approval actions required by the Federal Highway Administration (FHWA) are included in Section 8, Cooperating Agencies, of this ROD.

The necessary FAA determinations and approvals are summarized below:

a. Determination of project eligibility for Federal grant-in-aid funds (*49 U.S.C. Section 47101*, *et. seq.*) and PFC funds (*49 U.S.C. Section 40117*), for land acquisition and relocation (49 CFR Part 24), site preparation, runway, taxiway, runway safety area, and other airfield construction, terminal and related landside development, navigational and landing aids, roadway improvements and environmental mitigation.

b. Determination regarding air quality conformance of the proposed facility with applicable air quality standards under the Clean Air Act, as amended (*42 U.S.C.*

Section 7506, Section 176 (c) (1), and 40 CFR Part 93). (The FAA issued a Final General Conformity Determination and published a notice in the *St. Louis Post Dispatch* on June 29, 1998.)

c. Approvals for establishment of new instrument landing systems (ILS) and associated approach lighting systems and navigational aids, including use of a PRM, as appropriate, for the new runway, the existing runways, and the airport as a whole (*49 U.S.C. Section 44502 (a) (1)*).

d. Decisions to develop air traffic control and airspace management procedures to effect the safe and efficient movement of air traffic to and from the proposed new runway. This includes the development of a system for the routing of arriving and departing traffic and the design, establishment, and publication of standardized flight operating procedures, including instrument approach procedures and standard instrument departure procedures (*49 U.S.C. Section 40103 (b)*).

e. Determinations, through the aeronautical study process, under 14 CFR Part 77, regarding obstructions to navigable airspace (*49 U.S.C. Section 40103 (b) and 40113*).

f. Determinations under 14 CFR Part 157 as to whether the FAA objects to the airport development proposal from an airspace perspective, based upon aeronautical studies (*49 U.S.C. Section 40113 (a)*).

g. Determinations under the *49 U.S.C. Sections 47106 and 47107* pertaining to FAA funding of airport development (including approval of a revised ALP, *49 U.S.C. Section 47107 (a) (16)*), environmental approval (*42 U.S.C. Sections 4321-4347*, and *40 CFR Section 1500-1508*), and approvals under various executive orders discussed in the ROD.

h. A certification that the proposed facility is reasonably necessary for use in air commerce or for the national defense (*49 U.S.C. Section 44502 (b)*).

i. FAA review and approval of amended Airport Certification Manual (14 CFR Part 139).

j. FAA determination that there would be no undue burden (unusual circumstances) barring the sponsor from obtaining a Section 404 permit for the filling of wetlands.

k. FAA determination that there would be no undue burden (unusual circumstances) barring the sponsor from obtaining a National Pollutant Discharge Elimination System (NPDES) permit for stormwater and wastewater discharges.

4. PURPOSE AND NEED

The identification of a proposed action's purpose and need is the primary foundation for the identification of reasonable alternatives and the evaluation of the impacts of the development. In exercising its authority and in the public interest, the FAA considers assigning, maintaining and enhancing safety and security as its highest priority (*49 U.S.C. 40101(d)*). This is the FAA's first consideration in evaluating the purpose and need for any proposed airport improvements.

The *purpose* of the proposed action is to:

1. Enable Lambert to effectively and safely accommodate projected levels of aviation activity at an acceptable level of delay by:
   - Increasing airfield capacity.
   - Improving visual flight rules (VFR) capacity.
   - Allowing dual simultaneous independent IFR arrival operations.
   - Decreasing delays.
2. Enhance the National Airspace System (NAS) by:
   - Reducing delays nationwide.
   - Increasing airfield capacity.
3. Recognize the importance of the economic benefits provided by Lambert and allow the local communities and the region to continue to reap those economic benefits.
4. Facilitate the airline hub at St. Louis, which is vital to alleviating projected shortfalls in capacity at Lambert and in the NAS. This is interrelated with all of the above purposes for the proposed project.

The proposed action is *needed* because:

1. The existing airport is severely constrained and it is projected that the airport will be unable to adequately meet projected levels of demand without incurring unacceptable operational delays;

2. As an important component of the NAS, Lambert cannot be allowed to become a “bottleneck,” because it would have detrimental ripple effects throughout the airspace system; and

3. The airport serves an important function in providing economic benefits important to the airport sponsor and the region.

INCREASED AIRFIELD CAPACITY

The 9,000-foot length of Runway 12W/30W will accommodate the operation of most of the aircraft types currently operating and projected to operate at Lambert. Both ends of Runway 12W/30W will be equipped with an ILS. In addition, the PRM, which is to be installed for the existing airfield, will be used for the new runway.

The increased airfield capacity provided by Runway 12W/30W will substantially reduce the existing and projected average annual delay time per aircraft operation. These estimated decreases in delay time will result in annual savings in aircraft delay costs. Conversely, estimated aircraft taxiing distances and time will slightly increase aircraft operating costs as a result of Runway 12W/30W. Taken together, there will be an estimated net savings in aircraft delay costs and taxiing costs of close to $100 million in the year 2005 and approaching $300 million in the year 2015.

PASSENGER HUB EFFICIENCY

The continued use of Lambert as an effective major airline hub will be constrained if the airport facilities are not expanded to accommodate future demand. One key airside feature associated with other hub airports that is absent from Lambert is simultaneous independent IFR arrival capability (including marginal VFR). The lack of independent IFR arrival capability greatly impacts the ability of a hub airline in St. Louis to effectively meet projected demand. Without an improvement in IFR and marginal VFR operating capability, the reliability of services at Lambert will be increasingly burdened during the periods of the year when IFR and marginal VFR weather conditions occur (approximately 14 percent of the year). Without terminal and airfield expansion capabilities, it will be difficult for Lambert to continue as an effective hub airport. This lack of facilities and expansion capabilities will result in increased delay times, decreases in airport capacity, and increased costs to the airlines and the traveling public.

From a national perspective, it is in the interest of the FAA to maintain an airline hub at Lambert. The FAA believes that due to its central location in the U.S. and its local market, St. Louis is a natural hubbing location. St. Louis is the only place within hundreds of miles in any direction where there are both a very large air travel origination/destination market and airport capacity that can handle substantial hubbing activity. Keeping the traffic that now hubs at St. Louis flowing smoothly and efficiently is critical to the entire national aviation system.

MULTIPLE AIRPORT SYSTEMS

Shifting some of Lambert's operations to another airport to relieve existing and future forecast capacity problems has been debated and studied for several years. Recent studies have found that, even though there are nearby available facilities capable of handling commercial jet traffic, such as Scott Air Force Base/Mid-America Airport (Scott AFB/MAA), the overflow of commercial jet operations from Lambert to other airports in the region would not efficiently solve the capacity problem because most of the aviation activity is associated with airline hubbing. The lack of a sponsor for airport expansion in another political jurisdiction is a reality that the FAA is authorized to consider under CEQ regulations. Correspondence from St. Clair County, the operator of MAA (which is a joint-use facility with SCOTT AFB), indicates that St. Clair supports Lambert as the regional hub.

Use of multiple airports would complicate the hubbing issue, because an adequate level of peak-hour operations required to maintain hubbing operations at one location might not be obtainable if traffic were split between two airports. In this case, both airports would lose. In addition, a threshold of 10 to 12 million originating passengers is needed for a community to support a second commercial service airport. The St. Louis forecasts indicate that originating passengers for the St. Louis metropolitan area in the year 2015 would be approximately 8.7 million, below the threshold for a second commercial service airport.

The continued use of Lambert as a major airline hub is in question, unless expanded to accommodate future demand. St. Louis competes with other airline hubs that are being or have been expanded. Unless more operational capability is provided, Lambert's ability to compete will be limited.

ECONOMIC BENEFITS

Lambert plays an important role in supporting the economic goals of the St. Louis metropolitan region. Over the years, Lambert has evolved into one of the largest employment and income centers in the region. The proposed Runway 12W/30W project will strengthen Lambert as a major economic asset that serves as a vital link to the nation and world, as well as a significant employment and income center.

5. ALTERNATIVES ANALYSIS

In addition to the relevant environmental statutes, the FAA in its consideration of alternatives, has been mindful of its statutory charter to encourage the development of civil aeronautics and safety of air commerce in the United States (*49 U.S.C. 40104*). FAA has also considered the congressional policy declaration that airport construction and improvement projects that increase the capacity of facilities to accommodate passenger and cargo traffic be undertaken to the maximum feasible extent so that safety and efficiency increase and delays decrease (*49 U.S.C. 47101(a)(7)*).

While the FAA does not have the authority to control or direct the actions and decisions of the STLAA relative to planning for this project, it does have the authority to withhold project approval, including Federal funding and the other Federal actions discussed in this ROD. It was from this perspective that the various alternatives were considered in terms of evaluating and comparing their impacts to determine whether there was an alternative superior to that proposed by STLAA, or whether STLAA's proposal would cause impacts warranting disapproval of the Federal actions discussed in this ROD, including the withholding of Federal funds for the project.

The FAA identified numerous alternatives to the proposal (reference FEIS Section 3.2). During this exploration of alternatives, all reasonable alternatives were carefully examined, ranging from doing nothing to specific runway alignments at Lambert. After considering all reasonable alternatives, the FAA selected the construction of Runway 12W/30W and associated projects as the agency's preferred alternative in the FEIS. The FAA identified Alternative X-1, the No-Action Alternative, as the environmentally preferable alternative. Other alternatives were eliminated for a variety of reasons as discussed below.

The DEIS alternatives evaluation utilized a three-tiered evaluation process that concentrated on the purpose and need for the proposed project. The first tier evaluated whether the various alternatives met the purpose and need criteria established in Section 2.0 of the DEIS. Alternatives that satisfied these criteria were retained for evaluation under the second tier of analysis. The second tier evaluated the "constructability" (ability to phase and construct the alternative while maintaining continuous 24-hour operations, ability to maintain the hub at Lambert, and ability to operate the terminal and existing runways during construction), and the benefit/cost ratio (BCR) of the alternatives (BCR of less than "1" indicates costs outweigh economic benefits, greater than "1" indicates economic benefits outweigh costs). Alternatives that met these criteria were retained for evaluation under the third tier of analysis. The third tier evaluated multiple specific criteria relating to operational efficiency (taxi times, delay times), cost per passenger (lower costs vs. higher costs) and environmental impacts (noise, land use, social, etc.).

As part of Tier 3, the FAA analyzed the best representative alternatives from the remaining families of alternative runway alignments. The best representative selected for detailed analysis within each family was the best overall environmentally, particularly as to resources protected under special purpose environmental laws. This approach is consistent with guidance in CEQ's Forty Questions (Question 1), which provides that: "When there are potentially a very large number of alternatives, only a reasonable number of examples, covering the full spectrum of alternatives, must be analyzed and compared in the EIS. ... What constitutes a reasonable range of alternatives depends on the nature of the proposal and the facts in each case."

Alternatives that met the criteria under the third tier of analysis, were the best in their families and had the least overall environmental impact were retained for detailed analysis in subsequent sections of the DEIS. Table S.1 contains a summary of the tiered analysis used in the alternatives analysis for the DEIS (Appendix J of this ROD, FEIS Summary).

The alternatives explored in the FEIS include the following:

REASONABLE ALTERNATIVES EXAMINED AND ELIMINATED FROM DETAILED ANALYSIS

- Other modes of transportation, including surface transportation alternatives such as rail, bus and automobiles.

- Construct a new airport to replace Lambert.

- A multiple-airport system with a supplemental airport in addition to Lambert.

- Airfield alignment alternatives:
  - North Airfield Alternatives: N-1, NE-1, NE-1a
  - West Airfield Alternatives: W-1E, W-2
  - South Airfield Alternatives: Modified S-1
  - Canted Airfield Alternative: C-1

- Other on-airport alternatives:
  - Bridgeton's Lambert 2020 Plan
  - Hyland Plan
  - Alternative runway lengths
  - Existing facility with advanced navigational aids

These alternatives were rejected for the following reasons:

1. Other modes of transportation do not fulfill the main needs for improving Lambert. They do not meet local aviation needs, nor enhance the economic contribution of Lambert to the region, or strengthen Lambert's role in the NAS. Other modes, including automobiles, buses and rail, have a complementary role to air travel, not a replacement one. Further, the other modes do not provide the fast, flexible and efficient long-distance transportation needed by the public and provided by Lambert.

2. The construction of a new regional airport is not a viable solution to satisfy the projected capacity deficiency at Lambert in the foreseeable future due to time and cost requirements.

3. Although several other airports exist in the region, none--individually or collectively--can adequately accommodate the anticipated traffic from Lambert, fulfilling the need for the new runway. Multiple reasons are responsible: airline hubbing, lack of facilities at other airports, detrimental environmental impacts and airspace conflicts and constraints.

4. Although several on-airport runway alignment alternatives were considered, most were eliminated from detailed study. The FEIS examined in detail only those alternatives that provide for a similar magnitude of development and have the capability of providing simultaneous independent IFR arrival operations, which are considered critical to the operation of the airline hub. The airfield alignment alternatives and other on-airport alternatives not retained for detailed study were considered either: (a) to be infeasible and/or imprudent (in the case of alternatives not retained at Tiers 1 or 2), or (b) to present equivalent or greater impacts to parks and wetlands (in the case of alternatives not retained at Tier 3, the “best in family” comparison).

ALTERNATIVES CONSIDERED IN DETAIL

No-Action Alternative (X-1)

The No-Action Alternative would not accomplish the critical elements of the purpose and need that the selected alternative will provide. The No-Action Alternative (X-1) is depicted in Figure S.1 of the FEIS Summary (Appendix J of this ROD). Although the No-Action Alternative would be the least disruptive in terms of development impacts, it would not solve the capacity needs or delays existing at Lambert Airport, and thus would not achieve the purposes and needs for the proposed action. The No-Action Alternative would not provide capacity, delay reductions nor benefits to the community. In addition, the No-Action Alternative would not give Lambert the necessary operating flexibility provided by the selected alternative. To do nothing would, under some circumstances, actually exacerbate environmental conditions; for example, selection of the No-Action Alternative would worsen air quality as compared to the selected alternative. The environmental impacts associated with Alternative X-1 include increased air emissions and energy consumption due to added delay.

Alternative S-1

Alternative S-1 consists of the following developments, which would be initiated and/or completed by the year 2002:

- Land acquisition (approximately 1,332 acres) and associated relocation of homes and businesses.

- Construction of a new 9,000-foot parallel runway south of highway I-70. The new runway would be laterally separated by at least 5,500 feet from existing Runway 12L/30R. Although a PRM, for enhanced air traffic control of existing operations, has been installed at Lambert (projected commissioning scheduled for November 1998), Alternative S-1 would not require the use of a PRM.

- Construction of two new dual taxiway bridges across I-70.

- Construction of related taxiways, lighting, navigational aids, grading, drainage and utility relocations.

- Implementation of air traffic control procedures below 3,000 feet above ground level (AGL).

- Renovation and expansion of existing terminal facilities and associated aprons.

- Demolition of portions of the East Terminal Complex for Connector Taxiway construction.

- Relocation of airline support facilities.

- Implementation of mitigation measures and acquisition of permits.

- Improvements to I-70/Airport Terminal Interchange.

- Relocation of the Missouri Air National Guard (MoANG) and Navy/Marine Corps Reserve facilities.

- Realignment of McDonnell Boulevard, Lambert International Boulevard, and portions of the Metro Link light rail.

- Closure of numerous local roads between I-70 and what would become Lambert's new southern boundary.

Alternative S-1 also has one Phase II project that would be developed between the years 2002 and 2015:

- Construction of new landside terminal facilities, west of the existing terminal, possibly located at the current location of the MoANG and Navy/Marine Corps Reserve facilities. A portion of the terminal facilities may be located west of Runway 6/24.

The S-1 Alternative is depicted in Figure S.2 of the FEIS Summary (Appendix J of this ROD).

The S-1 concept was refined during the DEIS to ensure that the proposed parallel taxiways over I-70 would meet FAA design criteria. It was found that both pairs of taxiways would need to be shifted in order to meet FAA taxiway grade criteria of 1.5 percent. The shift in the east pair would require demolition of the East Terminal Complex and relocation of a portion of the Metro Link commuter rail system. The shift in the west pair from a perpendicular alignment to a slightly northwest diagonal alignment was also necessary to allow the taxiways to clear I-70 and meet FAA taxiway grade criteria.

Operational Considerations

Operationally, Alternative S-1 fulfills all of the first tier purpose and need review criteria, because it would allow dual simultaneous IFR arrival operations during IMC, improve VFR capacity at Lambert, help enhance the NAS, allow the passenger hub to remain at Lambert, and would be consistent with local planning and economic goals.

Of the reasonable alternatives retained for detailed evaluation, the FAA acknowledges that Alternative S-1 is superior from an operational standpoint. Alternative S-1 has a shorter stagger of runway threshold locations than Alternative W-1W. The absence of this stagger eliminates the double dependency of departures from the future center runway (existing Runway 12R/30L) with arrivals on the outboard runways (30R and 30W) in west flow conditions. Alternative S-1 would be more airfield-efficient and would reduce taxi times when compared to Alternative W-1W.

Financial Feasibility

A detailed analysis of the financial implications of each of the reasonable alternatives was prepared as part of the MPS. The results of this analysis indicate that for Alternative S-1, year 2015, the total savings in annual aircraft operating cost is calculated to be $329 million, cost per passenger is projected at $13, total construction cost is estimated to be $2.4 billion and the BCR is calculated to be 1.8. With a BCR of 1.8, the economic benefits of implementing this alternative are almost twice as great as the costs associated with its construction. However, the refined design of Alternative S-1, shifting the taxiways, would add approximately $75 to $100 million to the cost of Alternative S-1. This would bring the cost of Alternative S-1 up to approximately $2.5 billion and the per-passenger cost to over $13. The BCR would consequently be reduced to less than 1.8.

Environmental Impacts

Alternative S-1 would result in adverse environmental impacts including: the acquisition and displacement of established land uses, such as homes, schools, churches, and businesses; shifting aircraft noise exposure patterns over sensitive areas; impacting park and archaeological resources; requiring development in wetland and floodplain areas and potentially disrupting several hazardous materials sites.

Alternative S-1 would require the acquisition of approximately 4,528 households (relocating approximately 9,725 people), 210 businesses, 8 schools and 6 churches. The areas of acquisition would include the northern part of the City of St. Ann (displacing approximately 2,556 people), all of the City of Edmundson (approximately 1,107 people), two-thirds of the City of Woodson Terrace (2,640 people), the southwest part of the City of Berkeley (1,847 people), part of Bridgeton (406 people) and part of the City of St. John (1,169 people). Operations on the new south runway could increase aircraft noise levels at the University of Missouri-St. Louis campus to the southeast. Alternative S-1 would directly affect nine park and recreational areas (57 total acres), requiring replacement.

Alternative W-1W

Alternative W-1W consists of the following developments, which would be initiated and/or completed by the year 2002 (Phase I):

- Land acquisition (approximately 1,568 acres) and associated relocations of homes and businesses.

- Construction of a new runway complex parallel to and southwest of existing runways 12L/30R and 12R/30L. Runway 12W/30W would be 9,000 feet in length and 150 feet in width and would be capable of handling air carrier jet aircraft. The parallel runway would be laterally separated by 4,100 feet from existing Runway 12L/30R and would be south and west of existing Runway 6/24. A PRM, for enhanced air traffic control of existing operations, has been installed at Lambert (projected commissioning scheduled for November 1998). Alternative W-1W would require the use of a PRM.

- Construction of related taxiways, lighting, navigational aids, grading, drainage, and utility relocations.

- Implementation of air traffic control procedures below 3,000 feet AGL.

- Renovation and expansion of existing terminal facilities and associated aprons.

- Relocation of airline support facilities.

- Relocation of the MoANG and Navy/Marine Corps Reserve facilities.

- Realignment of Lindbergh Boulevard and construction of a roadway tunnel for those portions of Lindbergh Boulevard impacted by the construction of the new runway and the optional future extension of existing Runway 12R/30L.

- Realignment or relocation of roadways, including Natural Bridge Road, Bonfils Road, Fee Fee Road, Cypress Road, Gist Road, Lambert International Boulevard, Missouri Bottom Road and McDonnell Boulevard.

- Improvements to the I-70/Airport Terminal Interchange.

- Implementation of mitigation measures and acquisition of permits.

Alternative W-1W, Phase II projects that would be developed between the years 2002 and 2015 include the following:

- Construction of new landside terminal facilities (up to approximately 110 gates), west of the existing terminal, possibly located at the current location of the MoANG and Navy/Marine Corps Reserve facilities. A portion of the terminal facilities may be located west of Runway 6/24.

Phase III projects are beyond the 20-year planning period and are not specifically programmed for implementation. Possible projects that may be developed in Phase III, after the year 2015, include:

- Construction of a 2,500-foot extension to the northwest end of existing Runway 12R/30L.
- Additional construction of new west landside terminal facilities.
- Construction of a new airport access roadway from I-270 to the new west landside terminal complex.
- Demolition of the existing terminal complex and construction of new east airfield terminal concourses.

Alternative W-1W is depicted in Figure S.3 of the FEIS Summary (Appendix J of this ROD).

Operational Considerations

Operationally, Alternative W-1W fulfills all of the first tier purpose and need review criteria in the FEIS, because it would allow dual simultaneous IFR arrival operations, improve VFR capacity at Lambert, help enhance the NAS, allow the passenger hub to remain at Lambert and would be consistent with local planning and economic goals.

Financial Feasibility

The results of the MPS financial feasibility analysis indicate that for Alternative W-1W, in the year 2015, the total savings in annual aircraft operating cost is calculated to be $297 million, cost per passenger is projected at $10.50, total construction cost is estimated to be $2.2 billion, and the BCR is calculated to be 2.2. The BCR of 2.2 indicates that the economic benefits of implementing this alternative are more than twice as great as the costs associated with its construction. An independent benefit/cost analysis (BCA), conducted by FAA's Systems and Policy Analysis Division (APO-200), determined that Alternative W-1W had a BCR of 2.6.

Environmental Impacts

The adverse environmental impacts that would result from Alternative W-1W include the acquisition and displacement of established land uses including homes, schools, churches and businesses; shifting aircraft noise exposure patterns over sensitive areas; impacting park, historic and archaeological resources; requiring development in wetland and floodplain areas and potential disruption of several hazardous materials sites.

Alternative W-1W would require the acquisition of approximately 2,324 households (relocating approximately 5,680 people), 75 businesses, 6 schools, 6 churches and one nursing home for airfield development and surface transportation improvements. The areas of acquisition would be in the City of Bridgeton (displacing approximately 5,404 people), and the City of St. Ann (displacing 276 people). Alternative W-1W would directly affect four park and recreational areas (26 total acres), requiring replacement. The 12W end of the proposed runway would also be located within 10,000 feet of an existing active landfill and would not be consistent with FAA's current runway siting guidelines without mitigation.

THE FAA'S SELECTED ALTERNATIVE (ALTERNATIVE W-1W)

The FAA finds that the selected alternative is preferred principally because it enhances capacity and reduces delay for Lambert and the total NAS. The FAA in this ROD approves the preferred alternative.

Alternative W-1W was selected rather than Alternative S-1 because it meets purpose and need and is environmentally superior to S-1. Alternative W-1W has fewer impacts on people to be relocated, and less severe impacts on resources protected under special purpose laws (e.g., parks, wetlands).

The FAA has made its required special purpose law determinations that there is no possible, prudent and practicable alternative to Alternative W-1W, based upon the following information (see also Appendix J of this ROD, Table S.1A, page S-9):

- Both development alternatives would have unavoidable impacts on resources protected under Section 303 of the Department of Transportation Act and Section 6(f) of the Land and Water Conservation Fund Act. There are no possible or prudent alternatives to the use of these resources. Alternative W-1W will use approximately half the park and recreational resources and acres that would be required for Alternative S-1.

- Both Alternatives W-1W and S-1 would have unavoidable wetland impacts due to the proximity of wetlands to the airport. Consequently, there are no practicable alternatives to filling of wetlands. Alternative W-1W has the least amount (acreage) of wetland impacts.

- There is no practicable alternative to the floodplain impacts of Alternative W-1W. Mitigation measures to minimize the floodplain impacts can be accomplished. The floodplain encroachment will not be considered significant.

The FAA has also considered that the preferred alternative proposed in the FEIS has withstood extensive public scrutiny throughout the public involvement process. The FAA recognizes that some segments of the community strongly oppose Alternative W-1W. Lambert has been conducting ongoing negotiations with the neighboring cities to resolve issues related to the impacts and mitigation proposed in the FEIS.

Because the FAA determined that Alternative W-1W is the least impacting alternative, overall, it selected Alternative W-1W as the preferred alternative. A comparative table summarizing Alternatives X-1, S-1 and W-1W is contained in Table S.2 of the FEIS Summary (Appendix J of this ROD).

However, a few key comparisons of impacts to the communities are:

	Alternative S-1	**Alternative W-1W**
Number of people to be relocated	9,725	5,680
Number of households to be relocated	4,528	2,324
Number of residential parcels to be acquired	2,902	1,937
Number of businesses to be relocated	210	75
Number of schools to be acquired	8	6
Number of churches to be acquired	6	6
Number of nursing homes to be acquired	0	1
Number of parks directly affected	9	4
Acreage of parks directly affected	57	26
Acreage of parks affected	10.8	9.7
Acreage of floodplains affected	51	57

Accordingly, having considered: (1) the policies set forth at *49 U.S.C. Sections 40104 and 47101*, (2) the ability of the alternatives to meet the purpose and need, and (3) the administrative record which concerns these development projects, the FAA hereby selects the W-1W development recommended in the FEIS.

The FAA's approval of these expansion and improvement projects in this ROD signifies that these projects meet FAA standards for agency approval discussed in Section 3 of this ROD. It does not, however, signify an FAA commitment to provide a specific level of financial support for these projects, which must await future decisions under the criteria prescribed by *49 U.S.C. 47115(d) and 49 U.S.C. 40117*.

6. *MAJOR IMPACTS AND MITIGATION*

In accordance with 40 CFR 1505.3, the FAA will take appropriate steps, through Federal funding grant assurances and conditions, PFC "use" approvals, airport layout plan approvals and contract plans and specifications to ensure that the following mitigation actions are implemented during project development. The FAA will monitor the implementation of these mitigation actions as necessary. The approvals contained in this ROD are specifically conditioned upon full implementation of these mitigation measures. These mitigation actions will be made the subject of a special condition included in future airport grants to the STLAA.

A detailed environmental analysis of the potential environmental impacts resulting from the construction and operation of the selected alternative was accomplished as part of the FEIS. Two study periods were examined, 2002 and 2015. The year 2002 is projected to be the first year that the new runway and associated development will be operational. The year 2015 is the outside planning period of the MPS and when most of the ALP's recommendations will be operational. Twenty-two different environmental impact categories were examined.

SUPPLEMENTAL TECHNICAL REPORTS

Supplemental technical reports have been prepared, published and distributed separately from the FEIS. These reports address the potential direct and indirect effects to resources protected under special Federal laws. The following lists each of these reports and the relevant Federal law:

- Section 303 and 6(f) Evaluation - *49 U.S.C. Sections 303* [Recodified from and commonly known as Section 4(f) of the Department of Transportation Act 1966]; and the Land and Water Conservation Fund Act;
- Section 106 Documentation associated with the Final Environmental Impact Statement - Section 106 of the National Historic Preservation Act of 1966; and
- Draft and Final General Conformity Determinations - Federal Clean Air Act and State of Missouri requirements.

IMPACTS AND MITIGATION

This section of the ROD includes a summary of the mitigation measures, discussed more fully in the FEIS, Section 6.3, for each environmental impact category.

The primary responsibility for implementation of the mitigation program rests with the STLAA. The FAA will have oversight responsibility and will condition grant agreements and/or PFC "use" approvals upon completion of the mitigation program by the City of St. Louis. Mitigation measures for those impact categories where mitigation measures are necessary to avoid or minimize significant environmental impacts, as well as identified or adopted monitoring and enforcement programs, are summarized below. The FAA finds that all practical means to avoid or minimize environmental harm have been adopted, through appropriate mitigation planning.

Noise and Compatible Land Use Impacts and Mitigation

Because of the effects of the introduction of quieter Stage 3 aircraft, noise levels are projected to decrease in future years. For this reason, even with the selected alternative, there will be a significant reduction in land area and population impacted by noise in the years 2002 and 2015 when compared to current conditions. For future year comparisons, Alternative W-1W will impact fewer people within the Day-Night Equivalent Sound Level (DNL) 65 dB contour than Alternative S-1, but more than Alternative X-1, in both 2002 and 2015. A review of the proposed roadway improvements and realignments for Alternative W-1W indicates that traffic noise impacts would be minimal. Noise impacts resulting from the proposed airport development will be mitigated through measures identified in Section 6.3.1 of the FEIS.

The noise mitigation program for the selected alternative consists of operational and land use control measures. The program was developed in a manner which is consistent with the previous and ongoing noise mitigation and abatement programs implemented by the STLAA. The main objective of this program is to mitigate noise impacts associated with the selected alternative's aircraft operations by recommending appropriate measures consistent with the approved 1997 Part 150 Noise Compatibility Program Update. Although the mitigation program outlined below is designed to be consistent with the ongoing Lambert Part 150 process, the mitigation measures described below are associated with the specific impacts of Lambert's proposed expansion. It is the obligation of the City of St. Louis to implement the mitigation for the expansion.

The land use mitigation program is based on the potential noise impacts identified through the comparison of the year 2002 No-Action and selected alternative noise contours. The year 2002 selected alternative noise contours were chosen for the mitigation program, because they are larger in size than the year 2015 noise contours. The mitigation program consists of:

Land Acquisition for Mitigation of Noise Impacts Due to Alternative W-1W

The STLAA will acquire all residential and residentially zoned areas located within the 70 DNL noise contour for the year 2002, as well as all mobile home parks within the 65 DNL noise contour. It is anticipated that any of these land uses not acquired through the STLAA's ongoing Part 150 acquisition program for the existing airport will be acquired through the acquisition program for the construction of Alternative W-1W.

Voluntary Noise Mitigation Program

The STLAA will offer a voluntary noise mitigation program to eligible homeowners (located in the 65 DNL noise contour for the year 2002). Each eligible homeowner within this area will be offered the choice of one of three options: sales assistance, sound insulation or easement purchase. In exchange for one of these three options, the airport will receive an avigation easement.

Noise Mitigation Assurance

This element of the noise mitigation program enables STLAA to concentrate the voluntary and land acquisition measures on the areas actually experiencing the annual average DNL noise levels predicted in the FEIS, Section 5.1, after the opening of the new west runway. Using a permanent noise monitoring system, STLAA will monitor and analyze the noise levels resulting from actual, normal operation of the new west runway. If that actual experience diverges from the contours projected, an adjustment will be made to the boundaries of the areas eligible for the mitigation programs. The STLAA will reassess the average-annual noise characteristics of Lambert approximately 18 months after the new runway opens.

Accommodate New Runway in the Permanent Noise Management System

The STLAA is in the process of installing a new permanent noise management (monitoring) system, which will assist in the management of the noise program and monitor the effectiveness of operational noise mitigation measures. The STLAA will add or relocate noise monitoring stations to monitor operations on Runway 12W/30W and associated flight tracks. Appropriate sites will be selected to provide data for monitoring of Runway 12W/30W to assist STLAA in re-assessing the boundaries of the mitigation programs.

Noise Abatement Departure Procedures

This voluntary procedure, already in use for existing runways, involves the reduction of thrust for departing air-carrier aircraft to reduce noise levels in sensitive areas. Once

Runway 12W/30W is commissioned (or operational), commercial jet airline departures will be requested to use the voluntary "Distant Noise Abatement Departure Procedure," as defined in FAA Advisory Circular 91-53A.

Social Impacts and Mitigation; Environmental Justice Impacts

Residential and business displacements are the principal social impacts associated with the selected alternative. The selected alternative will result in the acquisition and relocation of numerous residences and businesses. Other direct social impacts involve the relocation of community facilities such as schools and churches. A large degree of community disruption will be experienced in the City of Bridgeton due to the selected alternative. All acquisitions and relocations will comply with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970. STLAA will develop a detailed plan for the relocation of all properties including residential, commercial, public, and nonprofit organizations. The program will be consistent with FAA Advisory Circular 150/5100-17, Land Acquisition and Relocation Assistance for Airport Improvement Program Assisted Projects.

Surface transportation patterns will be altered and temporarily disrupted with the selected alternative. Measures to mitigate surface transportation impacts are discussed in Section 6.3.13 of the FEIS and later in this Section of the ROD. The acquisition and relocation of residential and commercial properties will be required to accommodate the proposed surface transportation improvements associated with the selected alternative.

Acquisition of property will result in the loss of assessed valuation and, therefore, tax revenue to local taxing units through the year 2002. However, this loss should be offset between the years 2002 and 2015 by the development of commercial, industrial, office, and mixed land uses in or adjacent to the previously acquired areas. For that reason and because per capita tax revenues will likewise be maintained, formal mitigation actions for tax base impacts are not required. Implementation of the selected alternative will not result in disproportionately adverse impacts on minority or low-income populations. For example, the racial characteristics within the acquisition areas are approximately 95 percent white; 3 percent black; and less than 2 percent other races. Low-income persons make up approximately 1.5 percent of the total number of impacted persons. The measures to mitigate social impacts, discussed in Section 6.3.2 of the FEIS, are summarized below.

Acquisition and Relocation Program

This program will minimize the impacts of property acquisition and relocation on displaced residents, businesses and churches by providing services to educate, inform and respond to the needs of those affected, both individually and collectively. This program will also provide for the acquisition and relocation of public and private schools and other public facilities included within the development area for the selected alternative. This program will include measures to minimize the adverse effects associated with the displacement of these facilities.

Acquisitions and relocations will proceed in keeping with the following mitigation objectives:

- Comply with the Uniform Relocation Assistance and Real Property Acquisition Policies Act.
- Comply with the Missouri Airport Relocation Act, R.S. Mo. Section 305.600, *et seq.*
- Develop a detailed Relocation Plan that addresses the specific needs of relocated residents, such as access to employment, access to social services, residency in existing school districts, and access to commercial facilities.
- Educate residents about the Uniform Act and the STLAA's Relocation Plan by holding community meetings prior to the actual acquisition process.
- Work to maintain neighborhood relationships by providing comparable housing areas that can accommodate multiple households from acquisition areas.
- Coordinate with the St. Louis County Housing Authority, the Missouri Housing Development Corporation and the U.S. Department of Housing and Urban Development to provide access to housing assistance programs that meet the identified needs of displaced households.
- Provide information to the real estate industry on the project displacements and acquisition/relocation process. Communicate with real estate agents through the St. Louis Association of Realtors to facilitate access to the real estate market for needed replacement properties.
- Work closely with churches through the relocation process to determine facility needs based on net impact to church membership and to maintain church communities.
- Work with school districts and private schools to determine facility needs based on the net student enrollment impacts.

- Relocate acquired schools in existing enrollment areas to cause the least disruption to students.

Acquisitions related to construction will be completed before the opening of the new runway, estimated to be the year 2002. For those acquisitions not necessary for construction but for noise mitigation, the airport shall have made an offer for acquisition prior to the opening of the new runway, estimated to be the year 2002.

Induced Socioeconomic Impacts

Between 1998 and 2002, economic impacts of the airport expansion project and surface transportation improvements will be related primarily to construction employment, loss of market area population for certain retail developments, and the acquisition of commercial properties. The selected alternative will generate significantly greater construction employment than the No-Action Alternative. However, considering the long-term impacts of the airport, these short-term construction employment increases will not be significant. Loss of market area population will create isolated impacts for several retail establishments along Natural Bridge Road and Pear Tree Lane with the acquisition and relocation of commercial property. These localized impacts will not be significant when assessed from a regional perspective or for the local economy but could be significant to individual businesses, especially those businesses that depend on neighborhood patronage. Impacts to the local economy and the tax base will be short term, as anticipated induced growth and development resulting from airport expansion will replace initial tax base losses.

Since no adverse impacts are anticipated as a result of induced socioeconomic impacts, mitigation is not required.

Air Quality Impacts and Mitigation

Lambert is located in an area designated as moderate non-attainment for ozone and maintenance for carbon monoxide (CO). Based on recent monitoring data, the City of St. Louis may be redesignated by EPA as serious non-attainment for ozone. Air emissions from aircraft, motor vehicles, ground support equipment and adjacent roadway improvements associated with Lambert are expected to increase somewhat in the future as enplanements and aircraft operations increase. However, comparison of the Build and No-Build Alternative in 2002 shows that emissions resulting from the selected alternative are predicted to be lower, in nearly all cases, than emissions from the No-Build Alternative. Project-related emissions, including construction, do not exceed *de minimis* levels in 2002 for any pollutant (including nitrogen oxides, CO and volatile organic compounds (VOCs)). In spite of the increased airport capacity, emissions reductions result from decreased aircraft delay and queuing times attributable to the proposed improvements to Lambert. The only exception to this is the predicted increase in NO_X emissions over the No-Build condition some time between the years 2002 and 2015. However, this long-range (2015) estimate is beyond SIP forecasts and potentially imprecise due to likely changes in the future aircraft fleet and fuel combustion technology. These long-range estimates are subject to change, should only be used for planning or information purposes and are not appropriate for conformity determination. Notwithstanding the above, total emissions associated with Lambert are not expected to result in any violation of the National Ambient Air Quality Program (NAAQS), nor interfere with the goals of the State Implementation Plan (SIP).

Lambert-related emissions for aircraft and fueling are accounted for in the SIP through the year 2005. The action does not cause or contribute to a violation of the NAAQS. The project-related emissions are not regionally significant. Based on these findings, the FAA determined, in its Final General Conformity Determination, that the planned improvements to Lambert conform to the goals of the SIP and meet the requirements of the General Conformity Rule and the Clean Air Act.

Both EPA and MDNR reviewed the Draft General Conformity Determination developed for this project and determined that all of the relevant issues were addressed (see FEIS Appendix A, EPA letter dated November 7, 1997, and MDNR letter dated November 20, 1997). On June 29, 1998, the FAA published in the *St. Louis Post Dispatch* notice of its Final General Conformity Determination. Copies of the Final General Conformity Determination were provided to EPA and MDNR. In accordance with the Clean Air Act, and EPA General Conformity Regulations, the FAA has demonstrated that the selected alternative will conform with the Missouri SIP for achieving and maintaining the NAAQS for ozone and carbon monoxide, respectively.

As noted in this ROD, Section 11.C, after consultation with the Missouri Department of Natural Resources (MDNR) (the Governor's designated agency for air quality), the Governor of Missouri certified that there is a reasonable assurance that the project will meet all applicable air quality standards in accordance with Section 509(b)(7) of the Airport and Airway Improvement Act, recodified under *49 U.S.C. 47106(c)* (letter dated August 11, 1998, in Appendix I).

Further Studies and Ongoing and Planned Activities to Minimize Air Pollution

The FAA and STLAA have agreed to explore EPA's request to establish additional air quality monitors in the airport area. Also, the MPS identified certain terminal area improvement concepts that included roadway, parking structure, transit and terminal structure developments. These improvements have the potential to influence air quality for workers, passengers and visitors. However, the MPS did not provide design-specific details to enable the meaningful analysis of the carbon monoxide impacts of future terminal facilities. The FAA and STLAA have agreed that when terminal design progresses sufficiently, the STLAA will conduct a carbon monoxide hot-spot analysis for terminal expansion to ensure that the terminal structure is designed efficiently from an air-quality standpoint. The results of the terminal carbon monoxide hot-spot analysis will be submitted to EPA and MDNR.

While specific measures to mitigate for air-quality impacts were not required for the preferred alternative, some air-pollutant minimization efforts were considered reasonable and proposed by STLAA. Ongoing or planned STLAA air-quality minimization measures, contained in Section 6.3.3 of the FEIS, are summarized below:

- **Continued Membership in the St. Louis Regional Clean Cities Program:** The City of St. Louis, the owner and operator of Lambert, is a participating member of the St. Louis Regional Clean Cities Program, which is a partnership of public- and private-sector entities, who encourage voluntary emissions reductions through awareness, education and demonstration.

- **Conversion to Alternative, Cleaner Burning Fuels:** Lambert is using alternative, cleaner burning fuels in its maintenance vehicles. This program involves the retrofit or procurement of airport service vehicles capable of burning alternative fuel types, which emit fewer pollutants. An alternative fuel station will supply fuel for airport service vehicles. Construction of this facility is scheduled for 1998.

- **Use of Low Volatile Organic Compound (VOC) Traffic Coatings:** To limit both VOC and hazardous air pollution emissions, STLAA has switched to the use of coating materials for the airfield and roadway improvements, which emit extremely low levels of VOCs. These materials include paints and asphalt-seal coating.

- **Continued Compliance with the Stationary Source Operating Permit and Air Emission Source Survey:** STLAA has voluntarily chosen to limit its annual emissions below 100 tons per year for hazardous air pollutants. Lambert is placing a cap on the amount of fuel consumed at the East and West Power Plants.

Water Quality Impacts and Mitigation

Many of the routine operations that will occur at Lambert as a result of the selected alternative will affect the water quality of Coldwater Creek. Stormwater runoff from runways, taxiways, apron areas, storage areas, gates and surface transportation improvements has the potential to be contaminated. These areas may contain pollutants such as oil, grease, sediments and deicing agents that may require detention and/or treatment. In addition, effluent from oil/water separators or waste reduction activities on the airport may also contribute to degradation of water quality. As runoff from the above activities is subject to the requirements of the NPDES permit process, all future stormwater discharges will be required to comply with the permit-established pollutant limits.

As noted in Section 11.C of this ROD, after consultation with the MDNR (the Governor's designated agency for water quality), the Governor of Missouri certified that there is a reasonable assurance that the project will meet all applicable water quality standards in accordance with Section 509(b)(7) of the Airport and Airway Improvement Act, recodified under *49 U.S.C. 47106(c)* (letter dated August 11, 1998, in Appendix I).

The proposed airport improvements will result in an increase in potable water demand and wastewater generation. However, with the acquisition of additional land for airport development and noise compatibility, overall or net airport area water demand and wastewater generation will be less than the existing airport area demand. Proposed water quality mitigation measures are described in detail in Section 6.3.4 of the FEIS and summarized below:

- **Implement Glycol Deicing Master Plan System:** Airlines operating at Lambert currently use glycol fluids for the deicing of aircraft. This fluid has the potential to pass through the airport's drainage system into local surface waters. The airport is currently in the process of implementing a Glycol Deicing Master Plan, which centralizes the collection of deicing fluids for recycling and treatment. It is anticipated that this system will handle 90 percent of the storm events encountered during the deicing season. In addition, a central deicing facility for narrow body aircraft will be used when applicable for westbound departures from existing Runways 30R and 30L.

- **Implement Stormwater Management Options:** Lambert's NPDES permit regulates the discharge of stormwater to Coldwater Creek by imposing effluent limitation, monitoring and reporting obligations. The airport has undertaken voluntary management options to reduce pollutants entering the stormwater system. These include the use of potassium acetate and heated sand for runway/taxiway deicing, the use of remote aircraft deicing facilities and diversion and treatment of runoff containing deicing fluid to wastewater treatment plants. The STLAA will implement similar management options for the new runway and taxiways.

- **Create Stormwater Detention Areas For Attenuation of Stormwater Runoff:** Runoff from new impervious areas (associated with buildings, parking, apron, runway and roadway areas) will be directed to stormwater detention areas for peak discharge attenuation. These detention areas may consist of grassed swales, dry detention areas or underground vaults, which will allow stormwater to be detained prior to discharging to Coldwater, Cowmire or Maline Creeks.

- **Increase Airport Potable Water Storage and Pressure Capacity:** Potable water storage tank and booster pump capacity will be evaluated to ensure that adequate potable water and fire-protection supply and pressure requirements are met.

- **Review Wastewater Discharge Capacity:** The airport will be required to consult with the Metropolitan Sewer District (MSD) on future wastewater discharges to determine whether methods for increasing wastewater discharge capacity are needed.

- **Close Wastewater Lines in Acquisition Areas:** Existing wastewater lines will be removed or plugged prior to discharging to the MSD wastewater main lines. Otherwise, inflow of stormwater could occur through broken pipe joints and contribute to additional flow to the wastewater treatment plant. Closing abandoned lines will help offset future wastewater contributions from the airport expansion by reducing infiltration flows to the wastewater treatment plant.

With regard to normal airport operations, the airport sponsor, through its grant assurances with the FAA, commits to suitably operating and maintaining the airport and all facilities in a safe and serviceable condition and complying with all applicable Federal laws, regulations, executive orders and other mandatory requirements related to water quality.

Section 303 and Section 6(f) Impacts and Mitigation

The selected alternative will directly affect four park and recreation area Section 303 sites. Three of the sites adversely affected by the selected alternative are also protected under Section 6(f). The selected alternative, including the associated surface transportation improvements, also has the potential to directly and indirectly affect several historic and archaeological sites protected under Section 106 of the National Historic Preservation Act. These sites will be mitigated through a Section 106 Memorandum of Agreement (MOA) (Appendix H of this ROD). The project will also have indirect adverse impacts upon Section 303 and 6(f) sites. The selected alternative will not result in any incompatible park areas due to aircraft noise. In terms of avoidance alternatives, review of the tiered alternatives evaluation prepared in Section 3.0, Alternatives, of the FEIS, indicates that there are no prudent and feasible alternatives to the use of the Section 303 and 6(f) sites.

The FAA has coordinated with the public and agencies having jurisdiction over the affected sites to determine site significance and to develop mitigation measures necessary to meet Section 303 and 6(f) requirements. Generally, the entity responsible for conversion of the Section 6(f) parkland to other use is the local government entity where the Section 6(f) facilities are located, in this case, the City of Bridgeton. By letter dated January 16, 1997, the City of Bridgeton, through its counsel, has advised that it does not intend to initiate the 6(f) conversion process. A coordination meeting with the City of Bridgeton was held on April 18, 1997, with the mayor and key staff members to discuss Draft EIS comments relative to Section 303/6(f) issues, and to solicit input from the City of Bridgeton regarding future plans and goals for their parks and recreation program. Items listed in the City of Bridgeton's comprehensive plan were discussed regarding candidate mitigation options. The City of Bridgeton has stated that it will not initiate the Section 6(f) conversions for Lambert.

Since the FAA is issuing this ROD that approves the Federal actions needed to implement the selected alternative, the City of St. Louis and the STLAA will initiate condemnation proceedings and take possession of the parklands. The City of St. Louis and STLAA will then be responsible for the conversion of the 6(f) property as the owner of the parkland and local project sponsor. MDNR will be the authorized agency to document the adequacy of the replacement lands (see FEIS Appendix A, Department of Interior (DOI) letter commenting on FEIS.)

Measures to minimize harm to Section 303 and 6(f) resources are summarized in Section 6.3.5 of the FEIS. The Section 303 and 6(f) Evaluation, published separately, provides detailed information about the effects of the proposed improvements on Section 303 and 6(f) resources and describes the mitigation plans developed. The STLAA will provide mitigation that fulfills both the Section 303 and Section 6(f) requirements. Conceptual mitigation plans have been developed to minimize harm to the affected resources. The mitigation measures proposed in Section 6.3.5 of the FEIS are summarized below.

Develop and Replace Existing Parks and Associated Facilities

The selected alternative will directly affect three Section 6(f) properties, consisting of a portion of Oak Valley Park (approximately 5 acres), all of Freebourn Park (approximately 14 acres), and Cardinal Park (approximately 4 acres). The selected alternative will also affect one Section 303 resource, Bridgeton Memorial Park, which is approximately 3 acres in size.

Candidate replacement areas have been identified and are under consideration as mitigation for both Section 303 and Section 6(f) direct effects at Freebourn, Oak Valley and Cardinal parks. Definitive locations will be determined during final design of the project. Playgrounds, ballfields, ball courts and fitness and nature trails are some of the potential recreational opportunities that could be provided at each new site. Potential mitigation areas exceed an acre-for-acre replacement ratio to provide the opportunity for maximum flexibility in the actual types and locations of facilities. Because the STLAA has committed to exceeding an acre-for-acre replacement ratio as well as meeting fair-market value requirements, the proposed mitigation exceeds the minimum mitigation requirements and provides significant improvement to the recreational resources in the affected area.

The selected alternative will result in direct impacts to one Section 303 resource (Bridgeton Memorial Park), which is not a Section 6(f) resource. STLAA proposes to provide separate mitigation for the direct effects to this site. Candidate replacement property for this Section 303 resource, which is approximately 3 acres in size, would be located near other cemetery property close to the City of Bridgeton. In addition, the construction of a new neighborhood park in south Bridgeton, to supplement those facilities already in place, is also under consideration. This activity will commence when the Property Acquisition Program is implemented.

Expand and Enhance Existing Parks and Recreational Areas

Indirect effects associated with the selected alternative have been identified at four sites: O'Connor Park, Berry Hill Golf Course, Oak Valley Park and Carrollton Buffer Zone. As mitigation for these effects, enhanced vehicular access to these sites is under study. In addition, a new bicycle trail is being considered to link the City of Bridgeton's recreation resources to the regional bicycle network. This link to the regional bicycle network would occur via the Missouri Highway 370 bridge leading to St. Charles and would directly connect with the Katy Trail. A bicycle facility is already provided on the bridge. Potential trailheads could be located at the Bridgeton Municipal Athletic Complex and the (proposed) expanded O'Connor Park/Carrollton Buffer Zone Park Complex. The proposed new bicycle trail would increase and replace lost patronage, enhance the area's existing bicycling opportunities, provide a logical and accessible origin/destination point for trail users and be consistent with regional bicycle plans.

In addition to the proposed recreational bicycle trail, local roadway improvements associated with the selected alternative would provide the opportunity to integrate paved, striped bicycle lanes as a part of these roadway improvements. New bicycle lanes would enhance existing multi-modal transportation options, including linking community and neighborhood parks within the City of Bridgeton, as well as ultimately providing access to the regional trail network. Consultation with local and regional planning agencies has indicated that such improvements are consistent with long-range multi-modal plans for the area. The STLAA will assist in funding as appropriate. This activity will be scheduled concurrent with airport expansion.

Reasonably Equivalent Replacement Of Converted DOI Section 6(f) Lands

Mitigation for Section 6(f) impacts will consist of replacement of the converted Section 6(f) lands with land of equal or greater value and usefulness. At the time of conversion, appraisals will be conducted in accordance with the Uniform Appraisal Standards for Federal Land Acquisition (Interagency Land Acquisition Conference, 1992) to assure that fair market values of the replacement facilities will be at least equal to that of any converted Section 6(f) sites. This activity will commence when the Property Acquisition Program is implemented.

Historic, Architectural, and Archaeological Impacts and Mitigation

An evaluation of the potential impacts to historic and archaeological resources was accomplished in accordance with the requirements of Section 106 of the National Historic Preservation Act of 1966, as amended. The FAA has determined that the selected alternative will have an adverse effect on historic resources and may have an effect on archaeological resources eligible for listing in the National Register. The State Historic Preservation Officer (SHPO) has concurred in this determination.

The FEIS states that in the event artifacts are discovered during construction activities, construction in the area will be halted immediately in order to record the finding, determine its level of significance, and develop appropriate mitigation measures.

An MOA has been prepared stipulating measures to be implemented to avoid, reduce or mitigate the adverse effects from this project on historic properties. The Missouri SHPO, the Advisory Council on Historic Preservation (Advisory Council), the STLAA, and the City of Bridgeton have been consulted on the MOA and provided comments on the agreement document throughout its development (see FEIS Appendix N-1, November 18, 1997, letter from MDNR, and November 14, 1997, letter from City of Bridgeton). The FAA solicited final comments on the MOA from the consulting parties, including the City of Bridgeton.

The MOA, in compliance with Section 106 of the National Historic Preservation Act, has been signed by the FAA, STLAA and MDNR. The City of Bridgeton did not concur with the MOA and chose not to sign the agreement. The agreement was executed by the Council on May 29, 1998. As part of the FAA's comprehensive efforts to involve all appropriate commenters, the FAA will continue to work with the appropriate agencies. In reaching its conclusions relative to the National Historic Preservation Act, the FAA's findings are supported by the FEIS, and the Department of Transportation Section 303/Section 6(f) Evaluation. Execution of the MOA satisfies the FAA's Section 106 responsibilities for all actions associated with the selected alternative. The stipulations of the MOA are discussed in Section 6.3.6 of the FEIS. A final copy of the entire MOA is included in Appendix H of this ROD.

Memorandum of Agreement

Specifically, the stipulations within the MOA, summarized below, ensure that:

- The FAA will consult with the SHPO and the Council to seek ways to reduce or mitigate the adverse effects on the five (5) above ground historic properties within the undertaking's APE. These properties include the Bridgeton Inn, the Airport News Building, the Emmanuel Blum House, the Blum Store, and the De Hatre House.

- The FAA will prepare a preservation management plan, in consultation with the SHPO, that ensures the long-term protection of archaeological resources within the APE of the selected alternative which the FAA and the SHPO agree are considered eligible for listing on the National Register of Historic Places and that can be preserved in place.

- Those sites that the FAA and the SHPO agree are considered eligible for listing in the National Register of Historic Places and that cannot be preserved in place shall be treated in accordance with a data recovery plan.

- As the Village à Robert Cemetery (which is encompassed by the current Bridgeton Memorial Park Cemetery) cannot be preserved in place, it shall be treated in accordance with a data recovery plan.

The MOA also states that all human remains and funerary objects excavated during the data recovery will be reburied in a location where their subsequent disturbance is unlikely and in a manner as similar as possible to the manner in which they were originally interred. The location and method of reburial, and the memorialization and commemoration of the reburial site(s), will be made in consultation with descendants of individuals that were buried within the cemetery.

Biotic Communities Impacts

The selected alternative will impact upland and wetland communities. Although the project will reduce existing vegetation and small, fragmented areas of wildlife habitat, none of the affected areas are characterized by unique vegetative patterns. Development will impact biotic communities within the Cowmire Creek watershed, in addition to those of the Coldwater Creek watershed. The project will place aircraft at lower altitudes over the Missouri River floodplain, which may have the potential to disrupt feeding and nesting activities of birds in a flyway area. However, the anticipated impacts will be minimal and will not require mitigation.

Threatened and Endangered Species Impacts

Several Federally listed plant and animal species have historically occurred in the airport area. Based on information obtained and correspondence received, the expansion project for Lambert would not have an effect on Federal or state listed threatened and endangered species or areas designated as “critical habitat” by the U.S. Fish and Wildlife Service (FWS). In accordance with Section 7 of the Endangered Species Act, the FAA’s consulted with the FWS. The FWS concurred that Alternative W-1W will likely have no adverse effects on listed species or their habitats (letter dated September 1, 1994, in Appendix A of the FEIS). Therefore, mitigation measures are not required.

Wetlands Impacts and Mitigation

The airfield development and associated surface transportation improvements will result in impacts to existing wetlands. The various types of impacts will include loss of wetlands as a result of earthwork or construction, removal of existing vegetation and re-vegetation with grasses, or the clearing of trees and shrubs to ground level. Based on the conceptual plans used in the preparation of the FEIS, the selected alternative will impact approximately 9.7 acres. The majority of the wetlands that will be impacted have been previously disturbed and exhibit low habitat values. Their current status exhibits erosion, dumping, loss of canopy cover and extensive ditching.

Final design plans will be prepared in such a manner as to avoid, minimize and mitigate wetland impacts to the greatest extent practicable, as required by applicable rules and regulations. These plans will be developed during the permitting process and as construction plans are finalized. A formal jurisdictional wetland delineation with agencies having jurisdiction over this project will be conducted during the permitting process. Wetlands have been avoided to the extent practicable. Measures to mitigate wetland impacts have been developed, are contained in Section 6.3.7 of the FEIS and summarized below.

- **Enhance and Replace Existing Wetlands:** This program will mitigate for the removal of existing wetland areas by enhancing and/or replacing existing wetland areas. Enhancing and replacing existing wetland areas on-airport has been eliminated from further consideration because of the potential safety hazard associated with aircraft bird strikes. Off-site mitigation options that remain under consideration include: mitigation within the Coldwater Creek watershed, mitigation within the Cowmire Creek watershed or a combination.

- **Candidate Mitigation Sites:** Several candidate wetland mitigation sites have been examined; however, none have been formally designated for the Lambert wetland mitigation program at this time. Final mitigation requirements will be determined during the Section 404 permit application review process in consultation with the COE.

The wetland mitigation program will be initiated upon Section 404 permit approval. For any particular affected wetland area, the wetland mitigation (enhancement or replacement) will be completed prior to the removal of the existing wetland.

Floodplains Impacts and Mitigation

The project will result in additional development within the 100-year floodplain. Surface transportation improvements associated with the selected alternative will impact the 100-year floodplain as well. The project will impact approximately 22.3 acres for year 2002 and 35 acres for year 2015 in the Coldwater Creek floodplain. Therefore, this project will result in a floodplain encroachment. Mitigation will be developed to compensate for potential increased flooding caused by the proposed development. Mitigation measures to minimize the floodplain impacts will be accomplished so that the floodplain encroachment would not be considered significant. Floodplains have been avoided to the extent practicable, in light of greater impacts on protected resources in other impact categories. Measures to mitigate floodplain impacts, which are contained in Section 6.3.8 of the FEIS, are summarized here.

- **Limit Fill Within Floodplain Areas:** During design of the proposed runways and taxiways, the placement of fill within the floodplains adjacent to Coldwater Creek will be minimized. However, airport runways and taxiways must be designed to meet specific criteria related to runway profiles and cross slope. Some fill within the floodplain areas is unavoidable. Infield areas will be graded to reduce potential floodplain impacts.

- **Provide Stormwater Detention Areas:** To offset potential filling of shallow floodplain areas and construction of new impervious areas, detention storage volume may be provided to reduce peak discharges downstream, provide for floodplain storage compensation volume and avoid airport-induced increases of flood elevations upstream. The detention areas will be of shallow depth to minimize standing water in the ponds, thereby reducing attractiveness of the ponds to birds, which are a potential safety hazard to aircraft. Underground detention vaults may also be used. Detention areas will be constructed concurrently with the construction of new impervious areas.

Farmland Impacts

Development will not adversely impact any prime or unique farmlands or soil types as designated by the U.S. Department of Agriculture, Natural Resource Conservation Service. The areas have already been converted into urban uses, such as residential and commercial, and no longer retain their previous agricultural designation. Since there are no impacts anticipated, mitigation measures are not proposed.

Energy Supply and Natural Resources Impacts

Energy consumption at Lambert is expected to increase as activity increases. Aircraft and vehicle energy consumption estimates for the selected alternative are predicted to be less when compared to the No-Build Alternative. This reduction is a consequence of declining aircraft and vehicle fuel consumption resulting from shorter aircraft queuing times and moderate improvements to the roadway network surrounding Lambert. There are no known sources of mineral or energy resources in the Lambert area that will be impacted. Development of the selected alternative will not require the use of unusual materials or those that are in short supply in the Lambert area. Since there are no impacts anticipated, specific measures to mitigate energy consumption are not proposed.

Light Emissions Impacts and Mitigation

Areas sensitive to changes in light emissions are located in the vicinity of the proposed lighting systems. The proposed project will have the potential to create off-airport, light emission impacts. Through shielding and screening techniques, light emission impacts on surrounding residential areas will be minimized. Future light emission levels from airborne aircraft or aircraft operating on the ground are not anticipated to adversely impact surrounding residential areas. Proposed light emissions mitigation measures, described in Section 6.3.9 of the FEIS, include using light shields to direct light emissions away from residential or other sensitive areas. This measure will pertain primarily to the terminal area and roadway pole-mounted lighting.

Solid Waste Impacts and Mitigation

Alternative W-1W would increase the quantity of solid waste generated at the airport. This is primarily due to increased passenger flow and operations at the airport, increased airport tenant operations, and construction activity. Alternative W-1W would result in the generation of approximately 49,000 more cubic yards per year of solid waste as compared to the existing condition. However, this increase is not anticipated to adversely impact the area's solid waste handling practices or disposal facility capacity. Airport-generated solid waste levels comprise only a small percentage of the total waste produced in the metropolitan area, and existing solid waste disposal facilities have sufficient capacity to accommodate projected future solid waste generation levels.

While specific measures to mitigate for demolition-waste impacts were not required for the preferred alternative, some waste minimization efforts were considered reasonable and proposed by STLAA. These planned efforts to minimize demolition waste, contained in Section 6.3.10 of the FEIS, include the development and implementation of a construction recycling and salvage pilot program. This program will maximize recovery and reuse of construction materials, and reduce the waste entering landfills. Examples of the types of measures which may be considered in the pilot program are: conducting a salvage operation process to remove reusable building components and interior furnishings such as doors, windows, cabinets and plumbing fixtures and segregating building components and interior finishings by type and offering them for resale or reuse. The recycling and salvage management pilot program will be developed and approved prior to initiation of demolition and construction activities.

Several active landfills are located in the vicinity of Lambert. The Laidlaw Combined Sanitary and Demolition Landfill, at its closest point, is located approximately 9,166 feet west of the northwest end of proposed Runway 12W/30W. This is not consistent with FAA's runway siting guideline of 10,000 feet, which was developed to protect aircraft from potential bird strikes. The new runway will be compatible with all area landfills in accordance with FAA Order 5200.5A, as described in detail in Section 6.3.10 of the FEIS. STLAA will attempt to develop an agreement with the operator of the landfill to implement one of the following options:

- Re-prioritize the landfill utilization plan so that the subject portion (i.e., that portion within the FAA's 10,000-foot radius of incompatibility) of the landfill is utilized first;

- Require that STLAA be able to direct available fill that cannot be reasonably recycled from the construction projects to the subject portions of the landfill;
- Require that organic waste be capped in the landfill before the new runway is opened and that only clean fill (such as construction materials) be placed in the subject portions of the landfill once the runway is operational.

Should it not be practical to completely fill the subject landfill through the above measures, the STLAA will purchase an easement from the landfill operator which will provide the operator compensation for any lost revenue associated with the unused excess capacity. Any plan to convert or close the landfill must provide for a one-year bird-repelling program. Repelling efforts will begin 6 months before opening of the new runway and continue for a minimum of 6 months thereafter. The program will be in effect from dawn until dusk.

Coastal Barriers and Coastal Zone Management Program Impacts

The proposed improvements will not affect or involve the Coastal Zone Management Program or the Coastal Barriers Resources Act of 1982. Since there will be no impacts, mitigation measures have not been proposed.

Wild and Scenic Rivers Impacts

Review of the U.S. Department of the Interior's National Inventory of Wild and Scenic Rivers indicated that there are no designated "Wild and Scenic Rivers" within a 1,000-foot radius of Lambert. There will be no impact on any rivers designated as "Wild and Scenic"; therefore, mitigation measures are not warranted.

Construction Impacts and Mitigation

Construction impacts resulting from the airport development alternatives, including surface-transportation-related improvements, may include but are not limited to temporary impacts, such as soil erosion, increased air emissions, water quality degradation, noise disturbance and disrupted surface transportation patterns. These temporary impacts are short term in nature and can be minimized through the establishment and utilization of environmental controls and best management practices (BMPs).

To minimize construction impacts, environmental controls as specified in Advisory Circular 150/5370.10A will be included throughout the preparation of the plans and specifications for each of the proposed construction projects. These controls will be established to minimize the temporary air, water, noise, erosion, and light impacts typically associated with construction activities. STLAA will also incorporate all applicable State of Missouri and St. Louis County construction and environmental control provisions into the plans and specifications developed for all roadway and off-site airport-related improvements. Construction and environmental control measures will be developed as part of the preparation of plans and specifications for each airport development project and will be implemented with the initiation of demolition and construction activities.

Design, Art and Architecture Impacts

Design, art and architectural applications will be a consideration in the design and operation of the proposed improvements to the terminal facilities. Therefore, no mitigation measures are required.

Hazardous Materials Impacts and Mitigation

Several areas in the vicinity of Lambert have been reported to or have the potential to contain hazardous materials, hazardous wastes and/or petroleum products that have resulted in environmental contamination. Some of these sites have undergone preliminary investigations and will either be evaluated further, cleaned up or will require no further action by the responsible parties. Other sites have not been investigated. These sites have been identified and located so that they can be avoided or, if necessary, properly addressed during the planning and development of the proposed airport improvements. It is not expected that the project will involve any sites that are significantly impacted by hazardous materials, petroleum products or environmental contamination. Therefore mitigation measures *per se* are not required. However, BMPs developed as a means to minimize potential impacts are discussed in Section 6.3.12 of the FEIS. Examples of such BMPs include the following practices:

- **Assess and Remediate Contaminated Sites:** In accordance with state regulations, sites that are contaminated with hazardous materials will be fully assessed to determine the types and areas of the impacts. These sites will be cleaned up or other appropriate corrective measures will be undertaken.

- **Conduct Environmental Audits of Properties Prior to Acquisition:** The STLAA will conduct surveys of existing facilities requiring demolition to evaluate any potential involvement with asbestos, lead paint and/or other regulated materials. Site assessments will be included as part of the property acquisition process. Sites found to contain hazardous wastes, other regulated materials and/or environmental contamination will be properly addressed.

- **Develop/Implement Asbestos and Hazardous Materials Management Plan:** When materials containing asbestos or classified as hazardous are encountered during demolition, appropriate precautions will be followed. These include the employment of certified contractors trained and equipped to work under such conditions and the strict adherence to standards, practices and guidelines governing the handling and disposal of these materials.

Surface Transportation Impacts and Mitigation

Development will impact significant surface transportation facilities located in the airport vicinity. It will require the modification and/or realignment of several local and regional roadways to accommodate the proposed expansion of the airport.

It is estimated that after the year 2010, the additional aviation activity will result in increased associated surface traffic. Sections 5.22 and 6.3.13 of the FEIS provide a detailed analysis of the anticipated environmental impacts and mitigation measures associated specifically with the surface transportation improvements that would result from the proposed development.

Based on the assessment of surface transportation impacts detailed in Section 5.22 of the FEIS, there are no specific mitigation measures required for associated roadway improvements for the selected alternative. However, means to minimize impacts associated with the proposed roadway improvements, including construction of the Lindbergh Tunnel, are presented below.

- **Maintenance of Traffic Plan:** The Missouri Department of Transportation (MoDOT) will develop a staged implementation plan. This staging plan will identify what portions of the proposed roadway improvements will be constructed during each phase of the implementation plan, what the overall sequence of construction will be, and how traffic flow/access will be maintained during the construction phases. This staged construction plan will be coordinated with the appropriate county and city agencies prior to the beginning of construction. The maintenance of traffic plan will be developed during the preliminary engineering and final design of the improvements.

- **Roadway Improvement Safety Plan:** To mitigate the potential for vehicular accidents, fire and/or explosions occurring in the proposed

Lindbergh Tunnel, all applicable state and local fire codes will be adhered to during the design of the tunnel. The tunnel will also be designed to meet or exceed the current MoDOT lighting criteria/standards.

- **Visual Impacts from I-70/Airport Access Improvements:** Retaining walls will be incorporated into the construction design plans and implemented prior to the beginning of any roadway construction. The plans for retaining walls will be developed during the design phase of the I-70/Airport Interchange improvements and are dependent on specific requirements of MoDOT.

MITIGATION SUMMARY

The FAA has provided a comprehensive mitigation program, which establishes measures to mitigate the adverse effects of construction and operation of the proposed development. This program was developed to meet applicable Federal and state requirements and in consideration of local guidelines. The concerns and interests of the public and government agencies were also addressed. The mitigation program is described in Section 6.3, Mitigation, of the FEIS. A summary of the mitigation requirements for Alternative W-1W is contained in Table S.3 in Appendix J of this ROD.

Alternative mitigation measures considered in the FEIS are conditions of approval of the project in this ROD, and the project sponsor, the STLAA, has agreed to them. The FAA will monitor the implementation of these mitigation actions as necessary to assure they are carried out as project commitments. The FAA finds that these measures constitute all reasonable steps to minimize harm and all practicable means to avoid or minimize environmental harm from the selected alternative.

7. PUBLIC AND AGENCY INVOLVEMENT

From the outset, the concerns of the public have been considered. Both the STLAA and the FAA have been forthcoming with the communities about the project through extensive opportunities for public involvement. The interests of communities have been considered throughout the decision-making process regarding expansion at Lambert. This is shown in part by the information provided below.

Because of Lambert's impact on the surrounding communities, the FAA and the STLAA have conducted open public meetings to inform the public of the expansion plans. The FAA and the STLAA have received thousands of public comments throughout the EIS process. To the extent practicable, all of these comments have been reviewed to ensure that the needs and concerns of the public were considered and addressed. Based on the extensive opportunities for public participation, the FAA is satisfied that full consideration has been given to the public's views on airport expansion plans.

PUBLIC INVOLVEMENT PROCESS

Public involvement included the following:

- Three EIS scoping meetings were held on September 6 and 7, 1995.

- A scoping comment period extended from August 17 through September 21, 1995. A summary of the scoping comments is provided in Appendix J of the FEIS.

- A public workshop on the environmental process was held on June 11, 1996. There were 476 people in attendance. The meeting was advertised in the *St. Louis Post Dispatch* and other local newspapers. In addition, approximately 13,000 postcards were mailed to residents in the vicinity of the airport announcing the meeting and extending an invitation to the public to attend.

- The DEIS was distributed to local libraries, city halls and to principal commenting agencies. The DEIS was available for review from September 27, 1996, through January 17, 1997.

- The DEIS was available for more than the minimum 45 days required by CEQ regulations. The comment period for the DEIS opened on September 27, 1996. The initial comment period was extended twice, once in response to a request by the City of Bridgeton. The comment period on the DEIS closed on January 17, 1997.

- A public workshop/public hearing to receive comments on the DEIS was held on October 28, 1996, more than 30 days after the DEIS was released for review. Approximately 1,580 people attended.

- Over 15,000 comments were received from the public and agencies in response to the DEIS. The comments were reviewed and considered by the FAA in the preparation of the FEIS. All comments received were summarized and responded to in the FEIS (Appendices S, T, U, V, and W of the FEIS).

- The STLAA used a total of six newsletters to distribute information to approximately 13,000 airport neighbors and to provide information about commonly asked questions regarding airport expansion.

- The FEIS was distributed to local libraries, city halls and the principal commenters on the DEIS. The FEIS was available for review from December 22, 1997, through February 17, 1998.

The public involvement process for this project was documented in Section 7.0 of the FEIS. The list of recipients of the DEIS and FEIS is found in Section 8.2. DEIS and FEIS review locations are listed in Section 8.2.2.

Subsequent to the release of the FEIS and the end of the review period, a series of meetings was held prior to the ROD with certain interested organizations and citizens of local communities in the vicinity of Lambert. The purpose of these meetings was to allow these groups to air their concerns with the proposed expansion of Lambert and Alternative W-1W to FAA headquarters personnel.

ADDITIONAL MEETINGS

May 13, 1998

At the request of Senator Christopher Bond and Congressman Jim Talent, FAA Administrator Jane Garvey met in Washington, D.C., with citizens and representatives of organizations and local governments concerned with the proposed expansion of Lambert. Those meeting with the Administrator on May 13, 1998, were representatives of the Air Line Pilots Association (ALPA), National Air Traffic Controllers Association (NATCA), the City of Bridgeton, the City of St. Charles, St. Charles County, and Citizens Against Airport Noise (CAAN). Representatives from Congressman Talent's and Senator Bond's offices also attended.

ALPA, NATCA, the City of Bridgeton, St. Charles County, and CAAN gave presentations. The participants generally supported expansion at Lambert; however, they all oppose Alternative W-1W. Among the reasons given for opposing W-1W, ALPA and NATCA oppose W-1W based on the safety and capacity questions they raised. The represented communities oppose W-1W on the basis of noise concerns and general dissatisfaction with the adequacy of the FAA's EIS and hearing process. The impact to the City of Bridgeton would be a new runway in the city and impacts to approximately 2,324 households, 6 churches, 6 schools, 1 nursing home and 75 businesses. All support a real-time simulation study of Alternative W-1W.

The represented communities expressed a need to see that the STLAA and the FAA are concerned about noise and impacts to the historic district of St. Charles. The City of St. Charles believes that its historic district was ignored and that FAA did not hold a public hearing in St. Charles. St. Charles wants assurance that the EIS is accurate in its prediction of noise impacts. St. Charles desires an enforceable settlement agreement with STLAA if the FAA approves W-1W.

The attendees requested that they be given an opportunity to meet face-to-face with FAA personnel (program office and other specialists) to discuss their concerns, and that FAA authorize a real-time simulation study for the expansion project at Lambert.

The Administrator acknowledged that the meeting was helpful and raised important issues that the FAA would consider further. The Administrator stated that the FAA would take the time needed to study the issues raised.

June 9, 1998

As a follow-on to the FAA Administrator's meeting of May 13, 1998, representatives of ALPA and NATCA met in Washington, D.C., on June 9, 1998, with various FAA technical specialists and representatives of FAA's Headquarters and Regional Airports program offices. Also attending were representatives of Leigh Fisher Associates, the consultants to St. Louis on the MPS, who conducted the MPS capacity simulations. ALPA and NATCA wanted to present their concerns regarding the MPS, which they felt had not been considered during the planning and environmental processes.

ALPA and NATCA asserted that inaccurate assumptions and/or input data used for the MPS simulations resulted in an overstatement of benefits projected for the preferred Alternative W-1W and an understatement of benefits for the existing airfield. They also asserted that a real-time simulation study is needed to verify their opinion that: (1) it would be impossible to operate Alternative W-1W as proposed or (2) the capacity penalties required to make W-1W work would reduce the project benefit/cost ratio to a point where it would no longer be attractive to TWA. ALPA and NATCA submitted, and discussion was held on, a list of eighteen questions regarding simulation assumptions affecting the outcome of the MPS that they claim are incorrect or inappropriate.

FAA committed itself to carefully reviewing the ALPA and NATCA concerns. The ALPA and NATCA representatives expressed appreciation for the opportunity to discuss these matters with FAA headquarters personnel on a face-to-face basis.

June 16, 1998

As another follow-on to the FAA Administrator's meeting of May 13, 1998, representatives of ALPA, NATCA, the City of Bridgeton, the City of St. Charles, St. Charles County and CAAN met with the FAA Associate Administrator for Airports, Susan Kurland, on June 16, 1998, in Washington, D.C. Also in attendance were various FAA technical specialists and other representatives of FAA's Headquarters and Regional Airports program offices, and a representative from Congressman Talent's office.

For the most part, the presentations were a reiteration of the points brought up before in the meetings of May 13, 1998, and/or June 9, 1998, although in some cases in more detail. The parties either wanted to present their concerns regarding the MPS, which they felt had not been considered during the planning and environmental processes, or to express their general dissatisfaction with the adequacy of the FAA's EIS. They again expressed their opinion that a real-time simulation study is necessary to demonstrate that Alternative W-1W can be operated as proposed. The communities offered to provide the funding for the study.

The FAA reiterated its commitment to carefully review the concerns and issues raised.

July 20, 1998

In furthering the study of the issues, concerns and criticisms expressed during the above outlined meetings of May 13, June 9, and June 16, 1998, with FAA, the FAA's Acting Deputy Administrator, Monte Belger, gave the City of St. Louis the opportunity to meet with officials of FAA. That meeting was held in Washington, D.C., on July 20, 1998, with the St. Louis Director of Airports and his staff and consultants. In addition to the Acting Deputy Administrator, FAA was represented by the Associate Administrator for Regulation and Safety, the Associate Administrator for Airports and the Acting Associate Administrator for Air Traffic Services.

In addition to responding to a number of questions raised on certain safety aspects of Alternative W-1W, the City of St. Louis provided the FAA with a briefing, from its perspective, on several current issues before the FAA involving Alternative W-1W. As background, they provided a summary of the Lambert MPS planning process. They then provided comments on what they believed to be misleading allegations about Alternative W-1W. They also provided responses to questions raised by the FAA Flight Standards Office regarding the operation of Alternative W-1W, and responded as well to the 18 concerns raised by ALPA and NATCA in their June 9 meeting with FAA.

July 23, 1998

FAA Administrator, Jane Garvey; Acting Deputy Administrator, Monte Belger; Associate Administrator for Airports, Susan Kurland; and the Assistant Administrator of Government and Industry Affairs, Bradley Mims, attended a meeting at Congressman Richard Gephardt's office in Washington, D.C., on July 23, 1998, to discuss Lambert's proposed expansion.

Congressman Gephardt indicated that he had convened the meeting so that St. Louis public officials could make the case personally to the FAA Administrator in support of issuance of the ROD for the Alternative W-1W runway development project

St. Louis Mayor, Clarence Harmon, stressed that the Lambert expansion was the most critical project before the City of St. Louis in terms of the future economic viability of the city. Mr. Harold Gregory, representing the Let's Get On With Our Lives coalition, indicated his group has 1,100 petitions requesting a buyout and urged the Administrator to issue the ROD at the earliest possible time. Mr. Richard Fleming, President and CEO of the St. Louis Regional Commerce and Growth Association, told the FAA Administrator that each year of delay results in an estimated $400 million in business opportunities, 4,400 lost jobs, and $1.4 million in lost taxes. Ms. Norma Kaehler, Managing Director of TWA's Washington Government Affairs Office, indicated that TWA strongly supports the W-1W expansion plan. It is important to TWA from an operational viewpoint that the new runway proceed as soon as possible. Mr. Thomas Chapman, Southwest Airlines Government Affairs Director in Washington, paralleled TWA's comments. Lastly, the St. Louis Director of Airports, Leonard Griggs, stated that St. Louis believes that a real-time study of the planned runway operations is unnecessary and would cause a lengthy delay before the ROD could be issued. He reminded the group that Alternative W-1W has been coordinated with airline pilot and controller groups, and representatives of FAA's Flight Standard organization have been included in these past technical discussions. He urged the FAA Administrator to deny the pending request for a real-time study at St. Louis and to approve the ROD without delay.

8. COOPERATING AGENCIES

The environmental process involved the following cooperating agencies:

- U.S. Air Force - for environmental processing of relocation of the MoANG.
- U.S. Navy - for environmental processing of relocation of Naval and Marine Reserve Corps facilities.
- U.S. Army Corps of Engineers - for coordination of wetland impact and mitigation issues.
- Federal Highway Administration - for environmental processing of related roadway improvements.

A cooperating agency is an agency that has jurisdiction by law or special expertise regarding any environmental impact resulting from a proposed action or reasonable alternative. These agencies and the reasons for their inclusion in the process as cooperating agencies are described below.

U.S. AIR FORCE

The proposed expansion of Lambert involves the relocation and/or improvement of the MoANG, which falls under the jurisdiction of the USAF. To provide for additional terminal expansion, the Lambert development plan proposes to relocate the MoANG from its present location on the south side of the airfield to the northeast side of the airfield. The FEIS examined the potential environmental impacts associated with the relocation of the MoANG facilities and associated actions. This information will assist the USAF in meeting its specific environmental obligations.

The USAF has notified the FAA that it will prepare its own separate ROD at the appropriate time, once negotiations between the USAF and STLAA have progressed to the point that specific replacement facilities are identified and being finalized.

U.S. NAVY

The proposed expansion of Lambert involves the relocation and/or improvement of a Naval Reserve facility located on the south side of the airport. To provide for additional terminal expansion, the Lambert development plan proposes to relocate the Navy facility from its present location near the MoANG on the south side of the airfield to another site in the airport vicinity. The FEIS examined the potential environmental impacts associated with the relocation of the Navy facilities and associated actions. This information will assist the Navy in meeting its specific environmental obligations.

The Navy's ROD preparation would be similar to the USAF's in that it will be prepared at the appropriate time, once negotiations between the Navy and STLAA have progressed to the point that specific replacement facilities are identified and in the process of being finalized.

U.S. ARMY CORPS OF ENGINEERS

The proposed expansion of Lambert has the potential to impact wetlands, floodplains, and water quality--all under the jurisdiction of the COE. For that reason, the FEIS examined the potential environmental impacts to those resources and possible mitigation concepts. The involvement of the COE in conceptual mitigation planning at the EIS stage facilitates the subsequent preparation of permits, which may be required after the preparation of detailed design plans. The FEIS fulfills the National Environmental Policy Act (NEPA) requirements of the COE.

The COE will not need to prepare its own ROD for this project. It will approve a Section 404 permit application to be submitted by STLAA at the appropriate time after design plans are sufficiently finalized.

FEDERAL HIGHWAY ADMINISTRATION

The proposed expansion of Lambert involves the relocation and/or improvement of roadways under the jurisdiction of the FHWA. These roadways include improvements to portions of I-70 and relocation of a portion of Lindbergh Boulevard (U.S. 67) through a tunnel. The FEIS examined the potential environmental impacts associated with the modification of these and other local roadways. The FEIS fulfills the NEPA requirements of the FHWA.

The FHWA asked the FAA to include the following section in its ROD, which the FHWA will adopt regarding that agency's Federal actions.

Decisions Relative to Surface Transportation Actions

Airport development Alternative W-1W will impact significant surface transportation facilities located in the airport vicinity. Alternative W-1W will require the modification and/or realignment of several local and regional roadways to accommodate the proposed expansion of the airport. Section 5.22 of the FEIS provides a summary of the anticipated environmental impacts associated with surface transportation improvements that would result from the airport development alternative. This section of the EIS was designed to fulfill the NEPA requirements of both MoDOT and FHWA and addresses transportation impacts. Both MoDOT and FHWA assisted the FAA in the development of this section of FAA's FEIS. Only the incremental impacts of the roadway improvements are discussed in Section 5.22 of the FEIS, which is provided in a format consistent with the FHWA Technical Advisory T 6640.8A, "Guidance for Preparing and Processing Environmental and Section 303 Documents." The other portions of Section 5.0 of the FEIS address the cumulative impacts of the airport and roadway improvements. Measures to mitigate surface transportation impacts have been developed and are contained in Section 6.3.13 of the FEIS.

The proposed action is to expand Lambert-St. Louis International Airport, and Alternative W-1W was identified as the selected alternative to improve the airport. The selected alternative appears on Figures S-3 and 2.1 of the FEIS. Associated with that airport action are the following roadway location changes, along with an explanation of the proposed action and purpose/need for each of those changes:

Roadway	Proposed Action	Purpose/Need
Lindbergh Blvd (U.S. 67) [FEIS Figure 5.32]	Horizontal and vertical realignment through a tunnel 3,400' long by 6 lanes wide.	To accommodate new parallel runway and midfield terminal area, and to provide sufficient capacity to meet projected traffic demands.
Improvements to I-70/Airport Terminal Interchange and Terminal Area Roadway [FEIS Figure 5.31]	Improvements to I-70 in terminal area: improved system of access ramps and increased capacity along mainline. Re-alignment and expansion of on-airport terminal area roadway and ramp facilities, including parts of Lambert International Blvd., that provide access to terminal buildings and parking facilities.	To provide acceptable level of service by alleviating current congestion problems and accommodating future needs. To improve operational efficiency of the terminal area roadway system and provide added land area for proposed terminal expansion.
Natural Bridge Rd. (SR 115) [FEIS Figure 5.34]	Relocation of this road to the south, and relocate Natural Bridge-Lindbergh interchange immediately south of proposed Lindbergh tunnel.	To accommodate new parallel runway and midfield development and provide capacity to meet projected traffic demands.
McDonnell Blvd. [FEIS Figure 5.35]	Relocation of about 6,000 feet of Blvd., along I-70 right-of-way	To maximize the amount of land available for the relocation of the MoANG.
Missouri Bottom Rd. [FEIS Figure 5.38]	Relocation of the intersection of Missouri Bottom Rd. and Lindbergh Blvd.	To avoid conflict with the Lindbergh Blvd. north tunnel entrance/exit.
Local and neighborhood roadways [FEIS Figures 5.36 and 5.3.7]	Closure or relocation of numerous local and neighborhood roadways	To accommodate new parallel runway and midfield development. Acquisition of homes will make some roads no longer necessary.

Figure 5.29 of the FEIS provides a general location or description of area roadways that will be affected by Alternative W-1W. Figures 5.31 through 5.38 of the FEIS show individual roadway concepts, including the preferred alternative selected for each concept.

The final recommendation for the aviation-related preferred alternative selection, as well as the surface transportation-related preferred alternative selections, was accomplished through an assessment of the social, economic, engineering and environmental consequences of the alternatives, in combination with public involvement. After release of the DEIS, a public hearing was held on the airport improvements, and comments were grouped by category. Twenty-one comments were received relative to roadway improvements. Summaries of comments received on the DEIS and responses to those comments are located in Appendix V, number 27, of the FEIS.

Through the surface transportation alternatives screening process (described in Section 5.22.4 of the FEIS), it became apparent that the selected alternatives for each roadway had the least detrimental social, economic, engineering and environmental impacts. Additional discussion of the selected alternatives for roadway improvements appears in Section 5.22.4 of the FEIS. The selection of a preferred alternative to implement a solution for Lambert's capacity problems was completed in December 1997, with the concurrent release of the FEIS documentation. The FAA's FEIS review period ended on February 17, 1998.

While the aviation element of the overall project received strong opposition, the surface transportation alternatives received no strong public opposition. No notable concerns relative to surface transportation alternatives arose that would alter or prevent the selection of the preferred alignments.

Surface Transportation Alternatives Considered

A discussion of the process leading up to the selection of aviation-related facilities described in Alternative W-1W (including Runway 12W-30W) is provided in Section 5 of this ROD.

Per FHWA requirements, Transportation System Management (TSM) alternatives, such as High-Occupancy-Vehicle (HOV) lanes, park-and-ride lots, and employer-sponsored ridesharing programs, were examined. Public transit alternatives, such as bus systems and rail, were also considered. Based on the results of the evaluation process, it was concluded that the TSM strategy, and the transit strategy by themselves would not fulfill the safety and mobility goals of this project. As such, these two strategies were eliminated from this study for further evaluation as stand-alone solutions.

It has been concluded that the No-Build Alternative does not address the purpose and need of this project. However, it was the baseline alternative for the FEIS and is required by Federal law to be evaluated in concert with the other project alternatives.

The surface transportation alternative described below was found to be the only alternative to solve the safety and capacity problems associated with the selected aviation-related elements in Alternative W-1W.

The MPS identified surface transportation elements on the proposed ALP. However, the details provided on the ALP were conceptual in nature, requiring further refinement by the FAA, FHWA, MoDOT, STLAA and the FAA's FEIS consultant as part of the FEIS. This refinement consisted of traffic capacity analyses and development of alternative concepts that would more effectively meet roadway design standards and provide acceptable levels of service for surface vehicle traffic. Projected traffic volumes were developed based on traffic count data and methodologies provided by MoDOT. For each of the roadways discussed below that will be impacted by the new Runway 12W/30W, numerous alternatives were evaluated to determine the best solution to the surface transportation problems for that affected roadway area. In some instances, only one roadway concept is provided. This is primarily due to severe constraints imposed by the adjacent roadway system, the land uses, and the existing right-of-way.

The process leading to the selection of the preferred alternative for each of these roadway areas is summarized below and discussed in detail in the FEIS, Section 5.22.2.2 and in Appendix K, Roadway Concepts. Figure 5.29 in the FEIS depicts all the proposed roadway improvements associated with Alternative W-1W. Figures 5.31 through 5.38 in the FEIS show individual roadway concepts.

Lindbergh Boulevard (U.S. 67)

The implementation of new Runway 12W-30W will create a conflict with the existing alignment of Lindbergh Boulevard. Because Lindbergh Boulevard (U.S. 67) is a principal artery within St. Louis County, all of the alternatives developed and evaluated kept this roadway in service. Four alternatives for Lindbergh Boulevard were evaluated and are depicted in Figure 5.32 of the FEIS.

Alternative D, the preferred alternative, included the construction of a tunnel for Lindbergh Boulevard underneath the proposed Runway 12W-30W between the intersection of relocated Natural Bridge Road and relocated Missouri Bottom Road.

This alternative shifts the tunnel alignment approximately 200 to 300 feet to the west of the existing alignment of Lindbergh Boulevard.

Alternative D was selected because, among other reasons: (1) the horizontal alignment provides for a 60 mph design speed; (2) the vertical alignment provides for a 65 mph design speed; (3) the relocated Lindbergh Boulevard alignment would allow construction of the tunnel to occur while traffic was using the existing Lindbergh alignment. This alternative also offered the additional advantages of allowing the TWA training facility to remain at its present site and making 50 more acres available for future airport terminal expansion.

Improvements to I-70/Airport Terminal Interchange and Terminal Area Roadways

Improved capacity and access will be needed in the terminal area to provide an acceptable level of service. I-70 improvements include an improved system of access ramps and increased capacity along the mainline. These improvements are needed to provide an acceptable level of service by alleviating current congestion problems and to accommodate future needs. Re-alignment and expansion of terminal area roadways is required to improve operational efficiency and provide additional land area for terminal expansion. These improvements are depicted in Figure 5.31 of the FEIS.

Only one alternative, depicted in Figure 5.31 of the FEIS, was considered reasonable. This alternative involves the widening of I-70, adding ramps, reconstructing bridges, and reconstructing crossroads over I-70. In addition, this alternative involves improvements to the terminal access roadway system and reconstruction of the existing elevated Metro Link guideway.

This alternative was selected as the preferred alternative primarily based on its lesser right-of-way acquisition, fewer structures, lesser roadway length, and longer distances between successive ramps when compared to the other development concepts.

Natural Bridge Road (SR 115)

Because of the development of new Runway 12W-30W, Natural Bridge Road (SR 115) will require a relocation south with a new interchange to accommodate new parallel runway and midfield development.

Due to the need to maintain service on Natural Bridge Road and because of the high costs associated with some of the other alternatives, only one alternative was retained for the relocation of Natural Bridge Road. The relocation configuration is depicted in Figure 5.33 of the FEIS.

The major consideration of this proposed element involved alternatives for the new interchange that will be required at Lindbergh Boulevard and relocated Natural Bridge Road. Five alternative interchange configurations for Natural Bridge and Lindbergh Boulevard were evaluated and are depicted in Figure 5.34 of the FEIS.

Alternative E, which was selected as the preferred alternative, will be a partial cloverleaf interchange. The primary factors that led to the selection of this interchange configuration as the best type for this location are: (1) the available ramps to/from the north and (2) the need to maintain access between the Natural Bridge Road and Lindbergh Boulevard. There is a need to provide continuous traffic flow on Lindbergh Boulevard; therefore, the traffic signal on Lindbergh Boulevard was replaced with on/off ramps. To improve operations and safety for vehicles, other modifications are also provided.

McDonnell Boulevard

The proposed relocation of the MoANG will require relocation of McDonnell Boulevard east along the I-170 right-of-way and the reconfiguration of the intersection of I-170 and Airport Road.

Only one roadway alignment alternative, depicted in Figure 5.35 of the FEIS, was found to be reasonable and practicable for this roadway. McDonnell Boulevard will remain as a two-lane roadway from the end of the extended centerline of existing Runway 30R to the intersection of Airport Road. Internal roadways between existing McDonnell Boulevard and I-170 may be modified to meet the need of the MoANG.

The airport's future land use plans call for this area to be used by the MoANG. This alignment maximizes the efficient use of this land for the MoANG and other future airport-related developments.

Missouri Bottom Road

Relocation of the intersection of Missouri Bottom Road and Lindbergh Boulevard (approximately 1,800 feet north of its existing location) will be required to avoid conflict with the Lindbergh Boulevard north tunnel entrance/exit.

Only one alternative was considered reasonable for this improvement. It is depicted in Figure 5.38 of the FEIS. The development of the new Runway 12W-30W will require tunneling of Lindbergh Boulevard under the new runway. To safely maintain a connection between Missouri Bottom Road and Lindbergh Boulevard, the intersection of these roads will need to be relocated so that it will not conflict with the north tunnel entrance/exit. This alternative was selected as preferred because the shortest distance that will allow safe connection of this intersection is the 1,800 feet relocation to the north.

Local and Neighborhood Roadways

Closure or relocation of numerous local and neighborhood roadways will be needed to accommodate new parallel runway and midfield terminal development. Unnecessary roadways will also be removed.

Bonfils Drive - Bonfils Drive improvements that would be associated with Alternative W-1W include the realignment of Bonfils Drive from Gist Road to Natural Bridge Road. The two alternatives evaluated for this action are depicted in Figure 5.36 of the FEIS.

With Alternative B, the new roadway will be realigned so it will not travel through the proposed Runway Protection Zone (RPZ) of Runway 12W. The future road will be two lanes (approximately 4,700 feet long) and will serve as the local connector between Gist Road and Natural Bridge Road.

The primary consideration in evaluating the alternatives for this action were safety considerations involving the location and use of a public roadway within the active RPZ of future Runway 12W. FAA guidelines state that, whenever possible, roadways should be located outside the RPZ for the safety of the traveling public, as well as the safety of people and structures on the ground. For these reasons, Alternative B was selected as the preferred alternative for the relocation of Bonfils Drive.

Gist Road/Fee Fee Road - These two roadways are currently connected by a 90-degree intersection. Only one alternative runway alignment was found to be reasonable and practicable. Figure 5.37 of the FEIS depicts the preferred alternative for the Gist Road/Fee Fee Road improvements.

The proposed improvements will eliminate a portion of Fee Fee Road from Gist Road to relocated Natural Bridge Road (approximately 3,000 feet) and eliminate the existing T-intersection. The alignment of Gist Road in the vicinity of the existing Fee Fee Road intersection will be modified to provide a 300-foot turning radius. Gist Road will remain a two-lane facility. Because alternative north-south routes are available within proximity of Fee Fee Road (Lindbergh Boulevard and Bonfils Drive), the closure of Fee Fee Road in this area was determined to be the most reasonable and practicable alternative.

Summary of Proposed Roadway Development Plans for Alternative W-1W

All the above options were discussed at length during seven separate coordination meetings and six conference calls of the team overseeing the surface transportation projects. The team consisted of the cooperating agencies, FAA, FHWA and MoDOT, along with the airport sponsor, STLAA, and FAA's consultant, Greiner.

The individual roadway alternatives selected as the preferred, which make up the proposed development plan for each roadway area discussed above, are summarized as follows:

- Realignment of McDonnell Boulevard.
- Tunneling of Lindbergh Boulevard (Alternative D).
- Reconfiguration of the Lindbergh Boulevard/Natural Bridge Road Interchange (Alternative E).
- Improvements to the I-70/Airport Terminal Interchange.
- Realignment of Natural Bridge Road.
- Realignment of Bonfils Drive (Alternative B).
- Removal of approximately 3,000 feet of Fee Fee Road.
- Realignment of the intersection of Gist Road and Fee Fee Road.
- Terminal Area Roadway improvements.
- Relocation of portions of Gist Road and Fee Fee Road.
- Terminal area improvements and the relocation of Lambert International Boulevard.
- Realignment of Missouri Bottom Road.

Section 303 (Formerly Called Section 4(f)) and Section 6 Resources

There are no Section 303 (formerly called Section 4(f)) or Section 6(f) resources that will be impacted by the surface transportation elements of the overall project. The

Section 303/Section 6(f) impacts, associated with the aviation element, are discussed in Section 6 of this ROD.

Measures to Minimize Harm

All practicable measures to minimize harm have been incorporated into the decision for the selected alternative, W-1W, and its associated surface transportation elements.

The project will require approximately 24.2 acres of land for roadway right-of-way, consisting of 12 residential parcels, 7 commercial/industrial parcels, and 17 tax exempt parcels. These include six single-family residences, a 133-unit apartment complex, and the Drury Office Building. The proposed roadway improvements would not disproportionately impact low-income or minority groups. The acquisition and relocation program will be conducted in accordance with the Uniform Relocation Assistance and Real Properties Act of 1970, as amended in 1987 (*42 U.S.C. 4601*). A summary of the environmental impacts of surface transportation for Alternative W-1W follows:

Relocations	
Homes	6
Rental Units	133
Commercial Buildings	1
Population	276
Wetlands (acres)	1.8
Floodplains (acres)	2.3
Parks	0
Hazardous Material Sites	10

Section 6.3 of the FEIS provides further information regarding mitigation for surface transportation elements of Alternative W-1W. Efforts will be made to minimize disruption of communities and hardships on neighborhoods during construction of the roadway improvements through the development and implementation of a Maintenance of Traffic Plan and a Roadway Improvement Safety Plan.

Farmland impacts have been addressed. Because the area is zoned for urban uses and is fully developed, the criteria established in the Farmland Protection Policy Act do not apply and mitigation is not warranted.

Cultural resources have been addressed in accordance with regulations (36 CFR 800) implementing Section 106 of the National Historic Preservation Act (*16 U.S.C. 470*). The FAA determined that the surface transportation improvements may have an adverse effect on currently identified historic properties and additional, yet-to-be-identified historic properties. An MOA was required for the FEIS. The MOA was developed to specify measures to be implemented to avoid, reduce or mitigate any adverse effects. The MOA also details eligibility assessment and treatment measures for any additional archaeological and historic architectural resources that may be present in the undertaking's Area of Potential Effect (APE). The MOA was prepared in consultation with the Missouri SHPO and the Advisory Council on Historic Preservation and was executed by the Advisory Council on Historic Preservation on May 29, 1998. This satisfies the Section 106 responsibilities for all actions associated with the proposed surface transportation improvements. A final copy of the MOA is included in ROD Appendix H.

Due to the proximity of the alignment to residential areas, a carefully planned and executed drilling and blasting program will be implemented. The requirements of this blasting program will be governed by local, state and Federal regulations. This program can involve the following activities: pre-blast survey, vibration criteria, contractor's blasting plan, vibration monitoring during blasting, and post-blasting survey. This type of program has been successfully used on a large number of projects, including blasting in urban areas and along natural gas and electrical lines.

Motor vehicle emissions caused by the proposed action are estimated to be well below the *de minimis* levels requiring a determination to demonstrate conformity with the SIP. Emissions from all airport-related sources were evaluated in the Final General Conformity Determination, which FAA made available on June 19, 1998.

Job construction specifications will require erosion control measures to prevent sedimentation. MoDOT's Sediment and Erosion Control Plan, as approved by the MDNR, will be implemented to prevent pollution caused by construction activities. As described in detail in the FEIS, compliance with the provisions of the MDNR's stormwater regulations and the provisions of the NPDES permit will also minimize adverse water quality impacts.

MoDOT will implement BMPs for stormwater control and comply with MDNR stormwater regulations and the provisions of the NPDES, a general permit issued for road construction projects statewide.

Wetlands have been avoided to the extent practicable. The position of the selected alternatives have been chosen to minimize impacts to wetlands. The surface transportation elements associated with Alternative W-1W will require a structure across Coldwater Creek, the relocation of a culvert crossing for McDonnell Boulevard, and possible modifications to an existing ditch system. Final mitigation measures, if required, will be decided in coordination with the U.S. Army Corps of Engineers with the assistance of the U.S. Fish and Wildlife Service. Stormwater, NPDES and COE

Section 404 permits will be obtained prior to construction of any of the proposed roadway facilities. Mitigation measures addressing stormwater NPDES and COE Section 404 permits are discussed in Section 6.3 of the FEIS.

The proposed surface transportation improvements associated with Alternative W-1W will impact approximately 2.0 acres of Coldwater Creek floodplain and 0.3 acre of Cowmire Creek floodplain. Floodplain impacts have been reduced by holding right-of-way requirements to a minimum.

Wells found during construction will be sealed to prevent groundwater pollution from construction and from future road maintenance.

The project will not have adverse effects on any Federally listed endangered or threatened species.

Noise studies as detailed in the FEIS, dependent upon final design, indicate that traffic noise impacts will be minimal because: (1) noise-sensitive sites will be part of the relocation program associated with the airport alternative; (2) remaining noise-sensitive sites will experience traffic noise from another existing roadway; or (3) noise-sensitive sites will be impacted by aircraft noise. The mitigation of noise impacts all along the roadway project is unlikely. Consideration of noise barriers for residential properties adjacent to the highway project will be in accordance with the MoDOT policy on noise abatement. Mitigation of aircraft noise impacts is discussed in Section 6 of this ROD.

Ten sites (depicted in Figure 5.28 of the FEIS) potentially involving hazardous materials and/or environmental contamination, could be impacted by the surface transportation elements of Alternative W-1W. The preferred method of mitigation for hazardous waste sites is avoidance. The sites that cannot be avoided will require additional site inspection and characterization of material releases. It is not anticipated that remediation of potential contaminants will require substantial amounts of work. Sites requiring remediation will need to have a Remedial Action Plan developed with approval by the MDNR prior to implementation.

Monitoring or Enforcement Program

The proposed project will be subject to further review by Federal and state agencies and local units of government. Some permits will need to be obtained. This review and permit process will ensure that the included mitigation measures are implemented.

Comments on FEIS

The FEIS was approved for circulation on December 19, 1997, and was distributed to the agencies and individuals noted within the document on December 22, 1997. Those receiving a copy of the FEIS were provided 30 days to respond with comments. The Notice of Availability of the FEIS was published in the Federal Register on January 2, 1998. Only one letter, from Mr. Wilfred H. Adelt, mentioned the roadway projects. No other comments on the surface transportation projects were received on the FEIS.

Mr. Adelt suggested that the Lindbergh Boulevard tunnel will negatively impact the main thoroughfare between north and south St. Louis County. The response to that comment is as follows: The FAA has coordinated the proposed roadway changes, including the tunneling of Lindbergh Boulevard, with the FHWA and MoDOT. The environmental impacts of the roadway changes are contained in the FEIS Section 5.22. The proposed tunnel will not separate ties to neighborhoods, families or local businesses, or adversely affect community cohesion. The tunnel will be built to the appropriate level of service to accommodate the traffic needs of the roadway.

9. RELATED PLANNING ISSUES

Several commenting parties, principally ALPA and NATCA, maintain that Alternative W-1W will not provide the needed capacity at Lambert (Appendices C and G of this ROD). This belief is based in part on their view that the proposed operation of the expanded airport is unsafe and, therefore, cannot be operated as planned.

The major technical issues raised include:

- Safety

- Capacity
  - National Airspace System Capacity Benefits
  - Runway Stagger/Departure Dependency
  - PRM/No Transgression Zone (NTZ) Issue
  - Real Time Simulation
  - SIMMOD Input
  - Terminal Expansion
  - Benefit/Cost Analyses
  - ALPA/NATCA 18 points

SAFETY

Concerns have been expressed about safety issues and capacity/delay estimates developed during the MPS and EIS processes. In analyzing and comparing capacity and delay reduction benefits of various alternatives during the planning and environmental review processes, both the FAA and the City of St. Louis gave the highest priority to safety requirements in accordance with FAA's statutory mandate. Safety of operation is a prerequisite for operation and expansion of any airport. The FAA has rules (such as FAA Order 7110.65L, Air Traffic Control) and local air traffic control procedures, that govern the operation and interaction of aircraft in virtually any conceivable situation and combination of weather conditions. These rules include such things as in-trail, horizontal and vertical separations. The same rules applied by FAA's Air Traffic Division in operating existing airports are applied in airport planning to estimate the capacity and delay benefit of alternatives. The existing airport or any expanded airport will be operated safely in accordance with the rules established by FAA and applied by the Air Traffic Division.

The FAA has carefully considered all safety issues raised during the EIS process. Safety implications related to airfield layout are addressed by designing facilities in accordance with FAA design standards. The selected alternative, W-1W, is designed in accordance with Advisory Circular 150/5300-13. Alternative W-1W enhances safety because it reduces the project number of runway crossings with the existing airfield in 2015 from approximately 800 to 580 per day. See Appendix C of this ROD, response to Comment 8. See also Appendix G.

The selected alternative, W-1W, will use procedures that are already approved by FAA and used daily at airports throughout the United States. It was developed using FAA approved airport design standards for airfield layout.

CAPACITY

Estimates of capacity and delay are complex. The capacity and associated delay of a particular airport is influenced by a large number of variables, including the runway layout, taxiway system, terminal layout, gate utilization, weather variability, volume of demand, peaking characteristics of demand, airline operating strategies and fleet mix, to name a few. Estimating how well some future runway configuration will perform becomes a nearly impossible task, unless computer models are used to simulate the operation of the future airport. These models are very useful in analyzing different alternatives by changing one or two of the variables for comparative runs of the model and observing the differences in average annual delay that result. Such computer models have been used throughout this process.

The hourly capacity numbers for any specific set of circumstances produced as a result of this modeling are of far less importance than the relative magnitude of delay estimated. Any comparison or discussion of hourly capacity numbers for a specific case that does not include the associated delay results in an incomplete understanding of the operating efficiency of the case.

ALPA has stated that the runway stagger, which influences the dependence of departures from the existing Runway 30L on arrivals to the new Runway 30W, negates the advantage of the new runway. The FAA and the MPS consultant have always agreed that the departure dependence will exist. The condition was included in the modeling assumptions. The result is that the proposed expansion provides sufficient delay reduction to produce a very favorable benefit/cost ratio and acceptable projected delay levels through the planning period (the year 2015).

All of the inconsistencies in capacity/delay figures cited by ALPA have been derived from taking numbers from one study that used one set of assumptions and comparing them to another study that used different assumptions. Valid comparisons depend on use of the same assumptions and variables. Simulations for capacity and delay analysis are conducted by comparing each alternative with the existing airport and changing one variable at a time while keeping all the other variables constant.

Generally, capacity and delay estimates have more importance for comparative purposes than for any given absolute value.

The planning process for Lambert included capacity/delay analyses utilizing four different computer models: the FAA Runway Capacity Model, the FAA Annual Delay Model, SIMMOD and the National Airspace System Performance Analysis Capability (NASPAC) model. The assumptions and conditions used as input for these models were extensively discussed and coordinated with appropriate parties. In the case of the first three models, this included the Airfield and Airspace Working Group (AAWG). This group was comprised of representatives such as the St. Louis Air Traffic Control Tower (ATCT), ALPA, the airlines, Air Transport Association (ATA), and others. In the case of the National Airspace System Performance Analysis Capability (NASPAC) analysis, the FAA's William J. Hughes Technical Center (FAA Technical Center) performed the study, with input coordinated with FAA Airports Division and the St. Louis ATCT.

In the alternatives analysis stage of the master planning process, FAA's capacity and delay models were used to compare the relative operational efficiency of the various alternatives. The assumptions and results of this analysis are documented in Section 2 of the Master Plan Supplement Technical Compendium (MPSTC). Additionally, a sensitivity analysis was performed to assess the impact of changing circumstances that occurred during the planning process.

Once STLAA selected its preferred alternative, W-1W, different simulations were performed utilizing the more sophisticated SIMMOD computer model. The goals of the SIMMOD analysis were twofold: (1) to evaluate the most efficient means of operating the preferred airfield alternative, W-1W, reconfirming its overall operational benefits; and (2) to evaluate effects on aircraft delays and taxiing times of potential refinements to the operation and layout of Alternative W-1W. For these reasons, eighteen simulations were performed. The conditions and results of the model simulations are documented in Section 6 of the MPSTC.

The FAA Technical Center also performed capacity and delay simulation modeling to compare the preferred alternative (W-1W) to the existing airfield. This analysis utilized FAA's NASPAC computer model. Assumptions, conditions and results of this study are documented in a report published by the FAA Technical Center in June 1997, entitled "Evaluation of the Proposed Lambert-St. Louis Airport Expansion" and are discussed elsewhere in this section of the ROD.

Within each analysis, the alternatives being compared were subjected to the same sets of variables, which could affect the capacity/delay results of the study. This is necessary in order to draw valid comparisons between alternatives. Results of studies performed under different assumptions and circumstances do not provide for valid comparisons.

The proposed expansion does rely on the use of a PRM to allow dual simultaneous independent IFR approaches to the outboard runways. This procedure has been tested and approved by the FAA. Simultaneous IFR approaches to closely spaced parallel runways were subjected to real-time simulations prior to the FAA approving them. In addition, a PRM was installed and operated for over a year in Raleigh-Durham, North Carolina.

In summary, the proposed expansion at Lambert has been subjected to simulations using the FAA Runway Capacity Model, the Annual Delay Model, the SIMMOD model, and the NASPAC model. In each case, the proposed expansion has shown the potential to increase capacity and significantly reduce projected delays.

National Airspace System Capacity Benefits

The lack of airfield capacity at high-activity airports in the United States is a frequent cause of "bottlenecks" in the nation's aviation system. Lambert is identified as 1 of 23 existing delay-problem airports in the FAA's 1994 Aviation Capacity Enhancement Plan; therefore, the proposed project at the airport is crucial to the development of needed capacity for the NAS.

In 1997, the FAA Technical Center conducted a study of the proposed expansion of Lambert-St. Louis International Airport to determine the expected benefits of the proposed project to Lambert and the NAS. The study was initiated at the request of FAA Central Region Airports Division. A report documenting the methodology used and results of the study was published in June 1997.

The NASPAC Simulation Modeling System (SMS) was used to perform the task. The NASPAC SMS is a discrete event simulation model that tracks aircraft as they progress through the NAS and compete for Air Traffic Control (ATC) resources, e.g., airports, sectors, flow control restrictions and arrival and departure fixes. The NASPAC evaluates system performance based on the demand placed on resources modeled in the NAS and records statistics at the 50 busiest national airports and 8 associated airports.

The study used the model to calculate local and system-wide delays, with and without the new runway proposed for the airport. Monetary benefits of the new runway were calculated using the NASPAC Cost of Delay Module. The Cost of Delay Module calculates the passenger and operational delay cost based on actual cost reported by the airlines to the Department of Transportation's Office of Aviation Statistics. The results of the study indicate that the construction of the new runway would provide substantial monetary benefits to the airlines and the user community due to the abatement of operational and passenger delays locally and in the NAS.

Data were presented for operational delay, passenger delay and delay savings. Operational delay occurs whenever an aircraft has to compete for an ATC system resource. Passenger delay reflects the “ripple-effects” in the NAS and shows the lateness of a flight at the destination airport. The delay savings represent the difference in delay with or without the Lambert expansion project. The delay savings assumed that the current NAS stays essentially the same for the study period (2005 - 2015), with some new technologies introduced and some airspace procedures revised.

The new runway will reduce operational delay at Lambert by 63 percent in 2005, 65 percent in 2010 and 66 percent in 2015. NAS-wide, operational delay will be reduced by 5 percent in 2005, 8 percent in 2010 and 14 percent in 2015 with the implementation of the improvements at Lambert.

The new runway will also reduce passenger delay at Lambert by 55 percent in 2005, 52 percent in 2010 and 57 percent in 2015. NAS-wide, passenger delay will be reduced by 7 percent in 2005, 9 percent in 2010 and 18 percent in 2015.

Delay savings in monetary terms was also analyzed by the NASPAC model. The monetary savings indicated do not represent actual cash savings but an estimate of what could be saved by the airlines and passengers with the implementation of the Lambert expansion project. The benefits to the airlines were based on their direct cost as reported to the Department of Transportation. The passenger cost was assumed to be $45.50 per passenger hour, if they were reimbursed for lost time caused by delays in the system.

The estimated savings that could be realized by implementing the new runway at Lambert would result in significant operational and passenger delay savings both at Lambert and NAS-wide. In terms of cumulative operational delay savings during the study period (2005 - 2015), the model predicted a $1.9 billion savings at Lambert and a $5.1 billion savings NAS-wide. Likewise, cumulative passenger delay savings over the study period was predicted to be $1.4 billion at Lambert and $9.5 billion NAS-wide.

Runway Stagger/Departure Dependency

The selected alternative, W-1W, includes construction of one new parallel runway located 4,100 feet south of the existing north parallel runway (30R). The threshold of the proposed new runway is staggered approximately 12,200 feet to the west from the threshold of existing Runway 30R. This location, along with the location of the existing south parallel runway (30L), results in departures from either of the existing runways being dependent on arrivals to the new runway in IFR west flow conditions.

Critics of the W-1W plan claim this operation is unsafe and inefficient and, therefore, does not provide the capacity necessary to reduce delays as the MPS and FEIS suggest it will.

The stagger of Alternative W-1W increases safety because simultaneous arrivals will occur on runways separated by 4,100 feet instead of 3,400 feet. This is 600 feet more than the minimum lateral spacing of 3,400 feet allowed under PRM operations for straight-in approaches. The effects of the runway stagger and the dependency of departures have been thoroughly analyzed in the MPS. In addition, these issues have been addressed in the FEIS, in particular, see the responses to Comments 2-39, 2-64, 2-65, 2-137,2-142, 2-144 and 2-150 in Appendix V. The SIMMOD input and ALPA/NATCA 18 points are discussed below.

Precision Runway Monitor/No Transgression Zone Issue

This issue has both safety and capacity aspects. It also relates to the real-time simulation issue discussed below. The safety and capacity of operational procedures contemplated for use with Alternative W-1W has been the subject of numerous comments previously responded to in the FEIS. See FEIS response to Comment 1-50.

The Precision Runway Monitor (PRM) is a system comprised of a rapid update radar, an enhanced color graphic monitor and a software package, which aids the air traffic controller in more accurately monitoring the position of aircraft on final approach to a runway. As noted above, use of a PRM to allow dual simultaneous independent IFR approaches to closely spaced parallel runways has been subjected to real-time simulation and approved by the FAA. The FAA has certified PRM for use to provide simultaneous independent approaches with parallel runways separated by at least 3,000 feet (FAA Order 8260.39) (3,400 feet for straight-in approaches). PRM is the primary tool that has allowed the FAA to achieve this. The W-1W proposal for St. Louis includes outboard runways spaced 4,100 feet apart, and stipulates that a PRM would be required to provide independent approaches. Runways spaced 4,300 feet apart allow simultaneous independent approaches without a PRM.

One of the features of the PRM system is a digital map displayed on a computer terminal monitored by an air traffic controller. The digital map includes an area designated as the No Transgression Zone (NTZ). The NTZ is generally centered between the approach paths of the runways being monitored with the PRM. In the case of the Lambert expansion, the outboard runways are separated by 4,100 feet. The NTZ is 2,000 feet wide, centered between the runways. Therefore, the edge of the NTZ is

1,050 feet from the centerline of each outboard runway. Since the existing two parallel runways are 1,300 feet apart, the future center runway will be 250 feet inside the NTZ. The purpose of the NTZ is to assure proper horizontal separation between arrivals.

When operating the proposed expanded airport in IFR conditions in west flow, the plan envisions approaches to the outboard runways, existing 30R and the new runway 30W (which will be designated 30L after expansion), while allowing a departure on existing Runway 30L (which would be 30C after expansion). With the PRM in operation, this will result in the departure off existing Runway 30L (30C after expansion) entering the NTZ. With the current software design for the operation of PRM, the departure would generate an alarm notifying the controller monitoring the PRM that an aircraft has penetrated the NTZ.

Some commenters have expressed concerns that PRM has not been specifically tested with the approximately 12,200-foot stagger contemplated for Alternative W-1W or with simultaneous approaches to the outboard runways with departures from the center runway. Others comment that use of PRM with a staggered runway and departures on a center runway in the NTZ exceeds the parameters for PRM certification. The FAA has carefully considered whether use of the PRM is authorized in these circumstances. The Air Traffic Division and Flight Standards Division reviewed the plan for operation of Alternative W-1W and requirements under Air Traffic Control Handbook 7110.65 Chapters 3 and 5 and PRM procedures in FAA Order 8260.39 as they apply to that plan in detail. That review indicates that the planned operation of the runway configuration is authorized as explained below:

When operating in IFR conditions in west flow, aircraft will arrive on the outboard Runways 30W (which will be designated 30L after expansion) and 30R, while departing 30C. Departures from Runway 30C will be dependent on arrivals to both outboard runways. Before a departure is released from Runway 30C the air traffic controller will apply the provisions of FAA Order 7110.65L Paragraph 5-9-8 c.3, which defines conditions for termination of radar monitoring. Internal air traffic procedures will specify that when provisions of paragraph 5-9-8 c.3 have been applied, radar monitoring shall be terminated and no action will be required in response to any alarm that may be generated by aircraft departing runway 30C. The fact that a departure from the center runway (current 30L) is inside the NTZ is not relevant because radar monitoring will have been terminated for the approach, and PRM is not used to separate departures.

W-1W does not depend upon a change in the PRM software to deactivate alarms for departures to assure safety. The purpose of the NTZ is to enable controllers to detect loss of separation between simultaneous approaches. To conduct operations as planned, modification of the software may be required. If such a software modification is required it will be subject to appropriate testing not involving real-time simulation.

This review of the proposed procedures determined that they are authorized by current ATC guidance and consistent with procedures that would require real-time simulation, as discussed below, are necessary. This determination is documented in letters dated July 31, 1998, from the FAA Administrator, Jane Garvey, to Congressmen James Talent and Richard Gephardt (Appendix I of this ROD). The result of this review and documentation is to confirm that the proposed expanded runway configuration can be operated safely as planned and depicted in the MPS and the FEIS and that real-time simulation is not necessary to verify the safety of the procedures.

Real-Time Simulation

The request for real-time simulation was first submitted to the FAA in a letter dated December 29, 1997, from ALPA representative, Dean Adam, to John Turner, Central Region Administrator, FAA. In that letter, ALPA stated that real-time simulation was the only way to resolve capacity questions surrounding the W-1W proposal. Real-time simulation was subsequently requested to address claimed significant safety impacts and to confirm the operational assumptions in the MPS and FEIS, particularly in west flow. ALPA considers such a study essential to determine whether controllers can actually pair arrivals of aircraft having different approach speeds as simulated by computer modeling. ALPA also views testing as needed to address safe use of the NTZ for departures on the center runway.

Real-time simulation is the process by which computers, flight simulators, target generators and radar scopes, operated by real air traffic controllers and actual pilots, replicate actual flight operations in an air traffic control environment. The controllers are located in a radar lab (normally at the FAA Technical Center) while the pilots operate flight simulators at various locations throughout the country, many of which are leased from airline training departments.

The process begins with a definition of requirements. Next comes the design of the simulation, which involves the development of scenarios to reflect such variables as fleet mix, weather conditions, runway configuration and use, air traffic procedures, navigational aids, approach speeds and in-trail and lateral separation. Then the actual real-time simulation is completed. If further risk analysis is required, the data is sent to the FAA's Aeronautical Center for use in a computer simulation system. Analysis of the resulting data leads to a final report.

Real-time simulation has been used by FAA numerous times to test the viability of new procedures that have been developed for specific applications. Notably, the real-time simulation process has been used by FAA to test simultaneous independent parallel IFR approaches to closely spaced parallel runways using a PRM, when it was a new approach aid system. As a result of this and other analyses, FAA approved dual simultaneous independent IFR approaches to parallel runways spaced as close as 3,400 feet apart using PRM. Subsequently, FAA approved dual simultaneous independent IFR approaches to parallel runways spaced as close as 3,000 feet apart (3,400 feet for straight-in approaches) using PRM, with a 2½ degree offset of one of the approaches.

Real-time simulation was deemed unnecessary for this project because the procedures to be used with Alternative W-1W are authorized under existing procedures that are used daily at airports throughout the United States. Some commenters stated that real-time simulation would show that Alternative W-1W would not have the capacity claimed in comparison to other alternatives, particularly in west flow conditions. As new and untested procedures are not needed to support Alternative W-1W, real-time simulation would have no bearing on estimates of capacity and delay. While real-time simulation is a valuable tool in analyzing new and untested procedures and special situations, it is not a capacity tool. It does not provide capacity/delay numbers for comparison of alternatives.

SIMMOD Review

ALPA has commented throughout the environmental review process that various characteristics of Alternative W-1W were not properly reflected in the computer modeling and simulation analysis used by the airport's consultant and by the FAA in determining capacity. ALPA contends that incorrect information was used as input to the computer models, particularly the SIMMOD model. Others have commented that the SIMMOD capacity calculations overstate the capacity of Alternative W-1W and understate that of the existing airfield and Alternative NE-1a and that all alternatives should be evaluated using SIMMOD.

Some of the factors ALPA believes were incorrectly analyzed include the runway stagger, the dependency of departures from the center runway, the ground movements in front of the terminal, the arrival rates for the existing parallel runways, the arrival rates for the Dependent Converging Instrument Approach (DCIA) operation for the existing airfield, runway crossings and the effects of wake turbulence.

During the MPS, the City of St. Louis compared alternatives using the results of the FAA Airfield Capacity Model and the FAA Annual Delay Model. Numerous sensitivity analyses were performed throughout the planning and environmental review process using the capacity and delay models in order to determine what, if any, effect the suggested changes would have on the alternatives analysis. The latest of these analyses was conducted for the No-Action, S-1, NE-1a and three scenarios for W-1W in response to a list of 18 points that ALPA presented to FAA during a meeting on June 9, 1998 (Appendix C of this ROD).

After the capacity and delay models were used to make estimates that enabled the City of St. Louis to select its preferred alternative, Alternative W-1W, the SIMMOD was used to refine comparisons between Alternative W-1W and the No-Action Atlernative. Although FAA had already conducted one study that confirmed the results of the MPS SIMMOD analysis, to further address concerns about the adequacy of FAA's independent review, the FAA Technical Center reviewed the input files used by the consultant for the SIMMOD analysis, as well as the procedures used for modeling the runway crossings, departure dependencies and taxiway movements in front of the terminal.

The results of the FAA Technical Center review of the SIMMOD analysis of the proposed expansion are documented in an August 1998 report**.** The Technical Center established that the analysis was performed in conformance with the accepted standard practice and the results obtained are reasonable. The Technical Center's letter dated July 29, 1998, summarizing the results of this review, is documented in Appendix I of this ROD. As it is reasonable for the FAA to select Alternative W-1W based upon the comparison with other alternatives, it would not be useful to conduct additional SIMMOD analyses to refine other alternatives.

Terminal Expansion

One of the issues raised concerns the plan for expansion of the terminal facilities included in the overall expansion plan for Lambert.

The local press reported in May 1998, that TWA (the major hub operator at Lambert) was pressing the airport for immediate construction of a new 60-gate terminal. It was also reported that TWA was contemplating withdrawing its support of the W-1W plan, if the airline did not get its new terminal by the time the new runway was to open. This report stirred controversy, because the MPS and the FEIS envisioned development of new terminal facilities on a more gradual schedule.

The MPS and the FEIS documented terminal development to the west of the current terminal location, including a location west of Runway 06/24 (Figure S.3 in Appendix J of this ROD). The FEIS addresses impacts of terminal development relating to location (footprint) of new facilities and gates to accommodate the forecast aviation demand through 2015. It was estimated that 105 to 110 total gates would be necessary to accommodate the aviation demand in 2015. As part of the mitigation program in the FEIS, STLAA has agreed that when terminal design progresses sufficiently, the STLAA will conduct a carbon monoxide hot-spot analysis for terminal expansion to ensure that the terminal structure is designed efficiently from an air quality standpoint.

At the request of the FAA, the STLAA and TWA subsequently clarified the level and extent to which negotiations for new terminal facilities for TWA had progressed (see letters from STLAA and TWA in Appendix F of this ROD). Both parties reported that preliminary discussions had taken place, but that both STLAA and TWA were in full support of the expansion plan as developed in the MPS and documented in the FEIS.

An issue directly related to the terminal expansion plan that has been the subject of comments is the ground movement on Taxiway Delta in front of (and adjacent to) Concourse C. The current configuration of this taxiway in relationship to the terminal requires that aircraft using the gates on the north side of Concourse C push back into the taxiway. This restricts the efficient utilization of the taxiway.

This limitation was identified at the alternatives analysis stage in the MPS process. A number of possible solutions to the problem were explored with the participation of the AAWG. Some of those solutions were:

1. Remove a section of Concourse C near the main terminal to allow one-way taxi flow into the "back alley" between Concourses C and D, with opposite flow along the north side of Concourse C.

2. Move Runway 12R/30L 300 feet north of its present location to allow enough room to clear push backs from the terminal with a new parallel taxiway.

3. Reduce the width of Runway 12R/30L to 150 feet (presently 200 feet) to allow room to shift Taxiways Alfa and Delta 50 feet to the north.

4. Eliminate approximately 11 conventional gate positions on the north side of Concourse C, replacing them with 5 "power-in, power-out" gate positions to eliminate push backs into the taxiway--to be accomplished when terminal expansion to the west of the present terminal provides enough gates to compensate for the six-gate net loss required by the plan. This is the solution that was selected.

In summary, terminal development up to a total of 110 gates is covered in the FEIS. Terminal development west of the current terminal and some terminal development west of Runway 6/24 is documented in the FEIS. The proposed terminal areas are shown in green in Figure S.3 of the FEIS (Appendix J of this ROD). Impacts of the terminal facilities were considered for each of the 22 environmental categories examined in the FEIS and documented in the FEIS. The only additional analysis needed is a carbon monoxide hot-spot analysis unique to exact terminal design. Terminal development in excess of 110 total gates would need additional environmental review.

Benefit/Cost Analyses

Two separate benefit/cost analyses were prepared during the study process. The first was conducted by the MPS contractor for STLAA. A second independent BCA was conducted by the FAA.

Master Plan Supplement Benefit/Cost Analysis

Benefit/cost ratios (BCR) were computed in the MPS. Benefits included aircraft travel time and delay savings, while costs were calculated using construction costs to be incurred from 1996 to 2015. According to the analysis prepared by STLAA, the new runway at Lambert (Runway 12W/30W) would have a BCR of 2.2, indicating that its economic benefits are over two times greater than the project cost, and that it is economically preferable to not constructing the runway.

FAA's Independent Benefit/Cost Analysis

As a supplement to the analysis of the Lambert expansion plan (W-1W) for the FEIS, and in anticipation of a request for funding under the Airport Improvement Program (AIP), the FAA Airports Division requested the FAA's Systems and Policy Analysis Division (APO-200), Office of Aviation Policy and Plans, to conduct an independent BCA of the proposed plan.

In July 1997, the FAA performed and completed an independent BCA for Lambert. The analysis, performed by FAA's Systems and Policy Analysis Division, Office of Aviation Policy and Plans, compared Alternative W-1W with the No-Action Alternative. The methodology, assumptions and results of the analysis are documented in a report entitled "Benefit-Cost Analysis for Lambert-St. Louis International Airport Capacity Enhancement Project," dated July 31, 1997.

The results of the FAA analysis indicate that Alternative W-1W has a BCR of 2.6 compared to the No-Action Alternative, making it economically preferable to the No-Action Alternative.

The FAA report also includes a risk analysis, which calculates the effect of cost overruns, construction schedule slippage, traffic growth variations, and combinations of these variables. The risk analysis indicates that Alternative W-1W has a high probability of maintaining a BCR greater that 1.0 under a wide variety of scenarios.

In summary, regardless of whether one relies upon the BCR of 2.2 from the MPS or the FAA's BCR of 2.6, the BCR for Alternative W-1W is clearly advantageous.

Air Line Pilots Association/National Air Traffic Controllers Association 18 Points

ALPA and NATCA presented a written list of 18 concerns to FAA senior staff at a meeting on June 9, 1998, and submitted basically the same list when they met with the Associate Administrator for Airports on June 16, 1998.

In response to these concerns, the FAA Airports and Air Traffic staff met with STLAA and its consultant to determine the variables to examine in a "sensitivity" analysis. A sensitivity analysis is a process of reevaluation or recalculation of a previously completed analysis using one or more changed variables. The purpose of the sensitivity analysis is to see what effect the changed variables have on the results of the analysis, or how sensitive the results of the analysis are to the variables that are the subject of the sensitivity analysis. In this case, at the request of the FAA, STLAA and its consultant performed a sensitivity analysis to determine what effect the use of the variables suggested by ALPA and NATCA would have on the results of the capacity/delay analysis and the overall analysis of the alternatives. The results of the sensitivity analysis indicate that incorporation of the ALPA/NATCA data would make no significant difference in the capacity/delay and cost/benefit analysis relative comparison of the alternatives. The details of the sensitivity analysis are included in Appendix C of this ROD.

In recent comments, both ALPA and Bridgeton have misinterpreted FAA's use of different assumptions as proof that the assumptions and analyses in the MPS and the FEIS are incorrect. The sensitivity analysis was done with, among other assumptions, a lower arrival rate of 60 arrivals per hour instead of 72 per hour during VFR 1 conditions for the No-Action Alternative and Alternative W-1W. It also examined the effect of using outboard runways during VFR 1 and 2 conditions and west flow with Alternative W-1. These analyses were done to accommodate and address concerns about the validity and integrity of the process.

The operational assumptions used in the planning and EIS processes remain reasonable and valid. The arrival rate of 72 arrivals per hour includes ample time for voice communication between pilots and controllers and for clearances. The assumptions used in the MPS and the FEIS are consistent with operational efficiency. During good weather and west flow, it would be more efficent to use the new runway for departures and the existing runways for simultaneous independent arrivals than to sequence departures between gaps in simultaneous arrivals to the outboard runways given the demand for departures at Lambert.

10. ENVIRONMENTAL ISSUES RAISED ABOUT THE FEIS

During the 30-day review period, comments were received from the following in response to the FEIS:

Federal Agencies

- Department of Health and Human Services
- Department of the Interior
- Department of Transportation, Federal Transit Administration
- US Environmental Protection Agency

Local Agencies/Interest Groups

- City of Woodson Terrace
- St. Clair County Board
- St. Charles R-6 School District
- Office of the County Executive, St. Charles County
- City of Bridgeton
- City of St. Charles
- National Air Traffic Controllers Association
- Air Line Pilots Association
- People Building Community
- St. Charles County Citizens Against Aircraft Noise
- Bridgeton Air Defense

Interested Citizens

- 161 letters from interested citizens

Letters from the public echoed many of the comments received from the local governments and interest groups. Most of their comments were in the areas of noise, airport planning, alternatives and public involvement.

No substantive comments were received from the public on the following categories after the release of the FEIS: hazardous materials; water quality; historic, architectural and archaeological resources; biotic communities; endangered and threatened species; wetlands; farmlands; energy and natural resources; light emissions; solid waste impacts; construction impacts; cost considerations; environmental justice; surface transportation; floodplains; and design, art and architecture.

The FAA has carefully assessed and considered comment letters received on the FEIS in making its decision. Copies of these letters are available for inspection at the FAA Regional office. While not every comment in every letter has been addressed, Appendices A, B, C, D, E and G of this ROD provide detailed responses to comments on major issues raised by the principal commenting agencies and citizen groups. Airport planning issues raised in comments on the FEIS are summarized previously, in Section 9 of this ROD. The major environmental issues raised in comments on the FEIS are summarized below.

1. Flawed purpose statement includes dual simultaneous independent arrivals

Commenters contend that dual simultaneous independent arrivals are not a legitimate purpose and need.

The purpose and need statements contained in the FEIS present an accurate description of the purpose for the project and the reasons why the proposed Lambert action is needed. The FEIS, Section 2.0, Purpose and Need, identifies four major elements of the purpose of the proposed Federal action.

The first major element listed is associated with capacity and aircraft delay. One of the sub-items identified under capacity and delay is the development of a capability for dual simultaneous independent IFR arrival operations. This capability was identified as far back as the FAA's 1986 Capacity Enhancement Study, done by the FAA Technical Center. It was subsequently identified in the master planning process. Both the FAA and STLAA determined, based on the forecasts of aviation demand and analysis of existing airfield capacity, that a third parallel runway and a separation of at least 3,400 feet between the outboard parallel runways would have the greatest potential to reduce aircraft delays during adverse weather conditions. This capability was identified as a subordinate item under the general purpose of enhancing capacity and reducing delays, reflecting the operational importance of improving airport capacity during poor weather (IFR and VFR-3) conditions. This was the major capacity problem identified by the master planning process and confirmed by the FAA Technical Center's independent evaluation.

The City of Bridgeton commented both on the DEIS and on the FEIS that the FAA has unduly narrowed the purpose and need and skewed the analysis of alternatives by relying upon simultaneous instrument arrival capability as a factor. The inclusion of dual simultaneous independent IFR arrival operations at Lambert did not unduly narrow or restrict the consideration of alternatives.

It was reasonable to include simultaneous arrival capability during instrument meteorological conditions as a sub-element of the general purpose and need of enhancing capacity based on the 1986 and master planning studies. Simultaneous arrival capability did not skew the analysis of alternatives because it was one of seven project goals or factors weighed by FAA, along with reducing delay and enhancing capacity generally both at Lambert and in the NAS during visual meteorological conditions, consistency with local planning, and consistency with economic goals (FEIS, Section 3.2, p. 3-3-3-6). These factors, derived from the purpose and need section of the EIS (FEIS Section 2.0), are listed in Section 4 of this ROD. Subsequently, operational efficiency, financial and environmental concerns were considered in the decisionmaking process.

While independent arrival capability during IMC was dispositive in dismissing Alternative NE-1a in the DEIS, two other similar north airfield alternatives met this requirement and were retained for further consideration in Tier 2.

Even if simultaneous independent arrival capability in IMC was an overriding factor, the analysis of alternatives was not skewed because all but one of the eight development alternatives carried forward from the MPS met the criteria. In addition to Alternative W-1W, of the onsite airfield alternatives, Alternatives NE-1, N-1, C-1, W-1E, W-2 and S-1 met the simultaneous arrival capability criteria (FEIS, Table 3.7, p. 3-35). Alternative S-1, which had simultaneous independent arrival capability, was one of the reasonable alternatives evaluated fully throughout the EIS process. A recent NASA study indicates that additional runways, providing independent IFR capability, are one of the most promising strategies for improving capacity in the NAS (Pages 24-26 of the NASA study, attached to the City of Bridgeton's comments on the FEIS dated February 2, 1998). That the FAA and STLAA view independent arrival capability as important and the most plausible goal is not unreasonable because others might consider the lower levels of capacity and delay reduction of NE-1a tolerable.

The analysis of alternatives was also not skewed because the FAA has done supplemental analysis to assure that it did not elevate independent arrival capability over the larger project goals. In the DEIS, the FAA examined the FAA Runway Capacity Model and FAA Annual Delay Model results that estimated the capacity and delay associated with Alternative W-1W, and Alternative S-1, along with the other alternatives N-1, NE-1, NE-1a, C-1, W-1E, W-2 and the No-Action Alternative. This analysis indicated that Alternative W-1W provides greater capacity benefits than the No-Action Alternative. In response to comments on the DEIS, the FAA examined Alternative NE-1a in more detail in the FEIS (FEIS Section 3.3.4.1). Further examination in the FEIS indicates that Alternative NE-1a was not a reasonable alternative because it has substantially higher average annual delays, total annual delay and more runway crossings than the alternatives studied in detail in the EIS (MPS Section 3, Attachment D-2).

In response to further comments from the City of Bridgeton, ALPA and NATCA, that questioned the validity of the modeling assumptions used in the FEIS, the STLAA, with oversight from the FAA, conducted a sensitivity analysis in June 1998 that included Alternative NE-1a. This sensitivity analysis assumed, for the sake of argument, the truth of four different assumptions posited by these commenters. The sensitivity analysis indicated that Alternative W-1W increases capacity and reduces delays better than Alternative NE-1a and the No-Action Alternative. The commenters do not identify any alternative that provides capacity or delay reduction benefits comparable to or greater than Alternative W-1W but lacks simultaneous independent arrival capability.

This comment is very similar to prior comments on the DEIS. See responses to Comments 1-14, 1-21 and 1-49 in FEIS Appendix V.

2. FEIS flawed based on tiering process for screening alternatives

There were concerns that the FEIS and its alternatives analysis do not meet the requirements of NEPA, because the tiering process used by FAA to screen alternatives was flawed.

While some commenters believe that the FEIS is flawed, the FEIS is a comprehensive document that fully meets the spirit, intent and requirements of NEPA as well as other substantive statutes. The FAA prepared an evaluation of the proposed action through the EIS process as required by NEPA. The purpose of an EIS is to consider alternatives, present probable environmental impacts and examine possible mitigation to address the significant adverse environmental impacts of those alternatives. The FEIS identifies significant adverse environmental impacts for the preferred alternative and contains appropriate mitigation for those significant adverse environmental impacts.

The FAA solicited comments from interested parties, starting with the scoping process on the DEIS, and continuing throughout, so that it could correct any deficiencies in the documents and provide any additional analyses needed in the FEIS. As examples, because of comments received on the DEIS, the FAA supplemented its FEIS noise analysis with grid points outside the 65 DNL contour, and supplemented the air quality analysis to further describe issues of interest to EPA and MDNR.

The FAA worked closely with each jurisdictional agency to ensure that its concerns were adequately addressed in the FEIS. The EPA expressed satisfaction with the Draft General Conformity Determination, which demonstrated that the project meets the requirements of the Clean Air Act (EPA letter dated April 22, 1998, in Appendix A of this ROD). The DOI and MDNR commented on requirements of the Land and Water Conservation Fund Act and DOT Section 303 (also referred to as Section 4(f)) and had no outstanding issues remaining. Along with the FAA and the STLAA, the SHPO and Advisory Council on Historic Preservation signed an MOA (Appendix H of this ROD) that satisfies the requirements of the National Historic Preservation Act. The Corps of Engineers was consulted and had no objections to the proposed wetlands mitigation concept. These examples demonstrate that the FAA has fulfilled the procedural and substantive requirements of NEPA as well as other environmental statutes and requirements.

Regarding the FAA's tiering process and alternatives analysis, a full and comprehensive range of alternatives was explored by the FAA in the Federal EIS process. The EIS examined the alternatives of using a multiple airport system, using existing or proposed regional airports as a replacement or supplement to Lambert, development of a new airport, other modes of transportation and use of other runway configurations at Lambert.

The Council on Environmental Quality (CEQ) regulations require that reasonable alternatives be comprehensively considered and an explanation be provided as to why other alternatives were eliminated from detailed consideration. The FAA used a three-tiered analysis process, which the EPA acknowledged as meeting the requirements of NEPA, to determine the reasonable alternatives that were subject to detailed analysis. Alternatives that were not considered reasonable were not retained for detailed evaluation. In order to be carried through for detailed analysis, an alternative had to meet all the purposes and needs for the proposed action.

In its letter dated February 27, 1998, the EPA expressed concerns regarding the alternatives analysis in the FEIS. The FAA provided additional explanation to EPA in a letter dated April 9, 1998, and the EPA responded, in a letter dated April 22, 1998, that its remaining concerns had been resolved (Appendix A of this ROD contains these letters). In that letter, the EPA stated the following: "I believe it is important to note that while we may have expressed disagreements or requested clarification in the areas of air quality and noise impacts, our comments on the FEIS should not be viewed as questioning whether the FEIS met the spirit, intent, and requirements of NEPA in these two issue areas. Our comments concerning NEPA requirements were directed solely at the issue of the alternatives analysis contained in the FEIS, and particularly the role of economic factors in the screening process for the alternatives."

The tiered alternatives analysis presented a logical, objective means to screen all alternatives considered in the study. The tiered evaluation retained two reasonable alternatives, W-1W and S-1, for detailed evaluation, not just the sponsor's proposed action. In its letter of April 22, 1998, the EPA stated that the tiered screening analysis of alternatives, based on the particular purposes and needs identified for this project, represented an adequate screening of the alternatives consistent with the requirements of NEPA. In its response to FAA's clarification of the alternatives analysis, the EPA responded: "As we indicated in our earlier correspondence, our Agency supports the concept of screening a full range of alternatives against a project's purpose and needs to identify which alternatives are reasonable, and are carried forward for detailed analysis. We believe this approach meets the spirit, the intent, and the requirements of NEPA, provided that the process is conducted in a valid, legitimate manner. With the additional clarification provided in your letter of April 9, 1998, we better understand how FAA conducted the tiered alternatives screening, and believe that the analysis of alternatives, based on the particular purpose and needs identified for this project, represents an adequate screening of the alternatives consistent with the requirements of NEPA." Thus, the FAA's analysis of alternatives fulfills the requirements of NEPA.

These comments also do not raise entirely new issues, but are similar to comments previously raised on the DEIS. Tiering was discussed in the FEIS Appendix V, responses to Comments 2-74, 2-77, 2-78, 2-121, 2-131, 2-132, 2-133, and 2-134. The alternatives selection process was discussed in the FEIS responses to Comments 211, 2-15, 2-29, 2-58, 2-72 and 2-85.

In summary, the FEIS, including its alternatives analysis, is a comprehensive document that fully meets the spirit, intent and requirements of NEPA.

3. Use of Scott AFB/MAA

Citizens questioned why Mid-America Airport (MAA) could not be used as an alternative to supplement or replace Lambert.

The FAA believes that the effects of the future development of MAA on Lambert have been fully considered in the FEIS. The use of other airports, including MAA, as a hub or to supplement Lambert is not considered a viable alternative to the planned development of Lambert. At the present time, it appears that the capital investment required, the travel distance involved, and the impact on airline hub operations exceed the benefits derived. However, all airports in the St. Louis area were examined in the FEIS to determine their capability to handle commercial traffic.

In order to be carried through for detailed analysis, an alternative had to meet all the purposes and needs for the proposed action. Alternatives eliminated during Tier 1 of the analysis did not meet aviation-related project purposes and needs and were not considered reasonable. All off-site alternatives were found to be unreasonable alternatives in terms of the first tier of the analysis. In the EIS, we discussed specifically how the off-site alternatives, such as MAA, did not maintain a passenger hub at Lambert, a key component of the project need. If a proposed alternative could not enable Lambert to effectively function as a hub by safely accommodating projected levels of aviation activity at an acceptable level of delay, then it would serve no purpose to carry that alternative forward for detailed evaluation.

The lack of a sponsor for airport expansion in another political jurisdiction is a reality that the FAA is authorized to consider under CEQ regulations and the rule of reason. The FAA has received correspondence from St. Clair County, the operator of MAA (which is a joint-use facility with Scott AFB), that indicates it supports Lambert as the regional hub (FEIS Appendix A, pages A-20 and A-21). There has been no correspondence from St. Clair County or any other political entity in the region that indicates the desire to be the sponsor of such a hub airport.

Section 3.3.3 of the FEIS contains a thorough analysis of the MAA alternative. Also, comments on this alternative were received after release of the DEIS and FAA provided explanation of its elimination from consideration in FEIS Appendix V responses to Comments 2-3, 2-33, 2-45, 2-60 and 2-120.

4. Selection of Modified S-1 alternative

Some groups favored the Modified S-1 alternative, which was supported by ALPA, and believed FAA should select that alternative rather than Alternative W-1W.

An analysis contained in Section 3.3.4.3 of the FEIS details the environmental impacts associated with the Modified S-1 alternative. ALPA has proposed two versions of the Modified S-1 plan. It was estimated that the 1993 version would involve the purchase of nearly twice the number of homes, and the overall environmental impact would greatly exceed Alternative S-1. While the 1996 version would affect substantially fewer homes, simple review of the Modified S-1 plan reveals that it would so severely impact I-70 that the cost and construction difficulties make it unreasonable and also less desirable than Alternative S-1. As indicated in the FEIS analysis, this alternative would have significantly greater environmental impacts when compared to Alternative S-1. Therefore, after examination of the Modified S-1 alternative, the FAA eliminated it from further consideration, because there were no operational or cost advantages when compared to Alternative S-1.

These comments do not present significantly new issues. Similar comments were made on the DEIS. FAA previously provided responses to those comments (FEIS Appendix V responses to Comments 2-5, 2-27, 2-104, 2-140 and 2-155).

5. Selection of Alternative NE-1a

NATCA and other commenters suggested that FAA should select Alternative NE-1a as its preferred alternative. In comments provided on the DEIS, NATCA outlined numerous reasons why it believes that runways separated by 2,500 feet would meet Lambert's needs.

Although Alternative NE-1a provides only a 2,500-foot separation between the outboard runways, it was included and studied in detail in the MPS at the request of the airlines. One of the purposes of the proposed action is to increase IFR capacity, as well as VFR capacity. Alternative NE-1a was eliminated from detailed environmental analysis in the DEIS because it provides less than the 3,400-foot separation needed for simultaneous, independent arrivals in either IFR or VFR weather conditions.

In comments provided on the DEIS, NATCA outlined numerous reasons why it believed that runways separated by 2,500 feet would meet Lambert's needs. FAA's detailed responses to NATCA's comments are provided in responses to Comments 1-52, 2-157 and 2-158 in the FEIS Appendix V. Other FEIS Appendix V responses to comments that discuss Alternative NE-1a include Numbers 2-27, 2-40, 2-89, 2-90, 2-119, 2-126 and 2-139. In response to these comments, FAA conducted further analysis of NE-1a in the FEIS (FEIS Section 3.3.4.1). The analysis indicated that Alternative NE-1a increases the number of runway crossings over existing conditions, as well as over Alternative W-1W. Additionally, more significant interactions between arrivals and departures would be expected with NE-1a as compared to the other alternatives. Thus, the FAA did examine the alternative preferred by NATCA, NE-1a, but eliminated it from further consideration.

6. Selection of the Lambert 2020 alternative

The City of Bridgeton stated that the FAA should select the Lambert 2020 alternative, which was proposed by the City of Bridgeton.

The City of Bridgeton's Lambert 2020 Plan as submitted was very general in nature. However, the Lambert 2020 Plan is very similar to Alternative NE-1a, particularly as to runway location. The Lambert 2020 Plan calls for a third parallel runway in the same location as Alternative NE-1a. It does not meet the purpose and need, primarily because the runway spacing would only be 2,500 feet, which would not permit simultaneous, independent arrivals in poor weather conditions.

Section 3.3.4.5 of the FEIS provides further details regarding the elimination of this alternative. The Lambert 2020 plan was also previously discussed in FEIS Appendix V responses to Comments 2-24, 2-109 and 2-141.

7. EPA concerns with noise impact analysis and noise mitigation program

The EPA expressed concerns that the noise impact analysis and noise mitigation program, as described in the DEIS, werenot adequate. Those concerns were addressed in the FEIS, Appendix V, responses to Comments 3-77, 3-78, 3-79, 3-87 and 3-99.

The EPA was under the impression from the DEIS that the FAA deferred mitigation to a Part 150 study, which was not our intention. The FEIS states that mitigation for the EIS is separately required and not dependent upon a Part 150 study (Section 6.3.1 of the FEIS).

Regarding noise impacts, the FAA believes it provided a comprehensive analysis of noise impacts, including an analysis of the areas that will experience a 3-dB increase in the 60 to 65 DNL contour. Although it was not the type of analysis that the EPA expressed an interest in seeing, FAA believes that the extended analysis is within the framework of the Federal Interagency Committee on Noise (FICON) guidelines and public disclosure requirements under NEPA.

With respect to the EPA's suggestion for clarification of proposed mitigation, as stated in the FEIS, the FAA has determined that the mitigation programs will consist of: (1) for areas 70 DNL and higher, residential and residentially zoned areas will be acquired; and (2) for areas 65-70 DNL, a voluntary mitigation program (sound insulation or residential sales transaction assistance) will be offered for residences and community facilities, including schools, and mobile home parks will be acquired. For areas between 60-65 DNL, we have determined that mitigation measures are neither appropriate nor practical. We note also that the STLAA has an ongoing, FAA-approved FAR Part 150 Noise Compatibility Program, which already provides mitigation for existing and future noise impacts around the airport.

The FEIS noise mitigation program was explained to EPA staff, who concurred that it is sufficient. Therefore, the FAA believes its noise analysis and mitigation program adequately meet the spirit, intent and disclosure requirements of NEPA.

The development of Alternative W-1W will not reverse ongoing efforts to provide relief to residents impacted by existing airport noise. The airport is continuing with its Part 150 program, approved by the FAA in 1997, to address noise issues related to existing airport operations.

The STLAA is planning to install a new permanent noise monitoring and flight tracking system, intended to assist in the management of its noise program and monitor the effectiveness of operational noise mitigation measures, such as directing aircraft to turn over the Missouri River bottoms. Once a full year's noise and flight track data showing the actual noise levels and flight tracks resulting from the operation of the new west runway are available and have been analyzed, an adjustment will be made to the mitigation program, if appropriate.

8. Increases in noise and overflights in communities west of Lambert

Citizens in communities west of the airport, such as Bridgeton, St. Charles and Maryland Heights, question the noise analysis and believe there will be large increases of noise and overflights in their communities

The noise exposure analysis was prepared by Greiner and reviewed and approved by the FAA. Flight tracks were developed by Greiner under the direction of the FAA, utilizing information from FAA Air Traffic Control Specialists, analysis of Automated Radar Terminal System (ARTS) data and information gathered during field observations. The FAA's Integrated Noise Model (INM) was used to model dispersed flight tracks, which represent corridors of aircraft flight activity. Departure and arrival flight tracks used in the noise analysis represent average conditions, including both instrument and visual flight conditions. Flight tracks for Alternative W-1W were developed based on a 3-parallel runway configuration. The aircraft operations mix was developed through coordination with the FAA ATCT, airlines, the Missouri Air National Guard and other airport users. Information was also obtained from aircraft manufacturers regarding aircraft performance characteristics of existing and new generation aircraft. Projections of future operations were closely coordinated with the FAA and aircraft operators. Therefore, the noise exposure analysis and noise exposure maps contained in the FEIS are based on the most accurate information available regarding the current and predicted future operation of the airport. The flight paths projected do represent annual average conditions. We note, however, that flight paths may change from day to day because of wind, weather or other conditions.

Although noise measurements are not required for an FEIS, since the airport has had a permanent Noise Monitoring System, data collected by the Noise Monitoring System were used for the EIS. The purpose was to provide validation of, or adjustments to, the data base provided in the INM computer model. On-site noise measurements provided data to compare with that provided by the prediction model for the existing condition. Measured values were compared with the noise levels derived from the INM. On the basis of this comparison, it was concluded that the measured values of these sites were within reasonable conformance with values calculated by the computer program. No manual adjustments not already included in the computer model were required due to terrain or climatic variations. The INM noise analysis results correlated to within 1 dB of the actual monitored results (Section 4.2.4.2 of the FEIS).

Airplanes will fly over St. Charles or Maryland Heights. Departing flight tracks will not be concentrated over the central portions of the City of St. Charles. For the existing runways and the proposed new runway, departure corridors to the southwest would be over the Missouri River Bottoms. This would generally place aircraft over the Missouri River Bottoms, rather than over the City of St. Charles. Departure Track T46, as shown in Figure 5.7 of the FEIS, will be located over St. Charles. Tracks T47, T48 and T49 are also departing flight tracks from Runway 30W, which do not go over the City of St. Charles. As indicated in the FEIS Appendix F, Table F.21, of all the departures on Runway 30W, only 33 percent of general aviation and small and medium commercial jets will utilize Track T46. All large commercial jets and military jets, as well as 67 percent of general aviation and small and medium commercial jets departing from Runway 30W, will utilize Tracks T47, T48 and T49, which do not impact the City of St. Charles.

In summary, after Runway 12W/30W is operational, certain neighborhoods in St. Charles and other communities west of the airport will be overflown more directly and at shorter slant ranges than they are at present. Because of the effects of the introduction of quieter Stage 3 aircraft, noise levels are projected to decrease in future years. With the implementation of Alternative W-1W and the increased percentage of Stage 3 aircraft, the FEIS grid point analysis conducted for locations C01 through C06 in St. Charles indicates that noise levels at these locations will be well below the DNL 65 dB threshold. By the year 2002, aircraft noise levels will have decreased to below DNL 60 dB, with or without Runway 12W-30W.

Similar comments previously received on the DEIS regarding noise increases and flight tracks were addressed in responses to Comments 3-17, 3-86, 3-93, 3-102, 3-103, 3-107 and 29-62 in Appendix V of the FEIS.

9. Current noise levels in St. Charles

According to an independent noise study commissioned by the City of St. Charles and prepared by Engineering Dynamics International (EDI), St. Charles is currently experiencing high noise levels.

The current noise situation in St. Charles is not associated with the proposed Runway 12W/30W alternative. While some areas in St. Charles may currently experience noise levels between DNL 60 and 65 dB, they are not related to the proposed expansion, including Runway 12W/30W.

Section 4.2.4.2 of the FEIS contains a detailed analysis of the existing noise environment in the Lambert study area. Based on the information contained in this section, the St. Charles area is outside the DNL 65 dB contour area. This conclusion is supported by the results of both the St. Charles County Government study, prepared by EDI, and the FEIS. The EDI report was considered by the FAA in its preparation of the FEIS. In Appendix V of the FEIS, responses to Comments 3-43 and 3-54 address the findings of the EDI report.

10. Inappropriate use of 65 DNL as cutoff for noise impacts or mitigation

St. Charles citizens expressed the opinion that DNL 65 is not an appropriate cutoff for noise impacts or mitigation.

NEPA requires Federal agencies to evaluate the environmental consequences of a project's environmental impacts and to determine whether they are potentially significant. In some impact categories, that significance is determined by reliance upon certain thresholds or standards. In this case, the FAA used the 1.5 dB or greater increases in noise within the DNL 65 dB.

In 1979, Congress directed the FAA to adopt regulations to establish standard methodologies for measuring noise and guidelines for determining noise levels at which land uses are compatible with various levels of noise exposure (*49 U.S.C. 47502*). In 1981, the FAA issued 14 CFR Part 150. Under FAA guidelines, residential land uses are compatible with noise exposure levels below DNL 65 dB. The FAR Part 150 guidelines were established after years of extensive consideration by various agencies (i.e., EPA, HUD, FAA) of the impact of aircraft noise on people. FAA's policy decision regarding the selection of DNL 65 dB as the threshold of significant noise impact is based upon a variety of noise studies such as Impact of Noise on People (USDOT, May 1977) and Guidelines for Considering Noise in Land Use Planning and Control (Federal Interagency Committee on Urban Noise, June 1980). This study states that "a valid indicator of noise impact is the changing percentage of population associated with a given response category." The study indicates that at DNL 65 dB, 30 percent of the population rate noise as unacceptable, while 70 percent rate noise as acceptable. Use of the 65 DNL contour as the threshold of significance under FAA Orders 1050.1D and 5050.4A, which implement NEPA, is well established and has been judicially approved.

As discussed below, a DNL grid point analysis was done for certain noise-sensitive locations, including some residential areas in St. Charles. However, the FAA properly determined not to analyze alternative mitigation measures in areas surrounding the airport like St. Charles that would experience less than significant cumulative noise exposure levels as a result of the proposed action. The FICON report indicates that few mitigation measures are appropriate or practical in areas below DNL 65 dB. Noise abatement adjustments to flight procedures tend to be viewed as the most likely candidates for mitigating noise at lower levels, because they are within Federal control and do not involve changes in land use. However, this tool also has limitations. In order for a noise abatement flight procedure to be considered for analysis, there should be a reasonable expectation that a noise benefit of worthwhile magnitude would result and that implementation of the procedure is appropriate and practicable. Procedural changes usually involve moving noise around rather than eliminating it and may actually result in noise increases for some people, while reducing noise for others. It is generally expected that Federal priority will be given to mitigating noise at higher levels. It would not normally be a mitigating practice to increase the impacted population at higher noise levels in order to reduce increases at lower noise levels.

Recognizing that residents located outside the DNL 65 contour experience noise exposure, the FAA did examine noise at residential and other noise-sensitive facilities located in areas less than DNL 65. The noise impacts to St. Charles that can be expected with the implementation of Alternative W-1W are evaluated in Appendix Q of the FEIS. Table Q-1 in Appendix Q of the FEIS indicated that DNL levels will increase at three of the six grid points analyzed. However, in no instance was the DNL level in excess of DNL 60 dB with the proposed action. The table also indicates that the DNL level will decrease at three of the six grid point locations, again, with none of the locations experiencing DNL levels greater than DNL 60 dB with the proposed action. Therefore, residential land uses in St. Charles are compatible under Federal guidelines and no mitigation is required. No mitigation is warranted in St. Charles.

Comments on the DEIS stated that DNL 65 dB is not an appropriate standard for the examination of noise impacts or the establishment of the mitigation program for the Lambert expansion. The FAA explained this issue in the responses to Comments 3-10, 3-45, 3-56, 3-58, 3-67, 3-100, and 3-101 in Appendix V of the FEIS.

In summary, DNL is an appropriate noise metric and DNL 65 dB is an appropriate standard of significance. The FICON report states in Section 3 Airport Noise Policy Recommendations, “All Federal agencies have now adopted DNL as the metric for airport noise analysis in NEPA (EIS/EA) documents.”

11. Use of supplemental metrics for speech interference and sleep disturbance

Commenters requested that FAA should use supplemental metrics to determine speech interference and sleep disturbance impacts in St. Charles.

In keeping with the guidance provided by FICON, the use of supplemental metrics (such as single-event analysis) is best left to the discretion of individual agencies. At the onset of the study, and again later in the study after additional information was available, the FAA made a policy decision that the noise analysis in the FEIS would be based on DNL contour analyses. The FAA further found that the use of supplemental metrics to analyze noise conditions in the City of St. Charles was not necessary. However, in response to comments received on the DEIS, the FAA did prepare a DNL Grid Point analysis for several sites located within St. Charles County. The results of this analysis, contained in Appendix Q of the FEIS, indicate that DNL levels at each of the six modeled locations would be below DNL 60 dB for both the 2002 and 2015 study years.

Time-Above Analysis - The FAA's decision that a Time-above analysis is not needed in St. Charles is based upon the results of the DNL grid point analyses, which indicate that St. Charles will experience noise levels below DNL 60 dB. The time-above analysis has no standards or guidelines against which it can be compared, so it provides relatively limited information.

Speech Interference and Sleep Deprivation - As discussed above, supplemental noise analysis was done by evaluating noise impacts and noise-sensitive areas in St. Charles (FEIS Appendix Q). This analysis confirmed that the cumulative noise exposure levels will not exceed DNL 60 dB with the proposed action.

The FEIS does not include supplemental noise analysis concerning speech interference or sleep deprivation in St. Charles. Impact of Noise on People (USDOT May 1977) indicates that below DNL 65 dB less than 10 percent sentence interference occurs outdoors with normal voice level and 2 meters separation. Indoor interference does not begin to appear until the DNL 70 dB level is reached. At these levels of cumulative noise exposure, only 8 percent of the population experience sleep disruption at DNL 65 dB and only 1 percent at DNL 55 dB. At levels below DNL 60 dB, less than 2 percent sentence interference occurs outdoors with normal voice level and 2 meters separation. Based on these indicators, the FAA decided that the FEIS did not need to analyze potential speech interference or sleep deprivation impacts in areas surrounding Lambert that would be exposed to aviation noise at levels below DNL 60 dB.

With regard to the St. Charles historic river front district, in particular, the FAA did not analyze speech interference or sleep deprivation impacts for that area, because the INM grid analysis included in Appendix Q of the FEIS indicates that St. Charles will be below DNL 60 dB. The FICON report states in Section 3 Airport Noise Policy Recommendations, "...because public health and welfare effects below DNL 60 dB have not been well established, the FICON decided not to recommend evaluation of aviation noise impacts below DNL 60 dB." Since St. Charles is below DNL 60 dB with the proposed airport noise exposure, further evaluations of aviation noise impacts, such as speech interference and sleep deprivation effects, in St. Charles were not deemed necessary for the FEIS.

In addition, although not required, STLAA has committed to monitor noise for one year and to adjust the boundaries of the noise mitigation program in the unlikely event that actual noise levels exceed those predicted in the FEIS.

12. Unacceptable noise and vibration impacts in the St. Charles historic district, the Goldenrod Showboat and Frontier Park

Citizens of St. Charles believe that noise and vibration impacts will be unacceptable in the St. Charles historic district and two of its unique resources, the Goldenrod Showboat and Frontier Park.

The issues of noise exposure and vibrations on the City of St. Charles and its historic district have been thoroughly discussed throughout the FEIS (Sections 5.1 and 5.5). The effects of Alternative W-1W on the City of St. Charles, including noise and vibration impacts, are also documented in FEIS Appendix Q and FEIS Appendix V in numerous responses to comments, such as numbers 3-17, 3-43, 3-54, 3-56, 3-57, 3-58, 3-68, 36, 11-2, 11-6, 23-46, 23-47, 23-53, 23-54, 23-55, 23-56, 23-57, and 23-58.

The FAA uses 1.5 dB increases in the DNL 65 dB noise contour as the standard for evaluating the effects of increases in aircraft noise on historic properties used as residences and for outdoor music areas or amphitheaters, fulfilling the requirements of 36 CFR 800.9. This is based on FAA's land-use compatibility guidelines under 14 CFR Part 150. For other historic properties, the FAA considers whether noise or other impacts due to the proximity of the project substantially impair the activities, features, or attributes of the resource.

The historic properties in the City of St. Charles, including the Goldenrod Showboat, are not expected to be within the DNL 65 dB noise contour as a result of Alternative W-1W. The results of the FAA's noise analysis indicate that with the proposed W-1W improvements, cumulative aircraft noise levels will be below DNL 60 dB in the St. Charles historic district, including the Goldenrod Showboat and Frontier Park. DNL grid sites in St. Charles for future years 2002-2015 will range between DNL 48 and 58 dB (FEIS Appendix Q). Therefore, neither the Goldenrod Showboat, a national historic landmark used for performances, nor Frontier Park, used for festivals, will be significantly impacted by the project.

There are no impacts in St. Charles that require mitigation, and there will be no new substantial incompatible land uses as defined by FAR Part 150 guidelines. Impact of Noise on People (USDOT May 1977) indicates that at levels below DNL 60 dB, less than 2 percent sentence interference occurs outdoors with normal voice level and 2 meters separation. Indoor sentence interference will occur even less frequently as a result of the exterior-to-interior noise reduction provided by the Goldenrod Showboat. Aircraft noise levels of this magnitude will not have a significant impact on the many plays and events that occur on the Goldenrod Showboat or the festivals in Frontier Park.

One commenter noted that people occupy and care for many of the historic buildings. Under FAA noise compatibility guidelines, these buildings will continue to be compatible land uses appropriate for residential homes. Therefore, the proposed alternative will have no effect on historic properties within the City of St. Charles. The Missouri SHPO and the Advisory Council have concurred with the FAA on the area of potential effect, which encompassed land areas above DNL 65 dB.

To summarize, regarding noise impacts on historic properties in St. Charles, noise levels below DNL 60 dB are not considered significant. All land uses, including historic properties, are considered compatible with noise levels below DNL 60 dB. Given that noise levels in St. Charles are projected to be below DNL 60 dB with Runway 12W/30W in operation, it is unlikely that noise will significantly impact the daily lives of the citizenry of St. Charles, their carefully preserved national historic district, or the annual outdoor celebrations of their heritage. Therefore, the FAA has concluded that the new runway will not significantly affect the heart of St. Charles or its national historic district.

Regarding vibration impacts, generally, overflights by fixed-wing, subsonic aircraft do not generate vibration levels of the frequency or intensity to result in damage to structures. It has been found that exposure to normal weather conditions, such as thunder and wind, usually have more potential that could result in significant structural vibration than aircraft. Two recent studies that involved the measurement of vibration level resulting from aircraft operations upon sensitive historic structure concluded that aircraft operations do not result in significant structural vibration. Additional details regarding this comment are addressed in Section 5.1.6, Vibration Resulting from Aircraft Operations, in the FEIS.

13. Effect of Bridgeton's planning and zoning laws on airport expansion

The City of Bridgeton believes that the effects of its planning and zoning laws on the proposed Lambert expansion were not adequately considered by the FAA and STLAA.

In April 1996, the City of Bridgeton sued the City of St. Louis to block the proposed expansion plan. The lawsuit alleged that City of St. Louis officials were taking away Bridgeton's constitutional right to determine how its land is used, by expanding the airport onto land not zoned for airport use. The City of Bridgeton stated that Missouri law gives its residents control over airport expansion by allowing city officials to determine whether any land is zoned for airport use. The suit asserted that Missouri Revised Statutes, Section 305 prohibits the City of St. Louis from building an airport or landing field in any city in violation of zoning regulations. Since the proposed airport acquisition area in Bridgeton has not been zoned for airport use by the City of Bridgeton, the City of Bridgeton asserted that the proposed expansion plan cannot be built. The suit also claimed that the right of the City of Bridgeton to determine this zoning is guaranteed by the Missouri State Constitution and State statutes, and that as a Constitutional Charter City, Bridgeton is granted by the Missouri Constitution (Article VI, Section 19(a)) full authority to designate zoning within its borders.

The City of St. Louis moved to dismiss the lawsuit on the grounds that it was premature before the FAA issues its Record of Decision. On the merits, St. Louis maintained that the Missouri courts held in a previous suit of a similar nature, that upon balancing the needs of a community, i.e., a local city versus the needs of a metropolitan area for an airport, the needs of the metropolitan area are superseding.

The court dismissed the case, stating that until the FAA issues a ROD, no legal grounds exist to try the case. The outcome of the litigation does not affect the decisions of the FAA following completion of the FEIS. Whether the City of St. Louis is required to obtain a local permit is, in the circumstances, a matter of local law and is not relevant to the approval of the Federal actions pertaining to the expansion of Lambert. The FAA assumes that if the ordinances are finally determined to be applicable to the City of St. Louis, then the City of St. Louis will comply with them or will be exempted.

For the reasons discussed above, there may be little or no inconsistency with local plans. With regard to any restrictions on land acquisition by the City of St. Louis for essential aviation safety and aircraft operation purposes, the FAA notes that such planning policies may be of questionable applicability and legal validity, both under state and Federal law.

This issue was covered previously in the FEIS Sections 5.2.5.1 and 5.2.5.3 and in FEIS Appendix V responses to Comments 5-53, 6-23, and 6-24.

14. Effects of Alternative W-1W on the City of Bridgeton

The City of Bridgeton and its citizens commented that Alternative W-1W would destroy a large part of Bridgeton and there would be effects on the Bridgeton City Hall/Police Station complex.

The FAA acknowledges that Alternative W-1W will cause significant impacts to the City of Bridgeton including community disruption; displacement of residents; acquisition of community properties, parkland, historic properties, and community facilities; and changes to the local road network. Section 6.3 of the FEIS outlines specific measures to mitigate these impacts.

The FAA recognizes that people's lives will be adversely affected by the acquisition of their homes. The FAA will take all measures available to ensure that the STLAA minimizes the impacts as much as possible and to ensure that programs are implemented in a fair and equitable manner. The disruption of established neighborhoods and displacement of residents will be mitigated by ensuring that all property acquisitions and relocations are implemented according to the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970. The airport has committed to expediting and streamlining the acquisition process, after project approval, to minimize the amount of time residents will have to remain in neighborhoods where acquisition would be required. A relocation plan, developed in accordance with the Uniform Relocation Act, will be designed to minimize relocation impacts as much as possible. The relocation counselor assigned to each resident will provide advisory assistance to alleviate the stress associated with moving to a new location.

Because there will be a small area of new residential noncompatible land use in Bridgeton, the FEIS includes specific mitigation for the residential portion of Bridgeton that will be impacted by levels above DNL 65 dB (Section 6.3.1 and Figures 6.2 and 6.3 in the FEIS). Mitigation is not included for the portions of Bridgeton that will be impacted by noise levels below DNL 65 dB, because they are considered a compatible land use.

Section 5.3 of the FEIS discusses the acquisition of commercial properties in Bridgeton. All properties acquired will be entitled to fair market value, including commercial properties, and will be subject to the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970.

The realignment and/or closure of portions of the local roadway network will be minimized in order to reduce the impacts to the local communities. Those roadways that will be removed are associated with facilities within the acquisition areas. Other areas will be adequately served by the relocated roads. Prior to the construction of any proposed roadway improvements, MoDOT will develop a Maintenance of Traffic Plan designed to reduce impacts of roadway construction and maintain access during construction (Section 6.3.13 of the FEIS).

The effects on Bridgeton City Hall/Police Station complex were previously addressed in the FEIS Appendix V, responses to Comments 5-43, 29-46, 29-58 and 29-74. Alternative W-1W will not have a direct impact on the Bridgeton City Hall. The FEIS indicates that with the proposed action Bridgeton City Hall would be in the 70 DNL noise contour. Unless the existing structure includes noise attenuation of 25 dB, City Hall would be rendered incompatible in light of its governmental services and office uses, even without noise insulation measures. St. Louis will offer to provide any necessary soundproofing and is willing to work with Bridgeton to relocate City Hall, if necessary.

Parks and recreation facilities to be impacted by Alternative W-1W are described in Section 5.7 of the FEIS. The City of Bridgeton has been consulted regarding these impacts and the potential candidate mitigation sites. The proposed candidate mitigation sites are described in detail in the Section 303 and 6(f) Evaluation, which was released concurrently with the FEIS, and summarized in Section 6.3.5 of the FEIS.

The FAA has considered alternatives that avoid historic properties. As discussed in the Section 303 document, the FAA determined that due to environmental and social consequences, there was no prudent or feasible alternative to avoid the following historic properties in the City of Bridgeton: the Bridgeton Inn, the Airport News Building, the Emmanuel Blum House, the Blum Store, and the De Hatre House, which are eligible for inclusion in the National Register of Historic Places; and the Village à Robert Cemetery (which encompasses the current Bridgeton Memorial Park), which is eligible for inclusion in the National Register of Historic Places under National Register Criterion D. Therefore, there will be an adverse effect on these historic properties, pursuant to 36 CFR 800.9(b). Treatment measures for these adversely affected historic properties are included within the MOA for the selected alternative, W-1W. The MOA was signed by FAA, the SHPO, and the Advisory Council. The STLAA signed as a concurring party. The City of Bridgeton was invited to participate as a concurring party to the MOA, but it chose not to concur in the MOA. The Advisory Council executed the MOA on May 29, 1998. A copy of the MOA is included in Appendix H of this ROD.

15. People Building Community survey objections

People Building Community objects to a survey accomplished as part of the MPS, and referenced in the FEIS, which claims that the majority of residents want to be acquired. A detailed description of this survey, conducted in October 1995, by a subcontractor to the MPS consultant, is contained in Section 8 of the MPS. People Building Community wants FAA recognition of the results of the Peters Marketing Research Survey showing strong Bridgeton opposition to expansion. The FAA’s responses to comments on the FEIS submitted by People Building Community are contained in Appendix A of this ROD.

The FAA did not rely on the results of the referenced survey to make its decision. Its existence was only mentioned in the FEIS for informational purposes. Its mention was not intended to minimize or dismiss the concerns of neighboring communities. While the conduct of social surveys might provide information of interest to area residents, the information would not alter or affect the conclusions of an EIS process. The purpose of the EIS was to analyze the potential environmental impacts of the proposed improvements upon the communities surrounding the airport. In some cases, there were no impacts to the communities. In others, there were even positive effects overall. Where there were significant adverse impacts, the EIS examined mitigation to lessen the adverse impacts. The FAA's EIS identified the anticipated impacts associated with the alternatives analyzed and outlined the proposed measures for mitigation for significant impacts associated with the Alternative W-1W.

It is recognized that the impact categories of principal concern to neighboring residents are noise and land acquisition. The social impacts resulting from the airport development would include the displacement of persons, homes, businesses, and community facilities. These would be mitigated by ensuring that all property acquisition and relocations be implemented according to the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970.

The FAA recognizes that the acquisition/relocation process can be a difficult and emotionally upsetting experience for homeowners. As part of its land acquisition programs, the STLAA offers advisory services to those being relocated. Part of that advisory service is to notify those relocatees of special programs being offered by different agencies. This includes first-time home buyer programs, loan information, and assistance in understanding the various documents.

The FAA has acknowledged throughout the EIS process that some segments of the community strongly oppose the proposed plan. The comments provided by agencies, associations, elected officials and individuals have been thoroughly evaluated by the FAA during the EIS process and have been carefully considered in the development of this ROD. This included the FAA's review of the results of the Peters Marketing Research Survey, which People Building Community requested the FAA to consider. This survey was conducted to determine how many Bridgeton residents feel about the airport expansion.

The FAA acknowledges that there are also residents in the area of the proposed expansion, including Bridgeton residents, who feel they have been held hostage by the expansion process. Given the length of time needed to prepare the planning studies on the proposed expansion, this is understandable. The STLAA has received approximately 250 letters from residents, who indicated that they either need or want to move from their residence because of different hardship situations (STLAA letter dated

July 9, 1998, in Appendix I). The STLAA has received inquiries from another 150 residents, who wish to have their property purchased and move on with their lives. Many of those citizens have also called the FAA's Regional Office over the last several months to express those same views to the FAA decisionmakers on the ROD. The Let's Get On With Our Lives group, which consists of over 1,200 people living in the area proposed for acquisition, has requested that the FAA make a final decision on the Lambert as quickly as possible so that they can relocate (Don Vandervort letter, dated July 9, 1998, in Appendix I).

The FAA has carefully assessed and considered both sides of the issue in making its decision. Fair consideration has been given to the interests of communities in or near the project location throughout the EIS process.

16. Bridgeton's non-concurrence in DOT Section 303/DOI Section 6(f) process

Bridgeton has notified the FAA that it cannot concur in the DOT Section 303/DOI Section 6(f) process, because it believes that the alternative selected did not safeguard park land and other resources warranting special protection. Bridgeton commented on this issue after release of the DEIS, and its position has not changed since that time. For FAA's responses to Bridgeton's comments on this issue, see FEIS Appendix V, numbers 2-78, 10-10, 10-26, 10-27 and 10-34.

FAA environmental documents must provide evidence that replacement of affected Section 6(f) lands to the satisfaction of the Secretary of the Interior will be accomplished. Through its grant agreements, the FAA will require STLAA to comply with mitigation provisions of the FEIS related to replacement of Section 303 and Section 6(f) lands.

As documented in the Section 303/Section 6(f) Evaluation and the FEIS Section 5.7, the FAA will require STLAA to provide the responsible jurisdiction with the funds necessary to replace the converted land. In this case, the City of Bridgeton is considered to be the project sponsor, or subgrantee. It is generally held that in the event the subgrantee is unable or unwilling to replace the converted property, the State becomes fully responsible for actual replacement. Since the City of Bridgeton has declined to participate in the process of selecting and securing replacement lands, responsibility for replacement falls upon the MDNR. If Bridgeton continues to decline to participate in the process, the FAA will require STLAA to provide the funds to the MDNR for replacement of converted lands, providing that conversions-in-use are approved.

On January 28, 1998, the Department of Interior provided its final comments on the FEIS, the Section 303/Section 6(f) Evaluation, and the Section 106 process. Appendix

A of the ROD contains the DOI letter and FAA's responses to those comments. The receipt of DOI's comments completes consultation under Sections 303/6(f).

17. Bridgeton's non-concurrence in MOA for historic/archaeological resources

The City of Bridgeton notified the FAA that it could not concur in the MOA for proposed improvements at Lambert, because the City did not agree with the selection of Alternative W-1W.

As discussed in Section 6 of this ROD, on May 29, 1998, the Advisory Council executed the MOA for the proposed improvements at Lambert (Appendix H of this ROD). Other signatories to the MOA are the FAA and the Missouri SHPO. The STLAA signed the MOA as a concurring party.

The MOA stipulates measures to be implemented to avoid, reduce, or mitigate the adverse effects from this project on historic properties. The SHPO, the Council, the STLAA, and the City of Bridgeton have been consulted on the MOA and provided comments on the agreement document throughout its development (FEIS Appendix N-1, November 18, 1997, letter from MDNR, and November 14, 1997, letter from City of Bridgeton). The FAA solicited final comments on the MOA from the consulting parties, including the City of Bridgeton. As noted above under response to Comment 14, the City of Bridgeton chose not to sign the agreement.

On June 10, 1998, the FAA notified the following parties that the MOA for the Section 106 process had been executed by the Advisory Council: Deputy SHPO at MDNR; DOI; MoDOT, STLAA, and Bridgeton. By entering into and having STLAA carry out the terms of the Agreement, FAA has fulfilled its responsibilities under Section 106 of the National Historic Preservation Act and the Advisory Council's regulations.

18. Analysis of special purpose laws

Compliance with special purpose laws (e.g., for wetlands, water quality, and floodplains) was raised in comments on the DEIS, which are addressed in the FEIS Appendix V response to Comment 2-78.

All of the development alternatives studied in detail have unavoidable impacts on resources protected under Section 303 of the Department of Transportation Act and Section 6(f) of the Land and Water Conservation Fund Act. There are no possible or prudent alternatives to the use of these resources. Of the development alternatives, Alternative W-1W would use approximately half the park and recreational resources and acres required for S-1.

All of the reasonable alternatives have unavoidable wetland impacts due to the proximity of wetlands to the airport. Consequently, there are no practicable alternatives to filling of wetlands. Of the development alternatives evaluated, Alternative W-1W would have the least amount (acreage) of wetland impacts. This information is displayed in Table S.1A of the FEIS (Appendix J of this ROD, page S-9).

Impacts of the project on water quality have been examined in Section 5.6 of the FEIS. See also response to Comment 9-6 in Appendix V of the FEIS. The MDNR also provided its assurance that state water quality standards would be met with the project (MDNR letter dated November 20, 1997, in Appendix A of the FEIS). On August 11, 1998, the Governor of the State of Missouri provided a letter to the FAA certifying that there is reasonable assurance that the proposed construction and operation of the expansion of Lambert will be located, designed, constructed and operated so as to comply with applicable water quality standards (Governor's letter dated August 11, 1998, in Appendix I of this ROD.)

Potential impacts on floodplains were thoroughly evaluated in the FEIS. There is no practicable alternative to the floodplain impacts of the proposed project. Mitigation measures to minimize the floodplain impacts can be accomplished for each alternative so that the floodplain encroachment would not be considered significant. The floodplain mitigation measures are described in the FEIS Section 6.3.8. See also response to Comment 25-4 in FEIS Appendix V.

19. Adequacy of air quality conformity determination

The City of Bridgeton believes the air quality conformity determination prepared by the FAA is inadequate.

Bridgeton's comments on air quality issues were addressed in the FEIS Appendix V responses to Comments 7-18, 7-19, and 7-31 and in the Final General Conformity Determination. Based on EPA, MDNR, and other comments on the DEIS, the FAA has revised and supplemented the air quality analysis in the FEIS and prepared a Draft and Final General Conformity Determination. These documents and supporting underlying material are available for public review. Both EPA and MDNR indicated that the Draft General Conformity Determination was adequate. The Governor has also certified a reasonable assurance that the project will be designed, built, and operated in conformance with applicable air quality standards (Appendix I of this ROD).

The FAA has been very diligent in addressing air quality concerns. In response to comments made by the City of Bridgeton on the DEIS, the FAA revised its air quality analysis to address the effects of FAA Safety Notice N7110.157, "Wake Turbulence," upon the operational assumptions for air quality emission inventories. This notice, which was issued during preparation of the DEIS, has the effect of reducing airport capacity due to recategorization of certain aircraft types and a resulting increase in separation standards. The Safety Notice results in potentially constraining the 2015 No-Action Alternative at approximately 532,000 operations a year instead of 595,000 as originally projected in the DEIS. The results of the revised analysis show that, with the exception of NOx emissions in 2015, the development alternatives improve air quality in the St. Louis area in comparison with the No-Action Alternative. This is largely the result of increased airfield operational efficiency and reduced delay periods (FEIS Section 5.5.6).

In consultation with the EPA and MDNR, the FAA prepared Draft and Final General Conformity Determinations to address emissions associated with Alternatives S-1 and W-1W, specifically focusing on NOx, CO and VOCs. In December 1997, the FAA issued its Draft General Conformity Determination, along with the FEIS. In June 1998, the FAA issued the Final General Conformity Determination. It was subsequently announced in the *St. Louis Post Dispatch*. By issuing this Final Determination, the FAA has fulfilled its affirmative responsibilities to assure conformity of proposed Federal actions under Section 176(c) of the Clean Air Act, as amended in 1990.

20. Concerns of EPA regarding FAA's air quality modeling assumptions in DEIS

The EPA had questions regarding the assumptions used by FAA in its air quality modeling assumptions in the DEIS.

Based upon the EPA comments received on the air quality analysis in the DEIS, the FAA revised and supplemented information in the FEIS. That information was summarized in the FEIS Section 5.5, and is included in Appendices A and M. The FEIS Appendix V contains responses to EPA's comments on the DEIS (Comments 7-18, 7-69, 7-72, 7-73, 7-81 and 7-85).

Regarding air quality modeling, while EPA agreed that there would be no significant air quality impacts associated with the proposed project, it stated that its conclusion was based on air modeling done by MDNR. The Emissions Dispersion Modeling System (EDMS) is the FAA's preferred model for performing air quality analysis on airports and was utilized in this case for developing project emission inventories for NEPA and general conformity purposes. The development alternative would reduce carbon monoxide (CO) emissions compared to the No-Action and the project so that the project was clearly *de minimis* for CO under general conformity requirements. Although no further analysis was necessary, in response to requests from EPA and MDNR the FAA also conducted a microscale dispersion analysis to address "CO hotspots." It was determined, with EPA's concurrence, that the CAL3QHC and ISCST3 models would be appropriate to conduct this dispersion analysis. Based on the entire assessment of air quality, including modeling, we concluded that there would be no significant impacts to air quality in the St. Louis area. The modeling conducted by MDNR provided independent, definitive, corroboration of the conclusion. The EPA and MDNR have agreed that inclusion in this ROD of the results of the modeling done by MDNR resolves the air quality concerns expressed in EPA's letter dated February 27, 1998.

As noted above, MDNR provided its assurance that state air quality standards would be met with the project (MDNR letter dated November 20, 1997, in Appendix A of FEIS). On August 11, 1998, the Governor of the State of Missouri provided a letter to the FAA certifying that there is reasonable assurance that the proposed construction and operation of the expansion of Lambert will be located, designed, constructed and operated so as to comply with applicable air quality standards (Governor's letter dated August 11, 1998, in Appendix I of this ROD.)

As discussed in number 19 above, on June 19, 1998, the FAA made its Final General Conformity Determination. A legal notice announcing the Final General Conformity Determination was published in the *St. Louis Post Dispatch* on June 29, 1998. By publishing this Final Determination, the FAA has fulfilled its responsibilities under Section 176(c) of the Federal Clean Air Act.

Therefore, the FAA believes that the analysis of air quality impact satisfies the requirements of NEPA, including public disclosure requirements, and other air quality statutes.

21. Length of FEIS review period

Citizens commented that thirty days to review the FEIS was too short and believed the FAA ignored their comments.

FAA carefully reviewed all comments made by the public and local, state, and Federal agencies during the EIS process. The DEIS was available for review and comment from September 27, 1996 through January 17, 1997. A public hearing, attended by over 1580 people, was held, affording each of them the opportunity to provide written or verbal comments to court reporters. The FAA then carefully reviewed over 15,000 letters received on the DEIS. The FAA aggregated these comments and concerns into 29 major categories for review and written response by qualified personnel. All suggestions were taken into consideration and changes were made to the FEIS where appropriate. In addition, the FEIS was revised in some instances to make it clearer and easier to read and understand. All letters, as categorized, were available for public review at Lambert and at the FAA Regional office in Kansas City, Missouri. All comments received, whether in the form of testimony given to the court reporters at the public hearing or in the form of letters, were summarized, and responses were provided in the FEIS Appendices S, T, U, and V. Appendix W contained a list of commenters. The FEIS Volumes 1, 2, and 3 were available at 21 city halls and 11 libraries.

The 30-day review period after release of the FEIS is not a public comment period, but rather a minimum period that a Federal agency must wait before issuing a Record of Decision. The FEIS review period is required by CEQ regulation to be no less than 30 days. The review period for this FEIS was approximately 58 days. Late filed comments were considered as practicable. Much of the material provided to the public in the FEIS was not new information, as it was simply clarification or enhancement and refinement of material already in the EIS or was in other documents available during review of the DEIS. CEQ regulations permit the FAA to summarize and respond to comments in the FEIS.

Appendices A and B of this ROD contain responses to comments received during the FAA's review or "waiting" period. Appendices C, D, E and G of this ROD contain responses to comments from ALPA, NATCA, Bridgeton Air Defense, the City of Bridgeton, the City of St. Charles, the St. Charles County Executive, and U.S. Congressman Talent. All comments received by the FAA were reviewed and considered during the decision-making process for this ROD.

22. Inappropriate public hearing format

Commenters stated that the public hearing format was inappropriate. They would have preferred a "town hall" format. Commenters indicated that the FAA failed to provide an adequate opportunity for public input in a "formal" public hearing; therefore, they concluded that fair consideration had not been given to the interests of the communities near the project location.

The FAA recognizes that the "town hall" format is the more traditional approach. However, the format the FAA chose to use was equally acceptable and appropriate. The FAA exceeded NEPA requirements, which do not require Federal agencies to conduct public hearings, when it held the public hearing for the proposed action at Lambert. Federal agencies have wide latitude to structure public hearings as appropriate to facilitate public input for consideration in the decision-making process.

The public hearing was also held to afford an opportunity for a public hearing "to consider the economic, social and environmental effects of the [project] and the [project's] consistency with the objectives of any planning that the community has carried out" (*49 U.S.C. 47106(c)(1)(A)(I)*). The City of St. Louis must certify that this opportunity was provided to qualify for eligibility to receive funds for major airport development projects under the FAA's Airport Improvement Program.

Title 49 U.S.C. 47106(c)(1)(A)(I) does not dictate the manner in which the hearing should be held. No case law requires that a "town hall" or any specific type of hearing take place. The public hearing held for the proposed project met and exceeded the statutory standard that opportunity be provided to consider the effects of the proposed action. The record demonstrates that such opportunity was provided in this case.

The public hearing was held near the airport during the hours of 3 p.m. to 8 p.m. on October 28, 1996. Approximately 1,580 people attended. It was held in an open meeting format. The public could interact with FAA personnel and FAA's consultants at numerous displays or stations, and react to hearing materials provided, presentations made, and the DEIS. Persons could leave written comments, provide oral comments to court reporters, or submit written comments to FAA up until January 17, 1997.

Citizens accessed the public hearing area from an entryway where they were given a proposed project information packet, which contained information about the public hearing format, how to make public comments and a copy of the FEIS Summary about the proposed project itself. Citizens then proceeded through a videotape area, which provided additional information about the proposed project.

In the large hearing room, FAA employees and government contractors, who were involved in the environmental study process, were present the entire time to answer questions and explain exhibits, which were provided to give further information about the proposed project. Government representatives were clearly identified by name tags and circulated through the hearing room to provide opportunity for face-to-face information exchange. All government representatives and contractors present responded to all information sought from them and answered all questions asked of them. This format allowed citizens to view the materials and absorb information at their own pace. Citizens were able to talk to government and contractor representatives directly to obtain meaningful information exchange. In addition, the format allowed citizens to confer among themselves or in small groups with government or contractor representatives in an open forum.

In the middle of the hearing room, all citizens were given opportunity to provide written comments on the proposed project or comments of other persons. In an adjacent area, four court reporters were available to record verbal comments. Citizens had the choice to comment in writing, or verbally to a court reporter. This hearing format provided meaningful, informed community input to this public project. The public was informed about potential economic, social and environmental impacts of the proposed project by government representatives through the information packet, information displays and exhibits and the face-to-face interaction and information exchange. The opportunity for public comment was afforded in an orderly and open manner. All citizens who wished to comment at the hearing were provided with the opportunity to do so.

The format of the public hearing was selected to allow the attendees to view the materials at their leisure and talk to study team members. In addition, the format allowed for the attendees to talk among themselves and study team members in an open forum. Citizens had the choice to comment in writing or verbally to a court reporter. These are the same choices that would have been available had the FAA used an alternate format.

All comments received were responded to in the FEIS. In this way, informed public comments generated by the public hearing process were communicated to the public and taken into account by decision-makers. The public hearing provided ample opportunity to consider the "economic, social and environmental effects" of the proposed project (*40 U.S.C. 47106(c)(1)(A)*).

For a review of FAA's responses to comments received specifically regarding the public hearing format, see FEIS Appendix V Comments 21-17, 21-26, 21-27, 23-17, and 23-23.

23. Potential conflict of interest for FAA contractor

St. Charles Executive Ortwerth believes that FAA's contractor had a conflict of interest, because data compiled by Greiner were used in the MPS, as well as the EIS, and because St. Louis paid Greiner.

Specifically the commenter argues that Greiner had a conflict of interest for the following reasons:

- Greiner could not assist the FAA in accomplishing an independent review of alternatives as the FAA claims in FEIS response to Comment 2-72 because in April 1995 Greiner prepared an environmental evaluation of alternatives and baseline environmental information for the MPS.

- The MPS indicates that Greiner prepared the environmental evaluation of alternatives. Greiner did not prepare the information for the EIS then provide it to St. Louis as claimed in response to Comment 23-39 of the FEIS because Greiner did the work in April 1995 and scoping for the EIS began in September 1995.

- Greiner was intimately involved in developing the justification for the project; there is no evidence to justify that the FAA conducted an independent review of alternative studies of the alternatives rejected; very little independent work has been generated that distinguishes the EIS from the MPS prepared by the City of St. Louis.

- Greiner was paid by the project sponsor.

Under 40 CFR 1506.5(c) if a Federal agency decides to select a consultant to prepare the EIS, the consultant must "execute a disclosure statement ... specifying that [it has] no financial or other interest in the outcome of the project. A consultant with a known conflict of interest "should be disqualified from preparing the EIS." (CEQ 40 Questions, 46 Federal Register 18,026 18,031)

Whether there is a conflict of interest depends upon the definition of "financial or other interest" under 40 CFR 1506.5(c). In 1981, the CEQ interpreted the provision "broadly to cover any known benefits other than general enhancement of reputation." (CEQ 40 Questions 46 Federal Register at 18,031). Even then, the CEQ instructed agencies that contractors may bid in competition with others for future work on a project if the contractor has "no promise of future work or other interest in the outcome of the project." (40 Questions at 18,031). Subsequently, the CEQ clarified that, absent an agreement to perform construction on the proposed project or actual ownership of construction site, it is "doubtful that an inherent conflict of interest will exist" unless "the contract for the EIS preparer contains ... incentive clauses or guarantees of any future work on the project." (Guidance Re: NEPA Regulations, 48 Federal Register 34,263 34,266, CEQ, 1983).

In this case, after a competitive bidding process, the FAA selected URS Greiner in November 1992 to prepare the EIS. Greiner's contract was executed with STLAA in 1993.

In April 1995, the FAA requested that Greiner prepare preliminary environmental evaluations so that the FAA could begin to meet its responsibilities to evaluate other reasonable alternatives in preparation for the EIS. To assure consistency in the environmental analysis done as part of the ongoing Part 150, environmental and master planning studies, the FAA had Greiner submit this baseline environmental information and its environmental analysis of alternatives to St. Louis for use in its master planning and airport noise compatibility (14 CFR Part 150) studies. This practice was instituted several years ago as a practical matter to ensure consistency between the two processes. It arose, in part, as a result of a lawsuit filed by the City of Bridgeton, which challenged approval of the use of passenger facility charges for noise mitigation projects. The major issue was the adequacy of the environmental analysis, because the noise analysis done by the consultant that prepared the Part 150 study differed from that done by another consultant as part of a concurrent environmental study.

This practice does not constitute a conflict of interest. URS Greiner has executed the disclosure statement required under 40 CFR 1506.6(c) specifying that it has no financial or other interest in the outcome of the project. URS Greiner's only assignment at Lambert has been to assist the FAA in the EIS and at no time during the Lambert expansion process have they been involved in any other contract that could be construed to represent a conflict of interest. There have been no guarantees of future work or incentive clauses in the EIS contract.

While Greiner did prepare the environmental overview for the FAA, which was used as an appendix in the MPS, it did not participate in the STLAA's development of the airport facility needs or the selection of its preferred alternative for the project. Nor did Greiner's preparation of this factual information interfere with its ability to assist the FAA in using its judgment to independently review the range of primary and secondary alternatives to decide which to analyze in the FEIS. The FAA was actively participating in the MPS process at this point. This participation included independent operational analysis and input regarding the development and analysis of alternatives. Once the MPS was submitted to the FAA, as required, the FAA then independently reviewed and analyzed the development alternatives identified in the MPS as well as exploring other alternatives not identified in the MPS. These alternatives included different runway layouts, construction of a new airport facility as well as some publicly submitted alternatives. For a discussion on FAA involvement in the analysis of alternatives, see Section 3.0 of the FEIS.

Moreover, preparation of this information did not give Greiner any incentive to promote the Alternative W-1W over the No-Action Alternative. Providing information to St. Louis, at the FAA's direction, did not result in an enforceable promise, contract, or expectation of future work on the project or other interest in the outcome of the project so as to compromise the integrity of the NEPA process.

To the extent that FAA's practice could be perceived to give rise to a conflict, the FAA exercised a sufficient degree of supervision to cure any defect arising from the perceived conflict and preserve the objectivity and integrity of the NEPA process.

When an agency is integrally involved in the preparation of an EIS, that involvement diminishes the threat posed by any potential conflicts of interest because the agency then has the opportunity to direct the analysis and supplement areas it deems deficient. The record indicates that FAA exercised substantial supervision over the preparation of the EIS. Even after Greiner was hired, FAA continued to perform all management activities and only used Greiner's personnel for technical expertise or to supplement staff where there was insufficient manpower. FAA managers made all major decisions involved in the FEIS and Greiner's representatives reported to those managers, sometimes on a daily basis, to receive direction. Throughout the environmental process, approximately 90 percent of one FAA environmental program manager's work hours were dedicated solely to managing Greiner and its work products. Other FAA personnel, including airport planning specialists and air traffic controllers, reviewed and corrected Greiner work products, as needed. In addition, FAA prepared, without Greiner's assistance, those portions of the FEIS addressing airport planning and air traffic control issues, particularly responses to comments in FEIS Appendix V. The FAA independently and extensively reviewed all of Greiner's analyses, commented on Greiner's field data and written product, noted deficiencies in the data and analyses, gave direction to the work, and frequently required Greiner to gather more facts or perform supplemental analysis on aspects of the project. This degree of supervision exercised by the FAA protected the integrity and objectivity of the EIS.

Finally, with respect to the commenter's final point, the payment of Greiner by the City of St. Louis does not present a conflict of interest. Greiner was selected by the FAA to prepare the EIS using a common practice known as third-party contracting. Under this practice, the City of St. Louis entered into a contract with Greiner to fund work done on the EIS under the direction and supervision of the FAA. Approved by CEQ, third-party contracting is utilized by many Federal agencies during the preparation of an EIS (40 CFR 1506.5(c) and Forty Most Asked Questions No. 16). So long as the lead agency, or in certain cases the cooperating agency, selects the consulting firm to do the work, the project sponsor is permitted to pay the consultant. Once selected, the preparer's responsibility is to the lead agency to prepare an EIS that complies with NEPA. Third-party contracting is a voluntary practice that is ultimately beneficial to both the agency and the applicant. By paying for the preparation of the EIS, the applicant ensures that movement of its application will not be determined by the budgetary constraints of the agency it is dealing with. At the same time, the agency in question is able to focus its resources on analysis and evaluation rather than the preparation of the EIS.

In this case, the FAA selected Greiner to prepare the EIS. Greiner's responsibility was solely to the FAA to prepare an EIS that met NEPA regulations and FAA's NEPA procedures. As required by CEQ regulations, a memorandum of understanding (MOU) was executed between St. Louis and FAA setting out the procedures to be followed during the third-party contract process. Under the MOA, it was the FAA's responsibility to determine the scope of the EIS, evaluate all environmental data and analysis submitted by Greiner or St. Louis, and to revise or cause additional study and analysis to be performed as necessary.

In conclusion, none of the commenter's concerns have raised issues sufficient to show that the objectivity and integrity of the NEPA process has been compromised.

Greiner's actions were within the scope of its duties. It has properly disclosed that it had no interest, financial or otherwise, in the outcome of the project. The FAA independently evaluated the alternatives analysis and exercised supervision over Greiner's work.

This matter is also discussed in response to the City of St. Charles FEIS Comment FL0004, Comments 28 through 36 of this ROD.

24. <u>FAA realizes Lambert will not operate as planned and must prepare a revised or supplemental EIS</u>

According to commenters, the FAA has revealed that Lambert will not operate as planned and must withdraw and revise the FEIS or prepare a supplemental EIS to address the proposed new runway use. Specifically, ALPA, NATCA and the City of Bridgeton indicate that the FAA now plans to use the new Runway 12W/30W primarily for arrivals, instead of exclusively for departures in west flow during VFR 1 and 2 conditions (good weather) as analyzed in the MPS and the FEIS. As proof, the City of Bridgeton relies upon an excerpt from a preliminary draft memorandum prepared by Leigh Fisher Associates dated June 16, 1998. The memorandum states, in relevant part, "For W-1W, the Tower representatives recommended assuming no significant use of visuals to the close parallels (see response to Comment 7 below)." The commenters claim that this change in runway use would significantly impact communities southeast of the airport and requires a revised or supplemental EIS.

The commenters are correct that the environmental impacts in the FEIS, including the noise contours (or footprint), were predicated upon the assumption that the new runway would be used primarily, but not exclusively, for departures during good weather and in west flow. Thus, there would be some arrivals to the new runway. The FAA has not changed its plans for runway use. The statement in the Leigh Fisher Associates preliminary draft memorandum cannot be read in isolation, but rather in the broader context of the sensitivity analysis and related hypothetical assumption concerning arrival rates to which it relates. Appendix C of this ROD clarifies that although this assumption was made, it was only for purposes of modeling. The original assumptions in the MPS and FEIS remain valid. That the FAA elected to include a scenario that featured use of outboard runways during visual conditions and west flow (the "W-1W Outboards Case," see Appendix C, response to Comment 7), did not reflect an FAA realization, decision or intention to change the planned operation of new Runway 12W/30W.

This statement "For W-1W, the Tower representatives recommended assuming no significant use of visuals to the close parallels" is best understood in the context of the related comment from ALPA to which it also responds. As part of its 18 concerns, ALPA also commented that the MPS and FEIS incorrectly assumed that visuals to the existing closely spaced runways would be independent and arrive at a rate of 80 per hour and should have assumed a rate of 60 per hour instead. This change in assumption clearly would have the effect of increasing delays at the existing airport and under Alternative W-1W. By the referenced statement, the controllers at the June 15 meeting meant that, if the arrival rate during visual and west flow use of the closely spaced existing parallel runways was assumed to be only 60 aircraft per hour, then they agreed with ALPA that it should also be assumed that they would try to minimize delays by using the new runway more for arrivals than for departures. That is, to boost the arrival rate they would seek to use both outboard runways (the existing 30R and the new 30W) primarily for arrivals in west flow during VFR-1 and 2 conditions, instead of limiting its use to departures. The capacity studies done for the MPS estimated an arrival rate of 72 aircraft an hour, not 80 as asserted by ALPA.

Internal agency deliberations after the June 15, 1998, meeting and the preparation of this preliminary draft memorandum by St. Louis' consultant, including discussions with the Air Traffic Division of the Central Region, have confirmed that the FAA has not changed plans to operate Alternative W-1W. Those discussions have also confirmed that the assumptions used in the MPS and FEIS are reasonable and reflect the proposed operation of the airport. The results of the sensitivity analysis confirm that an arrival rate of 60 per hour is an unreasonable assumption. It results in delays greater than those currently experienced at the airport now. This issue is discussed in more detail in Appendix G, response to Comment 7.

11. THE AGENCY FINDINGS

In accordance with applicable law, the FAA makes the following determinations for this project, based upon the appropriate information and data contained in the FEIS and the administrative record.

A. The project is consistent with existing plans of public agencies for development of the area surrounding the airport (*49 U.S.C. 47106(a)(1)*).

The determination prescribed by this statutory provision is a precondition to agency approval of airport project funding applications. It has been the long-standing policy of the FAA to rely heavily upon actions of metropolitan planning organizations (MPOs) to satisfy the project consistency requirement of *49 U.S.C. 47106 (a) (1*) [see, e.g., *Suburban O'Hare Com'n* v. *Dole*, *787 F.2d 186, 199 (7th Cir., 1986)*]. Furthermore, both the legislative history and consistent agency interpretations of this statutory provision make it clear that reasonable, rather than absolute consistency with these plans is all that is required.

Under the provisions of both Federal and state law, the East-West Gateway Coordinating Council (EWGCC) has been designated as the MPO for the St. Louis metropolitan area and given primary responsibility for transportation planning in the region. On December 3, 1997, the EWGCC notified the FAA that it endorsed the EIS on the basis that it represented an accurate assessment of the related costs, operational feasibility, and community and environmental impacts. Furthermore, the EWGCC's board had voted to support Alternative W-1W (FEIS Section 5.2.5.3). Thus, Alternative W-1W is reasonably consistent with the plans of public agencies having broad geographic responsibilities in the area.

If the focus is limited to municipalities where land would be acquired for airport expansion, four of the five municipalities (St. Ann, Edmundson, Berkeley, and Hazelwood) have land-use policies for the acquisition areas consistent with W-1W. Alternative W-1W is not consistent with the zoning plans of the City of Bridgeton, but it is not clear that as a matter of state law, Bridgeton is authorized to enforce a zoning plan that is inconsistent with needed airport development.

The FAA finds that the project is reasonably consistent with the existing plans of public agencies authorized by the state in which the airport is located to plan for the development of the area surrounding the airport. The FAA is satisfied that it has fully complied with *49 U.S.C. 47106 (a)(1).*

With regard to this issue, however, the FAA has also reviewed the substantial documentation in the administrative record demonstrating that throughout the environmental process the STLAA has shown concern for the impact of the proposed development actions on surrounding communities. Moreover, the STLAA has attempted to ensure consistency of its project proposals with the planning efforts of neighboring communities. The administrative record for this ROD includes details of coordination between the STLAA and neighboring jurisdictions concerning local planning proposals, along with documents describing the public meetings, hearings, and other means by which public participation in project planning was accommodated. Further discussion of consistency of the proposed development projects with public agency planning is summarized in the FEIS Section 5.2.5.3.

The proposed Lambert expansion lies almost totally within the boundaries of the City of Bridgeton. The extent to which City of Bridgeton regulations apply to Lambert Airport development is unresolved. Meanwhile, the STLAA has offered to assist the City of Bridgeton in land-use planning activities, to address any issues relating to the proposed Lambert development.

The City of Bridgeton has engaged in land-use planning actions, which appear designed to limit airport expansion. Its local plans and ordinances establish zoning policies (a prohibition on use of lands acquired by public entities to be used for new commercial activities). These ordinances purport to restrict the use of some lands within Bridgeton's jurisdiction (e.g., for the new runway), needed by the STLAA in order to implement important safety and aircraft operation aspects of its preferred alternative.

In any event, it is not clear that the development actions proposed in the MPS would be subject to any of the plans and ordinances adopted by the City of Bridgeton. Thus there may be little or no inconsistency with local plans. Implementation of STLAA's preferred alternative would not be expected to result, after mitigation, in any significant increases of noise on land of these neighboring jurisdictions. With regard to any restrictions on land acquisition by STLAA for essential aviation safety and aircraft operation purposes, the FAA notes that such planning policies may be of questionable applicability and legal validity, both under state and Federal law.

In making its determination under *49 U.S.C. 47106 (a) (1)*, the FAA has considered the fact that local governments have been represented on the EWGCC and have participated as members of that organization in its decision to authorize the new runway project at Lambert (although some of these local governments may have disagreed, as individual EWGCC members, with that ultimate decision). The FAA has also recognized the fact that none of these jurisdictions has regulatory authority over airport operations, since long-established doctrines of Federal preemption preclude these communities from regulating aircraft operations conducted at Lambert.

Given the FAA determination in this ROD, under appropriate Federal law, that there is a compelling need for the proposed Lambert improvements, as documented in the FEIS, it is inappropriate for local communities to attempt to exercise local zoning control in a manner which would conflict with the domestic and international aviation requirements of this airport. If there were a conflict between Federal and local policies, the local policies must give way to the Federal policies, under the doctrine of Federal preemption.

B. The interest of the communities in or near where the project may be located was given fair consideration (*49 U.S.C. 47106(b)(2)*).

The determination prescribed by this statutory provision is a precondition to agency approval of airport development project funding applications. The regional planning process over the past decade and the environmental process for this project-specific EIS, which began in 1995 and extended to this point of decision, provided numerous opportunities for the expression of and response to issues put forward by communities in and near the project location. Nearby communities and their residents have had the opportunity to express their views during the DEIS public comment period, at a public hearing, as well as during the review period following public issuance of the FEIS. The FAA's consideration of these community views is set forth in FEIS Appendices J, U, and V and in Appendices A, B, C, D, E and G of this ROD.

Thus, the FAA has determined that throughout the environmental process, beginning at its earliest planning stages, fair consideration was given to the interest of communities in or near the project location.

C. The State of Missouri has certified in writing that there is reasonable assurance that the project will be located, designed, constructed and operated in compliance with applicable air and water quality standards (*49 U.S.C. Section 47106(c)(1)(B)*).

The determination prescribed by this statuary provision is a precondition to agency approval of airport development project funding applications involving a new runway. By letter dated August 11,1998, (Appendix I of this ROD), after consultation with the MDNR (the Governor's designated agency for air and water quality), the Governor of Missouri, certified that there is a reasonable assurance that the project will meet all applicable air and water quality standards.

The FAA concludes that the airport project evaluated in the FEIS will be located, designed, constructed and operated so as to comply with applicable air and water quality standards.

D. Effect on Natural Resources (*49 U.S.C. Section 47106(c)(1)(C)*).

Under this statutory provision, after consultation with the Secretary of the Interior and the Administrator of the EPA, the FAA may approve funding of a new runway having a significant adverse effect on natural resources, only after determining that no possible and prudent alternative to the project exists and that every reasonable step has been taken to minimize the adverse effect.

As documented in the FEIS, FAA has consulted extensively with both Interior and EPA. For several natural resource impact categories with established significance levels, the FAA finds that, without implementation of the mitigation summarized in Section 6.3 of the FEIS, the selected alternative would have a significant adverse effect. However, given the inability of other alternatives discussed in the FEIS, to satisfy the purpose and needs of the project, we have concluded that no possible and prudent alternative exists to development of the proposed alternative. As discussed in Section 6 of this ROD, and documented throughout the FEIS and the administrative record, every reasonable step has been taken to minimize adverse environmental effects resulting from the project.

In order to consider further mitigation under NEPA, and to address any possible adverse environmental effects resulting from the projects approved in this ROD, the FAA has decided to condition such approval upon the mitigation measures described in Section 6.3 of the FEIS and in Section 6 of this ROD. This conditional approval will be enforced through a special condition included in future Federal airport grants and PFC "use" approvals to the STLAA.

The FAA has determined that all reasonable steps have been taken to minimize any adverse effects on natural resources through mitigation.

E. Appropriate action, including the adoption of zoning laws, has been or will be taken to the extent reasonable to restrict the use of land next to or near the airport to uses that are compatible with normal airport operations (*49 U.S.C. Section 47107(a)(10)*).

The sponsor assurance prescribed by this statutory provision is a precondition to agency approval of airport development project funding applications. In addition to the actions described in Section 11.A of this ROD, the STLAA has worked extensively with local jurisdictions to develop and implement plans and policies to ensure compatible land use in the airport vicinity.

FEIS Section 5.2 describes the current status of zoning and land use planning for lands near the airport. The Airport has an existing noise compatibility program, designed to either reduce noise at the source or mitigate the noise received by sensitive land uses in the airport vicinity. As explained in the FEIS Section 6.3.1, with planned mitigation, development of the project will not result in any increased significant impacts on non-compatible land uses.

The FAA requires satisfactory assurances, in writing, that appropriate action, including the adoption of zoning laws, has been or will be taken to restrict, to the extent reasonable, the use of land adjacent to or in the immediate vicinity of the airport to activities and purposes compatible with normal airport operations, including landing and takeoff of aircraft. Appendix I of the FEIS contains Lambert's land use compatibility assurance.

Based upon the administrative record for this ROD, the FAA has concluded that existing and planned noise reduction programs at Lambert provide for appropriate action to ensure compatible land use in the airport vicinity.

F. Clean Air Act, Section 176 (c) (1) Conformity Determination Regarding Lambert-St. Louis International Airport Master Plan Supplement Development Actions (*42 U.S.C. Section 7506(c)*).

The determination prescribed by this statutory provision is a precondition for Federal Agency support or approval of airport development actions which are projected to exceed the *de minimis* air emission levels prescribed at 40 CFR Section 93.153. The EPA regulations more generally governing the conformity determination process are found at 40 CFR Part 93, Subpart B.

In the 1997 FEIS, the FAA made a Draft General Conformity Determination on the Lambert MPS proposals (FEIS Sections 5.5.6 and 5.5.7). Pursuant to EPA regulations, the FAA announced the availability of the Draft General Conformity Determination in the *St. Louis Post Dispatch*, and provided notice to appropriate Federal, state and local public agencies. The agencies and the general public were invited to review and comment on the Draft General Conformity Determination. Comments received on the Draft General Conformity Determination and responses to those comments are presented in the Final General Conformity Determination. The FEIS Appendix A presents letters from the EPA (dated November 7, 1997) and MDNR (dated November 20, 1997). In their letters, these air quality agencies concurred with the conformity determination analysis conclusions for general conformity under the Clean Air Act. The Final General Conformity Determination was prepared and a notice of the FAA's determination was published in the *St. Louis Post Dispatch* on June 28, 1998. No comments or requests were received regarding the Final General Conformity Determination.

In order to achieve public disclosure and to address community concerns, the FEIS presented an analysis of air quality impacts utilizing the regulatory structure set forth in the EPA conformity regulations. The FEIS analysis (Section 5.5) demonstrates that the project would not cause or contribute to any new exceedances of air quality standards. As confirmed by the MDNR, the project conforms to the Missouri SIP.

Because projects at Lambert are governed by the moderate non-attainment designation for ozone and the maintenance area designation for carbon monoxide, the FAA needed to determine that the project will not cause or contribute to any new violations of the NAAQS in the project area or the metropolitan area. The FEIS and other supporting documentation provided the FAA the information needed to make that determination. The computer modeling predicted that the carbon monoxide NAAQS would not be exceeded in the future with or without the proposed improvements. The FEIS showed that the project will not increase the frequency or severity of any existing violations of any NAAQS and that the project will not delay timely attainment of the NAAQS or any required interim emission reduction in the project area.

Based upon the air quality information and discussion presented in the FEIS and its appendices, the Final General Conformity Determination, and upon supporting material in the administrative record, the FAA finds that the development actions will not cause or contribute to any air quality standards being exceeded and conform to the Missouri SIP and the NAAQS.

G. For this project, involving new construction which will directly affect wetlands, there is no practicable alternative to such construction. The proposed action includes all practicable measures to minimize harm to wetlands that may result from such use. (Executive Order 11990, as amended).

This executive order requires all Federal agencies to avoid providing assistance for new construction located in wetlands, unless there is no practicable alternative to such construction, and all practicable measures to minimize harm to wetlands are included in the action.

The FEIS, Section 5.11 documents that the preferred development alternative selected by the STLAA from the MPS will directly affect approximately 9.7 acres of wetlands. The FEIS alternatives analysis (FEIS Section 3.3) identifies no reasonable alternative to developing a new runway at Lambert. The FAA additionally concludes that there is no practicable alternative to constructing such a runway, resulting in these wetland impacts, given the purposes and needs documented in the FEIS, consideration of environmental and economic factors, and land-use issues.

The FEIS, Section 5.11 states that the S-1 development alternative of a 9,000-foot runway would result in impacts to more wetlands (10.8 acres) than would Alternative W-1W (9.7 acres). The FEIS demonstrates that these are low quality wetlands. Two of their significant functions, floodwater attenuation and floodwater storage, would be fully mitigated within the airport basin. Additionally wetland functions for these wetlands will be mitigated as part of the overall wetlands mitigation program.

Alternatives of staggering runway ends or relocating the entire runway are not practicable, because, among other reasons, they would increase delays, have additional detrimental environmental effects, require considerable additional cost and complicate air traffic control procedures. Considering these and other reasons described more fully in Section 3.0 of the FEIS, and taking into consideration cost, existing air traffic control and aviation technology and logistics, in light of the overall purpose of the runway project, the FAA finds that there is no practicable alternative to the wetland loss associated with the 9,000-foot runway.

As noted in the FEIS Section 5.11, the COE has worked with the FAA as a cooperating agency to ensure that all practicable measures will be taken to minimize harm to wetlands, impacted through development of the selected alternative. This will be accomplished by using BMPs during construction and developing a wetland compensatory mitigation site. Following issuance of this ROD, the COE, in consultation with the MDNR, will complete its processing of a Section 404 permit, required for the STLAA to proceed with development impacting wetlands. The project approvals in this ROD and this wetlands determination are expressly conditioned upon permit approval and conditions to be outlined by the COE, and upon the STLAA accomplishing the wetlands mitigation measures identified in the FEIS and any COE permit approval.

Although it is generally preferable to attempt to mitigate wetland loss through replacement wetlands in the same watershed, this is not the case where such replacement would create man-made wetlands in the vicinity of airport aircraft movement areas. FAA Advisory Circular 150/5300-33, dated May 1, 1997, states the FAA's opposition to wetland mitigation projects located within 10,000 feet of airports serving turbine-powered aircraft (such as Lambert), due to the safety hazard such wetlands present as attractants of wildlife, which significantly increase the risk of bird/aircraft strikes.

The safety standards set forth in this FAA policy statement are recommended for the operators of all public-use airports. Furthermore, for airport sponsors who are the recipients of Federal grant funding, adherence to safety standards set forth in FAA advisory circulars is a requirement of standard grant assurance #34, as acknowledged in paragraph 4-6.a. of Advisory Circular 150/5200-33.

This recent agency policy guidance supports the FEIS determination that the replacement wetlands for the Lambert development actions should not be located in the vicinity of the airport. Given the potential hazard associated with the creation of wildlife attractions within 10,000 feet of jet runways, the FAA and COE agreed that it is prudent to permit the STLAA to replace these impacted wetlands outside of the Lambert watershed.

As detailed in the FEIS Section 6.3.7, a wetland mitigation program has been developed to offset the impacts of the project and to recognize other long-term biological problems. The mitigation plan calls for replacing the filled wetlands. Several candidate wetland mitigation sites have been examined. Final mitigation requirements will be determined during the Section 404 permit application and review process in consultation with the COE.

H. For this project, involving a significant encroachment on a floodplain, there is no practicable alternative to the selected development of the preferred alternative. The proposed action conforms to all applicable state and/or local floodplain protection standards. (Executive Order 11988).

This executive order, together with applicable DOT and FAA orders, establish a policy to avoid supporting construction within a 100-year floodplain where practicable, and where avoidance is not practicable, to ensure that the construction design minimizes potential harm to or within the floodplain.

Section 5.12 of the FEIS explains that, without mitigation, construction and operation of the MPS preferred alternative could result in adverse floodplain impacts in the Coldwater Creek floodplain.

As outlined in the "Alternatives" discussion in Section 5 of this ROD, and in the FEIS, there is no practicable alternative to the selected alternative. Development of this alternative achieves the purposes and needs for the projects in the most cost-effective manner with the least impact on the surrounding land uses. As shown in the FEIS Section 6.3.8, a mitigation program has been designed, which will create a floodplain so that there would be no net loss of flood storage capacity or increased risk of loss of human life or property damage. This program has been designed to comply with applicable requirements of the permitting agencies, with whom the FAA and the STLAA have been coordinating, in order to ensure that the construction design minimizes potential harm to or within the floodplain. Each of these agencies have agreed with the mitigation plan in concept, and coordination will continue throughout the permitting process.

I. Relocation Assistance (*42 U.S.C. Section 4601 et seq.*).

These statutory provisions, imposed by Title II of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, require that state or local agencies, undertaking Federally-assisted projects which cause the involuntarily displacement of persons or businesses, must make relocation benefits available to those persons impacted.

As detailed in the FEIS Section 5.3, the selected development alternative will displace approximately 2,324 households, 75 businesses, and 6 schools, 6 churches, and one nursing home.

The FAA will require Lambert to provide fair and reasonable relocation payments and assistance payments pursuant to the provision of the Uniform Relocation Assistance and Real Property Acquisition Policies Act. Comparable decent, safe, and sanitary dwellings are available for occupancy on the open market.

J. For any use of lands with significant historic sites, there is no prudent and feasible alternative to using the land; the project includes all possible planning to minimize harm resulting from the use (*49 U.S.C. Section 303(c)*).

The FEIS Section 5.7 concluded that the MPS development actions would involve either the use or constructive use of resources protected by this statutory provision, more commonly referred to as "4(f)" resources. The selected alternative would directly affect four park and recreation area Section 303 sites and indirectly affect four sites. One of the sites, Oak Valley Park, would have both direct and indirect effects. Three of the sites are also protected under Section 6(f) of the Land and Water Conservation Fund Act of 1965 (*16 U.S.C. Section 460l-8(f)3*).

In terms of avoidance alternatives, review of the tiered alternatives evaluation prepared in Section 3.0 of the FEIS indicated that there are no prudent and feasible alternatives to the identified impacts to Section 303 and 6(f) sites. The FAA has coordinated with the public and agencies having jurisdiction over the impacted sites to determine site significance and to develop mitigation measures necessary to meet Section 303 and 6(f) requirements. The agencies involved in the coordination were the DOI, the MDNR, the Council, STLAA, and the City of Bridgeton.

A coordination meeting with the City of Bridgeton was held on April 18, 1997, with the mayor and key staff members to discuss Draft EIS comments relative to Section 303/6(f) issues, and to solicit input from the City of Bridgeton regarding future plans and goals for their parks and recreation program. Items listed in the City of Bridgeton's comprehensive plan were discussed regarding candidate mitigation options. The City of Bridgeton has stated that it will not initiate the Section 6(f) conversions for Lambert. Measures to minimize harm to Sections 303 and 6(f) resources are summarized in Section 6.3.5 of the FEIS.

As discussed at FEIS Section 5.8, the FAA determined the project will impact five structures of historic significance. Assuming such "historical significance" and such "use," the referenced FEIS Section 5.8 demonstrates that there is no prudent or feasible alternative to any such use. Furthermore, based upon the planned mitigation (discussed at FEIS Section 6.3.6), the FAA concludes that there has been all possible planning to minimize any harm resulting from use of historic or archaeological resources.

The Missouri SHPO has been consulted concerning these determinations. Treatment measures for these adversely affected historic properties are included within the MOA for the selected alternative, W-1W. It stipulates measures to be implemented to avoid, reduce or mitigate the adverse effects this project will have on historic properties. The MOA was signed by the FAA, the Missouri SHPO, and the Advisory Council. The STLAA signed as a concurring party. The City of Bridgeton was invited to participate as a concurring party to the MOA, but it chose not to concur in the MOA. The Advisory Council executed the MOA on May 29, 1998. A copy of the MOA is included in Appendix H of this ROD.

K. There are no disproportionately high or adverse human health or environmental effects from the project on minority or low-income populations. (Executive Order 12898).

Environmental justice concerns were addressed in Section 5.3 of the FEIS, and it was concluded that no minority or low-income group would be disproportionately affected by displacements occurring as a result of the selected alternative. The FEIS contains a discussion of environmental justice issues relative to the selected alternative. It was concluded that the impacts from the proposed MPS improvements will not disproportionately affect minority or low-income communities.

L. The FAA has given this proposal the independent and objective evaluation required by the Council on Environmental Quality. (40 CFR 1506.5).

As the FEIS outlined, a lengthy process led to the ultimate identification of the selected alternative, disclosure of potential impacts and selection of appropriate mitigation measures. This process began with the FAA competitive selection of an independent EIS contractor, continuing throughout the preparation of the DEIS and FEIS, and culminating in this ROD. The FAA provided input, advice and expertise throughout the planning and technical analysis, along with administrative direction and legal review of the project. From its inception, the FAA has taken a strong leadership role in the environmental evaluation of this project and has maintained its objectivity.

12. APPROVALS AND FAA ORDER

FHWA APPROVAL

I have carefully considered the FHWA's goals and objectives in relation to the surface transportation aspects of the proposed MPS development actions discussed in the FEIS. After careful review of Section 5.22 of the FEIS and Section 8 of this ROD, I find the surface transportation projects described in this ROD meet the FHWA's NEPA requirements.

[signature] 9-30-98

FHWA Approving Official Date

FAA APPROVAL AND ORDER

Having determined that the agency's preferred alternative, Alternative W-1W, is the only possible, prudent, and practicable alternative, the remaining decision is whether to approve or not approve the agency actions necessary for implementation of the project. Approval would signify that applicable Federal requirements relating to airport development planning have been met, and would permit the City of St. Louis to proceed with the proposed development and possibly receive Federal funding for eligible items. Not approving these actions would prevent the City of St. Louis from proceeding with Federally supported development in a timely way.

I have carefully considered the FAA's goals and objectives in relation to various aeronautical aspects of the proposed MPS development actions discussed in the FEIS. These include the purposes and needs to be served by the projects, the alternative means of achieving them, the environmental impacts of these alternatives, the mitigation necessary to preserve and enhance the environment, and the costs and benefits of achieving these purposes and needs in terms of effective and fiscally responsible expenditure of Federal funds. I have also considered comments received by the FAA on the social, environmental and economic impacts of the proposed actions.

Therefore, under the authority delegated to me by the Administrator of the FAA, I find that the projects in this ROD are reasonably supported and approved. For those projects I, therefore, direct that action be taken to carry out the agency actions discussed more fully in Section 3 of this ROD, including:

A. Approval under existing or future FAA criteria of project eligibility for Federal grant-in-aid funds and/or PFC, including the following elements:

1. Land Acquisition
2. Site Preparation
3. Runway, Taxiway, and Runway Safety Area Construction
4. Landside Developments, including Roadways
5. Certain Navigational Aids
6. Acquisition/relocation of MoANG and Navy/Marine Corps Reserve Facilities
7. Terminal Facility Improvements and New Terminal Facilities
8. Environmental Mitigation

B. Approval of a revised ALP, based on determinations through the aeronautical study process regarding obstructions to navigable airspace, and no FAA objection to the airport development proposal from an airspace perspective.

C. Approval for relocation and/or upgrade of various navigational aids.

D. The development of air traffic control and airspace management procedures to effect the safe and efficient movement of air traffic to and from the proposed new runway, including the development of a system for the routing of arriving and departing traffic and the design, establishment, and publication of standardized flight operating procedures, including instrument approach procedures and standard instrument departure procedures.

E. Review and subsequent approval of an amended Airport Certification Manual for Lambert-St. Louis International Airport (per 14 CFR Part 139).

Finally, based upon the administrative record of this project, I certify, as prescribed by 49 U.S.C. 44502 (b), that implementation of the proposed project is reasonably necessary for use in air commerce.

Concur:

John C. Curry — Sept. 30, 1998

John C. Curry
Regional Counsel, Central Region

Date

Approved:

John E. Turner — Sep 30, 1998

John E. Turner
Regional Administrator, Central Region

Date

RIGHT OF APPEAL

This decision constitutes the Federal approval for the actions identified above and any subsequent actions approving a grant of Federal funds to the City of St. Louis. Today's action is taken pursuant to 49 U.S.C. Subtitle VII, Parts A and B, and constitutes a final order of the Administrator subject to review by the Courts of Appeals of the United States in accordance with the provisions of 49 U.S.C. Section 46110.

U.S. Department of Transportation Federal Aviation Administration

NEWS:
PUBLIC AFFAIRS STAFF
Atlanta, GA

FOR IMMEDIATE RELEASE

Sept. 30, 1998
Contact: Kathleen Bergen
816-426-5626

FAA ISSUES RECORD OF DECISION ON LAMBERT-ST. LOUIS INTERNATIONAL AIRPORT

The Federal Aviation Administration has approved Lambert-St. Louis International Airport’s proposed airside and landside improvements, commonly known as Alternative W-1W. This Record of Decision (ROD) in favor of W-1W deems the improvements eligible for federal financial assistance and commits the airport operator to specific conditions including environmental mitigation measures. The ROD was signed today by FAA Central Region Administrator John E. Turner.

The approved alternative was selected from numerous proposals considered during the environmental process. A central feature of W-1W is a new staggered parallel runway configuration, suitable for use by air carriers, to be located on the southwest side of the airport in Bridgeton, Mo. The plan also includes property acquisition, terminal expansion, roadway improvements and relocation of several airport tenants.

The principal features of the ROD, which is based on a review of the administrative record, including the Final Environmental Impact Statement, include:

- A statement of the agency’s decision;
- Identification of all alternatives considered by the FAA, including the environmentally preferable one, and
- Mitigation measures planned to prevent or minimize environmental harm.

The FAA issued its Final Environmental Impact Statement on Dec. 19, 1997, finding that the city of St. Louis's proposed alternative met the requirements of the National Environmental Policy Act (NEPA).

By Oct. 14, 1998, the ROD will be available for review at the following locations:

The City Halls of:

Bel Nor; Bel-Ridge; Berkeley; Bridgeton; Calverton Park; Cool Valley; Edmundson; Ferguson; Greendale; Hazelwood; Kinloch; Maryland Heights; Normandy; Northwoods; Pasadena Hills; Village of Pasadena Park; St. Ann; St. John; Woodson Terrace; St. Charles City; St. Charles County.

Libraries:

St. Louis County: St. Louis County-Main Branch; Bridgeton Trails Branch; Florrisant Valley Branch; Indian Trains Branch; Indian Trains Branch, Lewis and Clark Branch; Prairie Commons Branch; Rock Road Branch.

St. Charles County: Kathryn Linnemann Branch; Kisker Road Branch; Spencer Road Branch.

Federal Agencies:

FAA Central Regional Office, 601 E. 12th St., Kansas City, Mo.; FAA Headquarters, 800 Independence Ave., Washington, D.C.

Lambert-St. Louis International Airport
Planning and Development Office, 4610 N. Lindbergh, Bridgeton, Mo.

###

**Memorandum of Agreement Between
the Federal Aviation Administration,
the U.S. Air Force,
the U.S. Army,
the U.S. Environmental Protection Agency,
the U.S. Fish and Wildlife Service, and
the U.S. Department of Agriculture
to Address Aircraft-Wildlife Strikes**

PURPOSE

The signatory agencies know the risks that aircraft-wildlife strikes pose to safe aviation.

This Memorandum of Agreement (MOA) acknowledges each signatory agency's respective missions. Through this MOA, the agencies establish procedures necessary to coordinate their missions to more effectively address existing and future environmental conditions contributing to aircraft-wildlife strikes throughout the United States. These efforts are intended to minimize wildlife risks to aviation and human safety, while protecting the Nation's valuable environmental resources.

BACKGROUND

Aircraft-wildlife strikes are the second leading causes of aviation-related fatalities. Globally, these strikes have killed over 400 people and destroyed more than 420 aircraft. While these extreme events are rare when compared to the millions of annual aircraft operations, the potential for catastrophic loss of human life resulting from one incident is substantial. The most recent accident demonstrating the grievous nature of these strikes occurred in September 1995, when a U.S. Air Force reconnaissance jet struck a flock of Canada geese during takeoff, killing all 24 people aboard.

The Federal Aviation Administration (FAA) and the United States Air Force (USAF) databases contain information on more than 54,000 United States civilian and military aircraft-wildlife strikes reported to them between 1990 and 1999[1]. During that decade, the FAA received reports indicating that aircraft-wildlife strikes, damaged 4,500 civilian U.S. aircraft (1,500 substantially), destroyed 19 aircraft, injured 91 people, and killed 6 people. Additionally, there were 216 incidents where birds struck two or more engines on civilian aircraft, with damage occurring to 26 percent of the 449 engines involved in these incidents. The FAA estimates that during the same decade, civilian U.S. aircraft sustained $4 billion worth of damages and associated losses and 4.7 million hours of aircraft downtime due to aircraft-wildlife strikes. For the same period,

---

[1] FAA estimates that the 28,150 aircraft-wildlife strike reports it received represent less than 20% of the actual number of strikes that occurred during the decade.

USAF planes colliding with wildlife resulted in 10 Class A Mishaps[2], 26 airmen deaths, and over $217 million in damages.

Approximately 97 percent of the reported civilian aircraft-wildlife strikes involved common, large-bodied birds or large flocks of small birds. Almost 70 percent of these events involved gulls, waterfowl, and raptors (Table 1).

About 90 percent of aircraft-wildlife strikes occur on or near airports, when aircraft are below altitudes of 2,000 feet. Aircraft-wildlife strikes at these elevations are especially dangerous because aircraft are moving at high speeds and are close to or on the ground. Aircrews are intently focused on complex take-off or landing procedures and monitoring the movements of other aircraft in the airport vicinity. Aircrew attention to these activities while at low altitudes often compromises their ability to successfully recover from unexpected collisions with wildlife and to deal with rapidly changing flight procedures. As a result, crews have minimal time and space to recover from aircraft-wildlife strikes.

Increasing bird and wildlife populations in urban and suburban areas near airports contribute to escalating aircraft-wildlife strike rates. FAA, USAF, and Wildlife Services (WS) experts expect the risks, frequencies, and potential severities of aircraft-wildlife strikes to increase during the next decade as the numbers of civilian and military aircraft operations grow to meet expanding transportation and military demands.

SECTION I.

SCOPE OF COOPERATION AND COORDINATION

Based on the preceding information and to achieve this MOA's purpose, the signatory agencies:

A. Agree to strongly encourage their respective regional and local offices, as appropriate, to develop interagency coordination procedures necessary to effectively and efficiently implement this MOA. Local procedures should clarify time frames and other general coordination guidelines.

B. Agree that the term "airport" applies only to those facilities as defined in the attached glossary.

C. Agree that the three major activities of most concern include, but are not limited to:

1. airport siting and expansion;

[2] See glossary for the definition of a Class A Mishap and similar terms.

2. development of conservation/mitigation habitats or other land uses that could attract hazardous wildlife to airports or nearby areas; and

3. responses to known wildlife hazards or aircraft-wildlife strikes.

D. Agree that "hazardous wildlife" are those animals, identified to species and listed in FAA and USAF databases, that are most often involved in aircraft-wildlife strikes. Many of the species frequently inhabit areas on or near airports, cause structural damage to airport facilities, or attract other wildlife that pose an aircraft-wildlife strike hazard. Table 1 lists many of these species. It is included solely to provide information on identified wildlife species that have been involved in aircraft-wildlife strikes. It is not intended to represent the universe of species concerning the signatory agencies, since more than 50 percent of the aircraft-wildlife strikes reported to FAA or the USAF did not identify the species involved.

E. Agree to focus on habitats attractive to the species noted in Table 1, but the signatory agencies realize that it is imperative to recognize that wildlife hazard determinations discussed in Paragraph L of this section may involve other animals.

F. Agree that not all habitat types attract hazardous wildlife. The signatory agencies, during their consultative or decisionmaking activities, will inform regional and local land use authorities of this MOA's purpose. The signatory agencies will consider regional, local, and site-specific factors (e.g., geographic setting and/or ecological concerns) when conducting these activities and will work cooperatively with the authorities as they develop and implement local land use programs under their respective jurisdictions. The signatory agencies will encourage these stakeholders to develop land uses within the siting criteria noted in Section 1-3 of FAA Advisory Circular (AC) 150.5200-33 (Attachment A) that do not attract hazardous wildlife. Conversely, the agencies will promote the establishment of land uses attractive to hazardous wildlife outside those siting criteria. Exceptions to the above siting criteria, as described in Section 2.4.b of the AC, will be considered because they typically involve habitats that provide unique ecological functions or values (e.g., critical habitat for federally-listed endangered or threatened species, ground water recharge).

G. Agree that wetlands provide many important ecological functions and values, including fish and wildlife habitats; flood protection; shoreline erosion control; water quality improvement; and recreational, educational, and research opportunities. To protect jurisdictional wetlands, Section 404 of the Clean Water Act (CWA) establishes a program to regulate dredge and/or fill activities in these wetlands and navigable waters. In recognizing Section 404 requirements and the Clean Water Action Plan's goal to annually increase the Nation's net wetland acreage by 100,000 acres through 2005, the signatory agencies agree to resolve aircraft-wildlife conflicts. They will do so by avoiding and minimizing wetland impacts to the maximum extent practicable, and will work to compensate for all associated unavoidable wetland impacts. The agencies agree to work with landowners and communities to encourage and support wetland restoration or enhancement efforts that do not increase aircraft-wildlife strike potentials.

H. Agree that the: U.S. Army Corps of Engineers (ACOE) has expertise in protecting and managing jurisdictional wetlands and their associated wildlife; U.S. Environmental Protection Agency (EPA) has expertise in protecting environmental resources; and the U.S. Fish and Wildlife Service (USFWS) has expertise in protecting and managing wildlife and their habitats, including migratory birds and wetlands. Appropriate signatory agencies will cooperatively review proposals to develop or expand wetland mitigation sites, or wildlife refuges that may attract hazardous wildlife. When planning these sites or refuges, the signatory agencies will diligently consider the siting criteria and land use practice recommendations stated in FAA AC 150/5200-33. The agencies will make every effort to undertake actions that are consistent with those criteria and recommendations, but recognize that exceptions to the siting criteria may be appropriate (see Paragraph F of this section).

I. Agree to consult with airport proponents during initial airport planning efforts. As appropriate, the FAA or USAF will initiate signatory agency participation in these efforts. When evaluating proposals to build new civilian or military aviation facilities or to expand existing ones, the FAA or the USAF, will work with appropriate signatory agencies to diligently evaluate alternatives that may avoid adverse effects on wetlands, other aquatic resources, and Federal wildlife refuges. If these or other habitats support hazardous wildlife, and there is no practicable alternative location for the proposed aviation project, the appropriate signatory agencies, consistent with applicable laws, regulations, and policies, will develop mutually acceptable measures, to protect aviation safety and mitigate any unavoidable wildlife impacts.

J. Agree that a variety of other land uses (e.g., storm water management facilities, wastewater treatment systems, landfills, golf courses, parks, agricultural or aquacultural facilities, and landscapes) attract hazardous wildlife and are, therefore, normally incompatible with airports. Accordingly, new, federally-funded airport construction or airport expansion projects near habitats or other land uses that may attract hazardous wildlife must conform to the siting criteria established in the FAA Advisory Circular (AC) 150/5200-33, Section 1-3.

K. Agree to encourage and advise owners and/or operators of non-airport facilities that are known hazardous wildlife attractants (See Paragraph J) to follow the siting criteria in Section 1-3 of AC 150/5200-33. As appropriate, each signatory agency will inform proponents of these or other land uses about the land use’s potential to attract hazardous species to airport areas.

The signatory agencies will urge facility owners and/or operators about the critical need to consider the land uses' effects on aviation safety.

L. Agree that FAA, USAF, and WS personnel have the expertise necessary to determine the aircraft-wildlife strike potentials of various land uses. When there is disagreement among signatory agencies about a particular land use and its potential to attract hazardous wildlife, the FAA, USAF, or WS will prepare a wildlife hazard assessment. Then, the appropriate signatory agencies will meet at the local level to review the assessment. At a minimum, that assessment will:

1. identify each species causing the aviation hazard, its seasonal and daily populations, and the population's local movements;

2. discuss locations and features on and near the airport or land use attractive to hazardous wildlife; and

3. evaluate the extent of the wildlife hazard to aviation.

M. Agree to cooperate with the airport operator to develop a specific, wildlife hazard management plan for a given location, when a potential wildlife hazard is identified. The plan will meet applicable FAA, USAF, and other relevant requirements. In developing the plan, the appropriate agencies will use their expertise and attempt to integrate their respective programmatic responsibilities, while complying with existing laws, regulations, and policies. The plan should avoid adverse impacts to wildlife populations, wetlands, or other sensitive habitats to the maximum extent practical. Unavoidable impacts resulting from implementing the plan will be fully compensated pursuant to all applicable Federal laws, regulations, and policies.

N. Agree that whenever a significant aircraft-wildlife strike occurs or a potential for one is identified, any signatory agency may initiate actions with other appropriate signatory agencies to evaluate the situation and develop mutually acceptable solutions to reduce the identified strike probability. The agencies will work cooperatively, preferably at the local level, to determine the causes of the strike and what can and should be done at the airport or in its vicinity to reduce potential strikes involving that species.

O. Agree that information and analyses relating to mitigation that could cause or contribute to aircraft-wildlife strikes should, whenever possible, be included in documents prepared to satisfy the National Environmental Policy Act (NEPA). This should be done in coordination with appropriate signatory agencies to inform the public and Federal decision makers about important ecological factors that may affect aviation. This concurrent review of environmental issues will promote the streamlining of the NEPA review process.

P. Agree to cooperatively develop mutually acceptable and consistent guidance, manuals, or procedures addressing the management of habitats attractive to hazardous wildlife, when those habitats are or will be within the siting criteria noted in Section 1-3 of FAA AC 5200-33. As appropriate, the signatory agencies will also consult each other when they propose revisions to any regulations or guidance relevant to the purpose of this MOA, and agree to modify this MOA accordingly.

SECTION II.
GENERAL RULES AND INFORMATION

A. Development of this MOA fulfills the National Transportation Safety Board's recommendation of November 19, 1999, to form an inter-departmental task force to address aircraft-wildlife strike issues.

B. This MOA does not nullify any obligations of the signatory agencies to enter into separate MOAs with the USFWS addressing the conservation of migratory birds, as outlined in Executive Order 13186, *Responsibilities of Federal Agencies to Protect Migratory Birds*, dated January 10, 2001 (66 *Federal Register*, No. 11, pg. 3853).

C. This MOA in no way restricts a signatory agency's participation in similar activities or arrangements with other public or private agencies, organizations, or individuals.

D. This MOA does not alter or modify compliance with any Federal law, regulation or guidance (e.g., Clean Water Act; Endangered Species Act; Migratory Bird Treaty Act; National Environmental Policy Act; North American Wetlands Conservation Act; Safe Drinking Water Act; or the "no-net loss" policy for wetland protection). The signatory agencies will employ this MOA in concert with the Federal guidance addressing wetland mitigation banking dated March 6, 1995 (60 *Federal Register*, No. 43, pg. 12286).

E. The statutory provisions and regulations mentioned above contain legally binding requirements. However, this MOA does not substitute for those provisions or regulations, nor is it a regulation itself. This MOA does not impose legally binding requirements on the signatory agencies or any other party, and may not apply to a particular situation in certain circumstances. The signatory agencies retain the discretion to adopt approaches on a case-by-case basis that differ from this MOA when they determine it is appropriate to do so. Such decisions will be based on the facts of a particular case and applicable legal requirements. Therefore, interested parties are free to raise questions and objections about the substance of this MOA and the appropriateness of its application to a particular situation.

F. This MOA is based on evolving information and may be revised periodically without public notice. The signatory agencies welcome public comments on this MOA at any time and will consider those comments in any future revision of this MOA.

G. This MOA is intended to improve the internal management of the Executive Branch to address conflicts between aviation safety and wildlife. This MOA does not create any right, benefit, or trust responsibility, either substantively or procedurally. No party, by law or equity, may enforce this MOA against the United States, its agencies, its officers, or any person.

H. This MOA does not obligate any signatory agency to allocate or spend appropriations or enter into any contract or other obligations.

I. This MOA does not reduce or affect the authority of Federal, State, or local agencies regarding land uses under their respective purviews. When requested, the signatory agencies will provide technical expertise to agencies making decisions regarding land uses within the siting criteria in Section 1-3 of FAA AC 150/5200-33 to minimize or prevent attracting hazardous wildlife to airport areas.

J. Any signatory agency may request changes to this MOA by submitting a written request to any other signatory agency and subsequently obtaining the written concurrence of all signatory agencies.

K. Any signatory agency may terminate its participation in this MOA within 60 days of providing written notice to the other agencies. This MOA will remain in effect until all signatory agencies terminate their participation in it.

SECTION III. PRINCIPAL SIGNATORY AGENCY CONTACTS

The following list identifies contact offices for each signatory agency.

Federal Aviation Administration
Office Airport Safety and Standards
Airport Safety and
Compliance Branch (AAS-310)
800 Independence Ave., S.W.
Washington, D.C. 20591
V: 202-267-1799
F: 202-267-7546

U.S. Air Force
HQ AFSC/SEFW
9700 Ave., G. SE, Bldg. 24499
Kirtland AFB, NM 87117
V: 505-846-5679
F: 505-846-0684

U.S. Army
Directorate of Civil Works
Regulatory Branch (CECW-OR)
441 G St., N.W.
Washington, D.C. 20314
V: 202-761-4750
F: 202-761-4150

U.S. Environmental Protection Agy.
Office of Water
Wetlands Division
Ariel Rios Building, MC 4502F
1200 Pennsylvania Ave., SW
Washington, D.C. 20460
V: 202-260-1799
F: 202-260-7546

U.S. Fish and Wildlife Service
Division of Migratory Bird Management
4401 North Fairfax Drive, Room 634
Arlington, VA 22203
V: 703-358-1714
F: 703-358-2272

U.S. Department of Agriculture
Animal and Plant Inspection Service
Wildlife Services
Operational Support Staff
4700 River Road, Unit 87
Riverdale, MD 20737
V: 301-734-7921
F: 301-734-5157

Signature Page

Original Signed by:

Woodie Woodward **12/17/2002**

Associate Administrator for Airports, Date
Federal Aviation Administration

Original Signed by:

Kenneth W. Hess **27 May 2003**

Chief of Safety, Date
U. S. Air Force

Original Signed by:

R.L. Brownlee **December 9, 2002**

Assistant Secretary of the Army (Civil Works), Date
U.S. Army

Original Signed by:

G. Tracy Mehan, III **1/17/03**

Assistant Administrator, Office of Water, Date
U.S. Environmental Protection Agency

Original Signed by:

Paul R. Schmidt **7/29/03**

Assistant Director, Migratory Birds and State Programs, Date
U.S. Fish and Wildlife Service

Original Signed by:

Richard D Curnow **9 January 2003**

Acting Deputy Administrator, Wildlife Services Date
U.S. Department of Agriculture

GLOSSARY

This glossary defines terms used in this MOA.

Airport. All USAF airfields or all public use airports in the FAA's National Plan of Integrated Airport Systems (NPIAS). Note: There are over 18,000 civil-use airports in the U.S., but only 3,344 of them are in the NPIAS and, therefore, under FAA's jurisdiction.

Aircraft-wildlife strike. An aircraft-wildlife strike is deemed to have occurred when:

1. a pilot reports that an aircraft struck 1 or more birds or other wildlife;
2. aircraft maintenance personnel identify aircraft damage as having been caused by an aircraft-wildlife strike;
3. personnel on the ground report seeing an aircraft strike 1 or more birds or other wildlife;
4. bird or other wildlife remains, whether in whole or in part, are found within 200 feet of a runway centerline, unless another reason for the animal's death is identified; or
5. the animal's presence on the airport had a significant, negative effect on a flight (i.e., aborted takeoff, aborted landing, high-speed emergency stop, aircraft left pavement area to avoid collision with animal)

(Source: *Wildlife Control Procedures Manual*, Technical Publication 11500E, 1994).

Aircraft-wildlife strike hazard. A potential for a damaging aircraft collision with wildlife on or near an airport (14 CFR 139.3).

Bird Sizes. Title 40, Code of Federal Regulations, Part 33.76 classifies birds according to weight:

small birds weigh less than 3 ounces (oz).
medium birds weigh more than 3 oz and less than 2.5 lbs.
large birds weigh greater than 2.5 lbs.

Civil aircraft damage classifications. The following damage descriptions are based on the *Manual on the International Civil Aviation Organization Bird Strike Information System*:

Minor: The aircraft is deemed airworthy upon completing simple repairs or replacing minor parts and an extensive inspection is not necessary.

Substantial: Damage or structural failure adversely affects an aircraft's structural integrity, performance, or flight characteristics. The damage normally requires major repairs or the replacement of the entire affected component. Bent fairings or cowlings; small dents; skin punctures; damage to wing tips, antenna, tires or brakes, or engine blade damage not requiring blade replacement are specifically excluded.

Destroyed: The damage sustained makes it inadvisable to restore the aircraft to an airworthy condition.

Significant Aircraft-Wildlife Strikes. A significant aircraft-wildlife strike is deemed to have occurred when any of the following applies:

1. a civilian, U.S. air carrier aircraft experiences a multiple aircraft-bird strike or engine ingestion;
2. a civilian, U.S. air carrier aircraft experiences a damaging collision with wildlife other than birds; or
3. a USAF aircraft experiences a Class A, B, or C mishap as described below:

    A. **Class A Mishap:** Occurs when at least one of the following applies:
        1. total mishap cost is $1,000,000 or more;
        2. a fatality or permanent total disability occurs; and/or
        3. an Air Force aircraft is destroyed.

    B. **Class B Mishap:** Occurs when at least one of the following applies:
        1. total mishap cost is $200,000 or more and less than $1,000,000; and/or
        2. a permanent partial disability occurs and/or 3 or more people are hospitalized;

    C. **Class C Mishap:** Occurs when at least one of the following applies:
        1. cost of reported damage is between $20,000 and $200,000;
        2. an injury causes a lost workday (i.e., duration of absence is at least 8 hours beyond the day or shift during which mishap occurred); and/or
        3. an occupational illness causing absence from work at any time.

Wetlands. An ecosystem requiring constant or recurrent, shallow inundation or saturation at or near the surface of the substrate. The minimum essential characteristics of a wetland are recurrent, sustained inundation or saturation at or near the surface and the presence of physical, chemical, and biological features indicating recurrent, sustained inundation, or saturation. Common diagnostic wetland features are hydric soils and hydrophytic vegetation. These features will be present, except where specific physiochemical, biotic, or anthropogenic factors have removed them or prevented their development.

(Source the 1987 Delineation Manual; 40 CFR 230.3(t)).

Wildlife. Any wild animal, including without limitation any wild mammal, bird, reptile, fish, amphibian, mollusk, crustacean, arthropod, coelenterate, or other invertebrate, including any part, product, egg, or offspring there of (50 CFR 10.12, *Taking, Possession, Transportation, Sale, Purchase, Barter, Exportation, and Importation of Wildlife and Plants*). As used in this MOA, “wildlife” includes feral animals and domestic animals while out of their owner’s control (14 CFR 139.3, *Certification and Operations: Land Airports Serving CAB-Certificated Scheduled Air Carriers Operating Large Aircraft (Other Than Helicopters)*)

Table 1. Identified wildlife species, or groups, that were involved in two or more aircraft-wildlife strikes, that caused damage to one or more aircraft components, or that had an adverse effect on an aircraft's flight. Data are for 1990-1999 and involve only civilian, U.S. aircraft.

Birds	**No. reported strikes**
Gulls (all spp.)	874
Geese (primarily, Canada geese)	458
Hawks (primarily, Red-tailed hawks)	182
Ducks (primarily Mallards.)	166
Vultures (primarily, Turkey vulture)	142
Rock doves	122
Doves (primarily, mourning doves)	109
Blackbirds	81
European starlings	55
Sparrows	52
Egrets	41
Shore birds (primarily, Killdeer & Sandpipers)	40
Crows	31
Owls	24
Sandhill cranes	22
American kestrels	15
Great blue herons	15
Pelicans	14
Swallows	14
Eagles (Bald and Golden)	14
Ospreys	13
Ring-necked pheasants	11
Herons	11
Barn-owls	9
American robins	8
Meadowlarks	8
Buntings (snow)	7
Cormorants	6
Snow buntings	6
Brants	5
Terns (all spp.)	5
Great horned owls	5
Horned larks	4
Turkeys	4
Swans	3
Mockingbirds	3
Quails	3
Homing pigeons	3
Snowy owls	3
Anhingas	2

Birds	No. reported strikes
Ravens	2
Kites	2
Falcons	2
Peregrine falcons	2
Merlins	2
Grouse	2
Hungarian partridges	2
Spotted doves	2
Thrushes	2
Mynas	2
Finches	2
Total known birds	2,612

Mammals	No. reported strikes
Deer (primarily, White-tailed deer)	285
Coyotes	16
Dogs	10
Elk	6
Cattle	5
Bats	4
Horses	3
Pronghorn antelopes	3
Foxes	2
Raccoons	2
Rabbits	2
Moose	2
Total known mammals	340

Ring-billed gulls were the most commonly struck gulls. The U.S. ring-billed gull population increased steadily at about 6% annually from 1966-1988. Canada geese were involved in about 90% of the aircraft-goose strikes involving civilian, U.S. aircraft from 1990-1998. Resident (non-migratory) Canada goose populations increased annually at 13% from 1966-1998. Red-tailed hawks accounted for 90% of the identified aircraft-hawk strikes for the 10-year period. Red-tailed hawk populations increased annually at 3% from 1966 to 1998. Turkey vultures were involved in 93% of he identified aircraft-vulture strikes. The U.S. Turkey vulture populations increased at annually at 1% between 1966 and 1998. Deer, primarily white-tailed deer, have also adapted to urban and airport areas and their populations have increased dramatically. In the early 1900's, there were about 100,000 white-tailed deer in the U.S. Current estimates are that the U.S. population is about 24 million.

U.S. Department
of Transportation

Federal Aviation Administration

Advisory Circular

Subject: HAZARDOUS WILDLIFE ATTRACTANTS ON OR NEAR AIRPORTS	**Date:** 8/28/2007	**AC No:** 150/5200-33B
	Initiated by: AAS-300	**Change:**

1. PURPOSE. This Advisory Circular (AC) provides guidance on certain land uses that have the potential to attract hazardous wildlife on or near public-use airports. It also discusses airport development projects (including airport construction, expansion, and renovation) affecting aircraft movement near hazardous wildlife attractants. Appendix 1 provides definitions of terms used in this AC.

2. APPLICABILITY. The Federal Aviation Administration (FAA) recommends that public-use airport operators implement the standards and practices contained in this AC. The holders of Airport Operating Certificates issued under Title 14, Code of Federal Regulations (CFR), Part 139, Certification of Airports, Subpart D (Part 139), may use the standards, practices, and recommendations contained in this AC to comply with the wildlife hazard management requirements of Part 139. Airports that have received Federal grant-in-aid assistance must use these standards. The FAA also recommends the guidance in this AC for land-use planners, operators of non-certificated airports, and developers of projects, facilities, and activities on or near airports.

3. CANCELLATION. This AC cancels AC 150/5200-33A, *Hazardous Wildlife Attractants on or near Airports*, dated July 27, 2004.

4. PRINCIPAL CHANGES. This AC contains the following major changes, which are marked with vertical bars in the margin:

a. Technical changes to paragraph references.

b. Wording on storm water detention ponds.

c. Deleted paragraph 4-3.b, *Additional Coordination.*

5. BACKGROUND. Information about the risks posed to aircraft by certain wildlife species has increased a great deal in recent years. Improved reporting, studies, documentation, and statistics clearly show that aircraft collisions with birds and other wildlife are a serious economic and public safety problem. While many species of wildlife can pose a threat to aircraft safety, they are not equally hazardous. Table 1 ranks the wildlife groups commonly involved in damaging strikes in the United States according to their relative hazard to aircraft. The ranking is based on the 47,212 records in the FAA National Wildlife Strike Database for the years 1990 through 2003. These hazard rankings, in conjunction with site-specific Wildlife Hazards Assessments (WHA), will help airport operators determine the relative abundance and use patterns of wildlife species and help focus hazardous wildlife management efforts on those species most likely to cause problems at an airport.

Most public-use airports have large tracts of open, undeveloped land that provide added margins of safety and noise mitigation. These areas can also present potential hazards to aviation if they encourage wildlife to enter an airport's approach or departure airspace or air operations area (AOA). Constructed or natural areas—such as poorly drained locations, detention/retention ponds, roosting habitats on buildings, landscaping, odor-causing rotting organic matter (putrescible waste) disposal operations, wastewater treatment plants, agricultural or aquaculture activities, surface mining, or wetlands—can provide wildlife with ideal locations for feeding, loafing, reproduction, and escape. Even small facilities, such as fast food restaurants, taxicab staging areas, rental car facilities, aircraft viewing areas, and public parks, can produce substantial attractions for hazardous wildlife.

During the past century, wildlife-aircraft strikes have resulted in the loss of hundreds of lives worldwide, as well as billions of dollars in aircraft damage. Hazardous wildlife attractants on and near airports can jeopardize future airport expansion, making proper community land-use planning essential. This AC provides airport operators and those parties with whom they cooperate with the guidance they need to assess and address potentially hazardous wildlife attractants when locating new facilities and implementing certain land-use practices on or near public-use airports.

6. MEMORANDUM OF AGREEMENT BETWEEN FEDERAL RESOURCE AGENCIES. The FAA, the U.S. Air Force, the U.S. Army Corps of Engineers, the U.S. Environmental Protection Agency, the U.S. Fish and Wildlife Service, and the U.S. Department of Agriculture - Wildlife Services signed a Memorandum of Agreement (MOA) in July 2003 to acknowledge their respective missions in protecting aviation from wildlife hazards. Through the MOA, the agencies established procedures necessary to coordinate their missions to address more effectively existing and future environmental conditions contributing to collisions between wildlife and aircraft (wildlife strikes) throughout the United States. These efforts are intended to minimize wildlife risks to aviation and human safety while protecting the Nation's valuable environmental resources.

DAVID L. BENNETT
Director, Office of Airport Safety
and Standards

Table 1. Ranking of 25 species groups as to relative hazard to aircraft (1=most hazardous) based on three criteria (damage, major damage, and effect-on-flight), a composite ranking based on all three rankings, and a relative hazard score. Data were derived from the FAA National Wildlife Strike Database, January 1990–April 2003.[1]

Species group	Ranking by criteria: Damage[4]	Ranking by criteria: Major damage[5]	Ranking by criteria: Effect on flight[6]	Composite ranking[2]	Relative hazard score[3]
Deer	1	1	1	1	100
Vultures	2	2	2	2	64
Geese	3	3	6	3	55
Cormorants/pelicans	4	5	3	4	54
Cranes	7	6	4	5	47
Eagles	6	9	7	6	41
Ducks	5	8	10	7	39
Osprey	8	4	8	8	39
Turkey/pheasants	9	7	11	9	33
Herons	11	14	9	10	27
Hawks (buteos)	10	12	12	11	25
Gulls	12	11	13	12	24
Rock pigeon	13	10	14	13	23
Owls	14	13	20	14	23
H. lark/s. bunting	18	15	15	15	17
Crows/ravens	15	16	16	16	16
Coyote	16	19	5	17	14
Mourning dove	17	17	17	18	14
Shorebirds	19	21	18	19	10
Blackbirds/starling	20	22	19	20	10
American kestrel	21	18	21	21	9
Meadowlarks	22	20	22	22	7
Swallows	24	23	24	23	4
Sparrows	25	24	23	24	4
Nighthawks	23	25	25	25	1

[1] Excerpted from the *Special Report for the FAA, "Ranking the Hazard Level of Wildlife Species to Civil Aviation in the USA: Update #1, July 2, 2003".* Refer to this report for additional explanations of criteria and method of ranking.
[2] Relative rank of each species group was compared with every other group for the three variables, placing the species group with the greatest hazard rank for $\geq$ 2 of the 3 variables above the next highest ranked group, then proceeding down the list.
[3] Percentage values, from Tables 3 and 4 in Footnote 1 of the *Special Report*, for the three criteria were summed and scaled down from 100, with 100 as the score for the species group with the maximum summed values and the greatest potential hazard to aircraft.
[4] Aircraft incurred at least some damage (destroyed, substantial, minor, or unknown) from strike.
[5] Aircraft incurred damage or structural failure, which adversely affected the structure strength, performance, or flight characteristics, and which would normally require major repair or replacement of the affected component, or the damage sustained makes it inadvisable to restore aircraft to airworthy condition.
[6] Aborted takeoff, engine shutdown, precautionary landing, or other.

This page intentionally left blank.

Table of Contents

This page intentionally left blank.

SECTION 1.

GENERAL SEPARATION CRITERIA FOR HAZARDOUS WILDLIFE ATTRACTANTS ON OR NEAR AIRPORTS.

1-1. INTRODUCTION. When considering proposed land uses, airport operators, local planners, and developers must take into account whether the proposed land uses, including new development projects, will increase wildlife hazards. Land-use practices that attract or sustain hazardous wildlife populations on or near airports can significantly increase the potential for wildlife strikes.

The FAA recommends the minimum separation criteria outlined below for land-use practices that attract hazardous wildlife to the vicinity of airports. Please note that FAA criteria include land uses that cause movement of hazardous wildlife onto, into, or across the airport's approach or departure airspace or air operations area (AOA). (See the discussion of the synergistic effects of surrounding land uses in Section 2-8 of this AC.)

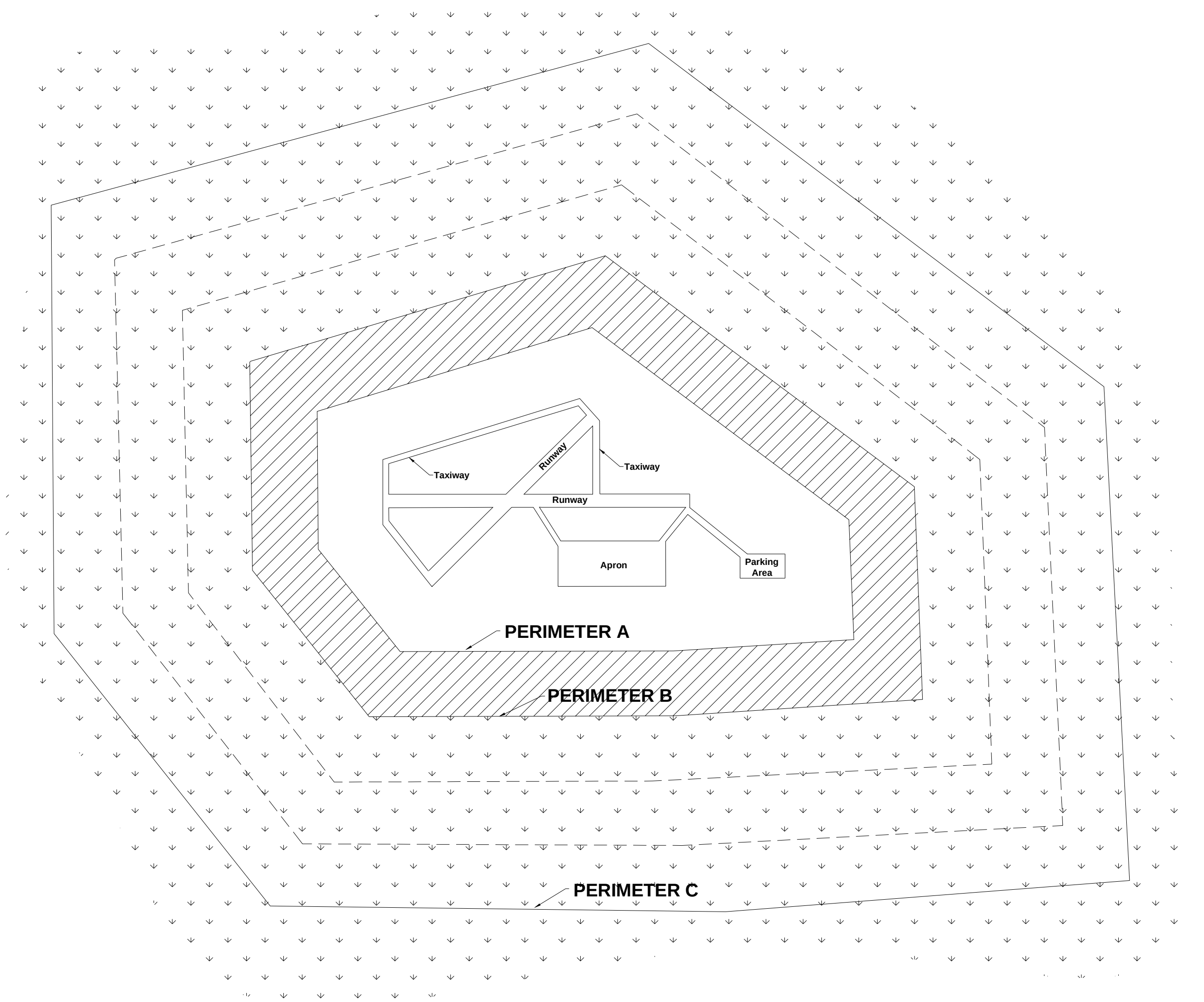
The basis for the separation criteria contained in this section can be found in existing FAA regulations. The separation distances are based on (1) flight patterns of piston-powered aircraft and turbine-powered aircraft, (2) the altitude at which most strikes happen (78 percent occur under 1,000 feet and 90 percent occur under 3,000 feet above ground level), and (3) National Transportation Safety Board (NTSB) recommendations.

1-2. AIRPORTS SERVING PISTON-POWERED AIRCRAFT. Airports that do not sell Jet-A fuel normally serve piston-powered aircraft. Notwithstanding more stringent requirements for specific land uses, the FAA recommends a separation distance of 5,000 feet at these airports for any of the hazardous wildlife attractants mentioned in Section 2 or for new airport development projects meant to accommodate aircraft movement. This distance is to be maintained between an airport's AOA and the hazardous wildlife attractant. Figure 1 depicts this separation distance measured from the nearest aircraft operations areas.

1-3. AIRPORTS SERVING TURBINE-POWERED AIRCRAFT. Airports selling Jet-A fuel normally serve turbine-powered aircraft. Notwithstanding more stringent requirements for specific land uses, the FAA recommends a separation distance of 10,000 feet at these airports for any of the hazardous wildlife attractants mentioned in Section 2 or for new airport development projects meant to accommodate aircraft movement. This distance is to be maintained between an airport's AOA and the hazardous wildlife attractant. Figure 1 depicts this separation distance from the nearest aircraft movement areas.

1-4. PROTECTION OF APPROACH, DEPARTURE, AND CIRCLING AIRSPACE. For all airports, the FAA recommends a distance of 5 statute miles between the farthest edge of the airport's AOA and the hazardous wildlife attractant if the attractant could cause hazardous wildlife movement into or across the approach or departure airspace.

Figure 1. Separation distances within which hazardous wildlife attractants should be avoided, eliminated, or mitigated.



PERIMETER A: For airports serving piston-powered aircraft, hazardous wildlife attractants must be 5,000 feet from the nearest air operations area.

PERIMETER B: For airports serving turbine-powered aircraft, hazardous wildlife attractants must be 10,000 feet from the nearest air operations area.

PERIMETER C: 5-mile range to protect approach, departure and circling airspace.

SECTION 2.

LAND-USE PRACTICES ON OR NEAR AIRPORTS THAT POTENTIALLY ATTRACT HAZARDOUS WILDLIFE.

2-1. GENERAL. The wildlife species and the size of the populations attracted to the airport environment vary considerably, depending on several factors, including land-use practices on or near the airport. This section discusses land-use practices having the potential to attract hazardous wildlife and threaten aviation safety. In addition to the specific considerations outlined below, airport operators should refer to *Wildlife Hazard Management at Airports,* prepared by FAA and U.S. Department of Agriculture (USDA) staff. (This manual is available in English, Spanish, and French. It can be viewed and downloaded free of charge from the FAA's wildlife hazard mitigation web site: http://wildlife-mitigation.tc.FAA.gov.). And, *Prevention and Control of Wildlife Damage,* compiled by the University of Nebraska Cooperative Extension Division. (This manual is available online in a periodically updated version at: ianrwww.unl.edu/wildlife/solutions/handbook/.)

2-2. WASTE DISPOSAL OPERATIONS. Municipal solid waste landfills (MSWLF) are known to attract large numbers of hazardous wildlife, particularly birds. Because of this, these operations, when located within the separations identified in the siting criteria in Sections 1-2 through 1-4, are considered incompatible with safe airport operations.

a. Siting for new municipal solid waste landfills subject to AIR 21. Section 503 of the Wendell H. Ford Aviation Investment and Reform Act for the 21st Century (Public Law 106-181) (AIR 21) prohibits the construction or establishment of a new MSWLF within 6 statute miles of certain public-use airports. Before these prohibitions apply, both the airport and the landfill must meet the very specific conditions described below. These restrictions do not apply to airports or landfills located within the state of Alaska.

The airport must (1) have received a Federal grant(s) under 49 U.S.C. § 47101, et. seq.; (2) be under control of a public agency; (3) serve some scheduled air carrier operations conducted in aircraft with less than 60 seats; and (4) have total annual enplanements consisting of at least 51 percent of scheduled air carrier enplanements conducted in aircraft with less than 60 passenger seats.

The proposed MSWLF must (1) be within 6 miles of the airport, as measured from airport property line to MSWLF property line, and (2) have started construction or establishment on or after April 5, 2001. Public Law 106-181 only limits the construction or establishment of some new MSWLF. It does not limit the expansion, either vertical or horizontal, of existing landfills.

NOTE: Consult the most recent version of AC 150/5200-34, *Construction or Establishment of Landfills Near Public Airports,* for a more detailed discussion of these restrictions.

b. Siting for new MSWLF not subject to AIR 21. If an airport and MSWLF do not meet the restrictions of Public Law 106-181, the FAA recommends against locating MSWLF within the separation distances identified in Sections 1-2 through 1-4. The separation distances should be measured from the closest point of the airport's AOA to the closest planned MSWLF cell.

c. Considerations for existing waste disposal facilities within the limits of separation criteria. The FAA recommends against airport development projects that would increase the number of aircraft operations or accommodate larger or faster aircraft near MSWLF operations located within the separations identified in Sections 1-2 through 1-4. In addition, in accordance with 40 CFR 258.10, owners or operators of existing MSWLF units that are located within the separations listed in Sections 1-2 through 1-4 must demonstrate that the unit is designed and operated so it does not pose a bird hazard to aircraft. (See Section 4-2(b) of this AC for a discussion of this demonstration requirement.)

d. Enclosed trash transfer stations. Enclosed waste-handling facilities that receive garbage behind closed doors; process it via compaction, incineration, or similar manner; and remove all residue by enclosed vehicles generally are compatible with safe airport operations, provided they are not located on airport property or within the Runway Protection Zone (RPZ). These facilities should not handle or store putrescible waste outside or in a partially enclosed structure accessible to hazardous wildlife. Trash transfer facilities that are open on one or more sides; that store uncovered quantities of municipal solid waste outside, even if only for a short time; that use semi-trailers that leak or have trash clinging to the outside; or that do not control odors by ventilation and filtration systems (odor masking is not acceptable) do not meet the FAA's definition of fully enclosed trash transfer stations. The FAA considers these facilities incompatible with safe airport operations if they are located closer than the separation distances specified in Sections 1-2 through 1-4.

e. Composting operations on or near airport property. Composting operations that accept only yard waste (e.g., leaves, lawn clippings, or branches) generally do not attract hazardous wildlife. Sewage sludge, woodchips, and similar material are not municipal solid wastes and may be used as compost bulking agents. The compost, however, must never include food or other municipal solid waste. Composting operations should not be located on airport property. Off-airport property composting operations should be located no closer than the greater of the following distances: 1,200 feet from any AOA or the distance called for by airport design requirements (see AC 150/5300-13, *Airport Design*). This spacing should prevent material, personnel, or equipment from penetrating any Object Free Area (OFA), Obstacle Free Zone (OFZ), Threshold Siting Surface (TSS), or Clearway. Airport operators should monitor composting operations located in proximity to the airport to ensure that steam or thermal rise does not adversely affect air traffic. On-airport disposal of compost by-products should not be conducted for the reasons stated in 2-3f.

f. Underwater waste discharges. The FAA recommends against the underwater discharge of any food waste (e.g., fish processing offal) within the separations identified in Sections 1-2 through 1-4 because it could attract scavenging hazardous wildlife.

g. Recycling centers. Recycling centers that accept previously sorted non-food items, such as glass, newspaper, cardboard, or aluminum, are, in most cases, not attractive to hazardous wildlife and are acceptable.

h. Construction and demolition (C&D) debris facilities. C&D landfills do not generally attract hazardous wildlife and are acceptable if maintained in an orderly manner, admit no putrescible waste, and are not co-located with other waste disposal operations. However, C&D landfills have similar visual and operational characteristics to putrescible waste disposal sites. When co-located with putrescible waste disposal operations, C&D landfills are more likely to attract hazardous wildlife because of the similarities between these disposal facilities. Therefore, a C&D landfill co-located with another waste disposal operation should be located outside of the separations identified in Sections 1-2 through 1-4.

i. Fly ash disposal. The incinerated residue from resource recovery power/heat-generating facilities that are fired by municipal solid waste, coal, or wood is generally not a wildlife attractant because it no longer contains putrescible matter. Landfills accepting only fly ash are generally not considered to be wildlife attractants and are acceptable as long as they are maintained in an orderly manner, admit no putrescible waste of any kind, and are not co-located with other disposal operations that attract hazardous wildlife.

Since varying degrees of waste consumption are associated with general incineration (not resource recovery power/heat-generating facilities), the FAA considers the ash from general incinerators a regular waste disposal by-product and, therefore, a hazardous wildlife attractant if disposed of within the separation criteria outlined in Sections 1-2 through 1-4.

2-3. WATER MANAGEMENT FACILITIES. Drinking water intake and treatment facilities, storm water and wastewater treatment facilities, associated retention and settling ponds, ponds built for recreational use, and ponds that result from mining activities often attract large numbers of potentially hazardous wildlife. To prevent wildlife hazards, land-use developers and airport operators may need to develop management plans, in compliance with local and state regulations, to support the operation of storm water management facilities on or near all public-use airports to ensure a safe airport environment.

a. Existing storm water management facilities. On-airport storm water management facilities allow the quick removal of surface water, including discharges related to aircraft deicing, from impervious surfaces, such as pavement and terminal/hangar building roofs. Existing on-airport detention ponds collect storm water, protect water quality, and control runoff. Because they slowly release water after storms, they create standing bodies of water that can attract hazardous wildlife. Where the airport has developed a Wildlife Hazard Management Plan (WHMP) in accordance with Part 139, the FAA requires immediate correction of any wildlife hazards arising from existing storm water facilities located on or near airports, using appropriate wildlife hazard mitigation techniques. Airport operators should develop measures to minimize hazardous wildlife attraction in consultation with a wildlife damage management biologist.

Where possible, airport operators should modify storm water detention ponds to allow a maximum 48-hour detention period for the design storm. The FAA recommends that airport operators avoid or remove retention ponds and detention ponds featuring dead storage to eliminate standing water. Detention basins should remain totally dry between rainfalls. Where constant flow of water is anticipated through the basin, or where any portion of the basin bottom may remain wet, the detention facility should include a concrete or paved pad and/or ditch/swale in the bottom to prevent vegetation that may provide nesting habitat.

When it is not possible to drain a large detention pond completely, airport operators may use physical barriers, such as bird balls, wires grids, pillows, or netting, to deter birds and other hazardous wildlife. When physical barriers are used, airport operators must evaluate their use and ensure they will not adversely affect water rescue. Before installing any physical barriers over detention ponds on Part 139 airports, airport operators must get approval from the appropriate FAA Regional Airports Division Office.

The FAA recommends that airport operators encourage off-airport storm water treatment facility operators to incorporate appropriate wildlife hazard mitigation techniques into storm water treatment facility operating practices when their facility is located within the separation criteria specified in Sections 1-2 through 1-4.

b. New storm water management facilities. The FAA strongly recommends that off-airport storm water management systems located within the separations identified in Sections 1-2 through 1-4 be designed and operated so as not to create above-ground standing water. Stormwater detention ponds should be designed, engineered, constructed, and maintained for a maximum 48–hour detention period after the design storm and remain completely dry between storms. To facilitate the control of hazardous wildlife, the FAA recommends the use of steep-sided, rip-rap lined, narrow, linearly shaped water detention basins. When it is not possible to place these ponds away from an airport's AOA, airport operators should use physical barriers, such as bird balls, wires grids, pillows, or netting, to prevent access of hazardous wildlife to open water and minimize aircraft-wildlife interactions. When physical barriers are used, airport operators must evaluate their use and ensure they will not adversely affect water rescue. Before installing any physical barriers over detention ponds on Part 139 airports, airport operators must get approval from the appropriate FAA Regional Airports Division Office. All vegetation in or around detention basins that provide food or cover for hazardous wildlife should be eliminated. If soil conditions and other requirements allow, the FAA encourages the use of underground storm water infiltration systems, such as French drains or buried rock fields, because they are less attractive to wildlife.

c. Existing wastewater treatment facilities. The FAA strongly recommends that airport operators immediately correct any wildlife hazards arising from existing wastewater treatment facilities located on or near the airport. Where required, a WHMP developed in accordance with Part 139 will outline appropriate wildlife hazard mitigation techniques. Accordingly, airport operators should encourage wastewater treatment facility operators to incorporate measures, developed in consultation with a wildlife damage management biologist, to minimize hazardous wildlife attractants. Airport operators should also encourage those wastewater treatment facility operators to incorporate these mitigation techniques into their standard operating practices. In addition, airport operators should consider the existence of wastewater treatment facilities when evaluating proposed sites for new airport development projects and avoid such sites when practicable.

d. New wastewater treatment facilities. The FAA strongly recommends against the construction of new wastewater treatment facilities or associated settling ponds within the separations identified in Sections 1-2 through 1-4. Appendix 1 defines wastewater treatment facility as "any devices and/or systems used to store, treat, recycle, or reclaim municipal sewage or liquid industrial wastes." The definition includes any pretreatment involving the reduction of the amount of pollutants or the elimination of pollutants prior to introducing such pollutants into a publicly owned treatment works (wastewater treatment facility). During the site-location analysis for wastewater treatment facilities, developers should consider the potential to attract hazardous wildlife if an airport is in the vicinity of the proposed site, and airport operators should voice their opposition to such facilities if they are in proximity to the airport.

e. Artificial marshes. In warmer climates, wastewater treatment facilities sometimes employ artificial marshes and use submergent and emergent aquatic vegetation as natural filters. These artificial marshes may be used by some species of flocking birds, such as blackbirds and waterfowl, for breeding or roosting activities. The FAA strongly recommends against establishing artificial marshes within the separations identified in Sections 1-2 through 1-4.

f. Wastewater discharge and sludge disposal. The FAA recommends against the discharge of wastewater or sludge on airport property because it may improve soil moisture and quality on unpaved areas and lead to improved turf growth that can be an attractive food source for many species of animals. Also, the turf requires more frequent mowing, which in turn may mutilate or flush insects or small animals and produce straw, both of which can attract hazardous wildlife. In addition, the improved turf may attract grazing wildlife, such as deer and geese. Problems may also occur when discharges saturate unpaved airport areas. The resultant soft, muddy conditions can severely restrict or prevent emergency vehicles from reaching accident sites in a timely manner.

2-4. WETLANDS. Wetlands provide a variety of functions and can be regulated by local, state, and Federal laws. Normally, wetlands are attractive to many types of wildlife, including many which rank high on the list of hazardous wildlife species (Table 1).

NOTE: If questions exist as to whether an area qualifies as a wetland, contact the local division of the U.S. Army Corps of Engineers, the Natural Resources Conservation Service, or a wetland consultant qualified to delineate wetlands.

a. Existing wetlands on or near airport property. If wetlands are located on or near airport property, airport operators should be alert to any wildlife use or habitat changes in these areas that could affect safe aircraft operations. At public-use airports, the FAA recommends immediately correcting, in cooperation with local, state, and Federal regulatory agencies, any wildlife hazards arising from existing wetlands located on or near airports. Where required, a WHMP will outline appropriate wildlife hazard mitigation techniques. Accordingly, airport operators should develop measures to minimize hazardous wildlife attraction in consultation with a wildlife damage management biologist.

b. New airport development. Whenever possible, the FAA recommends locating new airports using the separations from wetlands identified in Sections 1-2 through 1-4. Where alternative sites are not practicable, or when airport operators are expanding an existing airport into or near wetlands, a wildlife damage management biologist, in consultation with the U.S. Fish and Wildlife Service, the U.S. Army Corps of Engineers, and the state wildlife management agency should evaluate the wildlife hazards and prepare a WHMP that indicates methods of minimizing the hazards.

c. Mitigation for wetland impacts from airport projects. Wetland mitigation may be necessary when unavoidable wetland disturbances result from new airport development projects or projects required to correct wildlife hazards from wetlands. Wetland mitigation must be designed so it does not create a wildlife hazard. The FAA recommends that wetland mitigation projects that may attract hazardous wildlife be sited outside of the separations identified in Sections 1-2 through 1-4.

(1) Onsite mitigation of wetland functions. The FAA may consider exceptions to locating mitigation activities outside the separations identified in Sections 1-2 through 1-4 if the affected wetlands provide unique ecological functions, such as critical habitat for threatened or endangered species or ground water recharge, which cannot be replicated when moved to a different location. Using existing airport property is sometimes the only feasible way to achieve the mitigation ratios mandated in regulatory orders and/or settlement agreements with the resource agencies. Conservation easements are an additional means of providing mitigation for project impacts. Typically the airport operator continues to own the property, and an easement is created stipulating that the property will be maintained as habitat for state or Federally listed species.

Mitigation must not inhibit the airport operator's ability to effectively control hazardous wildlife on or near the mitigation site or effectively maintain other aspects of safe airport operations. Enhancing such mitigation areas to attract hazardous wildlife must be avoided. The FAA will review any onsite mitigation proposals to determine compatibility with safe airport operations. A wildlife damage management biologist should evaluate any wetland mitigation projects that are needed to protect unique wetland functions and that must be located in the separation criteria in Sections 1-2 through 1-4 before the mitigation is implemented. A WHMP should be developed to reduce the wildlife hazards.

(2) Offsite mitigation of wetland functions. The FAA recommends that wetland mitigation projects that may attract hazardous wildlife be sited outside of the separations identified in Sections 1-2 through 1-4 unless they provide unique functions that must remain onsite (see 2-4c(1)). Agencies that regulate impacts to or around wetlands recognize that it may be necessary to split wetland functions in mitigation schemes. Therefore, regulatory agencies may, under certain circumstances, allow portions of mitigation to take place in different locations.

(3) Mitigation banking. Wetland mitigation banking is the creation or restoration of wetlands in order to provide mitigation credits that can be used to offset permitted wetland losses. Mitigation banking benefits wetland resources by providing advance replacement for permitted wetland losses; consolidating small projects into larger, better-designed and managed units; and encouraging integration of wetland mitigation projects with watershed planning. This last benefit is most helpful for airport projects, as wetland impacts mitigated outside of the separations identified in Sections 1-2 through 1-4 can still be located within the same watershed. Wetland mitigation banks meeting the separation criteria offer an ecologically sound approach to mitigation in these situations. Airport operators should work with local watershed management agencies or organizations to develop mitigation banking for wetland impacts on airport property.

2-5. DREDGE SPOIL CONTAINMENT AREAS. The FAA recommends against locating dredge spoil containment areas (also known as Confined Disposal Facilities) within the separations identified in Sections 1-2 through 1-4 if the containment area or the spoils contain material that would attract hazardous wildlife.

2-6. AGRICULTURAL ACTIVITIES. Because most, if not all, agricultural crops can attract hazardous wildlife during some phase of production, the FAA recommends against the used of airport property for agricultural production, including hay crops, within the separations identified in Sections 1-2 through 1-4. . If the airport has no financial alternative to agricultural crops to produce income necessary to maintain the viability of the airport, then the airport shall follow the crop distance guidelines listed in the table titled "Minimum Distances between Certain Airport Features and Any On-Airport Agricultural Crops" found in AC 150/5300-13, *Airport Design*, Appendix 17. The cost of wildlife control and potential accidents should be weighed against the income produced by the on-airport crops when deciding whether to allow crops on the airport.

a. Livestock production. Confined livestock operations (i.e., feedlots, dairy operations, hog or chicken production facilities, or egg laying operations) often attract flocking birds, such as starlings, that pose a hazard to aviation. Therefore, The FAA recommends against such facilities within the separations identified in Sections 1-2 through 1-4. Any livestock operation within these separations should have a program developed to reduce the attractiveness of the site to species that are hazardous to aviation safety. Free-ranging livestock must not be grazed on airport property because the animals may wander onto the AOA. Furthermore, livestock feed, water, and manure may attract birds.

b. Aquaculture. Aquaculture activities (i.e. catfish or trout production) conducted outside of fully enclosed buildings are inherently attractive to a wide variety of birds. Existing aquaculture facilities/activities within the separations listed in Sections 1-2 through 1-4 must have a program developed to reduce the attractiveness of the sites to species that are hazardous to aviation safety. Airport operators should also oppose the establishment of new aquaculture facilities/activities within the separations listed in Sections 1-2 through 1-4.

c. Alternative uses of agricultural land. Some airports are surrounded by vast areas of farmed land within the distances specified in Sections 1-2 through 1-4. Seasonal uses of agricultural land for activities such as hunting can create a hazardous wildlife situation. In some areas, farmers will rent their land for hunting purposes. Rice farmers, for example, flood their land during waterfowl hunting season and obtain additional revenue by renting out duck blinds. The duck hunters then use decoys and call in hundreds, if not thousands, of birds, creating a tremendous threat to aircraft safety. A wildlife damage management biologist should review, in coordination with local farmers and producers, these types of seasonal land uses and incorporate them into the WHMP.

2-7. GOLF COURSES, LANDSCAPING AND OTHER LAND-USE CONSIDERATIONS.

a. Golf courses. The large grassy areas and open water found on most golf courses are attractive to hazardous wildlife, particularly Canada geese and some species of gulls. These species can pose a threat to aviation safety. The FAA recommends against construction of new golf courses within the separations identified in Sections 1-2 through 1-4. Existing golf courses located within these separations must develop a program to reduce the attractiveness of the sites to species that are hazardous to aviation safety. Airport operators should ensure these golf courses are monitored on a continuing basis for the presence of hazardous wildlife. If hazardous wildlife is detected, corrective actions should be immediately implemented.

b. Landscaping and landscape maintenance. Depending on its geographic location, landscaping can attract hazardous wildlife. The FAA recommends that airport operators approach landscaping with caution and confine it to airport areas not associated with aircraft movements. A wildlife damage management biologist should review all landscaping plans. Airport operators should also monitor all landscaped areas on a continuing basis for the presence of hazardous wildlife. If hazardous wildlife is detected, corrective actions should be immediately implemented.

Turf grass areas can be highly attractive to a variety of hazardous wildlife species. Research conducted by the USDA Wildlife Services' National Wildlife Research Center has shown that no one grass management regime will deter all species of hazardous wildlife in all situations. In cooperation with wildlife damage management biologist, airport operators should develop airport turf grass management plans on a prescription basis, depending on the airport's geographic locations and the type of hazardous wildlife likely to frequent the airport

Airport operators should ensure that plant varieties attractive to hazardous wildlife are not used on the airport. Disturbed areas or areas in need of re-vegetating should not be planted with seed mixtures containing millet or any other large-seed producing grass. For airport property already planted with seed mixtures containing millet, rye grass, or other large-seed producing grasses, the FAA recommends disking, plowing, or another suitable agricultural practice to prevent plant maturation and seed head production. Plantings should follow the specific recommendations for grass management and seed and plant selection made by the State University Cooperative Extension Service, the local office of Wildlife Services, or a qualified wildlife damage management biologist. Airport operators should also consider developing and implementing a preferred/prohibited plant species list, reviewed by a wildlife damage management biologist, which has been designed for the geographic location to reduce the attractiveness to hazardous wildlife for landscaping airport property.

c. Airports surrounded by wildlife habitat. The FAA recommends that operators of airports surrounded by woodlands, water, or wetlands refer to Section 2.4 of this AC. Operators of such airports should provide for a Wildlife Hazard Assessment (WHA) conducted by a wildlife damage management biologist. This WHA is the first step in preparing a WHMP, where required.

d. Other hazardous wildlife attractants. Other specific land uses or activities (e.g., sport or commercial fishing, shellfish harvesting, etc.), perhaps unique to certain regions of the country, have the potential to attract hazardous wildlife. Regardless of the source of the attraction, when hazardous wildlife is noted on a public-use airport, airport operators must take prompt remedial action(s) to protect aviation safety.

2-8. SYNERGISTIC EFFECTS OF SURROUNDING LAND USES. There may be circumstances where two (or more) different land uses that would not, by themselves, be considered hazardous wildlife attractants or that are located outside of the separations identified in Sections 1-2 through 1-4 that are in such an alignment with the airport as to create a wildlife corridor directly through the airport and/or surrounding airspace. An example of this situation may involve a lake located outside of the separation criteria on the east side of an airport and a large hayfield on the west side of an airport, land uses that together could create a flyway for Canada geese directly across the airspace of the airport. There are numerous examples of such situations;

therefore, airport operators and the wildlife damage management biologist must consider the entire surrounding landscape and community when developing the WHMP.

SECTION 3.

PROCEDURES FOR WILDLIFE HAZARD MANAGEMENT BY OPERATORS OF PUBLIC-USE AIRPORTS.

3.1. INTRODUCTION. In recognition of the increased risk of serious aircraft damage or the loss of human life that can result from a wildlife strike, the FAA may require the development of a Wildlife Hazard Management Plan (WHMP) when specific triggering events occur on or near the airport. Part 139.337 discusses the specific events that trigger a Wildlife Hazard Assessment (WHA) and the specific issues that a WHMP must address for FAA approval and inclusion in an Airport Certification Manual.

3.2. COORDINATION WITH USDA WILDLIFE SERVICES OR OTHER QUALIFIED WILDLIFE DAMAGE MANAGEMENT BIOLOGISTS. The FAA will use the Wildlife Hazard Assessment (WHA) conducted in accordance with Part 139 to determine if the airport needs a WHMP. Therefore, persons having the education, training, and expertise necessary to assess wildlife hazards must conduct the WHA. The airport operator may look to Wildlife Services or to qualified private consultants to conduct the WHA. When the services of a wildlife damage management biologist are required, the FAA recommends that land-use developers or airport operators contact a consultant specializing in wildlife damage management or the appropriate state director of Wildlife Services.

NOTE: Telephone numbers for the respective USDA Wildlife Services state offices can be obtained by contacting USDA Wildlife Services Operational Support Staff, 4700 River Road, Unit 87, Riverdale, MD, 20737-1234, Telephone (301) 734-7921, Fax (301) 734-5157 *(http://www.aphis.usda.gov/ws/)*.

3-3. WILDLIFE HAZARD MANAGEMENT AT AIRPORTS: A MANUAL FOR AIRPORT PERSONNEL. This manual, prepared by FAA and USDA Wildlife Services staff, contains a compilation of information to assist airport personnel in the development, implementation, and evaluation of WHMPs at airports. The manual includes specific information on the nature of wildlife strikes, legal authority, regulations, wildlife management techniques, WHAs, WHMPs, and sources of help and information. The manual is available in three languages: English, Spanish, and French. It can be viewed and downloaded free of charge from the FAA's wildlife hazard mitigation web site: http://wildlife-mitigation.tc.FAA.gov/. This manual only provides a starting point for addressing wildlife hazard issues at airports. Hazardous wildlife management is a complex discipline and conditions vary widely across the United States. Therefore, qualified wildlife damage management biologists must direct the development of a WHMP and the implementation of management actions by airport personnel.

There are many other resources complementary to this manual for use in developing and implementing WHMPs. Several are listed in the manual's bibliography.

3-4. WILDLIFE HAZARD ASSESSMENTS, TITLE 14, CODE OF FEDERAL REGULATIONS, PART 139. Part 139.337(b) requires airport operators to conduct a Wildlife Hazard Assessment (WHA) when certain events occur on or near the airport.

Part 139.337 (c) provides specific guidance as to what facts must be addressed in a WHA.

3-5. WILDLIFE HAZARD MANAGEMENT PLAN (WHMP). The FAA will consider the results of the WHA, along with the aeronautical activity at the airport and the views of the airport operator and airport users, in determining whether a formal WHMP is needed, in accordance with Part 139.337. If the FAA determines that a WHMP is needed, the airport operator must formulate and implement a WHMP, using the WHA as the basis for the plan.

The goal of an airport's Wildlife Hazard Management Plan is to minimize the risk to aviation safety, airport structures or equipment, or human health posed by populations of hazardous wildlife on and around the airport.

The WHMP must identify hazardous wildlife attractants on or near the airport and the appropriate wildlife damage management techniques to minimize the wildlife hazard. It must also prioritize the management measures.

3-6. LOCAL COORDINATION. The establishment of a Wildlife Hazards Working Group (WHWG) will facilitate the communication, cooperation, and coordination of the airport and its surrounding community necessary to ensure the effectiveness of the WHMP. The cooperation of the airport community is also necessary when new projects are considered. Whether on or off the airport, the input from all involved parties must be considered when a potentially hazardous wildlife attractant is being proposed. Airport operators should also incorporate public education activities with the local coordination efforts because some activities in the vicinity of your airport, while harmless under normal leisure conditions, can attract wildlife and present a danger to aircraft. For example, if public trails are planned near wetlands or in parks adjoining airport property, the public should know that feeding birds and other wildlife in the area may pose a risk to aircraft.

Airport operators should work with local and regional planning and zoning boards so as to be aware of proposed land-use changes, or modification of existing land uses, that could create hazardous wildlife attractants within the separations identified in Sections 1-2 through 1-4. Pay particular attention to proposed land uses involving creation or expansion of waste water treatment facilities, development of wetland mitigation sites, or development or expansion of dredge spoil containment areas. At the very least, airport operators must ensure they are on the notification list of the local planning board or equivalent review entity for all communities located within 5 miles of the airport, so they will receive notification of any proposed project and have the opportunity to review it for attractiveness to hazardous wildlife.

3-7 COORDINATION/NOTIFICATION OF AIRMEN OF WILDLIFE HAZARDS. If an existing land-use practice creates a wildlife hazard and the land-use practice or wildlife hazard cannot be immediately eliminated, airport operators must issue a Notice to Airmen (NOTAM) and encourage the land–owner or manager to take steps to control the wildlife hazard and minimize further attraction.

SECTION 4.

FAA NOTIFICATION AND REVIEW OF PROPOSED LAND-USE PRACTICE CHANGES IN THE VICINITY OF PUBLIC-USE AIRPORTS

4-1. FAA REVIEW OF PROPOSED LAND-USE PRACTICE CHANGES IN THE VICINITY OF PUBLIC-USE AIRPORTS.

a. The FAA discourages the development of waste disposal and other facilities, discussed in Section 2, located within the 5,000/10,000-foot criteria specified in Sections 1-2 through 1-4.

b. For projects that are located outside the 5,000/10,000-foot criteria but within 5 statute miles of the airport's AOA, the FAA may review development plans, proposed land-use changes, operational changes, or wetland mitigation plans to determine if such changes present potential wildlife hazards to aircraft operations. The FAA considers sensitive airport areas as those that lie under or next to approach or departure airspace. This brief examination should indicate if further investigation is warranted.

c. Where a wildlife damage management biologist has conducted a further study to evaluate a site's compatibility with airport operations, the FAA may use the study results to make a determination.

4-2. WASTE MANAGEMENT FACILITIES.

a. Notification of new/expanded project proposal. Section 503 of the Wendell H. Ford Aviation Investment and Reform Act for the 21st Century (Public Law 106-181) limits the construction or establishment of new MSWLF within 6 statute miles of certain public-use airports, when both the airport and the landfill meet very specific conditions. See Section 2-2 of this AC and AC 150/5200-34 for a more detailed discussion of these restrictions.

The Environmental Protection Agency (EPA) requires any MSWLF operator proposing a new or expanded waste disposal operation within 5 statute miles of a runway end to notify the appropriate FAA Regional Airports Division Office and the airport operator of the proposal (40 CFR 258, *Criteria for Municipal Solid Waste Landfills*, Section 258.10, *Airport Safety*). The EPA also requires owners or operators of new MSWLF units, or lateral expansions of existing MSWLF units, that are located within 10,000 feet of any airport runway end used by turbojet aircraft, or within 5,000 feet of any airport runway end used only by piston-type aircraft, to demonstrate successfully that such units are not hazards to aircraft. (See 4-2.b below.)

When new or expanded MSWLF are being proposed near airports, MSWLF operators must notify the airport operator and the FAA of the proposal as early as possible pursuant to 40 CFR 258.

b. Waste handling facilities within separations identified in Sections 1-2 through 1-4. To claim successfully that a waste-handling facility sited within the separations identified in Sections 1-2 through 1-4 does not attract hazardous wildlife and does not threaten aviation, the developer must establish convincingly that the facility will not handle putrescible material other than that as outlined in 2-2.d. The FAA strongly recommends against any facility other than that as outlined in 2-2.d (enclosed transfer stations). The FAA will use this information to determine if the facility will be a hazard to aviation.

c. Putrescible-Waste Facilities. In their effort to satisfy the EPA requirement, some putrescible-waste facility proponents may offer to undertake experimental measures to demonstrate that their proposed facility will not be a hazard to aircraft. To date, no such facility has been able to demonstrate an ability to reduce and sustain hazardous wildlife to levels that existed before the putrescible-waste landfill began operating. For this reason, demonstrations of experimental wildlife control measures may not be conducted within the separation identified in Sections 1-2 through 1-4.

4-3. OTHER LAND-USE PRACTICE CHANGES. As a matter of policy, the FAA encourages operators of public-use airports who become aware of proposed land use practice changes that may attract hazardous wildlife within 5 statute miles of their airports to promptly notify the FAA. The FAA also encourages proponents of such land use changes to notify the FAA as early in the planning process as possible. Advanced notice affords the FAA an opportunity (1) to evaluate the effect of a particular land-use change on aviation safety and (2) to support efforts by the airport sponsor to restrict the use of land next to or near the airport to uses that are compatible with the airport.

The airport operator, project proponent, or land-use operator may use FAA Form 7460-1, *Notice of Proposed Construction or Alteration*, or other suitable documents similar to FAA Form 7460-1 to notify the appropriate FAA Regional Airports Division Office. Project proponents can contact the appropriate FAA Regional Airports Division Office for assistance with the notification process.

It is helpful if the notification includes a 15-minute quadrangle map of the area identifying the location of the proposed activity. The land-use operator or project proponent should also forward specific details of the proposed land-use change or operational change or expansion. In the case of solid waste landfills, the information should include the type of waste to be handled, how the waste will be processed, and final disposal methods.

a. Airports that have received Federal grant-in-aid assistance. Airports that have received Federal grant-in-aid assistance are required by their grant assurances to take appropriate actions to restrict the use of land next to or near the airport to uses that are compatible with normal airport operations. The FAA recommends that airport operators to the extent practicable oppose off-airport land-use changes or practices within the separations identified in Sections 1-2 through 1-4 that may attract hazardous wildlife. Failure to do so may lead to noncompliance with applicable grant assurances. The FAA will not approve the placement of airport development projects pertaining to aircraft movement in the vicinity of hazardous wildlife attractants without appropriate mitigating measures. Increasing the intensity of wildlife control efforts is not a substitute for eliminating or reducing a proposed wildlife hazard. Airport operators should identify hazardous wildlife attractants and any associated wildlife hazards during any planning process for new airport development projects.

This page intentionally left blank.

APPENDIX 1. DEFINITIONS OF TERMS USED IN THIS ADVISORY CIRCULAR.

1. GENERAL. This appendix provides definitions of terms used throughout this AC.

1. **Air operations area.** Any area of an airport used or intended to be used for landing, takeoff, or surface maneuvering of aircraft. An air operations area includes such paved areas or unpaved areas that are used or intended to be used for the unobstructed movement of aircraft in addition to its associated runway, taxiways, or apron.

2. **Airport operator.** The operator (private or public) or sponsor of a public-use airport.

3. **Approach or departure airspace.** The airspace, within 5 statute miles of an airport, through which aircraft move during landing or takeoff.

4. **Bird balls.** High-density plastic floating balls that can be used to cover ponds and prevent birds from using the sites.

5. **Certificate holder.** The holder of an Airport Operating Certificate issued under Title 14, Code of Federal Regulations, Part 139.

6. **Construct a new MSWLF.** To begin to excavate, grade land, or raise structures to prepare a municipal solid waste landfill as permitted by the appropriate regulatory or permitting agency.

7. **Detention ponds.** Storm water management ponds that hold storm water for short periods of time, a few hours to a few days.

8. **Establish a new MSWLF.** When the first load of putrescible waste is received on-site for placement in a prepared municipal solid waste landfill.

9. **Fly ash.** The fine, sand-like residue resulting from the complete incineration of an organic fuel source. Fly ash typically results from the combustion of coal or waste used to operate a power generating plant.

10. **General aviation aircraft.** Any civil aviation aircraft not operating under 14 CFR Part 119, Certification: Air Carriers and Commercial Operators.

11. **Hazardous wildlife.** Species of wildlife (birds, mammals, reptiles), including feral animals and domesticated animals not under control, that are associated with aircraft strike problems, are capable of causing structural damage to airport facilities, or act as attractants to other wildlife that pose a strike hazard

12. **Municipal Solid Waste Landfill (MSWLF).** A publicly or privately owned discrete area of land or an excavation that receives household waste and that is not a land application unit, surface impoundment, injection well, or waste pile, as those terms are defined under 40 CFR § 257.2. An MSWLF may receive

other types wastes, such as commercial solid waste, non-hazardous sludge, small-quantity generator waste, and industrial solid waste, as defined under 40 CFR § 258.2. An MSWLF can consist of either a stand alone unit or several cells that receive household waste.

13. **New MSWLF.** A municipal solid waste landfill that was established or constructed after April 5, 2001.

14. **Piston-powered aircraft.** Fixed-wing aircraft powered by piston engines.

15. **Piston-use airport.** Any airport that does not sell Jet-A fuel for fixed-wing turbine-powered aircraft, and primarily serves fixed-wing, piston-powered aircraft. Incidental use of the airport by turbine-powered, fixed-wing aircraft would not affect this designation. However, such aircraft should not be based at the airport.

16. **Public agency.** A State or political subdivision of a State, a tax-supported organization, or an Indian tribe or pueblo (49 U.S.C. § 47102(19)).

17. **Public airport.** An airport used or intended to be used for public purposes that is under the control of a public agency; and of which the area used or intended to be used for landing, taking off, or surface maneuvering of aircraft is publicly owned (49 U.S.C. § 47102(20)).

18. **Public-use airport.** An airport used or intended to be used for public purposes, and of which the area used or intended to be used for landing, taking off, or surface maneuvering of aircraft may be under the control of a public agency or privately owned and used for public purposes (49 U.S.C. § 47102(21)).

19. **Putrescible waste.** Solid waste that contains organic matter capable of being decomposed by micro-organisms and of such a character and proportion as to be capable of attracting or providing food for birds (40 CFR §257.3-8).

20. **Putrescible-waste disposal operation.** Landfills, garbage dumps, underwater waste discharges, or similar facilities where activities include processing, burying, storing, or otherwise disposing of putrescible material, trash, and refuse.

21. **Retention ponds.** Storm water management ponds that hold water for several months.

22. **Runway protection zone (RPZ).** An area off the runway end to enhance the protection of people and property on the ground (see AC 150/5300-13). The dimensions of this zone vary with the airport design, aircraft, type of operation, and visibility minimum.

23. **Scheduled air carrier operation.** Any common carriage passenger-carrying operation for compensation or hire conducted by an air carrier or commercial

operator for which the air carrier, commercial operator, or their representative offers in advance the departure location, departure time, and arrival location. It does not include any operation that is conducted as a supplemental operation under 14 CFR Part 119 or as a public charter operation under 14 CFR Part 380 (14 CFR § 119.3).

24. Sewage sludge. Any solid, semi-solid, or liquid residue generated during the treatment of domestic sewage in a treatment works. Sewage sludge includes, but is not limited to, domestic septage; scum or solids removed in primary, secondary, or advanced wastewater treatment process; and a material derived from sewage sludge. Sewage does not include ash generated during the firing of sewage sludge in a sewage sludge incinerator or grit and screenings generated during preliminary treatment of domestic sewage in a treatment works. (40 CFR 257.2)

25. Sludge. Any solid, semi-solid, or liquid waste generated form a municipal, commercial or industrial wastewater treatment plant, water supply treatment plant, or air pollution control facility or any other such waste having similar characteristics and effect. (40 CFR 257.2)

26. Solid waste. Any garbage, refuse, sludge, from a waste treatment plant, water supply treatment plant or air pollution control facility and other discarded material, including, solid liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities, but does not include solid or dissolved materials in domestic sewage, or solid or dissolved material in irrigation return flows or industrial discharges which are point sources subject to permits under section 402 of the Federal Water Pollution Control Act, as amended (86 Stat. 880), or source, special nuclear, or by product material as defined by the Atomic Energy Act of 1954, as amended, (68 Stat. 923). (40 CFR 257.2)

27. Turbine-powered aircraft. Aircraft powered by turbine engines including turbojets and turboprops but excluding turbo-shaft rotary-wing aircraft.

28. Turbine-use airport. Any airport that sells Jet-A fuel for fixed-wing turbine-powered aircraft.

29. Wastewater treatment facility. Any devices and/or systems used to store, treat, recycle, or reclaim municipal sewage or liquid industrial wastes, including Publicly Owned Treatment Works (POTW), as defined by Section 212 of the Federal Water Pollution Control Act (P.L. 92-500) as amended by the Clean Water Act of 1977 (P.L. 95-576) and the Water Quality Act of 1987 (P.L. 100-4). This definition includes any pretreatment involving the reduction of the amount of pollutants, the elimination of pollutants, or the alteration of the nature of pollutant properties in wastewater prior to or in lieu of discharging or otherwise introducing such pollutants into a POTW. (See 40 CFR Section 403.3 (q), (r), & (s)).

30. Wildlife. Any wild animal, including without limitation any wild mammal, bird, reptile, fish, amphibian, mollusk, crustacean, arthropod, coelenterate, or other invertebrate, including any part, product, egg, or offspring thereof (50 CFR 10.12, *Taking, Possession, Transportation, Sale, Purchase, Barter, Exportation, and Importation of Wildlife and Plants*). As used in this AC, wildlife includes feral animals and domestic animals out of the control of their owners (14 CFR Part 139, Certification of Airports).

31. Wildlife attractants. Any human-made structure, land-use practice, or human-made or natural geographic feature that can attract or sustain hazardous wildlife within the landing or departure airspace or the airport's AOA. These attractants can include architectural features, landscaping, waste disposal sites, wastewater treatment facilities, agricultural or aquaculture activities, surface mining, or wetlands.

32. Wildlife hazard. A potential for a damaging aircraft collision with wildlife on or near an airport.

33. Wildlife strike. A wildlife strike is deemed to have occurred when:

a. A pilot reports striking 1 or more birds or other wildlife;

b. Aircraft maintenance personnel identify aircraft damage as having been caused by a wildlife strike;

c. Personnel on the ground report seeing an aircraft strike 1 or more birds or other wildlife;

d. Bird or other wildlife remains, whether in whole or in part, are found within 200 feet of a runway centerline, unless another reason for the animal's death is identified;

e. The animal's presence on the airport had a significant negative effect on a flight (i.e., aborted takeoff, aborted landing, high-speed emergency stop, aircraft left pavement area to avoid collision with animal) (Transport Canada, Airports Group, *Wildlife Control Procedures Manual*, Technical Publication 11500E, 1994).

2. RESERVED.

U.S. Department
of Transportation

**Federal Aviation
Administration**

Advisory Circular

Subject: CONSTRUCTION OR ESTABLISHMENT OF LANDFILLS NEAR PUBLIC AIRPORTS

Date: January 26, 2006
Initiated by: AAS-300

AC No: 150/5200-34A
Change:

1. Purpose.

This advisory circular (AC) contains guidance on complying with Federal statutory requirements regarding the construction or establishment of landfills near public airports.

2. Application.

The guidance contained in the AC is provided by the Federal Aviation Administration (FAA) for use by persons considering the construction or establishment of a new municipal solid waste landfill (MSWLF) near a public airport. Guidance contained herein should be used to comply with MSWLF site limitations contained in 49 U.S.C. § 44718(d), as amended by section 503 of the Wendell H. Ford Aviation Investment and Reform Act for the 21^{st} Century, Pub. L. No. 106-181 (April 5, 2000), "Structures interfering with air commerce." In accordance with § 44718(d), as amended, these site limitations are not applicable in the State of Alaska.

In addition, this AC provides guidance for a state aviation agency desiring to petition the FAA for an exemption from the requirements of § 44718(d), as amended.

3. Cancellation

This AC cancels AC 150/52300-34, *Construction or Establishment of Landfills Near Public Airports*, dated August 8, 2000.

This revision contains no substantive changes to the original. Changes include revised and new website addresses, revised strike statistics, and regulation titles.

4. Related Reading Materials.

AC - 150/5200-33, *Hazardous Wildlife Attractions On or Near Airports*.

Wildlife Strikes to Civil Aircraft in the United States. FAA Wildlife Aircraft Strike Database Serial Reports.

Report to Congress: *Potential Hazards to Aircraft by Locating Waste Disposal Sites in the Vicinity of Airports,* April 1996, DOT/FAA/AS/96-1.

Title 14, Code of Federal Regulation, Part 139, Certification of Airports.

Title 40, Code of Federal Regulation, Part 258, Municipal Solid Waste Landfill Criteria.

Some of these documents and additional information on wildlife management, including guidance on landfills, are available on the FAA's Airports web site at http://www.faa.gov/airports_airtraffic/airports/ or http://wildlife-mitigation.tc.faa.gov

5. Definitions.

Definitions for the specific purpose of this AC are found in Appendix 1.

6. Background.

The FAA has the broad authority to regulate and develop civil aviation under the Federal Aviation Act of 1958, 49 U.S.C. § 40101, et. seq., and other Federal law. In section 1220 of the Federal Aviation Reauthorization Act of 1996, Pub. L. No. 104-264 (October 9, 1996), the Congress added a new provision, section (d), to 49 U.S.C. § 44718 to be enforced by the FAA and placing limitations on the construction or establishment of landfills near public airports for the purposes of enhancing aviation safety. Section 503 of the Wendell H. Ford Aviation Investment and Reform Act for the 21st Century (AIR-21), Pub. L. No. 106-181 (April 5, 2000) replaced section 1220 of the 1996 Reauthorization Act, 49 U.S.C. § 44718 (d), with new language. Specifically, the new provision, § 44718(d), as amended, was enacted to further limit the construction or establishment of a municipal solid waste landfill (MSWLF) near certain smaller public airports.

In enacting this legislation, Congress expressed concern that a MSWLF sited near an airport poses a potential hazard to aircraft operations because such a waste facility attracts birds. Statistics support the fact that bird strikes pose a real danger to aircraft. An estimated 87 percent of the collisions between wildlife and civil aircraft occurred on or near airports when aircraft are below 2,000 feet above ground level (AGL). Collisions with wildlife at these altitudes are especially dangerous as aircraft pilots have minimal time to recover from such emergencies.

The FAA National Wildlife Aircraft Strike Database shows that more than 59,000 civil aircraft sustained reported strikes with wildlife from 1990 to 2004. Between 1990-2004, aircraft-wildlife strikes involving U. S. civil aircraft resulted in over $495 million/year worth of aircraft damage and associated losses and over 631,000 hours/year of aircraft down time.

From 1990 to 2004, waterfowl, gulls and raptors were involved in 77% of the 3,493 reported damaging aircraft-wildlife strikes where the bird was identified. Populations of Canada geese and many species of gulls and raptors have increased markedly over the last several years. Further, gulls and Canada geese have adapted to urban and suburban environments and, along with raptors and turkey vultures, are commonly found feeding or loafing on or near landfills.

In light of increasing bird populations and aircraft operations, the FAA believes locating landfills in proximity to airports increases the risk of collisions between birds and aircraft. To address this concern, the FAA issued AC 150/5200-33, *Hazardous Wildlife Attractions On or Near Airports*, to provide airport operators and aviation planners with guidance on minimizing wildlife attractants. AC 150/5200-33 recommends against locating municipal solid waste landfills within five statute miles of an airport if the landfill may cause hazardous wildlife to move into or through the airport's approach or departure airspace.

7. General.

Using guidance provided in the following sections, persons considering construction or establishment of a landfill should first determine if the proposed facility meets the definition of a new MSWLF (see Appendix 1). Section 44718(d), as amended, applies only to a new MSWLF. It does not apply to the expansion or modification of an existing MSWLF, and does not apply in the State of Alaska. If the proposed landfill meets the definition of a new MSWLF, its proximity to certain public airports (meeting the criteria specified in Paragraph 8 below) should be determined. If it is determined that a new MSWLF would be located within six miles of such a public airport, then either the MSWLF should be planned for an alternate location more than 6 miles from the airport, or the MSWLF proponent should request the appropriate State aviation agency to file a petition for an exemption from the statutory restriction.

In addition to the requirements of § 44718(d), existing landfill restrictions contained in AC 150/5200-33, *Hazardous Wildlife Attractions On or Near Airports* (see Paragraph 5, Background) also may be applicable. Airport operators that have accepted Federal funds have obligations under Federal grant assurances to operate their facilities in safe manner and must comply with standards prescribed in advisory circulars, including landfill site limitations contained in AC 150/5200-33.

8. Landfills Covered by the Statute.

The limitations of § 44718(d), as amended, only apply to a new MSWLF (constructed or established after April 5, 2000). The statutory limitations are not applicable where construction or establishment of a MSWLF began on or before April 5, 2000, or to an existing MSWLF (received putrescible waste on or before April 5, 2000). Further, an existing MSWLF that is expanded or modified after April 5, 2000, would not be held to the limitations of § 44718(d), as amended.

9. Airports Covered by the Statute.

The statutory limitations restricting the location of a new MSWLF near an airport apply to only those airports that are recipients of Federal grants (under the Airport and Airway Improvement Act of 1982, as amended, 49 U.S.C. § 47101, *et se*q.) and primarily serve general aviation aircraft and scheduled air carrier operations using aircraft with less than 60 passenger seats.

While the FAA does not classify airports precisely in this manner, the FAA does categorize airports by the type of aircraft operations served and number of annual passenger enplanements. In particular, the FAA categorizes public airports that serve air carrier operations. These airports are known as commercial service airports, and receive scheduled passenger service and have 2,500 or more enplaned passengers per year.

One sub-category of commercial service airports, nonhub primary airports, closely matches the statute requirement. Nonhub primary airports are defined as commercial service airports that enplane less than 0.05 percent of all commercial passenger enplanements (0.05 percent equated to 352,748 enplanements in 2004) but more than 10,000 annual enplanements. While these enplanements consist of both large and small air carrier operations, most are conducted in aircraft with less than 60 seats. These airports also are heavily used by general aviation aircraft, with an average of 81 based aircraft per nonhub primary airport.

In addition, the FAA categorizes airports that enplane 2,500 to 10,000 passengers annually as non-primary commercial service airports, and those airports that enplane 2,500 or less passengers annually as general aviation airports. Both types of airports are mainly used by general aviation but in some instances, they have annual enplanements that consist of scheduled air carrier operations conducted in aircraft with less than 60 seats. Of the non-primary commercial service airports and general aviation airports, only those that have scheduled air carrier operations conducted in aircraft with less than 60 seats would be covered by the statute. The statute does not apply to those airports that serve only general aviation aircraft operations.

To comply with the intent of the statute, the FAA has identified those airports classified as nonhub primary, non-primary commercial service and general aviation airports that:

1. Are recipients of Federal grant under 49 U.S.C. § 47101, et. seq.;

2. Are under control of a public agency;

3. Serve scheduled air carrier operations conducted in aircraft with less than 60 seats; and

4. Have total annual enplanements consisting of at least 51% of scheduled air carrier enplanements conducted in aircraft with less than 60 passenger seats.

Persons considering construction or establishment of a new MSWLF should contact the FAA to determine if an airport within six statute miles of the new MSWLF meets these criteria (see paragraph 11 below for information on contacting the FAA). If the FAA determines the airport does meet these criteria, then § 44718(d), as amended, is applicable.

An in-depth explanation of how the FAA collects and categorizes airport data is available in the FAA's National Plan of Integrated Airport Systems (NPIAS). This report and a list of airports classified as nonhub primary, non-primary commercial service and general aviation airports (and associated enplanement data) are available on the FAA's Airports web site at http://www.faa.gov/airports_airtraffic/airports/planning_capacity/.

10. Separation distance measurements.

Section 44718(d), as amended, requires a minimum separation distance of six statute miles between a new MSWLF and a public airport. In determining this distance separation, measurements should be made from the closest point of the airport property boundary to the closest point of the MSWLF property boundary. Measurements can be made from a perimeter fence if the fence is co-located, or within close proximity to, property boundaries. It is the responsibility of the new MSWLF proponent to determine the separation distance.

11. Exemption Process.

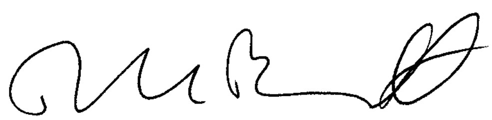
Under § 44718(d), as amended, the FAA Administrator may approve an exemption from the statute's landfill location limitations. Section 44718(d), as amended, permits the aviation agency of the state in which the airport is located to request such an exemption from the FAA Administrator. Any person desiring such an exemption should contact the aviation agency in the state in which the affected airport is located. A list of state aviation agencies and contact information is available at the National Association of State Aviation Officials (NASAO) web site at www.nasao.org or by calling NASAO at (301) 588-1286.

A state aviation agency that desires to petition the FAA for an exemption should notify the Regional Airports Division Manager, in writing, at least 60 days prior to the construction of a MSWLF. The petition should explain the nature and extent of relief sought, and contain information, documentation, views, or arguments that demonstrate that an exemption from the statute would not have an adverse impact on aviation safety. Information on contacting FAA Regional Airports Division Managers can be found on the FAA's web site at www.faa.gov.

After considering all relevant material presented, the Regional Airports Division Manager will notify the state agency within 30 days whether the request for exemption has been approved or denied. The FAA may approve a request for an exemption if it is determined that such an exemption would have no adverse impact on aviation safety.

12. Information.

For further information, please contact the FAA's Office of Airport Safety and Standards, Airport Safety and Operations Division, at (800) 842-8736, Ext. 7-3085 or via email at WebmasterARP@faa.gov. Any information, documents and reports that are available on the FAA web site also can be obtained by calling the toll-free telephone number listed above.



DAVID L. BENNETT
Director, Office of Airport Safety and Standards

APPENDIX 1. DEFINITIONS.

The following are definitions for the specific purpose of this advisory circular.

Construct a municipal solid waste landfill (MSWLF) means excavate or grade land, or raise structures, to prepare a municipal solid waste landfill as permitted by the appropriate regulatory or permitting authority.

Establish a municipal solid waste landfill (MSWLF) means receive the first load of putrescible waste on site for placement in a prepared municipal solid waste landfill.

Existing municipal solid waste landfill (MSWLF) means a municipal solid waste landfill that received putrescible waste on or before April 5, 2000.

General aviation aircraft means any civil aviation aircraft not operating under 14 CFR Part 119, Certification: Air carriers and commercial operators.

Municipal solid waste landfill (MSWLF) means publicly or privately owned discrete area of land or an excavation that receives household waste, and that is not a land application unit, surface impoundment, injection well, or waste pile, as those terms are defined under 40 CFR § 257.2. A MSWLF may receive other types of RCRA subtitle D wastes, such as commercial solid waste, nonhazardous sludge, small quantity generator waste and industrial solid waste, as defined under 40 CFR § 258.2. A MSWLF may consist of either a standalone unit or several cells that receive household waste.

New municipal solid waste landfill (MSWLF) means a municipal solid waste landfill that was established or constructed after April 5, 2000.

Person(s) means an individual, firm, partnership, corporation, company, association, joint-stock association, or governmental entity. It includes a trustee, receiver, assignee, or similar representative of any of them (14 CFR Part 1).

Public agency means a State or political subdivision of a State; a tax-supported organization; or an Indian tribe or pueblo (49 U.S.C. § 47102(15)).

Public airport means an airport used or intended to be used for public purposes that is under the control of a public agency; and of which the area used or intended to be used for landing, taking off, or surface maneuvering of aircraft is publicly owned (49 U.S.C. § 47102(16)).

Putrescible waste means solid waste which contains organic matter capable of being decomposed by micro-organisms and of such a character and proportion as to be capable of attracting or providing food for birds (40 CFR § 257.3-8).

Scheduled air carrier operation means any common carriage passenger-carrying operation for compensation or hire conducted by an air carrier or commercial operator for which the air carrier, commercial operator, or their representatives offers in advance the departure location, departure time, and arrival location. It does not include any operation that is conducted as a supplemental operation under 14 CFR Part 119, or is conducted as a public charter operation under 14 CFR Part 380 (14 CFR § 119.3).

Solid waste means any garbage, or refuse, sludge from a wastewater treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, including solid, liquid, semi-solid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities, but does not include solid or dissolved materials in domestic sewage, or solid or dissolved materials in irrigation return flows or industrial discharges that are point sources subject to permit under 33 U.S.C. § 1342, or source, special nuclear, or by-product material as defined by the Atomic Energy Act of 1954, as amended (68 Stat. 923) (40 CFR § 258.2).

Appendix A-4:

Meeting Notes
September 7, 2010 Meeting with
St. Louis Airport Authority

Summary of Airport Meeting

On September 7, 2010, representatives of Bridgeton Landfill LLC and the Environmental Protection Agency met with representatives of the St. Louis Airport Authority. The following persons attended the meeting:

Mario Pandolfo, legal services manager for the City of St. Louis/Lambert Airport
Joletta Golik, environment/health & safety manager for Lambert Airport
Robert C. Alexander, Jr., US Dept. of Agriculture/APHIS/Wildlife Services
Bill Beck, outside counsel (Lathrop & Gage) on behalf of Bridgeton Landfill
Dan Gravatt, EPA Region 7
Cheryle Micinski, EPA Region 7
David Vasbinder, environmental health & safety for Bridgeton Landfill
Jessie Merrigan, outside counsel (Lathrop & Gage) for Bridgeton Landfill
Kate Whitby, local counsel (Spencer Fane) for Bridgeton Landfill
Joseph Nassif, outside counsel (Husch Blackwell) for the Airport
Gerard Slay, Senior Deputy Director/COO, St. Louis Airport Authority

The meeting was requested by EPA to follow up on concerns raised by the PRPs that the Negative Easement recorded on the property would prohibit construction of the "on-site cell" evaluated as part of the Supplemental Feasibility Study.

Cheryle Micinski provided background on the site and the administrative process to date. Dan Gravatt provided a summary of the alternatives considered in the SFS – the ROD remedy; full excavation and disposal of all radiologically-contaminated materials off-site; and full excavation and disposal of all radiologically-contaminated materials in a new on-site cell.

Outside counsel for the Airport raised multiple questions about the logistics of an excavation remedy and any efforts thus far to estimate the risks created by such a remedy. He then stopped the discussion to state that the Airport could not accept the significant risks that would be created by an excavation remedy – either for on-site or off-site disposal.

The Airport representatives passed around (but did not provide copies of) a document displaying the actual flight paths used by aircraft at the Airport. This diagram showed multiple flight patterns extending directly over the Landfill. The Airport representatives also mentioned statistics indicating a significant decrease in bird strikes since the 2005 closure of the sanitary landfill at the site.

Senior Deputy Director Gerard Slay stated that use of the rail loading facility located at the Airport (as presumed by the SFS for the excavation and off-site disposal alternative) would not work for the Airport.

Airport representatives, including USDA, also stated that an excavation remedy would create risks that they could not even calculate, and that monitoring and management of risks created by wildlife would be impossible. They noted that under the ROD remedy the site will present no risk to human health or the environment, and said that creating new risks by implementing an excavation remedy did not seem advisable.

The representative for USDA noted that he investigated multiple wildlife vectors during the investigation and study processes for the SLAPS and Weldon Springs sites, including not only birds but other wildlife which might remove and ingest or otherwise disperse radiological materials made accessible by an excavation remedy. He suggested that the same issues would be problematic at West Lake.

The Airport representatives stated that while they would expect any damages (to aircraft, etc.) to be paid for by EPA or the PRPs, the risks of a bird strike or other adverse impacts on the Airport would still be unacceptable. They stated that this would necessitate FAA review of either an on-site or off-site excavation remedy and likely would result in objections from airlines as well as the FAA. The Airport representatives were particularly concerned that either excavation alternative would take years to perform.

Cheryle Micinski asked whether the Airport's concerns would be alleviated by excavation of only Area 2 (outside the 10,000 foot range). The unanimous response was no. They stated that the entire area is within the Negative Easement and subject to FAA review if "new landfilling operations" were to occur. In particular, they explained that construction of an on-site disposal cell would not qualify as an expansion or change to an existing landfill, but would instead constitute "new operations" at the site and therefore would trigger FAA review. They also could not predict the changes that any excavation activities would cause to the migratory patterns of birds using the site, and could not take the risk that such changes would increase the local bird population.

In 2006 the Airport submitted a comment letter in support of the ROD remedy. While the Airport representatives believe that this letter still accurately states their position, the Airport's outside counsel indicated that he wants to revisit the possible exposure of MSW waste during any regrading or contouring activities under the ROD Remedy.

The Airport representatives concluded the meeting by indicating that their attendees were unanimous in viewing any excavation remedy for the site as unwarranted and unacceptable to the Airport because of the increased risks to aircraft that would be created by such a remedy.

EPA asked that the Airport confirm this view in writing. The Airport representatives stated that they would provide a letter outlining their concerns about the risks created by an excavation remedy and the regulatory and other barriers which would impact such a remedy. They indicated that they would try to send such a letter to EPA prior to the September 22nd technical meeting.

The Airport representatives emphasized that while they work hard to cooperate with EPA, they could not accept the known and significant risks that an excavation remedy would cause to airport operations.

EPA asked the USDA representative for a similar letter confirming USDA's concerns in writing, and he said that he did not have counsel for this project, but would attempt to get such a letter prepared.

Appendix A-5:

St. Louis Airport Authority
September 20, 2010 Letter

Rhonda Hamm-Niebruegge
Director

LAMBERT-ST. LOUIS INTERNATIONAL AIRPORT®

City of St. Louis Airport Authority

P.O. BOX 10212 • ST. LOUIS, MISSOURI 63145-0212 • U.S.A.
TELEPHONE: (314) 426-8000 • WEBSITE. www.flystl.com

Francis G. Slay
Mayor
City of St. Louis

September 20, 2010

Mr. Daniel Gravatt
Project Manager/Environmental Scientist
U.S. EPA – Region 7
901 North 5th Street
Kansas City, Kansas 66101

Re: West Lake Landfill: Comments on Work Plan for Supplemental Feasibility Study

Dear Mr. Gravatt:

As requested, the City of St. Louis ("the City"), the owner and operator of Lambert-St. Louis International Airport® ("Airport") has reviewed the June 4, 2010 Work Plan for Supplemental Feasibility Study Radiological-Impacted Material Excavation Alternatives Analysis: West Lake Landfill Operable Unit-1 ("Work Plan"). The City supports the Environmental Protection Agency's ("EPA") evaluation of remedial alternatives to address radiologically contaminated materials located at the West Lake Landfill (formerly known as the Bridgeton Landfill). The City takes seriously the presence of radioactive materials at the West Lake Landfill and the long term impact those radioactive materials may have on water resources. The City urges EPA to select a remedy for the cleanup of the West Lake Landfill radioactive wastes that is practical and ensures that these wastes no longer pose a threat to human health and the environment. However, the City must ensure that any action involving the West Lake Landfill does not unnecessarily jeopardize the City's public safety obligations with respect to Airport and its operations.

The Federal Aviation Administration ("FAA") and United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services ("USDA") previously determined that the West Lake Landfill was a hazardous wildlife attractant for the Airport. _See_ June 2004 Lambert – St. Louis International Airport Wildlife Hazard Assessment for the Bridgeton Sanitary Landfill. The West Lake Landfill is located, at its closest point, within approximately 9,166 feet of Airport Runway 11/29 (formerly 12W/30W), which is inconsistent with FAA runway siting guideline requiring a 10,000 foot separation radius. _See_ FAA Advisory Circular 150/5200 33B (Hazardous Wildlife Attractants on or near Airports). The FAA, in a September 1998 Record of

Decision ("1998 FAA ROD") concerning expanded operations at the Airport, directed the City to mitigate the West Lake Landfill to protect aircraft from bird strikes at the Airport. *See* September 30, 1998 FAA Record of Decision: Lambert-St. Louis International Airport, pg. 42 - 43. Pursuant to the requirements of the 1998 FAA ROD, the City entered into the Negative Easement Agreement ("NEA") with the Bridgeton Landfill operators, at significant cost, to prohibit depositing or dumping of new or additional putrescible waste on the entirety of the property after August 1, 2005, and to require the landfill operators to comply with laws and regulations concerning proper landfill cover, so as to reduce or mitigate wildlife hazards to aircraft and airport facilities. *See* Negative Easement Agreement at pg. 2 – 3. The restrictive covenants in the NEA for the Bridgeton Landfill, along with other FAA required programs, have successfully mitigated aircraft bird strikes at the Airport, and particularly runway 11/29 (formerly 12W/30W). *See* Lambert St. Louis International Airport 2005 – 2010 Bird Strike Report Summary. Although these FAA restrictions and requirements may be mentioned as guidance in the feasibility study undertaken at the insistence of EPA, we are informed that these restrictions should be considered applicable or relevant and appropriate requirements for remedy selection purposes.

After consultation with Airport engineers and USDA Wildlife Services staff, the City believes that the excavation alternatives described in the Work Plan would adversely affect wildlife mitigation measures taken by the Airport to protect aircraft from bird strikes; thereby placing the City in violation of the 1998 FAA ROD requiring that such mitigation efforts be undertaken and maintained. In addition, such action on the part of the former landfill operators would violate the NEA. The primary issue here is aircraft and passenger safety. Bird studies conducted by the USDA have identified 11 of the top 15 most hazardous bird species to aircraft (damage and effect on flight) at the West Lake Landfill and surrounding areas. Many of these bird species, which include vultures, geese, hawks, gulls, owls and pigeons, have been reported in the approximately 600+ bird strike incidents that have occurred at the Airport since the 1990s. The USDA Wildlife Service has advised the City that uncovered radiologically impacted municipal waste at the West Lake Landfill will serve as a food attractant for a variety of bird species and increase the risk of bird/aircraft strikes at the Airport. *See* September 17, 2010 USDA letter to the Airport.

The Work Plan contemplates that municipal waste in the landfill will be removed by excavation and disposed on the property during the creation of the on-site engineered disposal cell, in direct violation of Paragraph 1 of the NEA. Further, the radioactive municipal waste materials will remain exposed at the site throughout the duration of excavation and landfill activities without a daily cover, which is in violation of Missouri Solid Waste Regulation 10 CSR 80-3 (17)(C)(1) and Paragraph 2 of the NEA. Moreover, based on anticipated waste volumes and available funding, the response action contemplated in the Work Plan would, rationally speaking, appear to be a ten to twenty year effort. The FAA considers any facility handling uncovered quantities of municipal solid waste outside, even if only for a short time, incompatible with safe airport operations if they are located within a 10,000 foot radius of an active airport runway. *See* FAA Advisory Circular 150/5200 33B (Hazardous Wildlife Attractants On or Near

Airports) at pg. 4, § 2 – 2. Thus, the presence of uncovered municipal solid waste at the West Lake Landfill may place the City in violation of 1998 FAA ROD. The Work Plan does not explain how the Respondents/Operators will comply with the terms of the NEA or Missouri Solid Waste Regulation daily landfill soil cover requirements during excavation and transport of contaminated municipal solid waste from the landfill. Any remediation objective selected by EPA for the West Lake Landfill must ensure that the remediation activities do not create a wildlife attractant that presents an intolerable risk of aircraft bird strikes at the Airport.

The excavation, movement and transportation of radiologically impacted municipal waste required during the response action at the West Lake Landfill is consistent with the characteristics of an operational solid waste landfill, as described in the Missouri Solid Waste Regulations. As a result, certain operational requirements (i.e. daily cover and surface water management) and landfill site selection standards (i.e. airport safety, flood plains, wetlands, seismic impact zones and unstable areas) will apply to the excavation alternatives described in the Work Plan. See 10 CSR 80-3.010 (4)(B)(1 – 6); 10 CSR 80-3.010(1)(C) (classifying non-compliant sanitary landfills as open dumps that are prohibited by law).

Missouri Solid Waste Regulations prohibit landfill operations within a 10,000 foot (3,048 meters) radius of any airport runway end used by turbojet aircraft unless the operators can demonstrate that the landfill operations pose no bird hazard to aircraft. See 10 CSR §80-3 (Sanitary Landfill). The Respondents/Operators must demonstrate the remediation activities at the Bridgeton Landfill, portions of which are located within a 10,000 foot radius of the Airport's runway 11/29, do not pose a hazard to aircraft using the Airport's facilities; or at the very least, do not increase the likelihood of bird/aircraft collisions. See Lambert – St. Louis International Airport Expansion Runway to Landfill Distance Study. It is very likely that the excavation and disposal alternatives contemplated in the Work Plan will disrupt the wildlife mitigation efforts undertaken by the City pursuant to the 1998 FAA ROD, and increase the likelihood of bird/aircraft collisions at the Airport. FAA Advisory Circular 150/5200 – 33B suggests that Respondents/Operators will not be able to mitigate the risk of wildlife strikes to aircraft during excavation and disposal activities at the Bridgeton/West Lake Landfill; as no facility has been able to demonstrate an ability to reduce and sustain hazardous wildlife to levels that existed before the putrescible–waste landfill began operating. See Hazardous Wildlife Attractants On or Near Airports - Advisory Circular 150/5200 – 33B. In fact, FAA does not even allow landfill operators to conduct demonstrations of experimental wildlife control measures within a 10,000 foot radius of an airport because of this perfect failure rate. Id. Thus, it seems that the Respondents/Operators will not be able to demonstrate that excavation and landfill activities at the Bridgeton/West Lake Landfill do not pose a threat to aviation operations at the Airport, particularly since the FAA /USDA have already determined that the municipal waste operations at the Bridgeton/West Lake Landfill are a hazardous wildlife attractant for the Airport. See

June 2004 Lambert – St. Louis International Airport Wildlife Hazard Assessment for the Bridgeton Sanitary Landfill.[1]

Missouri Solid Waste Regulations also require all operating solid waste disposal sites to cover "disposed solid waste with six inches of earthen material at the end of each operating day, or at more frequent intervals, as necessary, to control disease vectors, fires, odors, blowing litter and scavenging . . .". See 10 CSR 80-3 (17)(C)(1). Missouri's Solid Waste Regulations should be applicable to the remediation activities contemplated at the West Lake Landfill, which consist of exposing municipal/putrescible waste that may attract wildlife, disease vectors, blowing liter and risks of fire. The risk of creating a wildlife attractant near the Airport mandates that Respondents/Operators comply with Missouri daily landfill cover requirements during any excavation or disposal activities at the West Lake Landfill. The necessity of compliance with 10 CSR 80-3(17) may further complicate the remediation objectives by creating additional quantities of radiologically contaminated soils for disposal and increase cost and duration estimates contemplated under the Work Plan. However, any failure to comply with the daily cover requirements would create an unacceptable risk to aviation operations at the Airport. The lack of daily cover would also contribute to the distribution of low level radioactive contamination throughout the site by allowing surface waters to come in contact with uncovered radiologically contaminated municipal waste material, and possibly air blown dust, without adequate controls. Missouri Solid Waste Regulations require all active solid waste disposal sites to minimize environmental hazards and conform to applicable ground and surface water quality standards. See 10 CSR 80-3 (8). The Work Plan does not explain how the Respondents/Operator's will manage daily landfill cover requirement, or the surface waters and wind blown dust that come into contact with radiologically-impacted waste materials exposed during remediation activities.

The City is also concerned that Respondents/Operators have not identified a viable disposal location for the radiologically-impacted municipal wastes and soils that will be excavated from the West Lake Landfill. The proposed on-site engineered disposal cell location (OU-2 Stockpile Area) is not an appropriate site for long term storage of the radiologically impacted waste due to regulatory and capacity restrictions, and there is no licensed treatment, storage or disposal facility that may accept a mixture of radiologically impacted soils and municipal waste. The Work Plan indicates that the existing OU-2 Stockpile Area is the only location on the West Lake Landfill property that the on-site engineered disposal cell may be sited due to the geomorphic flood plain. However, this location, approximately 8,000 feet from the Airport, is incompatible with

[1] Similar to the Missouri solid waste regulations, the Missouri legislature specifically promulgated legally applicable requirements prohibiting the creation or establishment of airport hazards within 2 miles (10,560 feet) from an airport boundary. See Mo. Rev. Stat. § 305 (Aircraft and Airports). Local regulations further prohibit the use of land or water near the Lambert – St. Louis International Airport in such a manner as to create bird strike hazards, or otherwise in any way endanger or interfere with the landing, takeoff, or maneuvering of any aircraft intending to use the airport. See St. Louis County, Missouri Ordinance 1003.161 (Air Navigation Space Regulations – including height restrictions for structures near the Airport). To the extent remediation activities at the Bridgeton Landfill present a risk of bird/aircraft strikes, such activities are contrary to the interests of public health, safety and general welfare; and a violation of Missouri zoning laws.

state and federal regulations that prohibit the placement of a new solid waste disposal site within a 10,000 foot radius of an active runway, with one statute requiring a minimum separation 6 miles between the airport and a new disposal location. *See* 40 CFR §258.10 (Airport Safety); 40 CFR §258.16 (Closure of Unsafe Landfills); 10 CSR §80-3 (Sanitary Landfill); 49 USC 44718 (Structures Interfering with Air Commerce); FAA Advisory Circular 150/5200 – 34A (Construction or Establishment of Landfills Near Public Airports), *see also*, Negative Easement Agreement. Furthermore, it is not clear that the OU-2 Stockpile Area could accommodate the quantity of radiologically impacted waste (also unknown) that will be excavated from Radiological Areas 1 and 2, which would include additional quantities of contaminated landfill cover material generated on a daily basis. The process of selecting and evaluating a location for the on-site engineered disposal cell must comply with state and federal landfill siting requirements; but sets forth no methodology to address the direct prohibition against placement of a new landfill disposal site within a 10,000 foot radius of an active airport runway.

The EPA Responsiveness Summary and Work Plan also indicate that Respondents/Operators are aware of no licensed treatment, storage or disposal facility that can accept radiologically impacted soils and municipal solid waste; and there are no feasible methods of separating contaminated soils from municipal waste without creating additional unnecessary risks of harm to human health or the environment.

As a final comment, we respect the possibility, however unlikely, that the Earth City Levee System, which protects the area from a 500 year flood event, might be breached and flood waters might cover the current landfill site. However, when the City last reviewed EPA's prior selected remedy, it learned that such a circumstance would have little if any environmental significance in light of steps that would be taken to further cap the existing site under EPA Preferred Alternatives L4/F4. Recognizing that EPA must deal with possibilities and weigh their likelihood at times, the reality is that bird strikes happen at the Airport, even with the current reduction in attractant sites and mitigation measures. No one wants to be in the position of trading risks associated with an unlikelihood or theoretical possibility for reality. Any balancing of risks must take reality into account.

The City reserves the right to amend or provide additional comments concerning the proposed remediation activities at the West Lake Landfill. The City also requests that EPA and/or Respondents provide regular updates concerning their progress toward selecting a remedy for the West Lake Landfill.

Respectfully submitted,

Rhonda Hamm-Niebruegge

Rhonda Hamm-Niebruegge
Director of Airports

APPENDIX B:

Identification and Quantification of the Volume of RIM Above Cleanup Levels

Appendix B-1:

Identification of Occurrences of RIM Above Cleanup Levels

APPENDIX B-1

IDENTIFICATION OF RADIOLOGICALLY-IMPACTED MATERIAL THAT EXCEEDS THE CLEANUP CRITERIA

1 INTRODUCTION

An estimate of the distribution and volume of radiologically-impacted materials (RIM) that exceed the cleanup criteria established by EPA for the “complete rad removal” alternatives (EPA, 2010a and 2010b) was required to develop a scope for the excavation and disposal activities associated with these alternatives. This memorandum describes the evaluations performed to identify locations within Radiological Areas 1 and 2 (Areas 1 and 2) of Operable Unit-1 (OU-1) of the West Lake Landfill Superfund Site where RIM occurrences at activity levels greater than cleanup levels specified by EPA are present.

2 SCOPE AND APPROACH USED TO IDENTIFY RIM ABOVE CLEANUP LEVELS

EPA’s Scope of Work (SOW) (EPA, 2010b) indicated that “complete rad removal” was defined to mean attainment of risk-based radiological cleanup levels specified in OSWER Directives 9200.4-25 and 9200.4-18 (EPA, 1998a and 1997). The radiological cleanup levels specified in OSWER directive 9200.4-25 are total radium 226 + 228 greater than 5 pCi/g (above background) and total thorium 230 + 232 greater than 5 pCi/g (above background). For purposes of performing the SFS for “complete rad removal” alternatives, a cleanup level of 50 pCi/g plus background was used for uranium based on the uranium remediation goal of 50 pCi/g established by EPA for the St. Louis Downtown Site (SLDS) (EPA, 1998b) and SLAPs (EPA, 2005). Additional discussion regarding the development of the cleanup levels is presented in Section 2.2.2 of the main text of this SFS Report and in the SFS Work Plan (EMSI, 2010).

Background data obtained as part of the Remedial Investigation (McLaren/Hart, 1996a and EMSI, 2000) was used to define background levels for each of the radionuclides (see discussion in Section 2.2.2 of the main text of this SFS and in the SFS Work Plan [EMSI, 2010]). The resultant cleanup are the sum of the representative background concentrations and the appropriate risk-based remediation concentrations listed in the OSWER directives; that is 5 pCi/g plus background.

Based on the site background values presented in the RI (EMSI, 2000) the following site cleanup values were identified:

- Radium-226+228 = 7.9 pCi/g
- Thorium-230+232 = 7.9 pCi/g
- Total uranium = 54.5 pCi/g

These cleanup values were used to identify the site soils that would be included with the scope of the "complete rad removal" alternatives.

The results of the laboratory analyses of soil samples obtained during prior investigations of OU-1 (RMC, 1982, NRC, 1988, McLaren/Hart, 1996a, and EMSI, 2000) were assembled, tabulated and reviewed to identify boring locations and depth intervals where RIM occurrences above the cleanup levels have previously been identified. Although the pre-RI data (RMC, 1982, NRC, 1988) were reviewed and where possible used as part of the evaluation of RIM occurrences above cleanup levels, use of these data was limited. With the exception of locations where poly-vinyl chloride (PVC) pipe had been installed during the pre-RI investigations that were subsequently located and surveyed by McLaren/Hart (1996a) during the RI investigations, detailed survey information is not available for the pre-RI soil borings. In addition, pre-RI soil samples were generally only analyzed for radium-226 and were not analyzed for the other radium isotopes. In addition, only a limited number of the pre-RI samples were analyzed for uranium-238 and none of the samples were analyzed for the other uranium isotopes. Furthermore, none of the pre-RI samples were analyses for thorium isotopes. Lastly, the pre-RI investigations did not obtain any soil samples for laboratory analyses from Area 1. Therefore, although the pre-RI data were reviewed and considered in these evaluations, the value in identifying locations where RIM above cleanup levels are presented was limited.

The results of the downhole gamma logging (McLaren/Hart, 1996a) were also used to define areas and depth intervals that likely contain soil with radionuclide levels above the cleanup levels. McLaren/Hart performed downhole gamma logging of the fifty RI soil borings and also logged all of the pre-RI, PVC-cased, soil borings that could be located at the site (McLaren/Hart, 1996a). The downhole gamma logs were visually reviewed and qualitatively evaluated to identify locations and depth intervals where soil containing radionuclides above the cleanup levels are expected to be present.

The results of the overland gamma survey (McLaren/Hart, 1996b) in the area of the borings were also reviewed to assess whether occurrences of elevated levels of radionuclide may be present at each of the soil boring locations. As described in Appendix A-2, the overland gamma survey results were also reviewed to define the lateral extent of RIM occurrences above cleanup levels as part of the quantification of the lateral extent and volume of RIM above cleanup levels.

The results of these evaluations were tabulated to identify the locations and depth intervals that contain, or are likely to contain, radionuclide occurrences above the stated cleanup levels.

3 IDENTIFICATION OF RIM ABOVE CLEANUP LEVELS

Figure 1 displays the locations of the RI soil borings (WL-designation) and the pre-RI NRC soil borings (PVC-designation) that could be located in Area 1 during performance of the RI field work. Tables 1 through 3 summarize the radium, thorium, and uranium isotope results obtained by the laboratory analyses of the soil samples collected from Area 1 during performance of the NRC and RI field investigations. The total radium-226 plus radium-228, thorium-230 plus thorium-232, and total uranium activity levels are also shown on these tables. The total vales were calculated by summing the results for the individual isotopes. For sample results with one or more of the isotopes reported as being less than the minimum detectable activity (MDA) value, a surrogate value of one-half the MDA value was used for these calculations.

Table 4 presents a summary of the highest (peak) summed totals of radium, thorium, and uranium at each soil boring location in Area 1 based on the data presented on Tables 1 through 3. Soil sample results from Area 1 that exceed the cleanup levels are shown in bold. In the event that more than one soil sample was obtained from a soil boring the highest values found in any of the soil samples obtained from that boring are provided on Table 1. In the event that soil samples from more than one depth interval contained total radionuclide levels greater than the cleanup criteria, both depth intervals are listed.

Table 4 also lists the peak values obtained from the downhole gamma logging performed in Area 1, the depth at which the peak reading occurred, and the top and bottom of the zone that was identified as having elevated gamma readings based on visual inspection of the downhole gamma logs.

Table 4 also contains a qualitative assessment of the visual inspection of the overland gamma survey results (Figure 2) relative to each soil boring location. Locations in Area 1 where the overland gamma results were elevated above background are listed on Table 4. As discussed above and further in Appendix A-2, the overland gamma survey results were also used to confirm or expand the lateral extent of RIM above cleanup levels defined based on the soil sample analytical data and downhole gamma logging results.

Intervals for which either the soil sample analytical results and/or the downhole gamma logging results indicate the presence, or potential presence, of RIM above cleanup levels are highlighted on Table 4. The upper and lower bounds and the calculated total thickness of the RIM occurrences at each boring location are also provided on Table 4. As described in Appendix A-2, this information was subsequently used to define the lateral and vertical extent of RIM above cleanup levels that forms the basis for the calculations of the volumes of RIM above cleanup levels in Area 1.

Similar evaluations were performed for Area 2. Figure 3 displays the locations of the RI soil borings (WL-designation) and the NRC soil borings (PVC-designation) that could be located in Area 2 during performance of the RI. Tables 5 through 7 summarize the radium, thorium, and uranium isotope results obtained by the laboratory analyses of the soil samples collected from Area 2 during performance of the RI field investigations. Table 8 presents a summary of the highest (peak) summed totals of radium, thorium, and uranium at each soil boring location based on the data presented on Tables 5 through 7. There were some analytical results (primarily radium-226 and some uranium-238 data) for pre-RI soil samples obtained in Area 2 and these data are also provided on Table 8. Table 8 also lists the peak values obtained from the downhole gamma logging performed in Area 2, the depth at which the peak reading occurred, and the top and bottom of the zone that was identified as having elevated gamma readings based on visual inspection of the downhole gamma logs. Locations in Area 2 where the overland gamma results (Figure 2) were elevated above background are also listed on Table 8.

The evaluations described above indicated that in general for Area 1 there was only a single depth interval in each soil boring where RIM was present. In contrast, in Area 2 there were several borings in several different areas where RIM was found to be present at two different and distinct depth intervals (e.g., WL-209 area, WL-214 area and the WL-210/-218/-233/-235 area). Depth intervals containing separate occurrences of RIM materials are identified and listed separately for each boring location on Table 8.

As described in Appendix A-2, the results of these evaluations, as summarized on Tables 4 and 8, were used to define the lateral and vertical extent of RIM occurrences.

4 REFERENCES

Engineering Management Support, Inc. (EMSI), 2010, Work Plan for Supplemental Feasibility Study – Radiological-Impacted Material Excavation Alternatives Analysis, West Lake Landfill Operable Unit 1, June 4, 2010.

EMSI, 2000, Remedial Investigation Report, West Lake Landfill Operable Unit 1, April 10.

McLaren/Hart, 1996a, Soil Boring/Surface Soil Investigation Report, West Lake Landfill Areas 1 & 2, November 26.

McLaren/Hart, 1996b, Overland Gamma Survey Report, West Lake Landfill Radiological Areas 1 & 2, Bridgeton, Missouri, April 30.

Nuclear Regulatory Commission (NRC), 1988, Radioactive Material in the West Lake Landfill – Summary Report, NUREG 1308 – Rev. 1, June

Radiation Management Corporation (RMC), 1982, Radiological Survey of the West Lake Landfill, St. Louis County, Missouri.

United States Environmental Protection Agency (EPA), 2010a, Letter from Cecilia Tapia, Region 7 Director Superfund Division to Michael Hockley (Spencer Fane Britt & Browne, LLP), Charlotte Neitzel (Holme, Roberts & Owen, LLP), and Christina Richmond (U.S. Department of Justice) Re: West Landfill Site, Bridgeton, Missouri Administrative Order on Consent, Docket No.: 93-F-0005, January 11.

EPA, 2010b, Statement of Work for Supplemental Feasibility Study, West Lake Landfill Site (attachment to EPA's January 11, 2010 letter).

EPA, 2005, EPA Superfund Record of Decision: St. Louis Airport/Hazelwood Interim Storage/Futura Coatings Co., EPA ID: MOD980633176 OU 1, St. Louis, MO, EPA/ROD/R07-05/045, September 2.

EPA, 1998a, Memorandum: Use of Soil Cleanup Criteria in 40 CFR Part 192 as Remediation Goals for CERCLA Sites, OSWER Directive no. 9200.4-25, February 12.

EPA, 1998b, Superfund Record of Decision, St. Louis Airport/Hazelwood Interim Storage/Futura Coatings Co., EPA ID: MOD980633176 OU 2, St. Louis, MO, EPA/ROD/R07-98/169, August 27.

EPA, 1997, Memorandum: Establishment of Cleanup Levels for CERCLA Sites with Radioactive Contamination, OSWER Directive no. 9200.4-18, August 22.

TABLES

Table 1 : Area 1 Soil Radium Results

Boring	Depth	Radium-226			Radium-228			Total Radium
	(feet)	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	226+228
								using 1/2 MDA
AREA 1								
WL-101	5	**1.04**	0.22	0.33	< MDA		0.95	1.52
	20	**0.91**	0.19	0.35	< MDA		1.08	1.45
WL-102	5	**1.17**	0.22	0.26	< MDA		0.99	1.67
	15	**0.98**	0.23	0.35	< MDA		1.07	1.52
WL-103	5	**1.17**	0.26	0.34	< MDA		1.19	1.77
	10	**0.81**	0.34	0.53	< MDA		1.26	1.44
WL-104	5	**0.78**	0.18	0.30	< MDA		0.84	1.2
	20	**0.39**	0.19	0.34	< MDA		0.92	0.85
WL-105	10	**40.8**	2.1	0.6	< MDA		1.59	41.6
	30	**0.99**	0.23	0.34	< MDA		1.18	1.58
WL-106	0	**906**	37	2	< MDA		5.86	908.9
	5	**18.8**	1.3	0.4	**1.42**		1.07	20.2
	5 DUP (F)	**128**	6	1.0	< MDA		2.69	129.3
	25	**1.26**	0.25	0.4	< MDA		1.18	1.85
	25 DUP (F)	**2.92**	0.35	0.31	< MDA		1.16	3.50
WL-107	5	**0.80**	0.21	0.29	**0.91**	0.38	0.68	1.71
	51	**0.71**	0.21	0.36	< MDA		0.98	1.20
	51 DUP (L)	**0.42**	0.2	0.38	< MDA		1.11	0.98
WL-108	5	**0.95**	0.25	0.37	< MDA		1.34	1.62
WL-109	5	**0.90**	0.21	0.31	**1.18**	0.4	0.62	2.08
	50	**0.95**	0.21	0.30	**1.36**	0.48	0.71	2.31
	50 DUP (L)	**1.36**	0.37	0.56	< MDA		1.51	2.12
WL-110	5	**0.87**	0.25	0.40	< MDA		1.27	1.51
	50	**1.01**	0.21	0.31	< MDA		1.02	1.52
WL-111	0	**0.91**	0.22	0.33	< MDA		1.05	1.44
	5	**0.61**	0.21	0.42	< MDA		1.02	1.12
	5 DUP (L)	**0.91**	0.23	0.41	< MDA		1.36	1.59
	51	**0.48**	0.18	0.33	< MDA		1.10	1.03
	51 DUP (L)	**0.51**	0.22	0.35	< MDA		1.01	1.02
WL-112	0	**1.32**	0.24	0.41	< MDA		1.18	1.91
	5	**4.66**	0.46	0.42	< MDA		1.20	5.26
	42	**0.76**	0.20	0.34	**1.31**	0.44	0.58	2.07
WL-113	5	**0.97**	0.08	0.06	**1.06**	0.14	0.13	2.03
	5 DUP (F)	**1.06**	0.08	0.06	**0.98**	0.13	0.13	2.04
	10	**1.53**	0.15	0.12	**0.98**	0.22	0.24	2.51
WL-114	0	**109**	5	0.9	< MDA		2.50	110.3
	5	**2.59**	0.17	0.06	**0.39**	0.12	0.16	3.0
	5 DUP (L)	**2.54**	0.14	0.07	**0.46**	0.12	0.15	3
	15	**0.98**	0.08	0.07	**1.04**	0.15	0.14	2.02
	15 DUP (L)	**0.97**	0.08	0.07	**1.08**	0.17	0.15	2.05
WL-115	5	**1.00**	0.08	0.06	**0.93**	0.13	0.12	1.93
	40	**0.58**	0.05	0.05	**0.69**	0.1	0.10	1.27
WL-116	0	**0.94**	0.21	0.33	< MDA		1.19	1.54
	5	**1.11**	0.08	0.06	**0.94**	0.13	0.14	2.05
	5 DUP (F)	**1.18**	0.13	0.13	**1.0**	0.2	0.28	2.18
	10	**1.00**	0.07	0.05	**0.76**	0.11	0.11	1.76
WL-117	10	**3.15**	0.19	0.07	**0.64**	0.14	0.16	3.79
	25	**0.62**	0.06	0.05	**0.64**	0.12	0.12	1.26
WL-118	5	**18.4**	1	0.3	< MDA		0.73	18.8

Table 1 : Area 1 Soil Radium Results

Boring	Depth	Radium-226			Radium-228			Total Radium
	(feet)	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	226+228
								using 1/2 MDA
	10	**1.31**	0.1	*0.05*	**0.49**	0.09	*0.14*	1.8
WL-119	5	**0.89**	0.07	*0.06*	**0.73**	0.12	*0.12*	1.62
	50	**0.46**	0.05	*0.04*	**0.41**	0.09	*0.10*	0.87
	50 DUP (L)	**0.48**	0.05	*0.06*	**0.44**	0.1	*0.12*	0.92
	50 DUP (F)	**0.45**	0.05	*0.06*	**0.50**	0.10	*0.12*	0.95
WL-120	5	**1.00**	0.09	*0.07*	**1.08**	0.15	*0.16*	2.08
	50	**0.92**	0.1	*0.11*	**0.91**	0.21	*0.22*	1.83
	50 DUP (F)	**1.07**	0.09	*0.09*	**1.04**	0.18	*0.17*	2.11
EROSIONAL SEDIMENT								
AREA 1								
WL-121	0	*< MDA*		*7.28*	*< MDA*		*2.14*	4.71
WL-122	0	*< MDA*		*5.44*	*< MDA*		*1.69*	3.565
WL-123	0	*< MDA*		*5.98*	*< MDA*		*1.82*	3.9
WL-124	0	*< MDA*		*5.22*	*< MDA*		*1.79*	3.505

All values expressed as picoCuries per gram (pCi/g), unless otherwise noted.
DUP (F) = Field duplicate
DUP (L) = Laboratory duplicate
MDA = Minimum Detectable Activity
Bolded numbers indicate result reported above the minimum detectable activity (MDA).

Table 2 : Area 1 Soil Thorium Results

Boring	Depth	Thorium-230			Thorium-232			Total Thorium
	(feet)	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	230+232
								using 1/2 MDA
AREA 1								
WL-101	5	**2.18**	0.57	*0.07*	**0.89**		*0.07*	3.07
	20	**1.63**	0.57	*0.23*	**1.45**	0.53	*0.19*	3.08
WL-102	5	**4.18**	1.02	*0.23*	**0.90**	0.38	*0.14*	5.08
	15	**1.68**	0.58	*0.3*	**1.64**	0.56	*0.2*	3.32
WL-103	5	**1.42**	0.51	*0.22*	**0.78**	0.36	*0.17*	2.20
	10	**7.52**	1.65	*0.16*	**0.77**		*0.09*	8.29
WL-104	5	**3.08**	0.85	*0.21*	**0.94**	0.41	*0.19*	4.02
	20	**1.26**	0.47	*0.21*	**0.77**	0.35	*0.14*	2.03
WL-105	10	**522**	95	*0.09*	**4.34**	2.62	*1.36*	526.34
	30	**1.59**	0.56	*0.31*	**1.04**	0.42	*0.15*	2.63
WL-106	0	**9700**	1800	*11.8*	**35.2**		*11.2*	9735.20
	5	**731**	135	*0.21*	**3.22**		*0.2*	734.22
	5 DUP (F)	**766**	142	*0.14*	**4.71**		*0.12*	770.71
	25	**2.38**	0.55	*0.14*	**0.56**		*0.09*	2.94
	25 DUP (F)	**6.49**	1.37	*0.12*	**0.47**		*0.09*	6.96
WL-107	5	**0.89**	0.34	*0.13*	**0.89**	0.34	*0.09*	1.78
	51	**0.56**	0.27	*0.15*	**0.14**	0.12	*0.09*	0.70
	51 DUP (L)	**0.67**	0.33	*0.23*	**0.22**	0.17	*0.13*	0.89
WL-108	5	**1.21**	0.42	*0.16*	**0.79**	0.32	*0.12*	2.00
WL-109	5	**0.67**	0.3	*0.13*	**0.21**	0.16	*0.11*	0.88
	50	**1.1**	0.36	*0.2*	**0.58**	0.25	*0.21*	1.68
	50 DUP (L)	**2.43**	0.71	*0.26*	**1.13**		*0.12*	3.56
WL-110	5	**0.66**	0.35	*0.23*	**0.37**	0.25	*0.16*	1.03
	50	**0.87**	0.29	*0.12*	**0.87**	0.28	*0.08*	1.74
WL-111	0	**2.12**	0.72	*0.29*	**0.68**	0.36	*0.20*	2.80
	5	**2.76**	0.90	*0.77*	*< MDA*	*0.39*	*0.70*	3.11
	51	**2.47**	1.26	*0.79*	*< MDA*	*0.49*	*0.58*	2.76
WL-112	0	**2.67**	0.76	*0.25*	**0.84**	0.34	*0.19*	3.51
	5	**84.4**	15.8	*1.9*	*< MDA*	*0.81*	*1.56*	85.18
	42	**0.92**	0.44	*0.42*	**0.68**	0.37	*0.3*	1.60
WL-113	5	**0.33**	0.15	*0.11*	**0.19**	0.11	*0.08*	0.52
	5 DUP (F)	**0.58**	0.23	*0.15*	**0.15**	0.11	*0.08*	0.73
	10	**2.21**	0.52	*0.13*	**0.08**	0.07	*0.08*	2.29
WL-114	0	**7850**	1470	*0.92*	**18.1**	4.6	*0.78*	7868.10
	5	**23.2**	4.9	*0.4*	*< MDA*	*0.22*	*0.26*	23.33
	15	**1.08**	0.46	*0.28*	*< MDA*	*0.14*	*0.2*	1.18
WL-115	5	**0.84**	0.29	*0.18*	**0.21**	0.13	*0.11*	1.05
	40	**0.29**	0.16	*0.12*	**0.27**	0.15	*0.09*	0.56
WL-116	0	**1.94**	0.69	*0.52*	**0.52**	0.34	*0.46*	2.46
	5	**0.51**	0.21	*0.13*	**0.25**	0.14	*0.04*	0.76
	5 DUP (F)	**0.35**	0.17	*0.11*	**0.21**	0.13	*0.07*	0.56
	10	**0.36**	0.2	*0.21*	**0.33**	0.18	*0.13*	0.69
WL-117	10	**36.58**	7.4	*0.13*	**1**	0.35	*0.12*	37.58
	25	**0.7**	0.28	*0.15*	**0.2**	0.14	*0.12*	0.90
WL-118	5	**425**	87	*2.5*	**10.3**	3.5	*2.22*	435.30
	10	**7.19**	1.88	*0.2*	**0.35**	0.23	*0.2*	7.54
WL-119	5	**0.6**	0.28	*0.22*	**0.26**	0.17	*0.13*	0.86
	50	**0.67**	0.35	*0.41*	*< MDA*	*0.26*	*0.41*	0.88
	50 DUP (F)	**0.22**	0.13	*0.11*	**0.1**	0.08	*0.09*	0.32

Table 2 : Area 1 Soil Thorium Results

Boring	Depth	Thorium-230			Thorium-232			Total Thorium
	(feet)	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	230+232
WL-120	5	**0.48**	0.18	*0.12*	**0.14**	0.09	*0.09*	0.62
	50	**0.32**	0.19	*0.15*	**0.23**	0.16	*0.13*	0.55
	50 DUP (F)	**0.38**	0.19	*0.21*	**0.25**	0.15	*0.15*	0.63
EROSIONAL SEDIMENT								
AREA 1								
WL-121	0	**1.57**	0.36	*0.1*	**0.87**	0.23	*0.09*	2.44
WL-122	0	**1.93**	0.43	*0.12*	**1.02**	0.26	*0.1*	2.95
WL-123	0	**1.45**	0.34	*0.07*	**1.06**	0.27	*0.05*	2.51
WL-124	0	**2.16**	0.49	*0.07*	**1.16**	0.3	*0.07*	3.32

All values expressed as picoCuries per gram (pCi/g), unless otherwise noted.
DUP (F) = Field duplicate
DUP (L) = Laboratory duplicate
MDA = Minimum Detectable Activity
Bolded numbers indicate result reported above the minimum detectable activity (MDA).
Highlighted values indicate total radium results above the cleanup level of 7.9 pCi/g

Table 3 : Area 1 Soil Uranium Results

Boring	Depth	Uranium-238			Uranium-234			Uranium-235/236			Uranium-235			Total
	(feet)	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Uranium
														using 1/2 MDA
AREA 1														
WL-101	5	0.88	0.31	0.11	1.54	0.44	0.13	0.13	0.12	0.11	< MDA		0.72	2.55
	20	1.63	0.49	0.13	1.47	0.46	0.17	< MDA	0.14	0.16	< MDA		0.54	3.18
WL-102	5	0.88	0.33	0.12	1.06	0.37	0.11	< MDA	0.09	0.16	< MDA		0.49	2.02
	15	1.34	0.43	0.10	1.24	0.41	0.11	< MDA		0.09	< MDA		0.83	2.63
WL-103	5	1.60	0.48	0.16	1.95	0.55	0.20	0.21	0.17	0.16	< MDA		0.73	3.76
	10	1.12	0.34	0.14	1.41	0.39	0.19	0.23	0.16	0.16	< MDA		1.41	2.76
WL-104	5	0.70	0.27	0.14	1.19	0.37	0.15	< MDA	0.14	0.18	< MDA		0.55	1.98
	20	0.32	0.14	0.11	0.52	0.19	0.10	0.25	0.14	0.12	< MDA		0.56	1.09
WL-105	10	6.94	1.28	0.14	6.64	1.23	0.16	0.55	0.24	0.14	3.95	0.73	1.97	14.13
	30	1.10	0.34	0.08	1.16	0.36	0.10	< MDA	0.004	0.11	< MDA		0.73	2.32
WL-106	0	105	22	2	105	22	3	6.86	3.99	3.10	75.5	8.5	8.7	216.86
	5	6.69	3.5	2.73	11.5	4.8	4.0	< MDA	1.95	3.87	2.10	0.43	1.12	20.13
	5 DUP (F)	26.4	10.1	17.2	< MDA		35.3	< MDA	11.2	25.5	12.1	1.7	3.4	44.05
	25	2.89	0.56	0.06	2.7	0.53	0.06	0.24	0.12	0.07	< MDA		0.78	5.83
	25 DUP (F)	2.08	0.45	0.17	1.9	0.42	0.18	< MDA	0.09	0.14	< MDA		1.14	4.05
WL-107	5	0.89	0.34	0.11	1.30	0.43	0.11	< MDA	0.09	0.11	< MDA		0.58	2.25
	51	0.33	0.18	0.08	0.54	0.24	0.08	< MDA	0.0014	0.095	< MDA		0.63	0.92
	51 DUP (L)	0.59	0.25	0.08	0.34	0.19	0.08	< MDA	0.002	0.11	< MDA		0.63	0.99
WL-108	5	1.05	0.38	0.12	0.74	0.31	0.10	< MDA	0.07	0.13	< MDA		0.67	1.86
WL-109	5	0.66	0.24	0.07	0.66	0.25	0.08	< MDA	0.08	0.09	< MDA		0.61	1.37
	50	0.99	0.38	0.12	0.57	0.27	0.11	< MDA	0.1	0.14	< MDA		0.77	1.63
	50 DUP (L)	1.13	0.39	0.12	0.83	0.32	0.11	0.09	0.11	0.12	< MDA		1.28	2.05
WL-110	5	0.87	0.33	0.09	1.25	0.41	0.09	< MDA	0.09	0.08	< MDA		0.84	2.16
	50	1.14	0.39	0.23	1.17	0.4	0.20	< MDA	0.16	0.25	< MDA		0.74	2.44
WL-111	0	1.04	0.46	0.18	1.70	0.63	0.25	0.72	0.41	0.23	< MDA		0.70	3.46
	5	1.16	0.65	0.90	3.37	1.08	0.97	< MDA	0.66	1.49	< MDA		0.70	5.28
	51	< MDA	0.32	0.48	0.75	0.47	0.58	< MDA	0.3	0.35	< MDA		0.64	1.17
WL-112	0	1.22	0.43	0.12	1.45	0.48	0.13	0.24	0.19	0.17	< MDA		0.85	2.91
	5	3.44	1.58	0.42	2.92	1.46	0.89	< MDA	0.4	1.1	< MDA		0.99	6.91
	42	1.62	1.09	0.88	1.74	1.15	1.06	0.83	0.84	0.56	< MDA		0.56	4.19
WL-113	5	1.25	0.54	0.26	1.40	0.59	0.32	0.60	0.38	0.24	< MDA		0.23	3.25
	5 DUP (F)	0.62	0.30	0.08	0.76	0.34	0.16	< MDA	0.07	0.19	< MDA		0.17	1.48
	10	1.06	0.44	0.09	1.20	0.48	0.22	0.27	0.22	0.23	< MDA		0.42	2.53
WL-114	0	147	38	0.9	154	40	1.0	19.5	5.9	1.1	17.6	2.1	3.0	320.50
	5	3.54	1.38	0.51	3.43	1.35	0.63	0.82	0.63	0.51	0.32	0.06	0.27	7.79

Table 3 : Area 1 Soil Uranium Results

Boring	Depth	Uranium-238			Uranium-234			Uranium-235/236			Uranium-235			Total
	(feet)	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Uranium
	15	**1.60**	0.82	0.23	**1.29**	0.74	0.56	< MDA	0.43	0.44	< MDA		0.24	3.11
WL-115	5	**1.22**	0.49	0.21	**1.30**	0.52	0.29	**0.47**	0.31	0.31	< MDA		0.15	2.99
	40	**0.33**	0.20	0.11	**0.35**	0.21	0.16	< MDA	0.06	0.13	< MDA		0.13	0.75
WL-116	0	**0.88**	0.34	0.15	**1.04**	0.38	0.20	< MDA	0.12	0.20	< MDA		1.02	2.02
	5	**1.18**	0.50	0.41	**1.15**	0.49	0.36	< MDA	0.22	0.52	< MDA		0.17	2.59
	5 DUP (F)	**1.03**	0.51	0.20	**0.64**	0.39	0.28	< MDA	0.24	0.24	< MDA		0.44	1.79
	10	**1.32**	0.41	0.05	**1.14**	0.37	0.17	< MDA	0.07	0.10	< MDA		0.13	2.51
WL-117	10	**2.90**	0.86	0.16	**1.72**	0.61	0.25	< MDA	0.19	0.25	**0.30**	0.06	0.27	4.75
	25	**0.56**	0.31	0.10	**0.56**	0.31	0.17	< MDA	0.13	0.25	< MDA		0.20	1.25
WL-118	5	**17.8**	4.1	0.2	**15.6**	3.6	0.2	**1.46**	0.57	0.10	**2.40**	0.37	1.41	34.86
	10	**1.14**	0.47	0.17	**1.18**	0.48	0.18	< MDA	0.18	0.18	**0.18**	0.03	0.15	2.41
WL-119	5	**0.72**	0.35	0.17	**0.51**	0.29	0.21	< MDA	0.17	0.27	< MDA		0.15	1.37
	50	< MDA	0.36	0.58	**0.85**	0.53	0.50	< MDA	0.24	0.65	< MDA		0.12	1.47
	50 DUP (F)	**0.36**	0.23	0.25	**0.57**	0.29	0.19	< MDA	0.08	0.31	< MDA		0.13	1.09
WL-120	5	**0.95**	0.38	0.18	**1.15**	0.43	0.26	**0.33**	0.23	0.24	< MDA		0.24	2.43
	50	**0.52**	0.25	0.12	**0.46**	0.23	0.14	< MDA	0.12	0.12	< MDA		0.37	1.04
	50 DUP (F)	**0.92**	0.46	0.38	**0.98**	0.47	0.35	< MDA	0.18	0.53	< MDA		0.25	2.17
EROSIONAL SEDIMENT														
AREA 1														
WL-121	0	**0.94**	0.27	0.17	**0.78**	0.24	0.13	0.06	0.1	0.19				1.78
WL-122	0	**0.87**	0.25	0.09	**0.94**	0.26	0.1	0.09	0.08	0.12				1.90
WL-123	0	**2.33**	0.54	0.12	**2.94**	0.65	0.07	**0.2**	0.13	0.13				5.47
WL-124	0	**1.02**	0.26	0.06	**1.5**	0.34	0.06	**0.14**	0.08	0.07				2.66

All values expressed as picoCuries per gram (pCi/g), unless otherwise noted.
DUP (F) = Field duplicate
DUP (L) = Laboratory duplicate
MDA = Minimum Detectable Activity
Bolded numbers indicate result reported above the minimum detectable activity (MDA).

Table 4 : Area 1 Soil Intervals that Exceed Cleanup Levels

Boring No.	Interval Above Cleanup Levels: Top of Interval (ft bgs)	Bottom of Interval (ft bgs)	Thick-ness (ft)	Refuse Depth (ft bgs)	Samples Above Cleanup (ft bgs)	Peak Soil Sample Results: Sample Depth (ft bgs)	Radium 226+228 (pCi/g)	Thorium 230+232 (pCi/g)	Total Uranium (pCi/g)	Downhole Gamma Results: Peak Value (cpm)	Depth to Peak (ft bgs)	Top of Zone (ft bgs)	Bottom of Zone (ft bgs)	Overland Gamma Results (RI Fig 4-6)
Cleanup Levels							*7.9*	*7.9*	*54.4*					
WL-101	0	0	0	17	None	5	1.52	3.07	2.55	9000	No peak			
WL-102	0	6	6	23	None	5	1.67	5.08	2.02	60000	3.25	0	6	Elevated
WL-103	9	11	2	NA	10	10	1.44	**8.29**	3.76	6000	No peak			
WL-104	0	0	0	NA	None	5	1.2	3.32	1.98	6000	No peak			
WL-105	3	12	9	30	10	10	**41.6**	**526.34**	14.13	180000	9	3	12	Elevated
WL-106	0	6	6	24	0, 5	0	**908.9**	**9735.2**	**216.86**	25000	4	1	6	Elevated
WL-107	0	0	0	51	None	5	1.71	1.78	2.25	6000	No peak			
WL-108	0	0	0	>22	None	5	1.62	2.0	1.86	5000	No peak			
WL-109	0	0	0	49 - 56	None	5	2.08	0.88	1.37	6000	No peak			
WL-110	0	0	0	50	None	5	1.51	1.03	2.16	6000	No peak			
WL-111	0	0	0	50	None	5	1.59	3.11	5.28	6000	No peak			
WL-112	4	7	3	38	5	5	5.26	**85.18**	6.91	10000	5.5	4	7	
WL-113	3	5	2	42.5	None	10	2.51	2.29	2.53	14000	3.75	3	5	
WL-114	0	6	6	40	0, 5	0	**110.3**	**7868.1**	**320.5**	14000	5	3	6	Elevated
WL-115	0	0	0	34	None	5	1.93	1.05	2.99	6000	No peak			
WL-116	0	0	0	>20	None	5	2.18	0.76	2.59	3000	No peak			
WL-117	3	11	8	37	10	10	3.79	**37.58**	4.75	16000	6.5	3	8	
WL-118	0	7	7	>15	5	5	**18.8**	**435.3**	34.86	12000	0	0	2	Elevated
WL-119	0	0	0	44	None	5	1.62	0.86	1.37	6000	No peak			
WL-120	0	0	0	>52	None	5	2.08	0.62	2.43	6000	No peak			
WL-121	0	0	0	?	None	0	4.71	2.44	1.78	Not logged				
WL-122	0	0	0	?	None	0	3.57	2.95	1.9	Not logged				
WL-123	0	0	0	?	None	0	3.9	2.51	5.47	Not logged				
WL-124	0	0	0	?	None	0	3.51	3.32	2.66	Not logged				
PVC-24	0	0	0	?	None					6000	No peak			
PVC-25	7	11	4	?	NA					72000	9	7	11	Elevated
PVC-26	3	10	7	?	NA					86000	5	3	10	Elevated
PVC-27	0	0	0	?	NA					6000	No peak			
PVC-28	12	17	5	?	NA					132000	14	12	17	
PVC-29	0	0	0	?	NA					Not logged				
PVC-36	6	9.5	3.5	?	NA					15000	8	6	9.5	
PVC-37	0	0	0	?	NA					6000	No peak			
PVC-38	0	15	15	?	NA					1298000	10	0	15	
PVC-41	0	0	0	?	NA					6000	No peak			

Note: Highlighted lines indicate locations expected to have radionuclide activities above levels that would allow for unrestricted use. NA - Non soils samples taken

Depth intervals in italics are uncertain and are based on extension of the interval 1 ft if nearest soil sample result is within 10 times cleanup level, 2 feet if soil sample result is between 10 and 100 times the cleanup level, and 5 ft if soil sample result is greater than 100 times the cleanup level.

Table 5: Area 2 Soil Radium Results

Boring	Depth	Radium-226			Radium-228			Total Radium
	(feet)	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	226+228
AREA 2								using 1/2 MDA
WL-208	5	3.26	0.32	0.37	0.68	0.46	0.66	3.9
	5 DUP (L)	3.40	0.34	0.38	< MDA		1.03	3.9
	9	1.35	0.23	0.25	< MDA		0.74	1.7
WL-209	0	3720	142	10	< MDA		21.34	3,731
	5	2970	123	7	< MDA		16.34	2,978
	5 DUP (F)	3140	116	5	16.7	9.3	11.3	3,157
	25	0.85	0.18	0.29	< MDA		0.92	1.3
	25 DUP (F)	0.62	0.2	0.27	< MDA		0.85	1.0
WL-210	0	2280	89	4	< MDA		9.55	2,285
	5	520	26	3	< MDA		6.72	523
	5 DUP (F)	458	20	2	< MDA		4.66	460
	40	0.68	0.18	0.31	< MDA		0.83	1.1
	40 DUP (F)	1.66	0.4	0.59	< MDA		1.45	2.4
WL-211	5	8.52	0.58	0.33	< MDA		1.15	9.1
	25	0.42	0.19	0.31	< MDA		0.85	0.8
WL-212	5	1.26	0.4	0.46	< MDA		1.16	1.8
	10	1.77	0.24	0.28	< MDA		0.90	2.2
WL-213	0	1.00	0.26	0.37	< MDA		0.90	1.5
	5	1.26	0.23	0.27	< MDA		0.92	1.7
	25	0.93	0.33	0.52	< MDA		1.49	1.7
WL-214	5	0.95	0.18	0.22	< MDA		0.81	1.4
	25	< MDA		0.52	< MDA		0.89	0.7
WL-215	0	0.70	0.20	0.29	< MDA		0.73	1.1
WL-216	5	88.4	5.2	0.9	< MDA		2.21	89.5
	25	1.03	0.21	0.39	1.62	0.44	0.54	2.7
WL-217	5	0.60	0.21	0.31	< MDA		0.81	1.0
	10	1.27	0.24	0.29	< MDA		1.04	1.8
WL-218	0	1.06	0.19	0.24	0.82	0.38	0.66	1.9
	5	0.85	0.20	0.41	1.01	0.48	0.70	1.9
	40	0.68	0.23	0.43	< MDA		1.16	1.3
WL-219	5	1.12	0.26	0.33	1.17	0.59	0.77	2.3
	10	0.62	0.22	0.41	< MDA		1.04	1.1
WL-220	5	0.81	0.23	0.36	< MDA		1.22	1.4
	25	0.78	0.24	0.38	1.25	0.38	0.56	2.0
WL-221	5	0.75	0.2	0.34	< MDA		1.12	1.3
	35	< MDA		0.33	< MDA		1.09	0.7
WL-222	0	2.94	0.59	0.53	< MDA		1.75	3.8
	5	1.80	0.26	0.29	0.83	0.44	0.70	2.6
	30	0.82	0.39	0.60	< MDA		1.27	1.5
WL-223	5	1.73	0.27	0.30	< MDA		1.14	2.3
	22	0.52	0.19	0.33	< MDA		0.88	1.0
WL-224	5	0.84	0.21	0.28	1.23	0.47	0.67	2.1
	35	1.00	0.22	0.37	1.19	0.41	0.90	2.2
WL-225	5	1.07	0.27	0.40	< MDA		1.18	1.7
	35	< MDA		0.51	< MDA		1.50	1.0

Table 5: Area 2 Soil Radium Results

Boring	Depth	Radium-226			Radium-228			Total Radium
	(feet)	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	226+228
AREA 2								using 1/2 MDA
WL-226	10	**1.4**	0.27	*0.34*	**0.95**	0.46	*0.82*	2.4
	20	**3.26**	0.44	*0.40*	*< MDA*		*1.12*	3.8
WL-227	5	**1.32**	0.22	*0.29*	**1.35**	0.43	*0.73*	2.7
	40	**0.43**	0.18	*0.24*	*< MDA*		*0.79*	0.8
WL-228	5	**0.79**	0.20	*0.30*	**1.29**	0.41	*0.62*	2.1
	15	**0.64**	0.25	*0.37*	*< MDA*		*1.12*	1.2
WL-229	5	**1.15**	0.28	*0.70*	*< MDA*		*1.24*	1.8
	20	**0.38**	0.19	*0.34*	*< MDA*		*0.96*	0.9
WL-230	5	**1.67**	0.26	*0.34*	*< MDA*		*1.16*	2.3
	35	**0.53**	0.22	*0.36*	*< MDA*		*0.89*	1.0
WL-231	0	**0.91**	0.22	*0.29*	*< MDA*		*0.92*	1.4
	5	**4.06**	0.37	*0.28*	*< MDA*		*1.02*	4.6
	10	**1.37**	0.24	*0.40*	*< MDA*		*0.75*	1.7
WL-233	27	**4.44**	0.46	*0.38*	*< MDA*		*1.11*	5.0
	30	**0.79**	0.20	*0.41*	*< MDA*		*1.05*	1.3
WL-234	10	**3060**	116	*4*	**14.5**	7.9	*10.3*	3,075
	10 DUP (F)	**1260**	49	*3*	*< MDA*		*6.62*	1,263
	20	*< MDA*		*0.66*	*< MDA*		*1.25*	1.0
	20 DUP (F)	**1.18**	0.26	*0.39*	*< MDA*		*1.23*	1.8
WL-235	0	**0.90**	0.21	*0.32*	**1.19**	0.45	*0.56*	2.1
	5	**0.74**	0.46	*0.56*	*< MDA*		*1.58*	1.5
	30	**1.09**	0.25	*0.43*	*< MDA*		*0.93*	1.6
WL-236	5	**1.03**	0.23	*0.34*	*< MDA*		*1.00*	1.5
	35	**1.01**	0.24	*0.35*	*< MDA*		*1.23*	1.6
WL-239	5	**0.96**	0.11	*0.10*	**1.13**	0.19	*0.17*	2.1
	25	**0.90**	0.08	*0.06*	**0.72**	0.13	*0.12*	1.6
WL-241	5	**12.9**	0.54	*0.1*	*< MDA*		*0.24*	13.0
	15	**1.04**	0.09	*0.07*	**0.96**	0.16	*0.16*	2.0
WL-242	0	**1.57**	0.26	*0.51*	*< MDA*		*0.77*	2.0
	2	**2.42**	0.45	*0.59*	*< MDA*		*1.57*	3.2
WL-243	0	**4.78**	0.44	*0.33*	**1.13**	0.54	*0.84*	5.9
WL-244	0	**1.54**	0.22	*0.33*	*< MDA*		*1.05*	2.1
WL-245	0	**0.95**	0.26	*0.34*	*< MDA*		*1.20*	1.6
WL-246	0	**1.04**	0.26	*0.37*	*< MDA*		*1.07*	1.6

Table 5: Area 2 Soil Radium Results

Boring	Depth	Radium-226			Radium-228			Total Radium
	(feet)	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	226+228
AREA 2								using 1/2 MDA
PVC-1	0	16						16
	1	750						750
	2	22,000						22,000
	3	4,000						4,000
	4	1,300						1,300
	5	24						24
	6	3.9						3.9
	8	2.3						2.3
	10	2.3						2.3
	12	1.9						1.9
	14	1.8						1.8
	16	1.3						1.3
	18	1.2						1.2
	20	0.81						0.81
	22	0.65						0.65
	24	0.25						0.25
	26	0.63						0.63
	28	0.87						0.87
	30	0.43						0.43
	32	1.3						1.3
	34	2.4						2.4
	36	1.4						1.4
PVC-3	0	840						840
	1	15,000						15,000
	2	7,000						7,000
	3	23						23
	5	6.2						6.2
	7	4.7						4.7
	9	3.5						3.5
	11	1.8						1.8
	13	1.7						1.7
	15	4.5						4.5
	17	0.90						0.90
	19	0.29						0.29
	21	0.50						0.50
	23	1.0						1.0
	25	0.33						0.33
	27	0.97						0.97
	29	0.54						0.54

Table 5: Area 2 Soil Radium Results

Boring	Depth	Radium-226			Radium-228			Total Radium
	(feet)	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	226+228
AREA 2								using 1/2 MDA
PVC-4	0	130						130
	1	2,500						2,500
	2	150						150
	3	3.5						3.5
	4	1.6						1.6
	6	1.2						1.2
	8	1.5						1.5
	10	2.5						2.5
	14	1.7						1.7
	16	0.84						0.84
	18	0.80						0.80
	20	0.66						0.66
	22	1.1						1.1
	24	0.70						0.70
	26	0.54						0.54
	28	0.70						0.70
	30	0.75						0.75
	32	0.95						0.95
	34	1.6						1.6
PVC-5	0	1.8						1.8
	2	2.5						2.5
	4	3.4						3.4
	6	1.7						1.7
	8	1.3						1.3
	10	4.3						4.3
	12	2.1						2.1
	14	1.8						1.8
	16	0.83						0.83
	18	0.89						0.89
PVC-6	0	6.4						6.4
	4	0.0						0.0
	6	21						21
	7	13						13
	8	21						21
	9	40						40
	10	63						63
	11	230						230
	12	110						110
	13	5.5						5.5

Table 5: Area 2 Soil Radium Results

Boring	Depth	Radium-226			Radium-228			Total Radium
	(feet)	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	226+228
AREA 2								using 1/2 MDA
PVC-8	0	3.4						3.4
	2	1.3						1.3
	4	0.92						0.92
	6	1.1						1.1
	8	1.1						1.1
	10	1.1						1.1
	12	1.3						1.3
	14	1.1						1.1
	16	0.82						0.82
	18	1.1						1.1
PVC-9	0	2.0						2.0
	2	55						55
	3	6.5						6.5
	4	1.4						1.4
	6	0.56						0.56
	8	1.2						1.2
	10	0.65						0.65
	12	1.0						1.0
	14	0.70						0.70
	16	1.0						1.0
	20	0.98						0.98
	22	1.2						1.2
PVC-10	0	3.7						3.7
	1	18						18
	2	480						480
	3	520						520
	4	30						30
	5	10						10
	6	10						10
	8	15						15
	10	100						100
	12	13						13
	14	4.0						4.0
PVC-11	0	84						84
	1	3,600						3,600
	2	13,000						13,000
	3	1,700						1,700
	4	7.0						7.0
	5	4.9						4.9
	6	7.1						7.1
	7	8.3						8.3
	8	13						13

Table 5: Area 2 Soil Radium Results

Boring	Depth	Radium-226			Radium-228			Total Radium
	(feet)	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	226+228
AREA 2								using 1/2 MDA
PVC-16	2	11						11
	3	15						15
	4	42						42
	5	98						98
	6	100						100
	7	31						31
	8	12						12
	9	13						13
	10	50						50
	11	310						310
	12	480						480
	13	240						240
	14	6.0						6.0
	15	11,000						11,000
	16	9,200						9,200
	17	83						83
	18	27						27
	19	26						26
PVC-17	0	1.2						1.2
	2	54						54
	4	29						29
	6	27						27
	8	19						19
	10	22						22
	12	27						27
	14	65						65
	16	1.2						1.2
	18	1.4						1.4
	20	8.0						8.0
	22	1.5						1.5
PVC-18	2	1.2						1.2
	4	83						83
	6	88						88
	8	48						48
	10	49						49
	12	61						61
	14	61						61
	16	50						50

Table 5: Area 2 Soil Radium Results

Boring	Depth	Radium-226			Radium-228			Total Radium
	(feet)	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	226+228
AREA 2								using 1/2 MDA
PVC-19	0	1.3						1.3
	2	3.4						3.4
	4	3.5						3.5
	6	5.8						5.8
	7	39						39
	8	340						340
	9	22						22
	10	4.4						4.4
	12	0.70						0.70
	14	0.64						0.64
	16	0.57						0.57
PVC-20	0	14						14
	1	76						76
	2	17						17
	3	2.7						2.7
	5	1.1						1.1
	7	1.1						1.1
	9	1.0						1.0
	11	1.8						1.8
	15	1.1						1.1
	17	0.64						0.64
PVC-21	0	27						27
	1	12						12
	2	1.4						1.4
	3	1.3						1.3
	4	5.6						5.6
	5	64						64
	6	780						780
	7	3,700						3,700
	8	79						79
	9	35						35
	10	20						20
	11	12						12
	12	5.4						5.4
	13	7.3						7.3
	14	11						11
	15	9.4						9.4
	16	5.7						5.7
	17	5.2						5.2
	18	Invalid data						Invalid data
	20	5.5						5.5

Table 5: Area 2 Soil Radium Results

Boring	Depth	Radium-226			Radium-228			Total Radium
	(feet)	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	226+228
AREA 2								using 1/2 MDA
PVC-22	0	21						21
	1	25						25
	2	25						25
	3	4.9						4.9
	4	8.8						8.8
	6	6.7						6.7
	7	7.3						7.3
	8	8.4						8.4
	10	12						12
	12	11						11
	13	11						11
	14	11						11
	15	17						17
	16	19						19
	17	6.4						6.4
	18	15						15
	19	14						14
	20	30						30
	21	11						11
	22	21						21
	23	5,800						5,800
	24	750						750
	25	640						640
PVC-31	0	0.74						0.74
	2	0.53						0.53
	4	0.89						0.89
	6	0.63						0.63
	8	0.57						0.57
	10	0.45						0.45
	14	0.71						0.71
	16	0.51						0.51
	18	0.77						0.77
	20	0.50						0.50
	22	0.59						0.59
	24	1.0						1.0

Table 5: Area 2 Soil Radium Results

Boring	Depth	Radium-226			Radium-228			Total Radium
	(feet)	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	226+228
AREA 2								using 1/2 MDA
PVC-32	0	10						10
	1	160						160
	2	57						57
	3	4.2						4.2
	4	4.2						4.2
	6	1.4						1.4
	8	1.6						1.6
	10	1.5						1.5
	12	1.5						1.5
	14	2.4						2.4
	16	1.9						1.9
	18	0.99						0.99

All values expressed as picoCuries per gram (pCi/g), unless otherwise noted.

Note: A value of 4,400,000,000 for the 18 ft depth in boring PVC-21 is reported in the 1982 NRC report; however, this value appears to be in error. Based on other information presented in the 1982 NRC report, it is likely that the 4.4×10^9 value presented in the NRC report is a typographical error and should have been entered as 4.4×10^0. The value for this sample is considered invalid and is not used in this report.

DUP (F) = Field duplicate

DUP (L) = Laboratory duplicate

MDA = Minimum Detectable Activity

Bolded numbers indicate result reported above the minimum detectable activity (MDA).

Highlighted values indicate total radium results above the cleanup level of 7.9 pCi/g

Table 6 : Area 2 Soil Thorium Results

Boring	Depth	Thorium-230			Thorium-232			Total Thorium
	(feet)	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	230+232
AREA 2								using 1/2 MDA
WL-208	5	**123**		*0.10*	**1.43**	0.42	*0.08*	124.4
	5 DUP (L)	**94.9**		*0.23*	**0.82**	0.32	*0.14*	95.7
	9	**10.07**		*0.07*	**0.36**	0.16	*0.07*	10.4
WL-209	0	**29240**		*0.10*	**127**	23	*0.09*	29367
	5	**38280**		*40.2*	**138**	60	*32.2*	38418
	5 DUP (F)	**32680**		*29.0*	**180**	65	*20.2*	32860
	25	**26.9**		*0.12*	**0.71**	0.27	*0.05*	27.6
	25 DUP (F)	**12.85**		*0.72*	*< MDA*	*0.53*	*0.84*	13.3
WL-210	0	**18190**		*15.1*	**59.2**	23.2	*17.5*	18249
	5	**12400**		*0.14*	**106**	19	*0.06*	12506
	5 DUP (F)	**15610**		*0.11*	**120**	21	*0.06*	15730
	40	**18.2**		*0.12*	**0.37**	0.17	*0.08*	18.6
	40 DUP (F)	**10.8**		*0.1*	**0.82**	0.28	*0.07*	11.6
WL-211	5	**66.11**		*0.15*	**1.38**	0.35	*0.08*	67.5
	25	**4.97**		*0.16*	**0.32**	0.16	*0.08*	5.3
WL-212	5	**5.73**		*0.10*	**0.29**	0.14	*0.08*	6.0
	10	**116**		*0.23*	**0.9**	0.29	*0.13*	116.9
WL-213	0	**24.2**		*0.2*	**1.11**	0.41	*0.20*	25.3
	5	**17.29**		*0.16*	**0.89**	0.3	*0.15*	18.2
	25	**3.13**		*0.05*	**0.52**	0.21	*0.07*	3.7
WL-214	5	**44.4**		*0.21*	**0.41**	0.2	*0.14*	44.8
	25	**12.8**		*0.18*	**0.36**	0.19	*0.12*	13.2
WL-215	0	**5.35**		*0.07*	**0.31**	0.15	*0.07*	5.7
WL-216	5	**1131**		*0.93*	**3.05**	1.45	*0.81*	1134
	25	**1.46**		*0.17*	**1.17**	0.39	*0.1*	2.6
WL-217	5	**0.96**		*0.13*	*< MDA*	*0.005*	*0.085*	1.0
	10	**8.95**		*0.12*	**0.72**	0.31	*0.11*	9.7
WL-218	0	**1.77**		*0.14*	**0.77**	0.32	*0.07*	2.5
	5	**1.19**		*0.14*	**0.67**	0.3	*0.12*	1.9
	40	**7.27**		*0.1*	**0.58**	0.25	*0.09*	7.9
WL-219	5	**1.07**		*0.15*	**1.12**	0.42	*0.14*	2.2
	10	**0.64**		*0.08*	**0.44**	0.2	*0.07*	1.1
WL-220	5	**1.53**		*0.11*	**0.69**	0.27	*0.10*	2.2
	25	**0.56**		*0.11*	**0.22**	0.16	*0.1*	0.8
WL-221	5	**4.28**		*0.24*	**0.7**	0.28	*0.24*	5.0
	35	**1.24**		*0.16*	**0.63**	0.27	*0.14*	1.9
WL-222	0	**131**		*0.19*	**1.31**	0.40	*0.2*	132.3
	5	**81.4**		*0.76*	**1.3**	0.38	*0.17*	82.7
	30	**0.88**		*0.21*	**1.0**	0.3	*0.15*	1.9
WL-223	5	**9.16**		*0.12*	**0.64**	0.3	*0.12*	9.8
	22	**0.68**		*0.12*	**0.18**	0.13	*0.1*	0.9
WL-224	5	**2.85**		*1.15*	*< MDA*	*0.49*	*0.91*	3.3
	35	**4.08**		*0.84*	*< MDA*	*0.42*	*0.62*	4.4
WL-225	5	**2.84**		*1.32*	**1.76**	1.07	*0.62*	4.6
	35	**0.91**		*0.23*	**0.33**	0.17	*0.16*	1.2
WL-226	10	**14.1**		*1.1*	*< MDA*	*0.51*	*0.85*	14.5

Table 6 : Area 2 Soil Thorium Results

Boring	Depth	Thorium-230			Thorium-232			Total Thorium
	(feet)	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	230+232
AREA 2								using 1/2 MDA
	20	**173**		*1.0*	*< MDA*	*0.68*	*0.85*	173.4
WL-227	5	**20.4**		*0.9*	*< MDA*	*0.52*	*0.53*	20.7
	40	**2.78**		*0.94*	*< MDA*	*0.53*	*0.55*	3.1
WL-228	5	**2.72**		*1.05*	*< MDA*	*0.34*	*0.79*	3.1
	15	**2.13**		*0.46*	**0.62**	0.39	*0.37*	2.8
WL-229	5	**4.97**		*0.97*	**1.47**	0.97	*0.89*	6.4
	20	**1.17**		*1.02*	*< MDA*	*0.58*	*0.69*	1.5
WL-230	5	**26.8**		*1.3*	*< MDA*	*0.63*	*0.87*	27.2
	35	**1.33**		*1.25*	*< MDA*	*0.29*	*0.75*	1.7
WL-231	0	**1.21**		*0.20*	*< MDA*	*0.1*	*0.19*	1.3
	5	**94.5**		*1.0*	**1.11**	0.85	*0.83*	95.6
	10	**10.2**		*1.4*	*< MDA*	*0.28*	*0.87*	10.6
WL-233	27	**427**		*0.70*	**1.19**	0.83	*0.56*	428.2
	30	**9.93**		*0.9*	**0.82**	0.64	*0.49*	10.8
WL-234	10	**57300**		*238*	*< MDA*	*173*	*240*	57420
	10 DUP (F)	**12000**		*116*	*< MDA*	*84.6*	*98.7*	12049
	20	**16.2**		*0.04*	**0.67**	0.23	*0.07*	16.9
	20 DUP (F)	**11.3**		*0.5*	**0.85**	0.43	*0.38*	12.2
WL-235	0	**12.4**		*0.13*	**1.03**	0.31	*0.10*	13.4
	5	**3.21**		*1.16*	*< MDA*	*0.38*	*0.83*	3.6
	30	**3.15**		*1.0*	*< MDA*	*0.28*	*0.94*	3.6
WL-236	5	**5.92**		*0.97*	*< MDA*	*0.46*	*0.69*	6.3
	35	**4.9**		*1.01*	*< MDA*	*0.63*	*1.02*	5.4
WL-239	5	**0.5**		*0.12*	**0.26**	0.13	*0.07*	0.8
	25	**0.58**		*0.25*	**0.31**	0.17	*0.14*	0.9
WL-241	5	**343**		*0.11*	**3.84**	0.9	*0.05*	346.8
	15	**0.57**		*0.13*	**0.18**	0.11	*0.08*	0.8
WL-242	0	**8.63**		*0.76*	*< MDA*		*0.34*	8.8
	2	**21.3**		*1.11*	*< MDA*	*0.58*	*0.75*	21.7
WL-243	0	**265**		*0.22*	**6.73**	1.36	*0.15*	271.7
WL-244	0	**20.8**		*0.71*	**0.78**	0.68	*0.65*	21.6
WL-245	0	**3.92**		*0.16*	**0.38**	0.2	*0.11*	4.3
WL-246	0	**2.91**		*0.3*	**0.63**	0.31	*0.15*	3.5

All values expressed as picoCuries per gram (pCi/g), unless otherwise noted.
DUP (F) = Field duplicate
DUP (L) = Laboratory duplicate
MDA = Minimum Detectable Activity
Bolded numbers indicate result reported above the minimum detectable activity (MDA).
Highlighted values indicate total radium results above the cleanup level of 7.9 pCi/g

Table 7 : Area 2 Soil Uranium Results

Boring	Depth	Uranium-238			Uranium-234			Uranium-235/236			Uranium-235			Total
	(feet)	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Uranium
AREA 2														using 1/2 MDA
WL-208	5	1.60		0.10	2.05		0.12	0.16	0.15	0.13	< MDA		1.18	3.81
	5 DUP (L)	2.82		0.13	2.27		0.19	0.03	0.07	0.14	< MDA		1.04	5.12
	9	1.75		0.15	1.65		0.19	< MDA	0.13	0.18	< MDA		0.77	3.49
WL-209	0	294		0.7	575		0.7	251	79	0.7	263	33	33	1,120
	5	249		0.14	335		0.19	72.4	12.7	0.16	74.8	22.9	23.8	656
	5 DUP (F)	287		0.15	527		0.20	115	19	0.14	62.6	25.4	13.4	929
	25	0.58		0.12	0.46		0.23	< MDA	0.13	0.17	< MDA		0.84	1.13
	25 DUP (F)	0.61		0.08	0.59		0.09	< MDA	0.08	0.12	< MDA		0.70	1.26
WL-210	0	134		0.6	216		0.7	49.7	16.5	0.7	182	22	14	400
	5	65.5		0.12	145		0.18	15.5	2.9	0.17	< MDA		10.12	226
	5 DUP (F)	128		0.14	267		0.17	43.8	7.9	0.16	27.2	11.9	5.4	439
	40	0.91		0.11	0.69		0.12	< MDA	0.1	0.15	< MDA		0.78	1.68
	40 DUP (F)	0.54		0.09	0.93		0.11	0.25	0.17	0.14	< MDA		1.50	1.72
WL-211	5	2.61		0.11	2.30		0.10	0.22	0.15	0.13	< MDA		0.75	5.13
	25	0.66		0.26	0.68		0.26	< MDA	0.1	0.20	< MDA		0.79	1.44
WL-212	5	1.66		0.12	1.57		0.17	< MDA	0.12	0.16	< MDA		1.15	3.31
	10	1.77		0.12	1.86		0.14	< MDA	0.12	0.15	< MDA		0.56	3.71
WL-213	0	1.53		0.42	1.64		0.45	0.45	0.31	0.38	< MDA		0.88	3.62
	5	1.53		0.13	1.00		0.19	< MDA	0.09	0.15	< MDA		0.83	2.61
	25	0.45		0.13	1.06		0.14	< MDA	0.06	0.17	< MDA		1.35	1.60
WL-214	5	0.81		0.09	1.09		0.12	0.81	0.33	0.14	< MDA		0.52	2.71
	25	0.67		0.12	0.97		0.11	< MDA	0.1	0.15	< MDA		0.89	1.72
WL-215	0	1.53		0.45	1.86		0.48	0.77	0.54	0.72	< MDA		0.78	4.16
WL-216	5	11.4		2.20	12.5		1.90	< MDA	1.13	2.36	< MDA		3.07	25.1
	25	0.97		0.09	0.81		0.09	< MDA	0.1	0.12	< MDA		0.61	1.84
WL-217	5	0.51		0.08	0.45		0.08	< MDA	0.08	0.10	< MDA		0.53	1.01
	10	0.96		0.12	1.03		0.17	< MDA	0.07	0.16	< MDA		0.60	2.07
WL-218	0	1.12		0.16	1.53		0.24	0.41	0.3	0.23	< MDA		0.58	3.06
	5	0.81		0.12	0.73		0.12	< MDA	0.08	0.13	< MDA		0.84	1.61
	40	0.53		0.11	0.84		0.12	< MDA	0.06	0.13	< MDA		0.73	1.44
WL-219	5	1.09		0.09	0.91		0.09	< MDA	0.1	0.11	< MDA		0.80	2.06
	10	0.60		0.33	1.16		0.39	< MDA	0.23	0.41	< MDA		0.62	1.97
WL-220	5	1.00		0.09	1.16		0.09	< MDA	0.003	0.11	< MDA		0.79	2.22
	25	0.95		0.13	0.89		0.12	< MDA	0.08	0.18	< MDA		0.67	1.93

Table 7 : Area 2 Soil Uranium Results

Boring	Depth	Uranium-238			Uranium-234			Uranium-235/236			Uranium-235			Total
	(feet)	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Uranium
AREA 2														using 1/2 MDA
WL-221	5	**0.82**		*0.13*	**1.12**		*0.13*	**0.19**	0.15	*0.15*	*< MDA*		*0.64*	2.13
	35	**0.50**		*0.11*	**0.52**		*0.1*	*< MDA*	0.004	*0.12*	*< MDA*		*0.79*	1.08
WL-222	0	**3.36**		*0.42*	**2.26**		*0.25*	**0.69**	0.46	*0.56*	*< MDA*		*1.99*	6.31
	5	**1.21**		*0.09*	**1.46**		*0.13*	*< MDA*	0.1	*0.12*	*< MDA*		*0.64*	2.73
	30	**0.40**		*0.12*	**0.51**		*0.12*	*< MDA*	0.07	*0.16*	*< MDA*		*1.22*	0.99
WL-223	5	**1.22**		*0.10*	**1.44**		*0.11*	*< MDA*	0.1	*0.14*	*< MDA*		*0.75*	2.73
	22	**1.93**		*0.15*	**2.37**		*0.14*	*< MDA*	0.13	*0.19*	*< MDA*		*0.60*	4.40
WL-224	5	**0.63**		*0.40*	**0.75**		*0.68*	*< MDA*	0.15	*0.50*	*< MDA*		*0.71*	1.63
	35	**0.77**		*0.52*	**1.13**		*0.80*	*< MDA*	0.48	*1.14*	*< MDA*		*0.69*	2.47
WL-225	5	**1.29**		*1.01*	**3.17**		*1.22*	*< MDA*	0.48	*0.65*	*< MDA*		*0.75*	4.79
	35	*< MDA*		*0.77*	**0.72**		*0.40*	*< MDA*	0.43	*1.18*	*< MDA*		*0.93*	1.70
WL-226	10	**1.63**		*0.29*	**1.38**		*0.52*	**0.39**	0.34	*0.36*	*< MDA*		*0.80*	3.40
	20	**6.32**		*0.91*	**6.02**		*1.31*	*< MDA*	0.66	*1.19*	*< MDA*		*0.87*	12.94
WL-227	5	**2.01**		*0.32*	**1.68**		*0.57*	*< MDA*	0.4	*0.63*	*< MDA*		*0.66*	4.01
	40	*< MDA*		*0.53*	**0.66**		*0.55*	**0.36**	0.32	*0.33*	*< MDA*		*0.54*	1.29
WL-228	5	**1.84**		*1.3*	**1.50**		*1.37*	*< MDA*	0.9	*1.35*	*< MDA*		*0.51*	4.02
	15	*< MDA*		*0.78*	*< MDA*		*0.74*	*< MDA*	0.51	*1.09*	*< MDA*		*0.75*	0.76
WL-229	5	**1.45**		*0.39*	**0.82**		*0.52*	*< MDA*	0.24	*0.62*	*< MDA*		*0.64*	2.58
	20	**0.54**		*0.39*	**0.79**		*0.56*	*< MDA*	0.26	*0.52*	*< MDA*		*0.64*	1.59
WL-230	5	**0.92**		*0.16*	**2.23**		*0.49*	**0.48**	0.39	*0.38*	*< MDA*		*0.63*	3.63
	35	**2.05**		*0.46*	**1.75**		*1.18*	**1.02**	0.96	*1.01*	*< MDA*		*0.69*	4.82
WL-231	0	**2.04**		0.26	**3.18**		*0.32*	**0.91**	0.54	*0.38*	*< MDA*		*0.85*	6.13
	5	**3.86**		*2.18*	**6.97**		*2.14*	*< MDA*	1.73	*3.37*	*< MDA*		*0.73*	12.52
	10	**2.01**		*0.15*	**2.29**		*0.53*	**0.68**	0.48	*0.54*	*< MDA*		*0.79*	4.98
WL-233	27	**4.48**		*1.80*	**4.58**		*1.64*	*< MDA*	0.56	*2.32*	*< MDA*		*1.02*	10.22
	30	**1.99**		*1.93*	**2.60**		*2.34*	*< MDA*	0.95	*2.30*	*< MDA*		*0.64*	5.74
WL-234	10	**138**		*5.0*	**128**		*5*	**10.9**	7.5	*4.5*	**774**	150	*12*	277
	10 DUP (F)	**60.7**		*1.1*	**45.4**		*0.5*	**9.55**	3.37	*0.62*	**97.6**	11.2	*7.9*	116
	20	**0.98**		*0.28*	**0.94**		*0.37*	**0.43**	0.31	*0.15*	*< MDA*		*0.86*	2.35
	20 DUP (F)	**2.11**		*0.99*	**1.64**		*0.99*	*< MDA*	0.06	*1.23*	*< MDA*		*0.85*	4.37
WL-235	0	**0.77**		*0.37*	**0.97**		*0.31*	*< MDA*	0.15	*0.49*	*< MDA*		*0.56*	1.99
	5	**0.91**		*0.50*	**1.47**		*0.61*	*< MDA*	0.36	*0.92*	*< MDA*		*1.63*	2.84
	30	**1.31**		*0.24*	**1.25**		*0.41*	*< MDA*	0.16	*0.30*	*< MDA*		*0.84*	2.71

Table 7 : Area 2 Soil Uranium Results

Boring	Depth	Uranium-238			Uranium-234			Uranium-235/236			Uranium-235			Total
	(feet)	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Uranium
AREA 2														using 1/2 MDA
WL-236	5	**1.56**		*0.60*	**1.43**		*1.41*	*< MDA*	0.00	*0.75*	*< MDA*		*0.72*	3.37
	35	**1.95**		*0.82*	**2.37**		*0.54*	*< MDA*	0.86	*1.17*	*< MDA*		*0.69*	4.91
WL-239	5	**1.22**		*0.14*	**1.24**		*0.19*	**0.35**	0.24	*0.10*	*< MDA*		*0.35*	2.81
	25	**0.48**		*0.47*	**0.83**		*0.46*	*< MDA*	0.42	*0.66*	*< MDA*		*0.25*	1.64
WL-241	5	**3.90**		*0.18*	**4.51**		*0.15*	**0.23**	0.20	*0.23*	*< MDA*		*0.38*	8.64
	15	**0.64**		*0.13*	**0.59**		*0.20*	*< MDA*	0.14	*0.20*	*< MDA*		*0.23*	1.33
WL-242	0	**1.63**		*0.13*	**1.83**		*0.17*	**0.4**	0.22	*0.16*	--		--	3.86
	2	**0.75**		*0.1*	**1.35**		*0.1*	**0.56**	0.28	*0.15*	--		--	2.66
WL-243	0	**3.63**		*0.18*	**3.99**		*0.24*	**0.58**	0.31	*0.22*	--		--	8.20
WL-244	0	**1.35**		*0.09*	**0.88**		*0.12*	**0.09**	0.1	*0.14*	--		--	2.32
WL-245	0	**0.71**		*0.18*	**0.93**		*0.23*	**0.13**	0.15	*0.28*	--		--	1.77
WL-246	0	**0.73**		*0.18*	**0.94**		*0.14*	**0.1**	0.13	*0.27*	--		--	1.77
PVC-1	0	160												160
	1	170												170
	4	93												93
PVC-3	1	1,400												1,400
PVC-4	1	530												530
PVC-6	4	22												22
	7	16												16
	8	39												39
	12	44												44
PVC-9	2	46												46
	14	2.7												2.7
	20	0.76												0.76
PVC-10	10	73												73
	12	12												12
	14	4.9												4.9
PVC-11	1	770												770
	2	2,900												2,900

Table 7 : Area 2 Soil Uranium Results

Boring	Depth	Uranium-238			Uranium-234			Uranium-235/236			Uranium-235			Total
	(feet)	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Uranium
AREA 2														using 1/2 MDA
PVC-16	2	13												13
	4	28												28
	5	65												65
	8	12												12
	11	170												170
	12	190												190
	13	120												120
	14	330												330
	19	13												13
PVC-19	7	33												33
	8	42												42
	9	27												27
PVC-21	0	21												21
	5	18												18
	6	17												17
	7	450												450
	8	32												32
	15	5.6												5.6
	18	5.6												5.6
PVC-22	1	20												20
	2	19												19
	7	9.4												9.4
	8	10												10
	13	15												15
	14	9.1												9.1
	17	7.3												7.3
	18	18												18

Table 7 : Area 2 Soil Uranium Results

Boring	Depth	Uranium-238			Uranium-234			Uranium-235/236			Uranium-235			Total
	(feet)	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Uranium
AREA 2														using 1/2 MDA
PVC-31	18	0.85												0.85

All values expressed as picoCuries per gram (pCi/g), unless otherwise noted.
DUP (F) = Field duplicate
DUP (L) = Laboratory duplicate
MDA = Minimum Detectable Activity
Bolded numbers indicate result reported above the minimum detectable activity (MDA).
Highlighted values indicate total radium results above the cleanup level of 54.4 pCi/g

Table 8 : Area 2 Soil Intervals to be Excavated

Boring No.	Interval Above Cleanup Levels Top of Interval (ft bgs)	Bottom of Interval (ft bgs)	Thick-ness (ft)	Refuse Depth (ft bgs)	Samples Above Cleanup (ft bgs)	Peak Soil Sample Results Sample Depth (ft bgs)	Radium 226+228 (pCi/g)	Thorium 230+232 (pCi/g)	Total Uranium (pCi/g)	Downhole Gamma Results Peak Value (cpm)	Depth to Peak (ft bgs)	Top of Zone (ft bgs)	Bottom of Zone (ft bgs)	Overland Gamma Results (RI Fig 4-6)
Cleanup Levels							*7.9*	*7.9*	*54.4*					
WL-208	0	*10*	10	28	5, 9	5	3.9	**124.4**	5.12	12000	No peak			Elevated
WL-209	0	11	11		0, 5	0	**3731**	**38418**	**1120**	744000	0	0	11	Elevated
WL-209	*24*	*26*	2	28	25	25	1.3	**27.6**	1.26	6000	No peak			Elevated
WL-210	0	16.5	16.5		0, 5	0	**2285**	**18249**	**399.7**	509000	0	0	16.5	Elevated
WL-210	39	49.5	10.5	53	40	40	2.4	**18.6**	1.72	88000	47.5	46	49.5	Elevated
WL-211	0	13	13	25	5	5	**9.1**	**67.5**	5.13	330000	0.75	0	13	Elevated
WL-212	*8*	*12*	4	28	10	10	2.2	**116.9**	3.71	6000	No peak			
WL-213	0	*6*	6	24	0, 5	0	1.5	**25.3**	3.62	6000	No peak			
WL-214	*4*	*6*	2		5	5	1.4	**44.8**	2.71	6000	No peak			
WL-214	*24*	*26*	2	24	25	25	0.7	**13.2**	1.72	Not logged				
WL-215	0	0	0	>16	None	0	1.1	5.7	4.16	Not logged				
WL-216	0	9	9	22	5	5	**89.5**	**1134**	25.08	48000	3.5	0	9	Elevated
WL-217	9	11	2	>17	10	10	1.8	**9.7**	2.07	6000	No peak			Elevated
WL-218	39	41	2	37	40	40	1.3	**7.9**	1.44	6000	No peak			
WL-219	0	0	0	27	None	5	2.3	2.2	2.06	6000	No peak			
WL-220	0	0	0	>30	None	5	1.4	2.2	2.22	6000	No peak			
WL-221	0	0	0	34	None	5	1.3	5.0	2.13	6000	No peak			Elevated
WL-222	0	*7*	7	30	0, 5	0	3.8	**132.3**	6.31	6000	No peak			Elevated
WL-223	1	7.5	6.5	22	5	5	2.3	**9.8**	2.73	15000	4	1	7.5	Elevated
WL-224	0	0	0	33	None	35	2.2	4.4	2.47	6000	No peak			
WL-225	0	0	0	>37	None	5	1.7	4.6	4.79	6000	No peak			
WL-226	0	*22*	22	42	10, 20	20	3.8	**173.4**	12.94	370000	10.5	0	17.5	Elevated
WL-227	*4*	*6*	2	40	5	5	2.7	**20.7**	4.01	8000	No peak			
WL-228	0	0	0	None	None	5	2.1	3.1	4.02	6000	No peak			
WL-229	0	0	0	5	None	5	1.8	6.4	2.58	6000	No peak			
WL-230	0	*6*	6	32	5	5	2.3	**27.2**	3.63	10000	1.5	0	3	Elevated
WL-231	4	*11*	7	>40	5, 10	5	4.6	**95.6**	12.52	29000	5.5	4	7.5	
WL-233	17	*31*	14	>42.5	27, 30	27	5.0	**428.2**	10.22	90000	22	17	26	
WL-234	0	*21*	21	39	10, 20	10	**3075**	**57420**	**276.9**	1104000	7	0	18	Elevated
WL-235	0	*1*	1		0	0	2.1	**13.4**	1.99	6000	No peak			
WL-235	20.5	24.5	4	>30	NA					20000	22.5	20.5	24.5	
WL-236	0	0	0	>37	None	5	1.5	6.3	3.37	6000	No peak			
WL-237	0	0	0	34	NA					6000	No peak			Elevated
WL-238	1	10.5	9.5	27	NA					130000	6	1	10.5	Elevated
WL-239	0	0	0	?	None	5	2.1	0.8	2.81	6000	No peak			

Table 8 : Area 2 Soil Intervals to be Excavated

Boring No.	Interval Above Cleanup Levels Top of Interval (ft bgs)	Bottom of Interval (ft bgs)	Thick-ness (ft)	Refuse Depth (ft bgs)	Samples Above Cleanup (ft bgs)	Peak Soil Sample Results Sample Depth (ft bgs)	Radium 226+228 (pCi/g)	Thorium 230+232 (pCi/g)	Total Uranium (pCi/g)	Downhole Gamma Results Peak Value (cpm)	Depth to Peak (ft bgs)	Top of Zone (ft bgs)	Bottom of Zone (ft bgs)	Overland Gamma Results (RI Fig 4-6)
Cleanup Levels							*7.9*	*7.9*	*54.4*					
WL-240	0	0	0	>11	NA					6000	No peak			
WL-241	1	9.5	8.5	>40	5	5	**13.0**	**346.8**	8.64	46000	5.5	1	9.5	
WL-242	0	*3*	3	?	0, 2	2	3.2	**21.7**	2.66	Not logged				
WL-243	0	*2*	2	?	0	0	5.9	**271.7**	8.2	Not logged				Elevated
WL-244	0	*1*	1	?	0	0	2.10	**21.6**	2.32	Not logged				
WL-245	0	0	0	?	None	0	1.6	4.3	1.77	Not logged				
WL-246	0	0	0	?	None	0	1.6	3.5	1.77	Not logged				
PVC-4	0	5.5	5.5		0, 1, 2	1	**2500**		**530**	1290000	1	0	5.5	Elevated
PVC-4	9.5	13	3.5		None	10	2.5			14000	11.5	9.5	13	Elevated
PVC-5	1	7	6		None	6	1.7			15000	5.5	1	7	Elevated
PVC-5	9.5	14.5	5		None	10	4.3			14000	11.5	9.5	14.5	Elevated
PVC-6	0	16	16		6 - 13	11	**230**			367000	11	0	16	Elevated
PVC-6	19	*22.5*	3.5		NA					23000	20.5	19	>21.5	Elevated
PVC-7	0	7	7		NA					1386000	2	0	7	Elevated
PVC-7	17	*22*	5		NA					22000	19.5	17	>21	Elevated
PVC-8	0	1.5	1.5		None	2	1.3			24000	0.5	0	1.5	Elevated
PVC-9	*1*	6.5	5.5		2	2	**55**		46	22000	5	3	6.5	Elevated
PVC-10	0	*13*	13		1 - 12	3	**520**			752000	3	0	7	Elevated
PVC-10	0	*13*	13		1 - 12	10	**100**		**73**	152000	9.5	7	13	Elevated
PVC-11	0	10.5	10.5		0 - 3	2	**13000**		**2900**	2286000	2.5	0	10.5	Elevated
PVC-12	0.5	5.5	5		NA					58000	2.5	0.5	5.5	
PVC-13	0	0	0		NA					6000	No peak			
PVC-18	0	0	0		None					6000	No peak			Elevated
PVC-19	6	10.5	4.5		7 - 9	8	**340**		42	332000	8	6	10.5	Elevated
PVC-20	0	4	4		0 - 2	2	**17**			127000	1.5	0	4	Elevated
PVC-33	1.5	3.5	2		NA					10000	2.5	1.5	3.5	Elevated
PVC-34	0	3	3		NA					22000	1	0	3	Elevated
PVC-35	0.5	8	7.5		NA					745000	4	0.5	8	
PVC-39	1.5	4	2.5		NA					14000	2.5	1.5	4	
PVC-40	0.5	5	4.5		NA					120000	2.5	0.5	5	Elevated
PVC-40	5	9.5	4.5		NA					46000	7	5	9.5	Elevated

Note: Highlighted lines indicate locations above cleanup levels to be considered for excavation NA - no soil samples taken

Depth intervals in italics are uncertain and are based on extension of the interval 1 ft if nearest soil sample result is within 10 times cleanup level, 2 feet if soil sample result is between 10 and 100 times the cleanup level, and 5 ft if soil sample result is greater than 100 times the cleanup level.

FIGURES

M:\clients\EMSI\westlake\2010\July\appendix\WL-appdx-Fig-1.dwg plotted: 09/21/2011

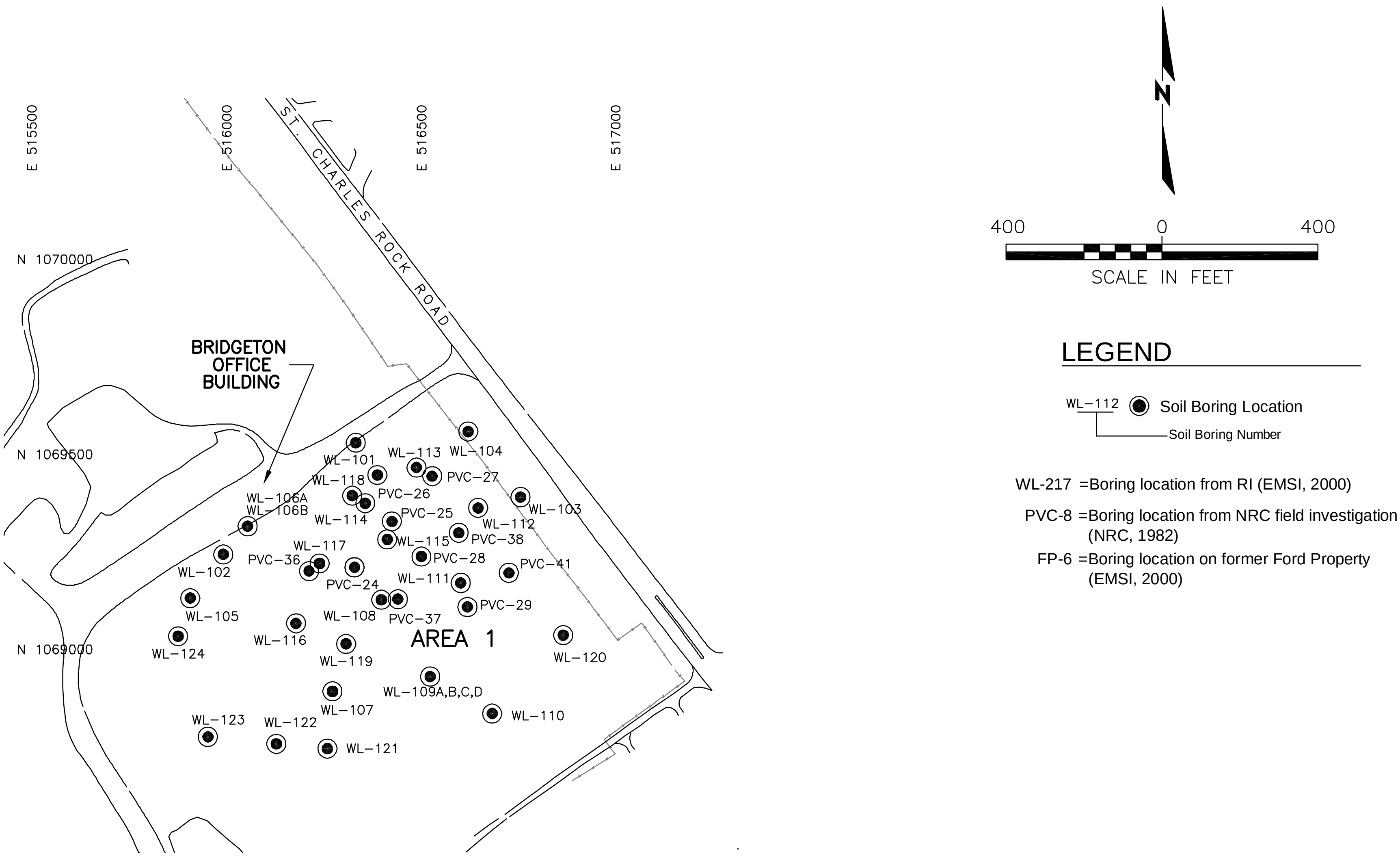


Figure 1
Area 1
Soil Boring Locations
West Lake Landfill OU-1 Remedial Investigation Report

EMSI Engineering Management Support, Inc.

M:\clients\EMSI\westlake\2010\July\appendix\WL-appdx-Fig-2.dwg plotted: 07/13/2010

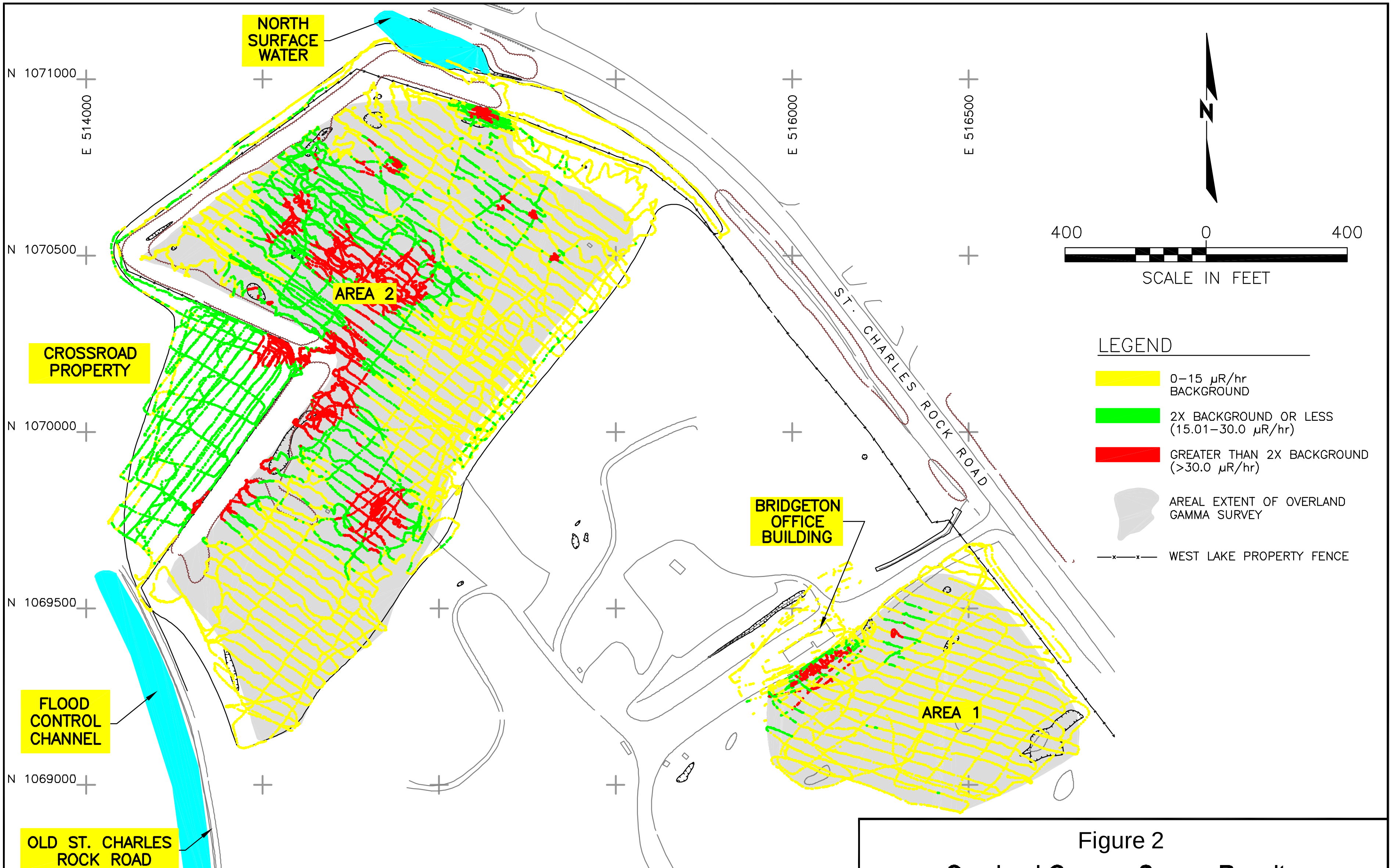


Figure 2

Overland Gamma Survey Results Compared to a 15 μR/hr Background Value

West Lake Landfill OU-1 Remedial Investigation Report

EMSI Engineering Management Support, Inc.

M:\clients\EMSI\westlake\2010\July\appendix\WL-appdx-Fig-3.dwg plotted: 09/21/2011

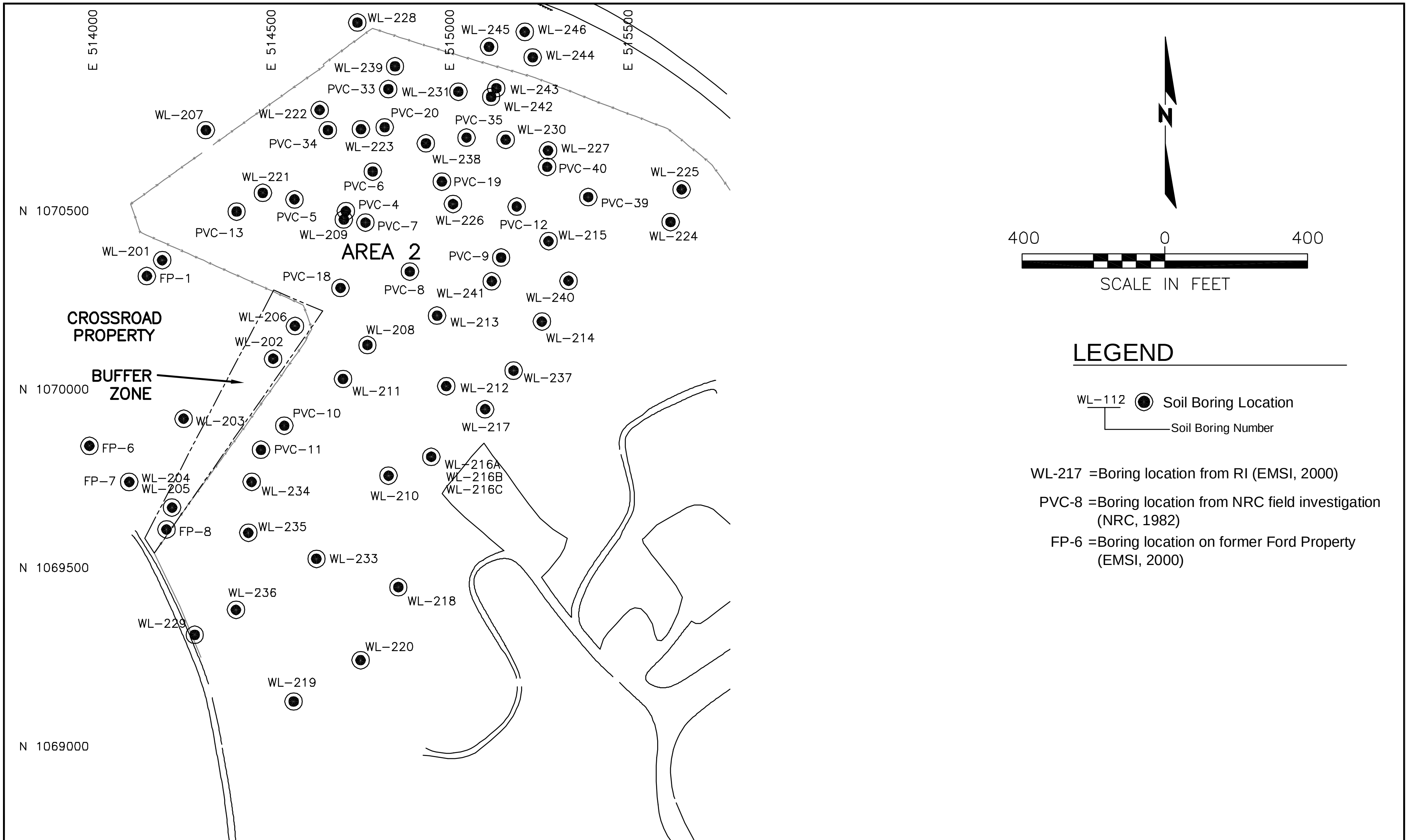


Figure 3

Area 2

Soil Boring Locations

West Lake Landfill OU-1 Remedial Investigation Report

EMSI Engineering Management Support, Inc.

Appendix B-2:

Quantification of the Volume of RIM Above Cleanup Levels

APPENDIX B-2

RADIOLOGICAL-IMPACTED MATERIAL QUANTIFICATION OF EXTENT AND VOLUME

Table of Contents

Figures

Attachments

1 INTRODUCTION

This document is authored to explain the procedures used to quantify the Radiological Impacted Materials (RIM) from the West Lake Superfund Site - Operable Unit 1, or OU-1. The volume estimation techniques and assumptions for the RIM and associated overburden are explained herein.

2 DATA

FEI used data provided by others to quantify the RIM. This data included the latest available aerial topography, the boring data, and the elevations of the RIM within the boring thickness.

2.1 Surface Topography

FEI used the 2005 aerial flyover developed by Sanborn Company of Chesterfield Missouri. The flight date was January 20, 2005. A digital photograph was also obtained during the same flight, and was used within many figures contained herein. Figure 001 entitled "2005 Topography" depicts the 2-feet contour elevations, the underlying digital photo, and the general locations of Area 1 and Area 2 that were described by ESMI in the March 2010 Supplemental Work Plan.

2.2 Boring Data

Within the March 2010 Supplemental Work Plan, ESMI summarized the previous subsurface investigations. These investigations yielded boring logs within the refuse. The borings were surveyed on the same coordinate system as the 2005 surface topography. FEI used this survey data to plot the locations of the investigative borings spatially. FEI then obtained the 2005 elevations at each boring location, and compared these elevations to the original boring elevations. Elevation discrepancies are generally expected over time periods for solid waste fills due to additional filling that may have occurred (outside the impacted limit), and due to settlement of putrescible waste. When the original boring elevations were compared to the 2005 surface topography, the lower of the two elevations were used for the boring. This procedure assumed the settlement would occur lower than the RIM, and the original difference between the top of refuse and the top of the RIM would be preserved during settlement. The settlement concept is further explained in Section 2.4.

Figure 002 depicts the horizontal extent of the RIM locations. The locations of the borings and the surface comparisons for Area 1 are included in Attachment A, while the comparisons for the Area 2 Upper RIM are included in Attachment B, and the Area 2 Lower RIM data are included in Attachment C. The Area 2 Upper and Lower RIM delineations are further explored in Section 2.3.

2.3 Elevations of RIM Material

ESMI reviewed the historical soil sample results and the results of the downhole gamma logging to define areas and depth intervals that likely contain soil with radionuclide levels above the cleanup levels. ESMI developed an interval of impacted material for each boring. For Area 2, some of the impacted borings had 2 discrete intervals which required the RIM to be treated as an upper and lower level. ESMI provided the impacted data in units of feet below ground surface, based upon the original boring logs.

FEI converted the impacted data to feet above Mean Sea Level (MSL), by subtracting the depth of impacted material from the lower of the two elevations (the 2005 surface topography versus the original boring surface elevation) as described in Section 2.2. This data is included in the Supplemental Feasibility Study, Radiological-Impacted Material, Excavation Alternatives Analysis, West Lake Landfill Operable Unit-1.

2.4 Waste Settlement Assumptions

The surface elevations for the Remedial Investigation (RI) soil borings as reported for the RI (McLaren Hart, 1996), the surface elevations obtained from the 2005 topographic survey of the landfill, and the differences between these two values are summarized on Attachments A, B and C to Appendix B-2 of the Supplemental Feasibility Study (SFS). As shown, in many cases there were differences between the 1995 surface elevation data for the RI soil borings and the more recent 2005 surface elevations of the landfill surface at each of the soil borings. For example, the surface elevation for RI soil boring WL-101 was reported (McLaren Hart, 1996) to be 456.5 ft above mean sea level (amsl). In contrast, review of the 2005 topographic survey map of the landfill indicated that the surface elevation at WL-101 was 455.53 ft amsl.

A number of possible reasons for such variations exist, including one or more of the following:

1. Differences in the accuracy and precision of the survey data (vertical benchmarks and horizontal control) used as the basis for the survey events and comparisons between the two surveys;
2. Localized variations in the surface elevations that result in significant variability in the 2005 topographic surface over small distances;
3. Consolidation and settlement of the landfilled wastes over the ten year period between the 1995 RI surveying activities and the 2005 topographic surveying effort;
4. Placement of additional clean fill material on the landfill surface during the intervening period between 1995 and 2005.

Appendix B-2, Section 2.2 of the SFS discussed the techniques used to quantify the RIM volume based upon the currently available data. As was explained therein, the lower of the 1995 and 2005 elevations were used for purposes of calculating the depth to the top and bottom of the RIM interval.

Use of the lower of the two elevations for purposes of calculating the depth to the top and bottom of the RIM is reasonable and conservative, and is based on an assumption that the primary cause of the differences between the two elevations was consolidation and settlement of the waste materials. The rationale for adopting this approach is that it assumes that settlement would primarily occur in the waste materials located below the RIM owing to the relatively shallow depths at which the RIM is located (generally in the upper 20 feet) compared to the overall depth and thickness of all of the wastes (generally approximately 50 feet). This assumption is based on the greater thickness of waste material (hence greater potential for settlement and consolidation) below the RIM compared to above the RIM. Accordingly, this approach preserves the original difference between the top of refuse and the top of the RIM identified on the soil boring logs. This is conservative in that it could result in a slight over-estimate of the volume of overburden waste that would need to be removed to provide access to the RIM compared to assuming that the thickness of RIM was compressed. Without site specific data regarding settlement, assumptions other than conservative ones would not be prudent.

3 IDENTIFICATION OF VOLUMES OF SOIL TO BE EXCAVATED AND DISPOSED

FEI used the data obtained in Sections 2.1, 2.2, and 2.3 to identify the waste materials containing radionuclides above the cleanup levels using three-dimensional orientations within the overall waste mass. By using computer-assisted volumetric calculating software, a volume projection was estimated for both the waste materials containing radionuclides above the cleanup levels and the overburden waste which must be removed as overburden.

FEI used the AutoCAD Civil 3D 2010 software to complete the volume calculations. This program generates surfaces of a layer of interest, and then uses a volume calculation algorithm to estimate the in-place volume between two defined surfaces. A surface is the three-dimensional geometric representation of an area of land. Surfaces are developed by triangles or grids, which are created by either three-dimensional contours (from an aerial topography), or from a series of three dimensional points (x,y,z).

The AutoCAD Civil 3D 2010 software uses the defined surfaces to calculate a volume by subtracting the difference in elevations within the specific grid, and multiplying the difference in elevation by a grid area. The surface is broken into several smaller grid areas, and the total volume adds the incremental volume calculated from each sub-grid area.

3.1 General RIM Development Methods and Extrapolations

To model the 3 dimensional extent of the RIM, the impacted borings (borings with known RIM) were separated from the non-impacted borings. A horizontal limit of impacted borings was developed. This was the impacted limit. Then a horizontal limit was developed by connecting the closest non-impacted borings, or other areas of known limits such as toe of slopes, or roads. This was termed the non-impacted limit.

FEI developed a nomenclature to identify the upper occurrence of the RIM as RIM 1. The lower boundary of the RIM was termed RIM 2. However, before a volume could be developed for the RIM total, a procedure was needed to determine how the upper and lower RIM surfaces were merged to form a contiguous three dimensional polygon.

Figure 005 entitled “Pie Treatment Options A-D” shows the four methods the RIM was terminated and how RIM 1 and RIM 2 were merged to form the contiguous three dimensional polygons. Treatment “A” is the primary method of terminating the RIM extents, and is illustrated by an impacted and non-impacted boring in Area 1 (See Figure 003 for the location of PVC-25 and WL-115). Boring PVC-25 is an impacted boring, with a surface elevation of 466.0. The upper RIM elevation (or RIM 1 elevation) was calculated to be at elevation 459.0. The lower RIM elevation (or RIM 2 elevation) was calculated at elevation 455.0. The known RIM extent is depicted using a red line within the section “a” on Figure 005. WL-115 is a neighboring boring without impact.

Therefore, the RIM merges somewhere between PVC-25 and WL-115. It is unlikely that the RIM extent stops at the impacted limit. The non-impacted boring is a known zero limit. Therefore, the RIM extent could be extended to the midpoint elevation at the non-impacted limit, similar geometry to a pie crust. However, with the understanding of how waste was deposited and spread, it is unlikely that the waste was spread to a zero thickness. Therefore, it was assumed that the RIM extended to the midpoint between the impacted boring and the non-impacted boundary, and the thickness was half of the last known thickness within the impacted boring. With our example, RIM 1 was extended to the midpoint location to an elevation of 458.0 feet, while RIM 2 was extended to the midpoint location to an elevation of 456.0 feet. The RIM extension is depicted as a magenta line.

While this treatment was used for the majority of extrapolated RIM limits, there were three other methods of extrapolating RIM beyond the known impacted limit.

Treatment "B" shown on Figure 005 shows a scenario where an impacted boring is near a sideslope, where there was not a corresponding non-impacted boring. In this instance, the known RIM 1 and RIM 2 elevations for the closest impacted boring was extrapolated horizontally until the RIM "daylights" along the surface of the sideslope.

Treatment "C" shown on Figure 005 shows a scenario similar to Treatment "A", but the RIM 1 extension daylights before the midpoint elevation. However, there is a non-impacted boring to suggest no RIM. Therefore, instead of daylighting the known RIM elevation horizontally, this treatment uses the half thickness method at the midpoint location, but follows the surface elevation for the RIM 1 extension.

Treatment "D" shown on Figure 005 is similar to Treatment "B", where there is not a non-impacted boring to suggest a zero thickness of RIM, but rather a sideslope. The RIM extension is projected horizontally until the RIM 1 daylights. This method is different in that the horizontal projection of RIM 2 is below the toe of slope, so the RIM 2 never daylights along a slope. In this method, the RIM 2 elevation is projected horizontally until the toe of slope (assumed waste boundary). Then the RIM 2 is projected vertically until it meets RIM 1.

These treatment methods were used for both Area 1 and Area 2 RIM development.

3.2 Area 1 RIM Development

FEI used the procedure discussed in Section 3.1 to identify the extent of the RIM within the Area 1 limit. This area is south of the entrance road and scalehouse area. Figure 003 entitled "Area 1 – RIM 1 Development" depicts the borings that were used for Area 1. The red line depicted on this drawing represents the impacted limit while the cyan line depicts the non-impacted limit. The magenta line represents the extrapolated limit, also referred to as the Pie 1 line.

Figure 004 entitled “Area 1 – RIM 2 Development” depicts the same impacted and non-impacted boundary. However, the magenta extrapolated limit is modified since the RIM elevations daylight at different locations. In addition, the extrapolated limits were extended horizontally to ensure any areas noted as impacted from the surface gamma scans were included.

The calculations for extrapolated RIM (FEI coined term “pie calculations”) are included in Attachment D.

Based upon the above discussion, the limits of the RIM 1 were contoured and the elevations and contours are depicted on Figure 006 entitled “Area 1 – RIM 1 Contours”. The elevations of the RIM 1 for Area 1 vary from a low of 440.53 feet to a high of 469.9 feet. In a similar manner, the limits of the RIM 2 were contoured and the elevations and contours are depicted on Figure 007 entitled “Area 1 – RIM 2 Contours”. The elevations of the RIM 2 for Area 1 vary from a low of 438.5 feet to a high of 461.0 feet.

3.3 Area 1 RIM Volume

Once the RIM has been identified, and the boundaries extrapolated, a volume of the RIM was calculated. Figure V-002 entitled “Area 1 – RIM Volume” depicts the amount of impacted material that would require excavation. The volume thickness on this figure varies from a minimum thickness of 0 feet to a maximum thickness of 14.9 feet.

3.4 Area 1 Total Excavation Volume

Once the three dimensional polygon for the RIM was defined, an excavation grading plan was developed. This grading plan involved extending the outermost RIM 2 limit to the 2005 Surface Topography using a 3 Horizontal to 1 Vertical (3H:1V) slope. Figure V-001 entitled “Total Excavation Volume” depicts the grading and volume needed to remove the entire RIM and overburden waste. This volume figure depicts a minimum thickness of 0 feet to a maximum thickness of 27.2 feet.

3.5 Area 1 Excavation Summary

Table 3.1 summarizes the excavation and RIM volumes for Area 1.

RIM Volume	33,452 cubic yards (bank)
Overburden Volume (Including Slopes)	48,910 cubic yards (bank)
Total Volume (Excavation and RIM)	82,362 cubic yards (bank)

3.6 Area 2 RIM Development – Upper

FEI used the procedure discussed in Section 3.1 to identify the extent of the RIM within the Area 2 limit. This area is north of the entrance road and west of the St. Charles Rock Road. Figure 008 entitled “Area 2 – RIM 1 (Upper) Development” depicts the borings that were used for Area 2. The red line depicted on this drawing represents the impacted limit while the cyan line depicts the non-impacted limit. The magenta line represents the extrapolated limit, also referred to as the Pie 1 line.

Figure 009 entitled "Area 2 – RIM 2 (Upper) Development" depicts the same impacted and non-impacted boundary. However, the magenta extrapolated limit is modified since the RIM elevations daylight at different locations. In addition, the extrapolated limits were extended horizontally to ensure any areas noted as impacted from the surface gamma scans were included.

The calculations for extrapolated RIM (FEI coined term "pie calculations") are included in Attachment E.

Based upon the above discussion, the limits of the RIM 1 were contoured and the elevations and contours are depicted on Figure 010 entitled "Area 2 – RIM 1 (Upper) Contours". The elevations of the RIM 1 Upper for Area 2 vary from a low of 449.8 feet to a high of 479.5 feet. In a similar manner, the limits of the RIM 2 upper were contoured and the elevations and contours are depicted on Figure 011 entitled "Area 2 – RIM 2 (Upper) Contours". The elevations of the RIM 2 Upper for Area 2 vary from a low of 445.0 feet to a high of 478.5 feet.

3.7 Area 2 Upper RIM Volume

Once the RIM has been identified, and the boundaries extrapolated, a volume of the RIM was calculated. Figure V-004 entitled "Area 2 – RIM (Upper) Volume" depicts the amount of impacted material that would require excavation. The volume thickness on this figure varies from a minimum thickness of 0 feet to a maximum thickness of 23.5 feet.

3.8 Area 2 RIM Development - Lower

FEI used the procedure discussed in Section 3.1 to identify the extent of the RIM within the Area 2 limit. However, some of the impacted borings had two discrete RIM layers. The lower RIM was based upon the second occurrence of the RIM. However, upon review of the spatial orientation of the lower RIM, it was obvious that there were three separate locations of the lower RIM.

Figure 012 entitled "Area 2 – RIM 1 (Lower) Development" depicts the borings that were used for Area 2. The red line depicted on this drawing represents the impacted limit while the cyan line depicts the non-impacted limit. The magenta line represents the extrapolated limit, also referred to as the Pie 1 line. Note the location of the three non-contiguous locations of the RIM.

Figure 013 entitled "Area 2 – RIM 2 (Lower) Development" depicts the same impacted and non-impacted boundary.

The calculations for extrapolated RIM (Lower) are included in Attachment F.

Based upon the above discussion, the limits of the RIM 1 Lower were contoured and the elevations and contours are depicted on Figure 014 entitled "Area 2 – RIM 1 (Lower) Contours". The elevations of the RIM 1 Lower for Area 2 vary from a low of 437.7 feet to a high of 459.0 feet. In a similar manner, the limits of the RIM 2 lower were contoured and the elevations and contours are depicted on Figure 015 entitled "Area 2 – RIM 2 (Lower) Contours". The elevations of the RIM 2 lower for Area 2 vary from a low of 427.2 feet to a high of 455.0 feet.

3.9 Area 2 Lower RIM Volume

Once the RIM has been identified, and the boundaries extrapolated, a volume of the RIM was calculated. Figure V-005 entitled "Area 2 – RIM (Lower) Volume" depicts the amount of impacted material that would require excavation. The volume thickness on this figure varies from a minimum thickness of 0 feet to a maximum thickness of 10.4 feet.

3.10 Area 2 Total Excavation Volume

Once the three dimensional polygon for the RIM was defined, an excavation grading plan was developed. This grading plan involved extending the outermost RIM 2 limit to the 2005 Surface Topography using a 3 Horizontal to 1 Vertical (3H:1V) slope. The two levels of RIM complicated the grading plan. First, the Upper RIM 2 limit was blended into the 2005 Surface Topography. Then the Lower RIM 2 limit was blended into the previous blended surface to obtain a total excavation for Area 2.

Figure V-003 entitled "Area 2 – (U +L) Excavation Volume" depicts the grading and volume needed to remove the entire RIM and overburden waste. This volume figure depicts a minimum thickness of 0 feet to a maximum thickness of 48.8 feet.

3.11 Area 2 Excavation Summary

Table 3.2 summarizes the excavation and RIM volumes for Area 2.

RIM Volume (Upper)	279,040 cubic yards (bank)
RIM Volume (Lower)	22,997 cubic yards (bank)
Overburden Volume (Including Slopes)	309,703 cubic yards (bank)
Total Volume (Excavation and RIM)	611,740 cubic yards (bank)

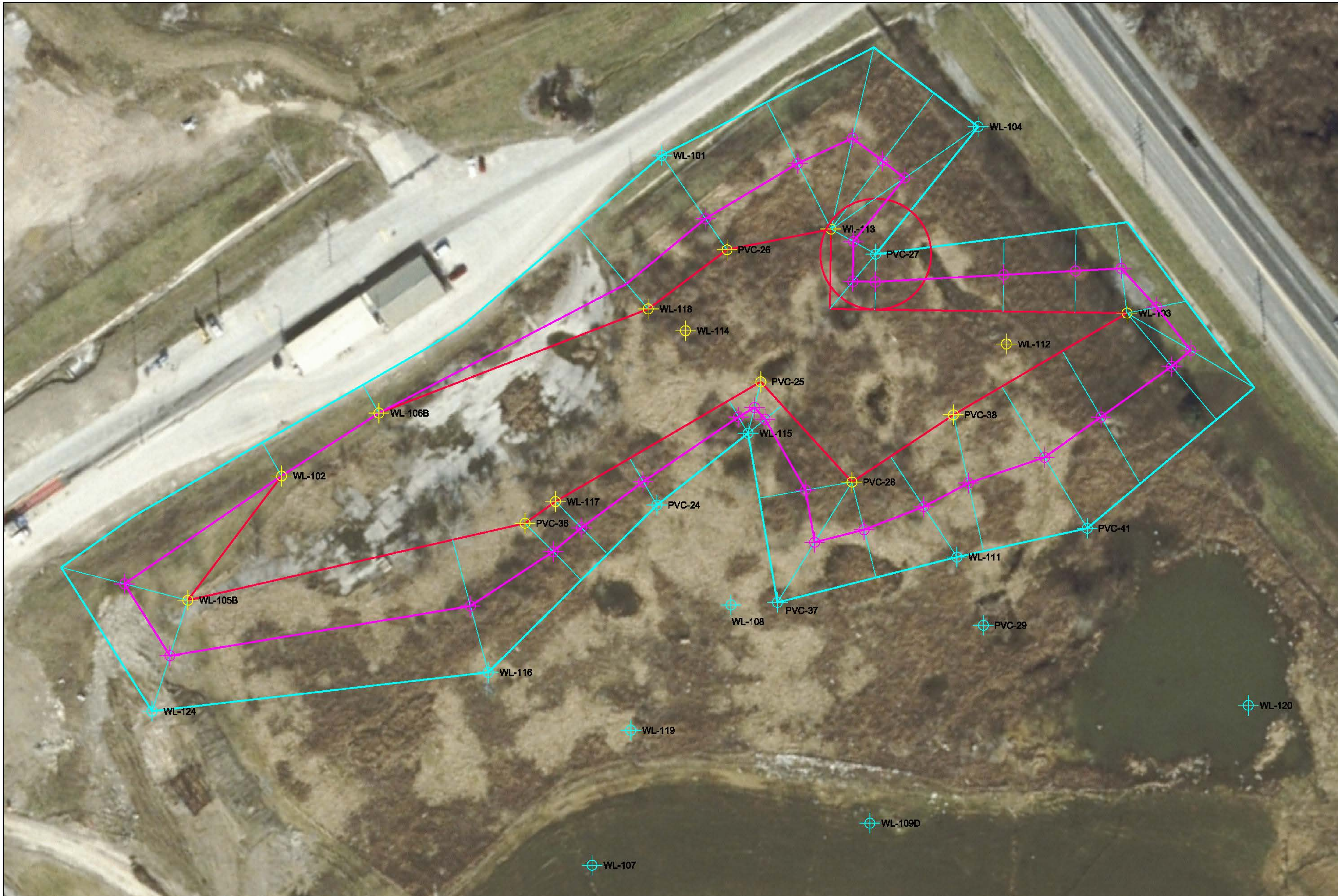
4 CONCLUSION

It must be noted that there is a large degree of uncertainty associated with the volume estimates. This uncertainty arises from the limits on the accuracy of the existing site topographic mapping, which is based on aerial photogrammetry without ground control producing, at best, a topographic surface with a tolerance of approximately one foot. In addition, past subsurface investigations of the site were focused on providing information on the general nature and extent of occurrences of radiologically-impacted materials. The current understanding of the lateral and vertical extent of the radiologically-impacted materials is based on data density derived from approximately one soil boring per acre. This information was determined to be sufficient to characterize the potential risks posed by the site and to identify and evaluate potential remedial alternatives for the site.

Figures

West Lake Landfill Operable Unit-1	Radiologically-Impacted Material (RIM) Analysis	FEEZOR ENGINEERING, INC.	DATE: MARCH 2010
2005 Topography			DRAWING NO.: 001

West Lake Landfill Operable Unit-1	Radiological-Impacted Material (RIM) Analysis	FEEZOR ENGINEERING, INC. Engineering for a Better World	DATE: MARCH 2010 DESIGNED BY: APPROVED BY:
Boring Locations			DRAWING NO.: **002**
PROJECT NUMBER: ST-005	FILE PATH:		REVISION / DATE



Non-RIM Limit
Extrapolated RIM Limit
Known RIM Limit

SCALE IN FEET

West Lake Landfill Operable Unit-1	Radiological-Impacted Material (RIM) Analysis	DATE: MARCH 2010
AREA 1 - RIM 1 Development	FEEZOR ENGINEERING, INC. Engineering for a Better World	DESIGNED BY: / APPROVED BY:
PROJECT NUMBER: 07-005		REVISION / DATE

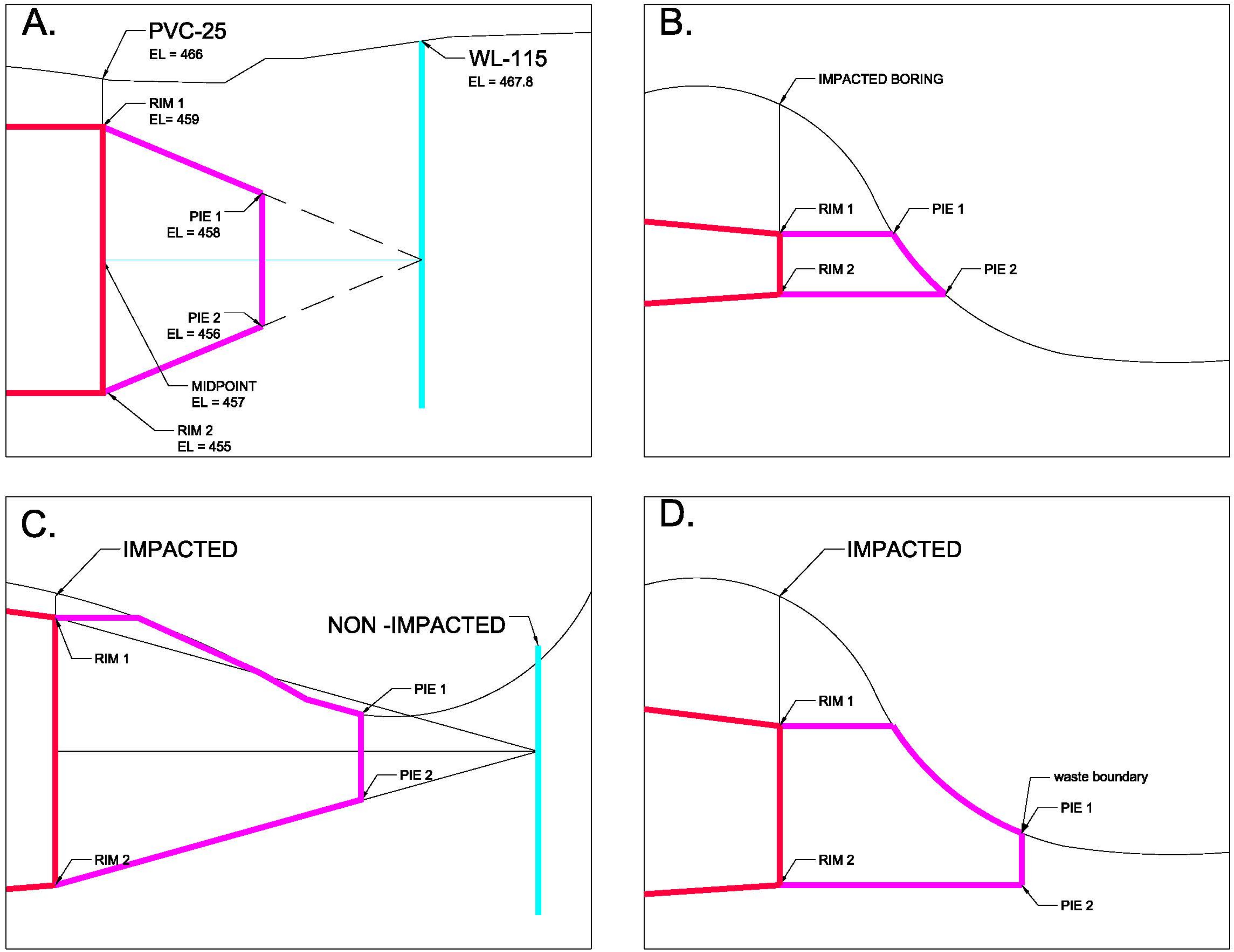
DRAWING NO.: **003**

Non-RIM Limit
Extrapolated RIM Limit
Known RIM Limit

SCALE: IN FEET

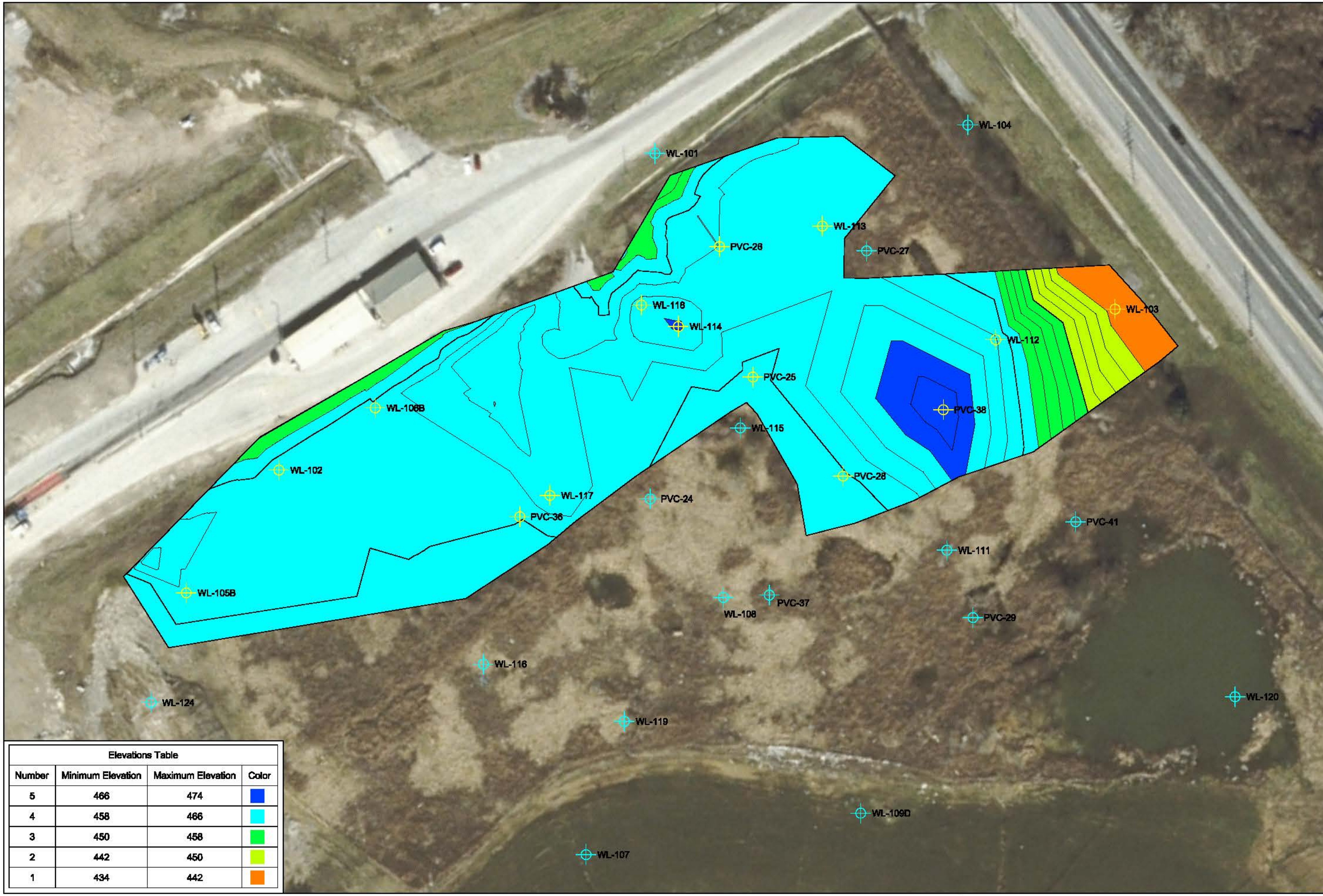
West Lake Landfill Operable Unit-1	Radiological-Impacted Material (RIM) Analysis	FEEZOR ENGINEERING, INC.	DATE: MARCH 2010
AREA 1 - RIM 2 Development			DESIGNED BY:
PROJECT NUMBER: ST-006	FILE PATH:		APPROVED BY:
			REVISION / DATE

DRAWING NO.: **004**



West Lake Landfill Operable Unit-1	Radiological-Impacted Material (RIM) Analysis	DATE: MARCH 2010	DRAWING NO:
Pie Treatment Options A-D		DESIGNED BY:	**005**
		APPROVED BY:	
PROJECT NUMBER: ST-005	FILE PATH:	REVISION	DATE

Engineering for a Better World
FEEZOR ENGINEERING, INC.



Elevations Table

Number	Minimum Elevation	Maximum Elevation	Color
5	466	474	
4	458	466	
3	450	458	
2	442	450	
1	434	442	

West Lake Landfill Operable Unit-1

Radiological-Impacted Material (RIM) Analysis

AREA 1 - RIM 1 Contours

FEEZOR ENGINEERING, INC.

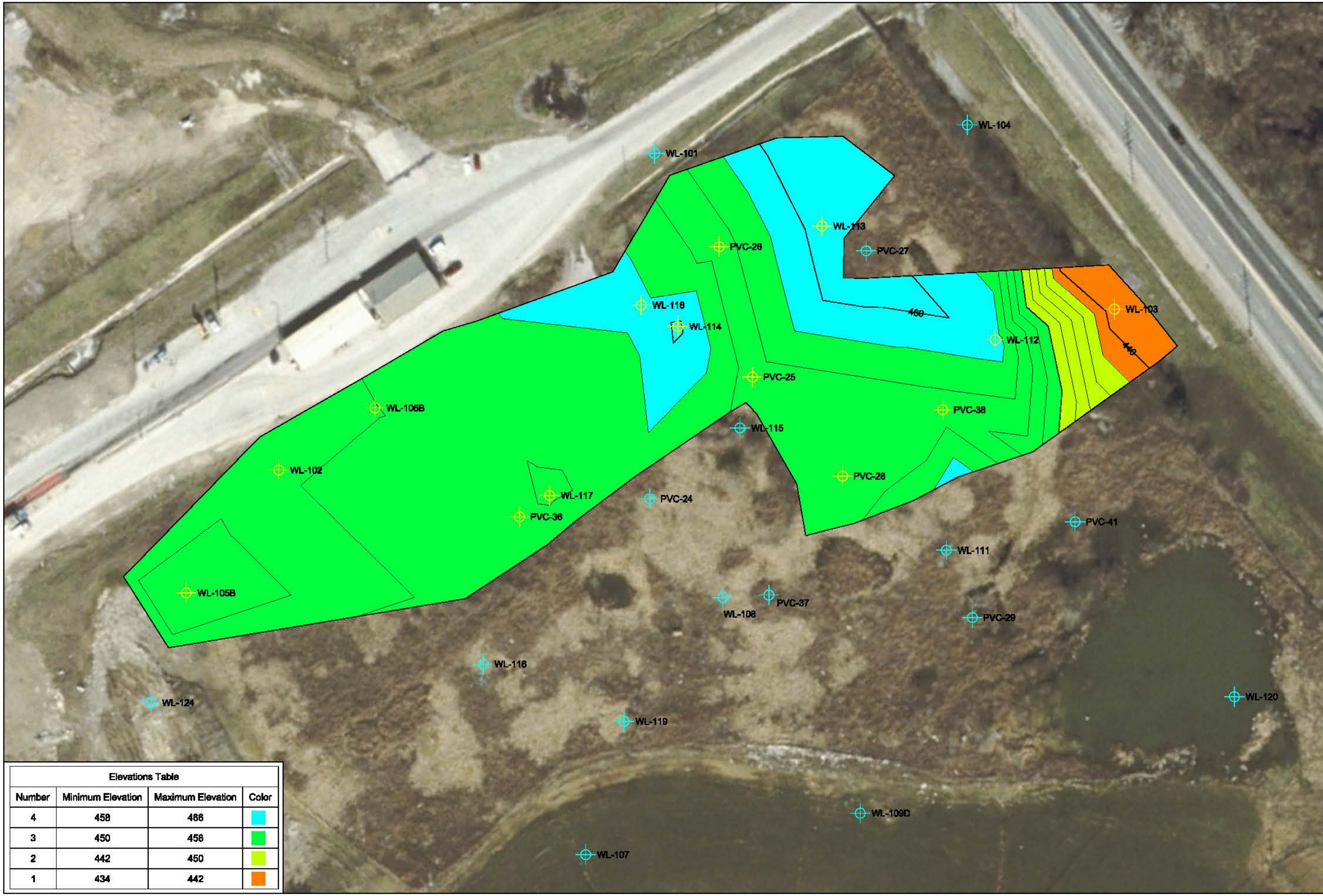
DATE: MARCH 2010

DESIGNED BY:

APPROVED BY:

REVISION | DATE

DRAWING NO.: 006



Elevations Table

Number	Minimum Elevation	Maximum Elevation	Color
4	458	466	
3	450	458	
2	442	450	
1	434	442	

SCALE IN FEET

West Lake Landfill Operable Unit-1

Radiological-Impacted Material (RIM) Analysis

AREA 1 - RIM 2 Contours

FEEZOR ENGINEERING, INC.

DATE: MARCH 2010

DESIGNED BY:

APPROVED BY:

REVISION DATE

DRAWING NO.: 007

Non-RIM Limit
Extrapolated RIM Limit
Known RIM Limit

SCALE IN FEET

West Lake Landfill Operable Unit-1	Radiological-Impacted Material (RIM) Analysis	FEEZOR ENGINEERING, INC. Engineering for a Better World	DATE: MARCH 2010	DRAWING NO.:
AREA 2 - RIM 1 (Upper) Development			DESIGNED BY: / APPROVED BY:	008
PROJECT NUMBER: ST-005	FILE PATH:		REVISION / DATE	

Non-RIM Limit

Extrapolated RIM Limit

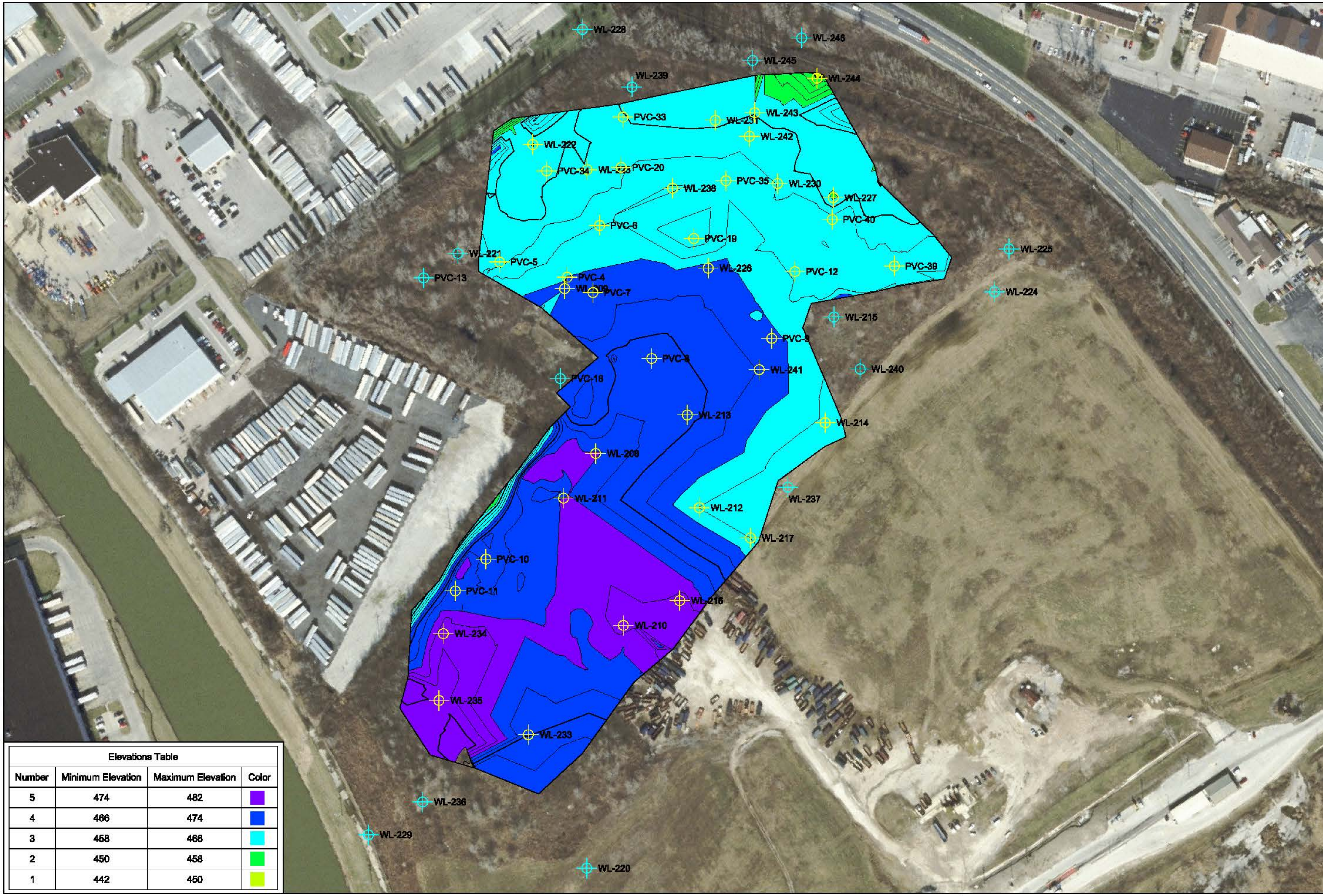
Known RIM Limit

SCALE IN FEET

West Lake Landfill Operable Unit-1	Radiological-Impacted Material (RIM) Analysis	Engineering for a Better World FEEZOR ENGINEERING, INC.	DATE: MARCH 2010 / DESIGNED BY: / APPROVED BY:
AREA 2 - RIM 2 (Upper) Development			REVISION / DATE
PROJECT NUMBER: ST-000	FILE PATH:		

DRAWING NO.:

009



Elevations Table			
Number	**Minimum Elevation**	**Maximum Elevation**	**Color**
5	474	482	
4	466	474	
3	458	466	
2	450	458	
1	442	450	

SCALE IN FEET

West Lake Landfill Operable Unit-1

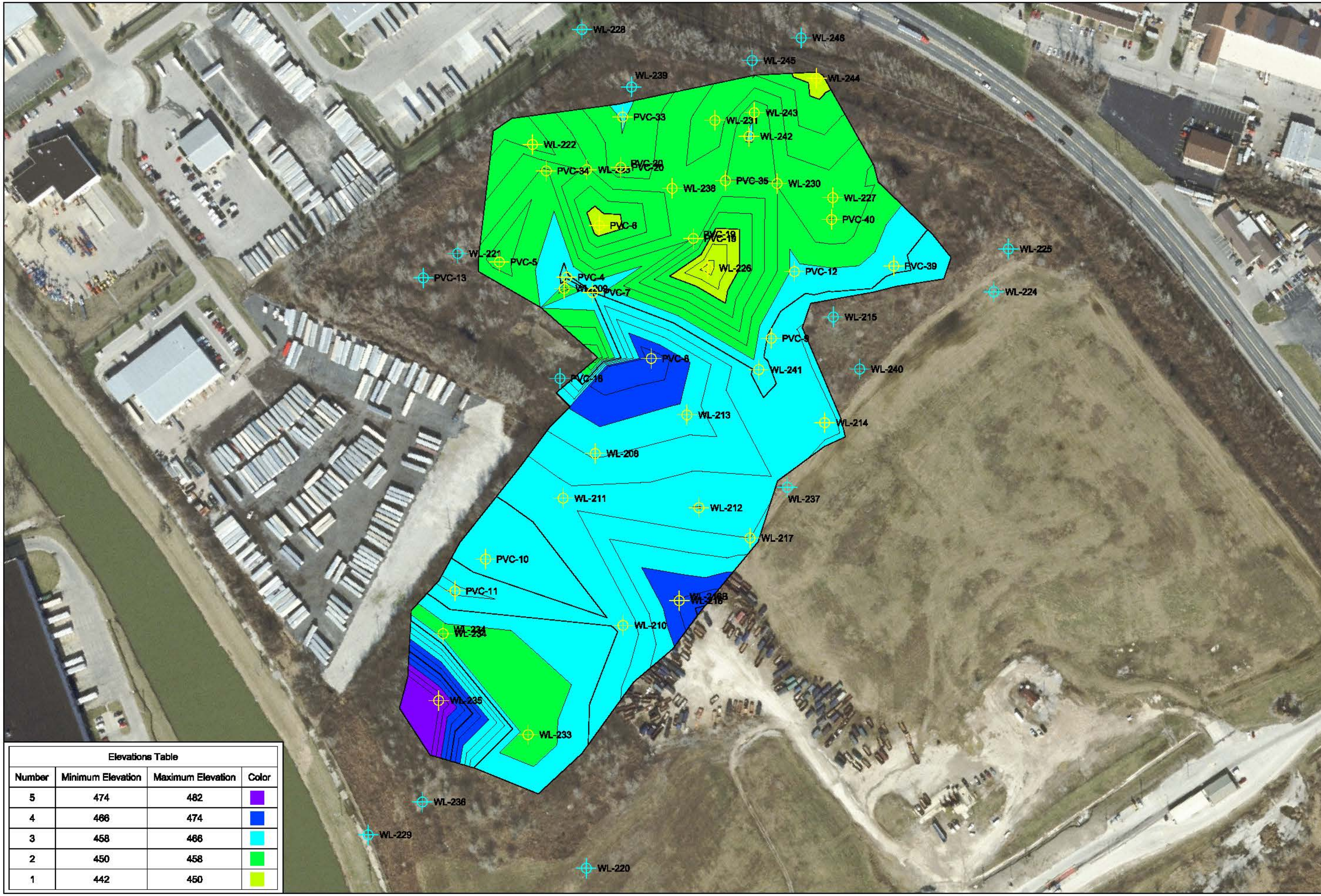
Radiological-Impacted Material (RIM) Analysis

AREA 2 - RIM 1 (Upper) Contours

FEEZOR ENGINEERING, INC.

DATE: MARCH 2010
DESIGNED BY:
APPROVED BY:

DRAWING NO.: **010**



Elevations Table

Number	Minimum Elevation	Maximum Elevation	Color
5	474	482	
4	466	474	
3	458	466	
2	450	458	
1	442	450	

West Lake Landfill Operable Unit-1

Radiological-Impacted Material (RIM) Analysis

AREA 2 - RIM 2 (Upper) Contours

FEEZOR ENGINEERING, INC.

DATE: MARCH 2010

DRAWING NO.: 011

- Non-RIM Limit
- Extrapolated RIM Limit
- Known RIM Limit

SCALE: IN FEET

West Lake Landfill Operable Unit-1	Radiological-Impacted Material (RIM) Analysis	FEEZOR ENGINEERING, INC. Engineering for a Better World	DATE: MARCH 2010 / DESIGNED BY: / APPROVED BY:
AREA 2 - RIM 1 (Lower) Development			REVISION / DATE
PROJECT NUMBER: ST-005	FILE PATH:		DRAWING NO.: 012

Non-RIM Limit
Extrapolated RIM Limit
Known RIM Limit

SCALE IN FEET

West Lake Landfill Operable Unit-1	Radiological-Impacted Material (RIM) Analysis	Engineering for a Better World FEEZOR ENGINEERING, INC.	DATE: MARCH 2010 DESIGNED BY: APPROVED BY:

AREA 2 - RIM 2 (Lower) Development

DRAWING NO.: 013

PROJECT NUMBER: ST-005 | FILE PATH: | REVISION | DATE

Elevations Table			
Number	Minimum Elevation	Maximum Elevation	Color
4	458	466	
3	450	458	
2	442	450	
1	434	442	

West Lake Landfill Operable Unit-1

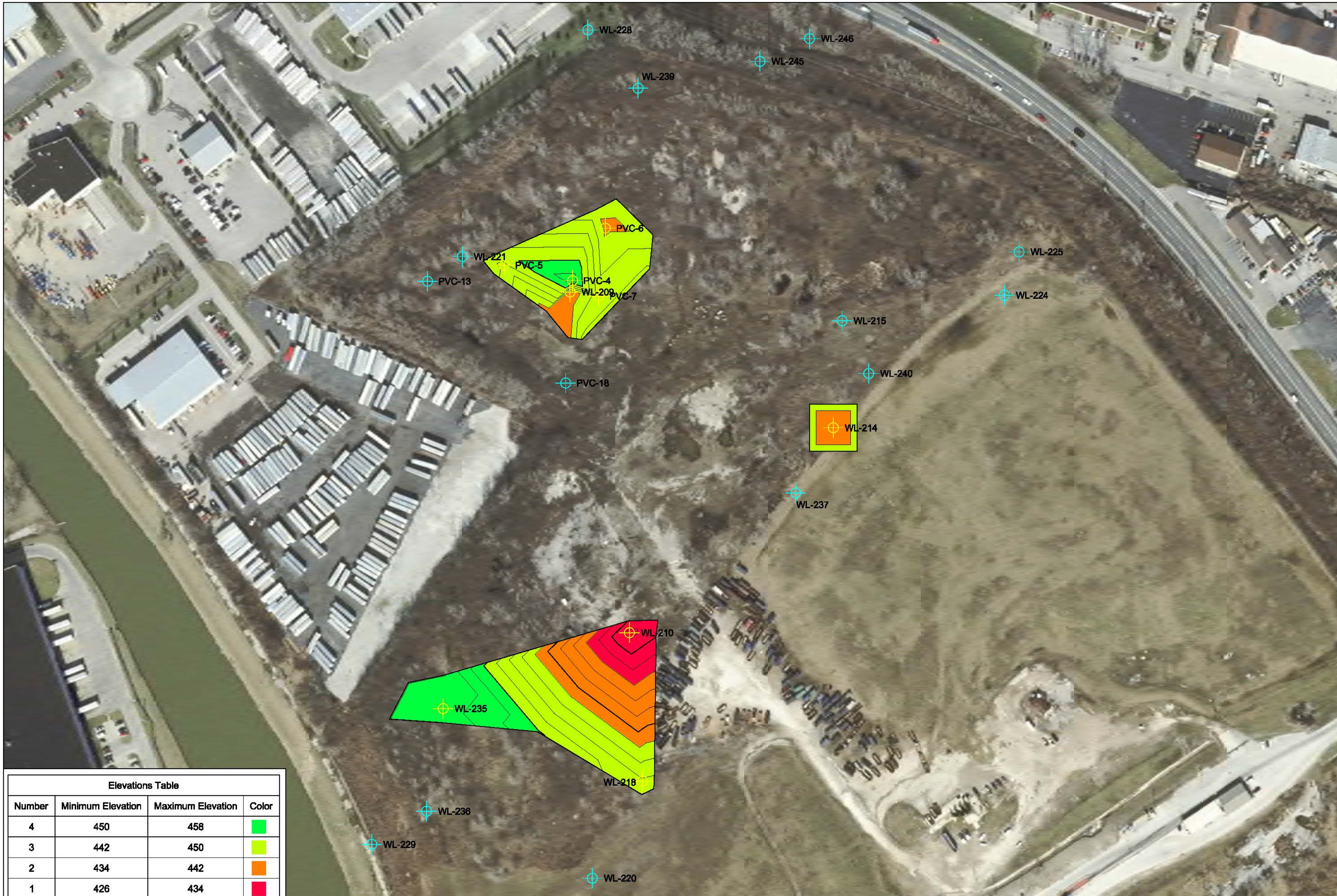
Radiological-Impacted Material (RIM) Analysis

AREA 2 - RIM 1 (Lower) Contours

FEEZOR ENGINEERING, INC.

DATE: MARCH 2010

DRAWING NO.: 014



Elevations Table

Number	Minimum Elevation	Maximum Elevation	Color
4	450	458	
3	442	450	
2	434	442	
1	426	434	

West Lake Landfill Operable Unit-1 | Radiological-Impacted Material (RIM) Analysis

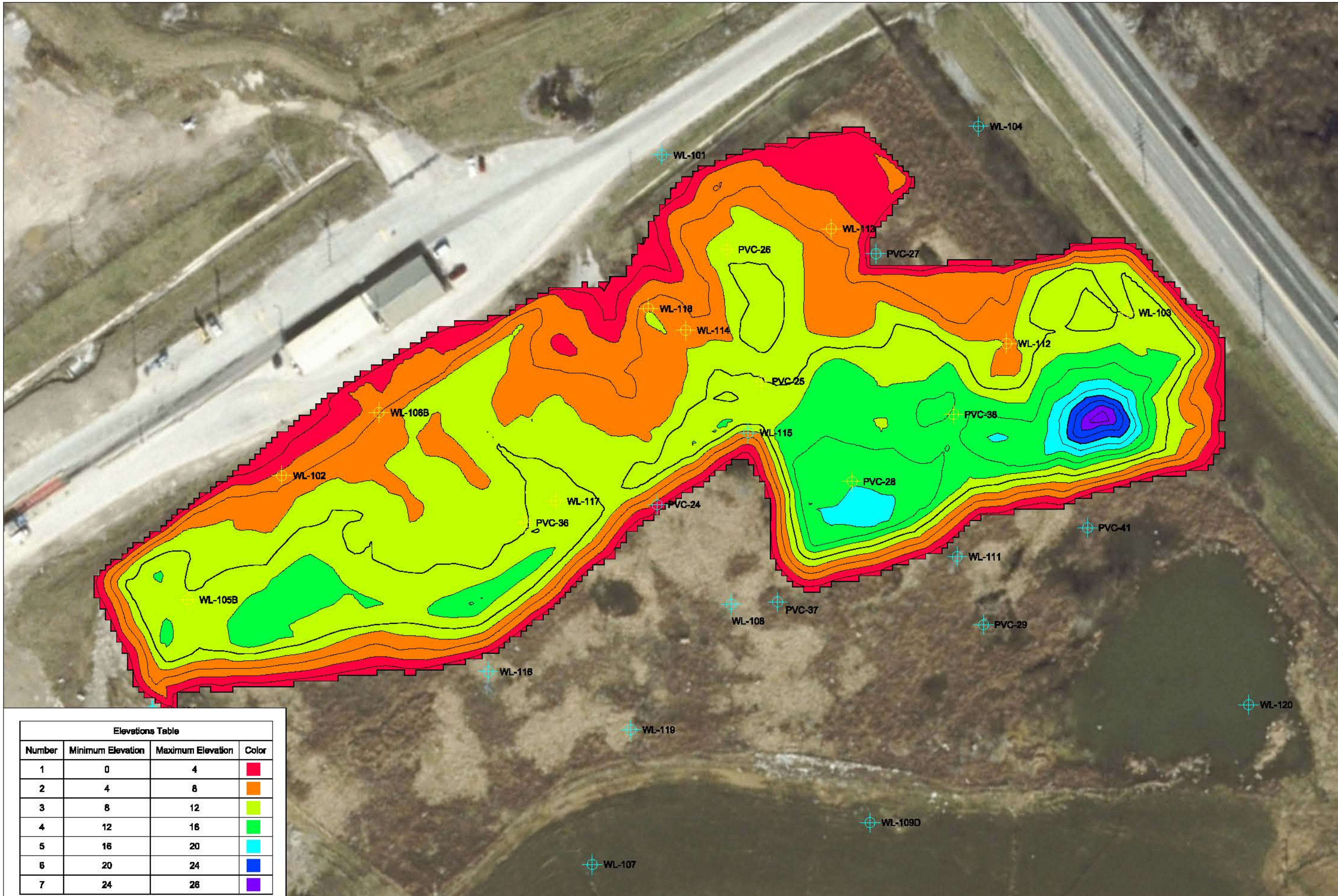
AREA 2 - RIM 2 (Lower) Contours

FEEZOR ENGINEERING, INC.
Engineering for a Better World

DATE: MARCH 2010
DESIGNED BY:
APPROVED BY:

DRAWING NO.: 015

PROJECT NUMBER: ST-005 | FILE PATH: | DATE



Elevations Table			
Number	Minimum Elevation	Maximum Elevation	Color
1	0	4	
2	4	8	
3	8	12	
4	12	16	
5	16	20	
6	20	24	
7	24	28	

West Lake Landfill Operable Unit-1

Radiologically-Impacted Material (RIM) Analysis

AREA 1 - Total Excavation Volume

FEEZOR ENGINEERING, INC.

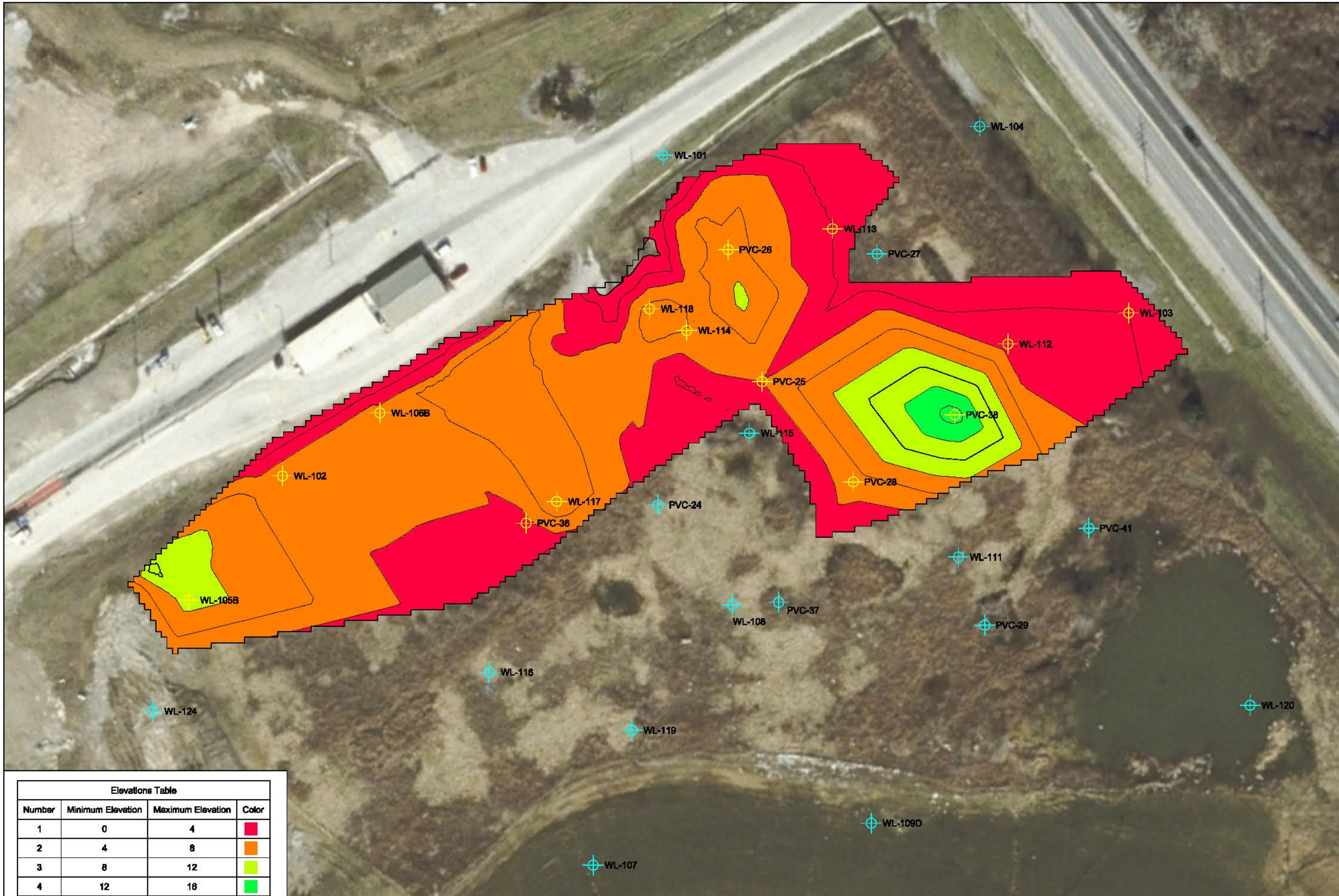
DATE: MARCH 2010

DESIGNED BY:

APPROVED BY:

DRAWING NO.:

V-001



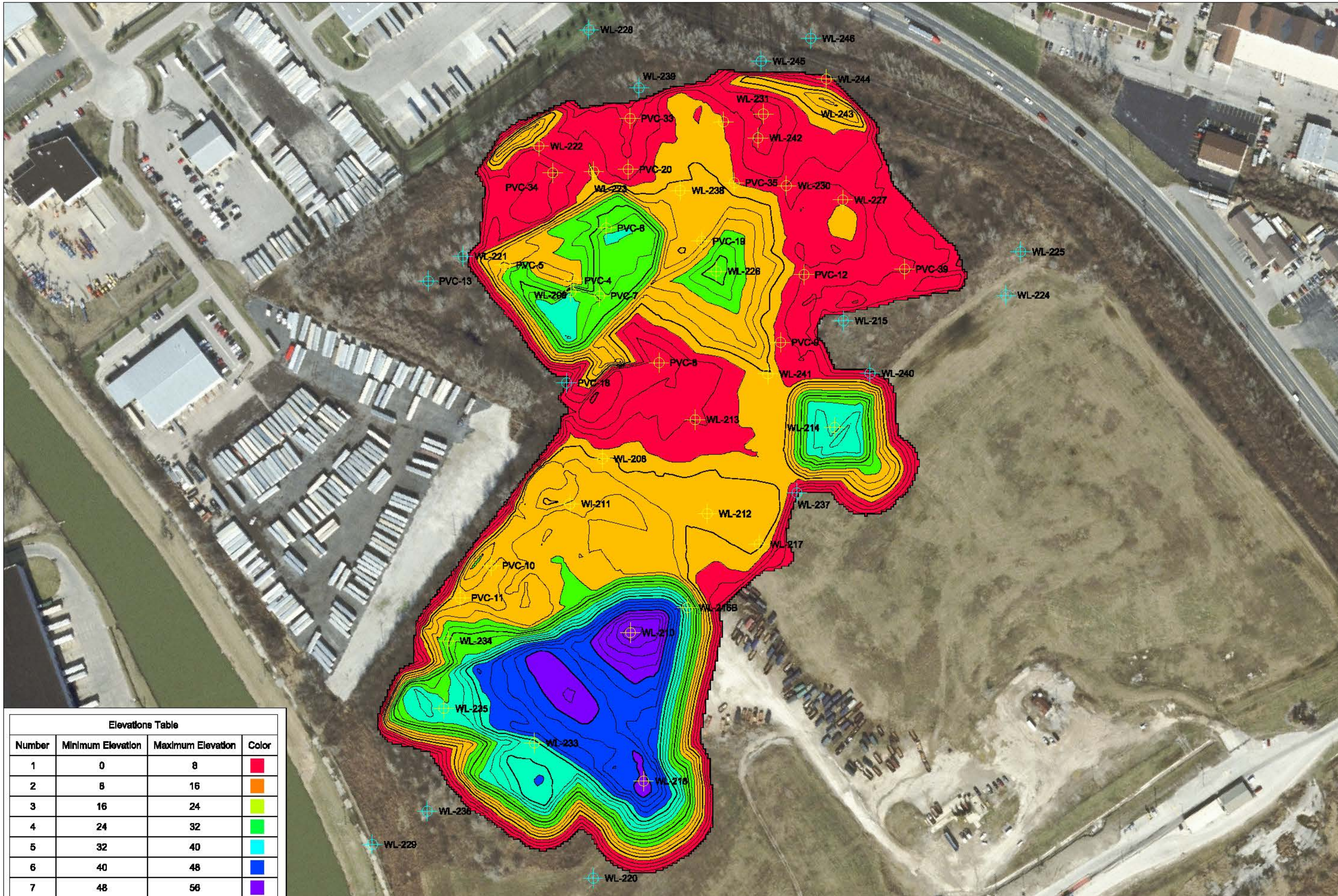
Elevations Table			
Number	Minimum Elevation	Maximum Elevation	Color
1	0	4	
2	4	8	
3	8	12	
4	12	16	

West Lake Landfill Operable Unit-1 | Radiological-Impacted Material (RIM) Analysis

AREA 1 - RIM Volume

FEEZOR ENGINEERING, INC.

DRAWING NO.: **V-002**



Elevations Table

Number	Minimum Elevation	Maximum Elevation	Color
1	0	8	
2	8	16	
3	16	24	
4	24	32	
5	32	40	
6	40	48	
7	48	56	

SCALE: IN FEET

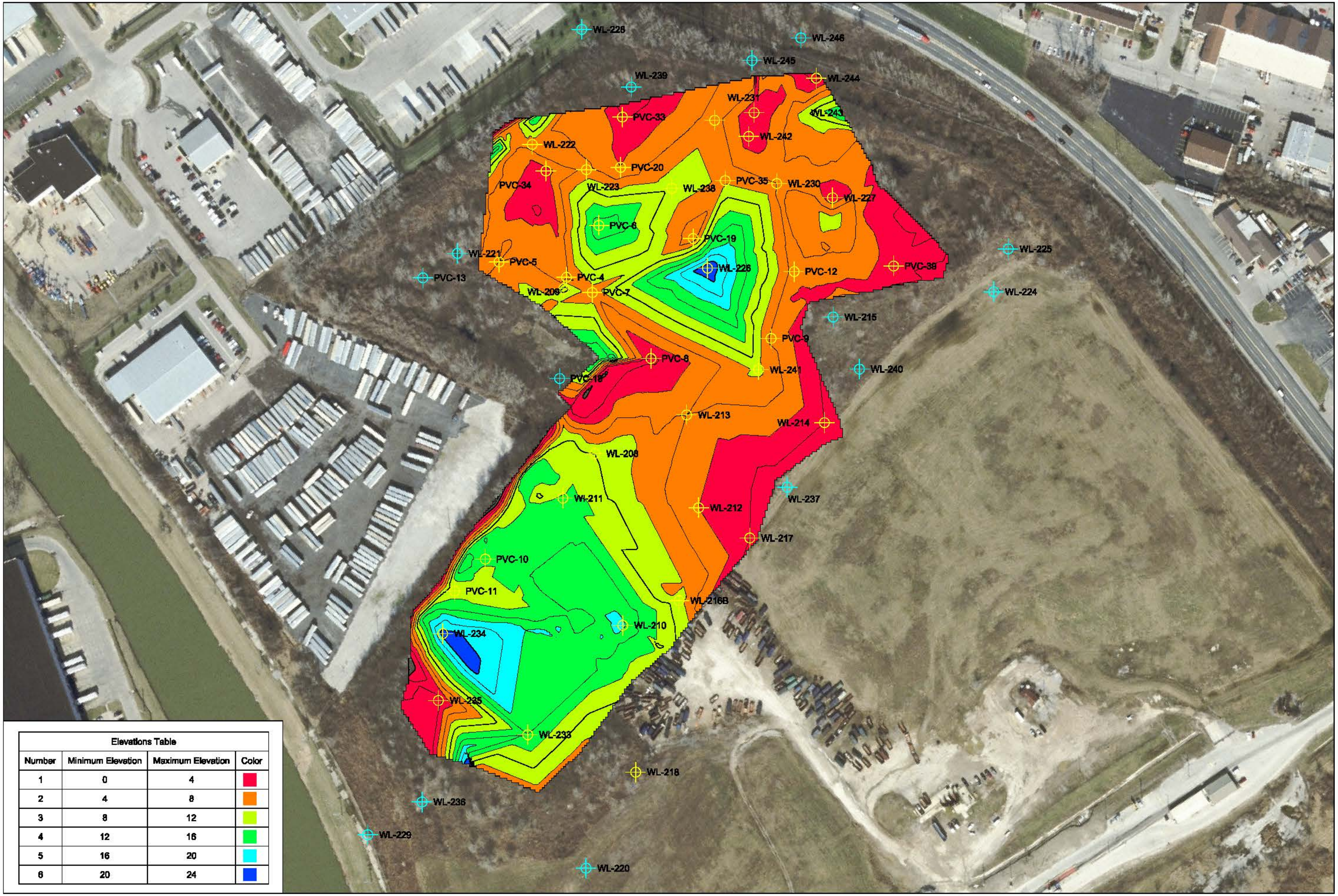
West Lake Landfill Operable Unit-1

Radiological-Impacted Material (RIM) Analysis

AREA 2 - (U+L) Excavation Volume

FEEZOR ENGINEERING, INC.

DRAWING NO.: V-003



Elevations Table

Number	Minimum Elevation	Maximum Elevation	Color
1	0	4	
2	4	8	
3	8	12	
4	12	16	
5	16	20	
6	20	24	

West Lake Landfill Operable Unit-1

Radiological-Impacted Material (RIM) Analysis

AREA 2 - RIM (Upper) Volume

FEEZOR ENGINEERING, INC.

DATE: MARCH 2016

DESIGNED BY:

APPROVED BY:

REVISION | DATE

DRAWING NO.:

V-004

Elevations Table

Number	Minimum Elevation	Maximum Elevation	Color
1	0	4	
2	4	8	
3	8	12	

West Lake Landfill Operable Unit-1

Radiological-Impacted Material (RIM) Analysis

AREA 2 - RIM (Lower) Volume

FEEZOR ENGINEERING, INC.

DATE: MARCH 2016
DESIGNED BY:
APPROVED BY:

DRAWING NO.: V-005

Attachment A:

RIM Worksheet for Area 1

Area 1 RIM Worksheet

Coordinates from boring log/survey reports using 2005 topo el.				
Point #	Northing	Easting	SRF el.	Description
1001	1069549.55	516317.21	455.5306	WL-101
1002	1069260.46	515974.05	461.8869	WL-102
1003	1069407.36	516737.06	449.533	WL-103
1004	1069575.47	516602.77	448.7161	WL-104
1005	1069148.42	515889.5	464.2942	WL-105B
1006	1069317.25	516061.92	461.9552	WL-106B
1007	1068909.52	516254.31	495.9717	WL-107
1008	1069144.21	516379.68	470.9013	WL-108
1009	1068947.38	516504.97	482.9969	WL-109D
1010	1068852.431	516664.5787	508.2668	WL-110
1011	1069187.35	516583.61	472.6424	WL-111
1012	1069379.45	516628.22	466.1951	WL-112
1013	1069483.19	516469.95	465.9636	WL-113
1014	1069391.53	516338.57	466.3667	WL-114
1015	1069298.98	516395.13	467.8177	WL-115
1016	1069083.49	516160.6	473.2091	WL-116
1017	1069237.4	516221.33	466.6282	WL-117
1018	1069411.09	516304.95	465.4069	WL-118
1019	1069031.14	516289.26	475.6765	WL-119
1020	1069053.64	516846.57	469.9996	WL-120
1021	1068759	516242.537	523.21	WL-121
1022	1068770.341	516111.2136	507.1922	WL-122
1023	1068787.352	515935.3051	480.1352	WL-123
1024	1069048.379	515857.247	470.4836	WL-124
1025	1069234.28	516312.81	468.2238	PVC-24
1026	1069345.42	516406.58	465.9981	PVC-25
1027	1069464.45	516376.13	465.0392	PVC-26
1028	1069460.56	516510.3	466.9661	PVC-27
1029	1069255.02	516488.89	471.6061	PVC-28
1030	1069125.9	516607.45	469.7372	PVC-29
1031	1069217.89	516193.84	466.0849	PVC-36
1032	1069146.48	516421.57	471.9099	PVC-37
1033	1069315.55	516580.41	469.862	PVC-38
1034	1069213.33	516701.18	470	PVC-41

B. Log El.	2005 El.	Dif.	Fill Check	QC Review				Decision
456.50	455.5306	-0.97		WL-101	1,069,549.6	516,317.2	456.5	455.53
462.80	461.8869	-0.91		WL-102	1,069,260.5	515,974.1	462.8	461.89
450.90	449.533	-1.37		WL-103	1,069,407.4	516,737.1	450.9	449.53
449.80	448.7161	-1.08		WL-104	1,069,575.5	516,602.8	449.8	448.72
466.00	464.2942	-1.71		WL-105B	1,069,148.4	515,889.5	466	464.29
462.80	461.9552	-0.84		WL-106B	1,069,317.3	516,061.9	462.8	461.96
486.10	495.9717	9.87	FILL	WL-107	1,068,909.5	516,254.3	486.1	486.10
472.50	470.9013	-1.60		WL-108	1,069,144.2	516,379.7	472.5	470.90
485.60	482.9969	-2.60		WL-109D	1,068,947.4	516,505.0	485.6	483.00
482.82	508.2668	25.45	FILL	WL-110	1,068,852.4	516,664.6	482.818	482.82
474.50	472.6424	-1.86		WL-111	1,069,187.4	516,583.6	474.5	472.64
467.60	466.1951	-1.40		WL-112	1,069,379.5	516,628.2	467.6	466.20
467.00	465.9636	-1.04		WL-113	1,069,483.2	516,470.0	467	465.96
468.30	466.3667	-1.93		WL-114	1,069,391.5	516,338.6	468.3	466.37
468.90	467.8177	-1.08		WL-115	1,069,299.0	516,395.1	468.9	467.82
474.30	473.2091	-1.09		WL-116	1,069,083.5	516,160.6	474.3	473.21
467.60	466.6282	-0.97		WL-117	1,069,237.4	516,221.3	467.6	466.63
465.80	465.4069	-0.39		WL-118	1,069,411.1	516,305.0	465.8	465.41
477.40	475.6765	-1.72		WL-119	1,069,031.1	516,289.3	477.4	475.68
474.70	469.9996	-4.70		WL-120	1,069,053.6	516,846.6	474.7	470.00
498.01	523.21	25.20	FILL	WL-121	1,068,759.0	516,242.5	498.015	498.01
494.06	507.1922	13.14	FILL	WL-122	1,068,770.3	516,111.2	494.055	494.06
486.06	480.1352	-5.93		WL-123	1,068,787.4	515,935.3	486.064	480.14
470.81	470.4836	-0.32		WL-124	1,069,048.4	515,857.2	470.808	470.48
469.57	468.2238	-1.35		PVC-24	1,069,234.28	516,312.81	469.57	468.22
467.65	465.9981	-1.65		PVC-25	1,069,345.42	516,406.58	467.65	466.00
465.22	465.0392	-0.18		PVC-26	1,069,464.45	516,376.13	465.22	465.04
469.14	466.9661	-2.17		PVC-27	1,069,460.56	516,510.30	469.14	466.97
473.11	471.6061	-1.50		PVC-28	1,069,255.02	516,488.89	473.11	471.61
473.46	469.7372	-3.72		PVC-29	1,069,125.90	516,607.45	473.46	469.74
466.80	466.0849	-0.72		PVC-36	1,069,217.89	516,193.84	466.8	466.08
473.43	471.9099	-1.52		PVC-37	1,069,146.48	516,421.57	473.43	471.91
470.52	469.862	-0.66		PVC-38	1,069,315.55	516,580.41	470.52	469.86
474.06	470	-4.06		PVC-41	1,069,213.33	516,701.18	474.06	470.00

Area 1 RIM Data														
Hot Spots	SRF -RIM 1	SRF-RIM 2		Point #	Northing	Easting	RIM 1 EL	Description		Point #	Northing	Easting	RIM 2 EL	Description
WL-101	0	0												
WL-102	0	6		2002	1069260.46	515974.05	461.89	WL-102		3002	1069260.46	515974.05	455.89	WL-102
WL-103	9	11		2003	1069407.36	516737.06	440.53	WL-103		3003	1069407.36	516737.06	438.53	WL-103
WL-104	0	0												
WL-105	3	12		2005	1069148.42	515889.5	461.29	WL-105B		3005	1069148.42	515889.5	452.29	WL-105B
WL-106	0	6		2006	1069317.25	516061.92	461.96	WL-106B		3006	1069317.25	516061.92	455.96	WL-106B
WL-107	0	0												
WL-108	0	0												
WL-109	0	0												
WL-110	0	0												
WL-111	0	0												
WL-112	4	7		2012	1069379.45	516628.22	462.20	WL-112		3012	1069379.45	516628.22	459.20	WL-112
WL-113	3	5		2013	1069483.19	516469.95	462.96	WL-113		3013	1069483.19	516469.95	460.96	WL-113
WL-114	0	6		2014	1069391.53	516338.57	466.37	WL-114		3014	1069391.53	516338.57	460.37	WL-114
WL-115	0	0												
WL-116	0	0												
WL-117	3	11		2017	1069237.4	516221.33	463.63	WL-117		3017	1069237.4	516221.33	455.63	WL-117
WL-118	0	7		2018	1069411.09	516304.95	465.41	WL-118		3018	1069411.09	516304.95	458.41	WL-118
WL-119	0	0												
WL-120	0	0												
WL-121	0	0												
WL-122	0	0												
WL-123	0	0												
WL-124	0	0												
PVC-24	0	0												
PVC-25	7	11		2026	1069345.42	516406.58	459.00	PVC-25		3026	1069345.42	516406.58	455.00	PVC-25
PVC-26	3	10		2027	1069464.45	516376.13	462.04	PVC-26		3027	1069464.45	516376.13	455.04	PVC-26
PVC-27	0	0												
PVC-28	12	17		2029	1069255.02	516488.89	459.61	PVC-28		3029	1069255.02	516488.89	454.61	PVC-28
PVC-29	0	0												
PVC-36	6	9.5		2031	1069217.89	516193.84	460.08	PVC-36		3031	1069217.89	516193.84	456.58	PVC-36
PVC-37	0	0												
PVC-38	0	15		2033	1069315.55	516580.41	469.86	PVC-38		3033	1069315.55	516580.41	454.86	PVC-38
PVC-41	0	0												

Attachment B:

RIM Worksheet for Area 2 Upper

Area A2 Upper RIM Worksheet

Area 2 (Upper Layer)

Coordinates from boring log/survey reports using 2005 topo el.									QC Review				
Point #	Northing	Easting	Original El	Description	B. Log El.	2005 El.	Dif.	Fill Check					Decision
7001	1070378.84	514177.6	444.7514	WL-201	444	444.7514	0.7514	FILL	**WL-201**	1,070,378.8	514,177.6	444.00	444.00
7002	1070102.59	514488.27	445.4622	WL-202	444.9	445.4622	0.5622	FILL	**WL-202**	1,070,102.6	514,488.3	444.90	444.90
7003	1069934.54	514237.48	445.3778	WL-203	444.7	445.3778	0.6778	FILL	**WL-203**	1,069,934.5	514,237.5	444.70	444.70
7004	1069685.83	514205.01	443.444	WL-204	443.3	443.444	0.144	FILL	**WL-204**	1,069,685.8	514,205.0	443.30	443.30
7005	1069698.26	514212.18	443.3596	WL-205	443.2	443.3596	0.1596	FILL	**WL-205**	1,069,698.3	514,212.2	443.20	443.20
7006	1070194.31	514549.5	446.0842	WL-206	444.4	446.0842	1.6842	FILL	**WL-206**	1,070,194.3	514,549.5	444.40	444.40
7007	1070743.05	514299.87	444.1073	WL-207	444.5	444.1073	-0.3927		**WL-207**	1,070,743.1	514,299.9	444.50	444.11
7008	1070141.19	514752.42	474.2944	WL-208	474.8	474.2944	-0.5056		**WL-208**	1,070,141.2	514,752.4	474.80	474.29
7009	1070492.55	514686.34	466.3081	WL-209	467.4	466.3081	-1.0919		**WL-209**	1,070,492.6	514,686.3	467.40	466.31
7010	1069775.15	514811.55	476.7315	WL-210	477.8	476.7315	-1.0685		**WL-210**	1,069,775.2	514,811.6	477.80	476.73
7011	1070046.08	514684.07	474.1171	Wl-211	475.3	474.1171	-1.1829		**Wl-211**	1,070,046.1	514,684.1	475.30	474.12
7012	1070025.86	514973.26	471.9492	WL-212	472.9	471.9492	-0.9508		**WL-212**	1,070,025.9	514,973.3	472.90	471.95
7013	1070223.38	514947.61	471.1068	WL-213	472.3	471.1068	-1.1932		**WL-213**	1,070,223.4	514,947.6	472.30	471.11
7014	1070206.86	515241.19	467.6374	WL-214	468.5	467.6374	-0.8626		**WL-214**	1,070,206.9	515,241.2	468.50	467.64
7015	1070432.01	515259.72	468.311	WL-215	470	468.311	-1.689		**WL-215**	1,070,432.0	515,259.7	470.00	468.31
7016	1069827.87	514931.35	477.3276	WL-216B	477.5	477.3276	-0.1724		**WL-216B**	1,069,827.9	514,931.4	477.50	477.33
7017	1069961.3	515082.21	472.9908	WL-217	474.7	472.9908	-1.7092		**WL-217**	1,069,961.3	515,082.2	474.70	472.99
7018	1069462.69	514839.09	487.3196	WL-218	489.7	487.3196	-2.3804		**WL-218**	1,069,462.7	514,839.1	489.70	487.32
7019	1069142.47	514545.63	494.8523	WL-219	496.7	494.8523	-1.8477		**WL-219**	1,069,142.5	514,545.6	496.70	494.85
7020	1069258.11	514733.38	501.9807	WL-220	503.9	501.9807	-1.9193		**WL-220**	1,069,258.1	514,733.4	503.90	501.98
7021	1070567.35	514459.37	461.2141	WL-221	462.3	461.2141	-1.0859		**WL-221**	1,070,567.4	514,459.4	462.30	461.21
7022	1070799.38	514618.74	458.3032	WL-222	457.8	458.3032	0.5032	FILL	**WL-222**	1,070,799.4	514,618.7	457.80	457.80
7023	1070745.71	514734.14	461.1435	WL-223	462.2	461.1435	-1.0565		**WL-223**	1,070,745.7	514,734.1	462.20	461.14
7024	1070485.74	515601.73	467.9914	WL-224	468.4	467.9914	-0.4086		**WL-224**	1,070,485.7	515,601.7	468.40	467.99
7025	1070576.93	515632.66	466.9565	WL-225	468.2	466.9565	-1.2435		**WL-225**	1,070,576.9	515,632.7	468.20	466.96
7026	1070536.03	514992.1	467.0045	WL-226	467.5	467.0045	-0.4955		**WL-226**	1,070,536.0	514,992.1	467.50	467.00
7027	1070685.99	515258.39	461.5749	WL-227	462	461.5749	-0.4251		**WL-227**	1,070,686.0	515,258.4	462.00	461.57
7028	1071044.4	514724.16	441.8351	WL-228	441.6	441.8351	0.2351	FILL	**WL-228**	1,071,044.4	514,724.2	441.60	441.60
7029	1069329.26	514268.59	448.4459	WL-229	448.5	448.4459	-0.0541		**WL-229**	1,069,329.3	514,268.6	448.50	448.45
7030	1070716.09	515139.66	461.9048	WL-230	463.3	461.9048	-1.3952		**WL-230**	1,070,716.1	515,139.7	463.30	461.90
7031	1070850.73	515007.27	463.5242	WL-231	464.8	463.5242	-1.2758		**WL-231**	1,070,850.7	515,007.3	464.80	463.52
7032	1069542.4	514609.19	487.1202	WL-233	489.2	487.1202	-2.0798		**WL-233**	1,069,542.4	514,609.2	489.20	487.12
7033	1069757.62	514428.12	477.6446	WL-234	480	477.6446	-2.3554		**WL-234**	1,069,757.6	514,428.1	480.00	477.64
7034	1069615.23	514418.87	479.5286	WL-235	481.1	479.5286	-1.5714		**WL-235**	1,069,615.2	514,418.9	481.10	479.53
7035	1069399.29	514384.13	482.4488	WL-236	484.3	482.4488	-1.8512		**WL-236**	1,069,399.3	514,384.1	484.30	482.45
7036	1070069.42	515161.88	472.379	WL-237	473.9	472.379	-1.521		**WL-237**	1,070,069.4	515,161.9	473.90	472.38
7037	1070705.96	514916.28	465.2239	WL-238	466.2	465.2239	-0.9761		**WL-238**	1,070,706.0	514,916.3	466.20	465.22
7038	1070921.77	514829.72	460.1381	WL-239	458.9	460.1381	1.2381	FILL	**WL-239**	1,070,921.8	514,829.7	458.90	458.90
7039	1070320.97	515315.69	467.541	WL-240	468.5	467.541	-0.959		**WL-240**	1,070,321.0	515,315.7	468.50	467.54
7040	1070319.84	515100.73	468.9055	WL-241	469.6	468.9055	-0.6945		**WL-241**	1,070,319.8	515,100.7	469.60	468.91
7041	1070816.6	515079.9129	461.2981	WL-242	462.448806	461.2981	-1.1507062		WL-242	1,070,816.6	515,079.9	462.4488062	461.30
7042	1070867.017	515091.2519	459.8985	WL-243	460.025637	459.8985	-0.1271365		WL-243	1,070,867.0	515,091.3	460.0256365	459.90
7043	1070940.412	515223.854	451.8306	WL-244	449.805419	451.8306	2.0251806	FILL	WL-244	1,070,940.4	515,223.9	449.8054194	449.81
7044	1070978.294	515086.7812	448.0001	WL-245	445.655889	448.0001	2.3442107	FILL	WL-245	1,070,978.3	515,086.8	445.6558893	445.66
7045	1071026.183	515191.0685	436.2535	WL-246	438.359807	436.2535	-2.1063068		WL-246	1,071,026.2	515,191.1	438.3598068	436.25
7046	1070516.46	514691.78	466.064	PVC-4	467.36	466.064	-1.296		PVC-4	1,070,516.46	514,691.78	467.36	466.06
7047	1070548.99	514548.01	462.065	PVC-5	462.56	462.065	-0.495		PVC-5	1,070,548.99	514,548.01	462.56	462.07
7048	1070626.94	514760.76	464.0573	PVC-6	464.13	464.0573	-0.0727		PVC-6	1,070,626.94	514,760.76	464.13	464.06
7049	1070484.08	514746.72	467.0597	PVC-7	468.28	467.0597	-1.2203		PVC-7	1,070,484.08	514,746.72	468.28	467.06
7050	1070343.56	514871.72	471.244	PVC-8	471.41	471.244	-0.166		PVC-8	1,070,343.56	514,871.72	471.41	471.24
7051	1070386.31	515127.48	467.3742	PVC-9	468.72	467.3742	-1.3458		PVC-9	1,070,386.31	515,127.48	468.72	467.37
7052	1069916.35	514518.86	471.3932	PVC-10	471.25	471.3932	0.1432	FILL	PVC-10	1,069,916.35	514,518.86	471.25	471.25
7053	1069848.44	514453.6	473.2949	PVC-11	473.06	473.2949	0.2349	FILL	PVC-11	1,069,848.44	514,453.60	473.06	473.06
7054	1070528.68	515176.76	464.2179	PVC-12	464.72	464.2179	-0.5021		PVC-12	1,070,528.68	515,176.76	464.72	464.22
7055	1070515.37	514386.08	460.0744	PVC-13	461.15	460.0744	-1.0756		PVC-13	1,070,515.37	514,386.08	461.15	460.07
7056	1070300.94	514677.19	469.806	PVC-18	470	469.806	-0.194		PVC-18	1,070,300.94	514,677.19	470	469.81
7057	1070599.18	514961.49	466.8066	PVC-19	466.35	466.8066	0.4566	FILL	PVC-19	1,070,599.18	514,961.49	466.35	466.35
7058	1070750.51	514806.92	461.5655	PVC-20	463.25	461.5655	-1.6845		PVC-20	1,070,750.51	514,806.92	463.25	461.57
7059	1070857.78	514810.78	461.7247	PVC-33	461.71	461.7247	0.0147	FILL	PVC-33	1,070,857.78	514,810.78	461.71	461.71
7060	1070742.95	514647.99	459.8197	PVC-34	459.43	459.8197	0.3897	FILL	PVC-34	1,070,742.95	514,647.99	459.43	459.43
7061	1070722.28	515029.87	463.9533	PVC-35	464.46	463.9533	-0.5067		PVC-35	1,070,722.28	515,029.87	464.46	463.95
7062	1070540.52	515388.6	463.7853	PVC-39	463.95	463.7853	-0.1647		PVC-39	1,070,540.52	515,388.60	463.95	463.79
7063	1070639.64	515256.1	463.4254	PVC-40	464.25	463.4254	-0.8246		PVC-40	1,070,639.64	515,256.10	464.25	463.43

	Area 2 Upper RIM Data												
Point #	Hot Spots	SRF-TOR	SRF-BOR	Point #	Northing	Easting	TOR EL (U)	Description	Point #	Northing	Easting	BOR EL (U)	Description
7001													
7002													
7003													
7004													
7005													
7006													
7007													
7008	WL-208	0	*10*	8008	1070141.19	514752.42	474.29	WL-208	9008	1070141.19	514752.42	464.29	WL-208
7009	WL-209	0	11	8009	1070492.55	514686.34	466.31	WL-209	9009	1070492.55	514686.34	455.31	WL-209
7010	WL-210	0	16.5	8010	1069775.15	514811.55	476.73	WL-210	9010	1069775.15	514811.55	460.23	WL-210
7011	WL-211	0	13	8011	1070046.08	514684.07	474.12	WL-211	9011	1070046.08	514684.07	461.12	WL-211
7012	WL-212	*8*	*12*	8012	1070025.86	514973.26	463.95	WL-212	9012	1070025.86	514973.26	459.95	WL-212
7013	WL-213	0	*6*	8013	1070223.38	514947.61	471.11	WL-213	9013	1070223.38	514947.61	465.11	WL-213
7014	WL-214	*4*	*6*	8014	1070206.86	515241.19	463.64	WL-214	9014	1070206.86	515241.19	461.64	WL-214
7015	WL-215	0	0										
7016	WL-216	0	9	8016	1069827.87	514931.35	477.33	WL-216	9016	1069827.87	514931.35	468.33	WL-216
7017	WL-217	9	11	8017	1069961.3	515082.21	463.99	WL-217	9017	1069961.3	515082.21	461.99	WL-217
7018													
7019	WL-219	0	0										
7020	WL-220	0	0										
7021	WL-221	0	0										
7022	WL-222	0	*7*	8022	1070799.38	514618.74	457.80	WL-222	9022	1070799.38	514618.74	450.80	WL-222
7023	WL-223	1	7.5	8023	1070745.71	514734.14	460.14	WL-223	9023	1070745.71	514734.14	453.64	WL-223
7024	WL-224	0	0										
7025	WL-225	0	0										
7026	WL-226	0	*22*	8026	1070536.03	514992.1	467.00	WL-226	9026	1070536.03	514992.1	445.00	WL-226
7027	WL-227	*4*	*6*	8027	1070685.99	515258.39	457.57	WL-227	9027	1070685.99	515258.39	455.57	WL-227
7028	WL-228	0	0										
7029	WL-229	0	0										
7030	WL-230	0	*6*	8030	1070716.09	515139.66	461.90	WL-230	9030	1070716.09	515139.66	455.90	WL-230
7031	WL-231	4	*11*	8031	1070850.73	515007.27	459.52	WL-231	9031	1070850.73	515007.27	452.52	WL-231
7032	WL-233	17	*31*	8032	1069542.4	514609.19	470.12	WL-233	9032	1069542.4	514609.19	456.12	WL-233
7033	WL-234	0	*21*	8033	1069757.62	514428.12	477.64	WL-234	9033	1069757.62	514428.12	456.64	WL-234
7034	WL-235	0	*1*	8034	1069615.23	514418.87	479.53	WL-235	9034	1069615.23	514418.87	478.53	WL-235
7035	WL-236	0	0										
7036	WL-237	0	0										
7037	WL-238	1	10.5	8037	1070705.96	514916.28	464.22	WL-238	9037	1070705.96	514916.28	454.72	WL-238
7038	WL-239	0	0										
7039	WL-240	0	0										
7040	WL-241	1	9.5	8040	1070319.84	515100.73	467.91	WL-241	9040	1070319.84	515100.73	459.41	WL-241
7041	WL-242	0	*3*	8041	1070816.6	515079.9129	461.30	WL-242	9041	1070816.6	515079.9129	458.30	WL-242
7042	WL-243	0	*2*	8042	1070867.017	515091.2519	459.90	WL-243	9042	1070867.017	515091.2519	457.90	WL-243
7043	WL-244	0	*1*	8043	1070940.412	515223.854	449.81	WL-244	9043	1070940.412	515223.854	448.81	WL-244
7044	WL-245	0	0										
7045	WL-246	0	0										
7046	PVC-4	0	5.5	8046	1070516.46	514691.78	466.06	PVC-4	9046	1070516.46	514691.78	460.56	PVC-4
7047	PVC-5	1	7	8047	1070548.99	514548.01	461.07	PVC-5	9047	1070548.99	514548.01	455.07	PVC-5
7048	PVC-6	0	16	8048	1070626.94	514760.76	464.06	PVC-6	9048	1070626.94	514760.76	448.06	PVC-6
7049	PVC-7	0	7	8049	1070484.08	514746.72	467.06	PVC-7	9049	1070484.08	514746.72	460.06	PVC-7
7050	PVC-8	0	1.5	8050	1070343.56	514871.72	471.24	PVC-8	9050	1070343.56	514871.72	469.74	PVC-8
7051	PVC-9	*1*	6.5	8051	1070386.31	515127.48	466.37	PVC-9	9051	1070386.31	515127.48	460.87	PVC-9
7052	PVC-10	0	*13*	8052	1069916.35	514518.86	471.25	PVC-10	9052	1069916.35	514518.86	458.25	PVC-10
7053	PVC-11	0	10.5	8053	1069848.44	514453.6	473.06	PVC-11	9053	1069848.44	514453.6	462.56	PVC-11
7054	PVC-12	0.5	5.5	8054	1070528.68	515176.76	463.72	PVC-12	9054	1070528.68	515176.76	458.72	PVC-12
7055	PVC-13	0	0										
7056	PVC-18	0	0										
7057	PVC-19	6	10.5	8057	1070599.18	514961.49	460.35	PVC-19	9057	1070599.18	514961.49	455.85	PVC-19
7058	PVC-20	0	4	8058	1070750.51	514806.92	461.57	PVC-20	9058	1070750.51	514806.92	457.57	PVC-20
7059	PVC-33	1.5	3.5	8059	1070857.78	514810.78	460.21	PVC-33	9059	1070857.78	514810.78	458.21	PVC-33
7060	PVC-34	0	3	8060	1070742.95	514647.99	459.43	PVC-34	9060	1070742.95	514647.99	456.43	PVC-34
7061	PVC-35	0.5	8	8061	1070722.28	515029.87	463.45	PVC-35	9061	1070722.28	515029.87	455.95	PVC-35
7062	PVC-39	1.5	4	8062	1070540.52	515388.6	462.29	PVC-39	9062	1070540.52	515388.6	459.79	PVC-39
7063	PVC-40	0.5	9.5	8063	1070639.64	515256.1	462.93	PVC-40	9063	1070639.64	515256.1	453.93	PVC-40

Attachment C:

RIM Worksheet for Area 2 Lower

Area A2 Lower RIM Worksheet

Area 2 (Lower Layer)

Coordinates from boring log/survey reports w 2005 topo el.				
Point #	Northing	Easting	Original El	Description
7001	1070378.84	514177.6	444.7514	WL-201
7002	1070102.59	514488.27	445.4622	WL-202
7003	1069934.54	514237.48	445.3778	WL-203
7004	1069685.83	514205.01	443.444	WL-204
7005	1069698.26	514212.18	443.3596	WL-205
7006	1070194.31	514549.5	446.0842	WL-206
7007	1070743.05	514299.87	444.1073	WL-207
7008	1070141.19	514752.42	474.2944	WL-208
7009	1070492.55	514686.34	466.3081	WL-209
7010	1069775.15	514811.55	476.7315	WL-210
7011	1070046.08	514684.07	474.1171	Wl-211
7012	1070025.86	514973.26	471.9492	WL-212
7013	1070223.38	514947.61	471.1068	WL-213
7014	1070206.86	515241.19	467.6374	WL-214
7015	1070432.01	515259.72	468.311	WL-215
7016	1069827.87	514931.35	477.3276	WL-216B
7017	1069961.3	515082.21	472.9908	WL-217
7018	1069462.69	514839.09	487.3196	WL-218
7019	1069142.47	514545.63	494.8523	WL-219
7020	1069258.11	514733.38	501.9807	WL-220
7021	1070567.35	514459.37	461.2141	WL-221
7022	1070799.38	514618.74	458.3032	WL-222
7023	1070745.71	514734.14	461.1435	WL-223
7024	1070485.74	515601.73	467.9914	WL-224
7025	1070576.93	515632.66	466.9565	WL-225
7026	1070536.03	514992.1	467.0045	WL-226
7027	1070685.99	515258.39	461.5749	WL-227
7028	1071044.4	514724.16	441.8351	WL-228
7029	1069329.26	514268.59	448.4459	WL-229
7030	1070716.09	515139.66	461.9048	WL-230
7031	1070850.73	515007.27	463.5242	WL-231
7032	1069542.4	514609.19	487.1202	WL-233
7033	1069757.62	514428.12	477.6446	WL-234
7034	1069615.23	514418.87	479.5286	WL-235
7035	1069399.29	514384.13	482.4488	WL-236
7036	1070069.42	515161.88	472.379	WL-237
7037	1070705.96	514916.28	465.2239	WL-238
7038	1070921.77	514829.72	460.1381	WL-239
7039	1070320.97	515315.69	467.541	WL-240
7040	1070319.84	515100.73	468.9055	WL-241
7041	1070816.6	515079.9129	461.2981	WL-242
7042	1070867.017	515091.2519	459.8985	WL-243
7043	1070940.412	515223.854	451.8306	WL-244
7044	1070978.294	515086.7812	448.0001	WL-245
7045	1071026.183	515191.0685	436.2535	WL-246
7046	1070516.46	514691.78	466.064	PVC-4
7047	1070548.99	514548.01	462.065	PVC-5
7048	1070626.94	514760.76	464.0573	PVC-6
7049	1070484.08	514746.72	467.0597	PVC-7
7050	1070343.56	514871.72	471.244	PVC-8
7051	1070386.31	515127.48	467.3742	PVC-9
7052	1069916.35	514518.86	471.3932	PVC-10
7053	1069848.44	514453.6	473.2949	PVC-11
7054	1070528.68	515176.76	464.2179	PVC-12
7055	1070515.37	514386.08	460.0744	PVC-13
7056	1070300.94	514677.19	469.806	PVC-18
7057	1070599.18	514961.49	466.8066	PVC-19
7058	1070750.51	514806.92	461.5655	PVC-20
7059	1070857.78	514810.78	461.7247	PVC-33
7060	1070742.95	514647.99	459.8197	PVC-34
7061	1070722.28	515029.87	463.9533	PVC-35
7062	1070540.52	515388.6	463.7853	PVC-39
7063	1070639.64	515256.1	463.4254	PVC-40

Point #	B. Log El.	2005 El.	Dif.	Fill Check	QC Review				Decision
7001	444	444.7514	0.7514	FILL	WL-201	1,070,378.8	514,177.6	444.00	444.00
7002	444.9	445.4622	0.5622	FILL	WL-202	1,070,102.6	514,488.3	444.90	444.90
7003	444.7	445.3778	0.6778	FILL	WL-203	1,069,934.5	514,237.5	444.70	444.70
7004	443.3	443.444	0.144	FILL	WL-204	1,069,685.8	514,205.0	443.30	443.30
7005	443.2	443.3596	0.1596	FILL	WL-205	1,069,698.3	514,212.2	443.20	443.20
7006	444.4	446.0842	1.6842	FILL	WL-206	1,070,194.3	514,549.5	444.40	444.40
7007	444.5	444.1073	-0.3927		WL-207	1,070,743.1	514,299.9	444.50	444.11
7008	474.8	474.2944	-0.5056		WL-208	1,070,141.2	514,752.4	474.80	474.29
7009	467.4	466.3081	-1.0919		WL-209	1,070,492.6	514,686.3	467.40	466.31
7010	477.8	476.7315	-1.0685		WL-210	1,069,775.2	514,811.6	477.80	476.73
7011	475.3	474.1171	-1.1829		Wl-211	1,070,046.1	514,684.1	475.30	474.12
7012	472.9	471.9492	-0.9508		WL-212	1,070,025.9	514,973.3	472.90	471.95
7013	472.3	471.1068	-1.1932		WL-213	1,070,223.4	514,947.6	472.30	471.11
7014	468.5	467.6374	-0.8626		WL-214	1,070,206.9	515,241.2	468.50	467.64
7015	470	468.311	-1.689		WL-215	1,070,432.0	515,259.7	470.00	468.31
7016	477.5	477.3276	-0.1724		WL-216B	1,069,827.9	514,931.4	477.50	477.33
7017	474.7	472.9908	-1.7092		WL-217	1,069,961.3	515,082.2	474.70	472.99
7018	489.7	487.3196	-2.3804		WL-218	1,069,462.7	514,839.1	489.70	487.32
7019	496.7	494.8523	-1.8477		WL-219	1,069,142.5	514,545.6	496.70	494.85
7020	503.9	501.9807	-1.9193		WL-220	1,069,258.1	514,733.4	503.90	501.98
7021	462.3	461.2141	-1.0859		WL-221	1,070,567.4	514,459.4	462.30	461.21
7022	457.8	458.3032	0.5032	FILL	WL-222	1,070,799.4	514,618.7	457.80	457.80
7023	462.2	461.1435	-1.0565		WL-223	1,070,745.7	514,734.1	462.20	461.14
7024	468.4	467.9914	-0.4086		WL-224	1,070,485.7	515,601.7	468.40	467.99
7025	468.2	466.9565	-1.2435		WL-225	1,070,576.9	515,632.7	468.20	466.96
7026	467.5	467.0045	-0.4955		WL-226	1,070,536.0	514,992.1	467.50	467.00
7027	462	461.5749	-0.4251		WL-227	1,070,686.0	515,258.4	462.00	461.57
7028	441.6	441.8351	0.2351	FILL	WL-228	1,071,044.4	514,724.2	441.60	441.60
7029	448.5	448.4459	-0.0541		WL-229	1,069,329.3	514,268.6	448.50	448.45
7030	463.3	461.9048	-1.3952		WL-230	1,070,716.1	515,139.7	463.30	461.90
7031	464.8	463.5242	-1.2758		WL-231	1,070,850.7	515,007.3	464.80	463.52
7032	489.2	487.1202	-2.0798		WL-233	1,069,542.4	514,609.2	489.20	487.12
7033	480	477.6446	-2.3554		WL-234	1,069,757.6	514,428.1	480.00	477.64
7034	481.1	479.5286	-1.5714		WL-235	1,069,615.2	514,418.9	481.10	479.53
7035	484.3	482.4488	-1.8512		WL-236	1,069,399.3	514,384.1	484.30	482.45
7036	473.9	472.379	-1.521		WL-237	1,070,069.4	515,161.9	473.90	472.38
7037	466.2	465.2239	-0.9761		WL-238	1,070,706.0	514,916.3	466.20	465.22
7038	458.9	460.1381	1.2381	FILL	WL-239	1,070,921.8	514,829.7	458.90	458.90
7039	468.5	467.541	-0.959		WL-240	1,070,321.0	515,315.7	468.50	467.54
7040	469.6	468.9055	-0.6945		WL-241	1,070,319.8	515,100.7	469.60	468.91
7041	462.448806	461.2981	-1.1507062		WL-242	1,070,816.6	515,079.9	462.44881	461.30
7042	460.025637	459.8985	-0.1271365		WL-243	1,070,867.0	515,091.3	460.02564	459.90
7043	449.805419	451.8306	2.0251806	FILL	WL-244	1,070,940.4	515,223.9	449.80542	449.81
7044	445.655889	448.0001	2.3442107	FILL	WL-245	1,070,978.3	515,086.8	445.65589	445.66
7045	438.359807	436.2535	-2.1063068		WL-246	1,071,026.2	515,191.1	438.35981	436.25
7046	467.36	466.064	-1.296		PVC-4	1,070,516.46	514,691.78	467.36	466.06
7047	462.56	462.065	-0.495		PVC-5	1,070,548.99	514,548.01	462.56	462.07
7048	464.13	464.0573	-0.0727		PVC-6	1,070,626.94	514,760.76	464.13	464.06
7049	468.28	467.0597	-1.2203		PVC-7	1,070,484.08	514,746.72	468.28	467.06
7050	471.41	471.244	-0.166		PVC-8	1,070,343.56	514,871.72	471.41	471.24
7051	468.72	467.3742	-1.3458		PVC-9	1,070,386.31	515,127.48	468.72	467.37
7052	471.25	471.3932	0.1432	FILL	PVC-10	1,069,916.35	514,518.86	471.25	471.25
7053	473.06	473.2949	0.2349	FILL	PVC-11	1,069,848.44	514,453.60	473.06	473.06
7054	464.72	464.2179	-0.5021		PVC-12	1,070,528.68	515,176.76	464.72	464.22
7055	461.15	460.0744	-1.0756		PVC-13	1,070,515.37	514,386.08	461.15	460.07
7056	470	469.806	-0.194		PVC-18	1,070,300.94	514,677.19	470	469.81
7057	466.35	466.8066	0.4566	FILL	PVC-19	1,070,599.18	514,961.49	466.35	466.35
7058	463.25	461.5655	-1.6845		PVC-20	1,070,750.51	514,806.92	463.25	461.57
7059	461.71	461.7247	0.0147	FILL	PVC-33	1,070,857.78	514,810.78	461.71	461.71
7060	459.43	459.8197	0.3897	FILL	PVC-34	1,070,742.95	514,647.99	459.43	459.43
7061	464.46	463.9533	-0.5067		PVC-35	1,070,722.28	515,029.87	464.46	463.95
7062	463.95	463.7853	-0.1647		PVC-39	1,070,540.52	515,388.60	463.95	463.79
7063	464.25	463.4254	-0.8246		PVC-40	1,070,639.64	515,256.10	464.25	463.43

Point #	Area 2 Lower RIM Data														
	Hot Spots	SRF-TOR	SRF-BOR		Point #	Northing	Easting	TOR EL (U)	Description		Point #	Northing	Easting	BOR EL (U)	Description
7009	WL-209	24	26		13009	1070492.55	514686.34	442.31	WL-209		14009	1070492.55	514686.34	440.31	WL-209
7010	WL-210	39	49.5		13010	1069775.15	514811.55	437.73	WL-210		14010	1069775.15	514811.55	427.23	WL-210
7014	WL-214	24	26		13014	1070206.86	515241.19	443.64	WL-214		14014	1070206.86	515241.19	441.64	WL-214
7018	WL-218	39	41		8018	1069462.69	514839.09	448.32	WL-218		9018	1069462.69	514839.09	446.32	WL-218
7034	WL-235	20.5	24.5		13034	1069615.23	514418.87	459.03	WL-235		14034	1069615.23	514418.87	455.03	WL-235
7046	PVC-4	9.5	13		13046	1070516.46	514691.78	456.56	PVC-4		14046	1070516.46	514691.78	453.06	PVC-4
7047	PVC-5	9.5	14.5		13047	1070548.99	514548.01	452.57	PVC-5		14047	1070548.99	514548.01	447.57	PVC-5
7048	PVC-6	19	22.5		13048	1070626.94	514760.76	445.06	PVC-6		14048	1070626.94	514760.76	441.56	PVC-6
7049	PVC-7	17	22		13049	1070484.08	514746.72	450.06	PVC-7		14049	1070484.08	514746.72	445.06	PVC-7

Attachment D:

Area 1 Extrapolated RIM (Pie) Calculations

Area A1 Extrapolated RIM Worksheet

A1 Pie 1 Worksheet

Pie Calculation from known RIM Elevation

Insert Pie Data with Surface Elevation

Insert Well Data

Manually update relevant data (indicated by pink text box)

North./East. Proximity Check

	0	1069192.29	516219.2	469.7527	PVC-000		Directly Perpendicular to limit from PVC-36					-25.605	25.366	36.04261747		
PVC-000	6	9.5		2031	1069218	516193.8	460.085	PVC-000	3031	1069217.9	516193.8	456.58	PVC-000			
Delta Elev	3.5															
Midpoint Elevation	458.3349												Pie 1	0	1069192.3	516219.2 459.2099 PVC-000
													Pie2	1000	1069192.3	516219.2 457.4599 PVC-000

Location Results with Rim Elevations

Pie Calculation from Interpolated RIM Elevation

	10026	1070482.51	515256.9	463.95	Between PVC-12 and PVC-39		Perp to Perimeter from WL-215		-50.4913	2.8245	50.57024002		
Interpolation for Perimeter		Northing	1070533.001	Easting	515254.1								
PVC-12	0.5	5.5	8054	1070529	515176.8	463.718	PVC-12	9054	1070528.7	515176.8	458.72	PVC-12	
PVC-39	1.5	4	8062	1070541	515388.6	462.285	PVC-39	9062	1070540.5	515388.6	459.79	PVC-39	
	Point A	Point B	Point A Dist.	Total Dist.	Percent	Diff.	RIM 1 EL.		Diff.	RIM 2 EL.			
	PVC-12	PVC-39	77.4361	212.1706	36.50%	1.4326	463.20		1.0674	459.11			
Delta Elev	4.09												
Midpoint Elevation	461.15								Pie 1	10026	1070482.5	515256.9	462.1731 Between PVC-12 and PVC-39
									Pie2	11026	1070482.5	515256.9	460.1294 Between PVC-12 and PVC-39

Pie Calculation Using Manual Override for Daylighting

	4021	1069507	516346.7	460.1067	PVC-26										
PVC-26	3	10	2027	1069464	516376.1	462.039	PVC-26	3027	1069464.5	516376.1	455.04	PVC-26		P1 !!!	
Delta Elev	7														
Midpoint Elevation	458.5392										Pie 1	4021	1069507	516346.7	460.2892 PVC-26
											Pie2	5021	1069507	516346.7	456.7892 PVC-26
							28.12	-19.4672	34.19858		Pie 1 Override	4021	1069492.6	516356.7	462.0392 PVC-26
							65.04	-45.0304	79.10623		Pie 2 Override	5021	1069529.5	516331.1	455.0392 PVC-26

Area A1 Extrapolated RIM Worksheet

a	4001	1069192.29	516219.2	469.7527	PVC-36		Directly Perpendicular to limit from PVC-36					-25.605	25.366	36.04261747					
	PVC-36	6	9.5		2031	1069218	516193.8	460.085	PVC-36	3031	1069217.9	516193.8	456.58	PVC-36					
	Delta Elev	3.5																	
	Midpoint Elevation	458.3349												Pie 1	4001	1069192.3	516219.2	459.2099	PVC-36
														Pie2	5001	1069192.3	516219.2	457.4599	PVC-36
a	4002	1069213.74	516244.8	468.9789	WL-117		Directly Perpendicular to limit from WL--117					-23.656	23.436	33.29915439					
	WL-117	3	11		2017	1069237	516221.3	463.628	WL-117	3017	1069237.4	516221.3	455.63	WL-117					
	Delta Elev	8																	
	Midpoint Elevation	459.6282												Pie 1	4002	1069213.7	516244.8	461.6282	WL-117
														Pie2	5002	1069213.7	516244.8	457.6282	WL-117
a	4003	1069255.35	516300.5	467.7219	Between PVC-25 and WL-117				Perp to Perimeter from PVC-24			-21.0683	12.283	24.38760301					
	Interpolation for Perimeter		Northing	1069276.417	Easting	516288.2													
	PVC-25	7	11		2026	1069345	516406.6	458.998	PVC-25	3026	1069345.4	516406.6	455	PVC-25					
	WL-117	3	11		2017	1069237	516221.3	463.628	WL-117	3017	1069237.4	516221.3	455.63	WL-117					
		Point A	Point B	Point A Dist.	Total Dist.	Percent		Diff.	RIM 1 EL.				Diff.	RIM 2 EL.					
		PVC-25	WL-117	136.9854	214.4432	63.88%		4.6301	461.96				0.6301	455.40					
	Delta Elev	6.56																	
	Midpoint Elevation	458.68												Pie 1	4003	1069255.3	516300.5	460.317	Between PVC-25 and WL-117
														Pie2	5003	1069255.3	516300.5	457.0394	Between PVC-25 and WL-117
a	4004	1069313.79	516386.4	467.6752	PVC-25		Perp to Perimeter from WL-115					-31.63	-20.148	37.50171538					
	PVC-25	7	11		2026	1069345	516406.6	458.998	PVC-25	3026	1069345.4	516406.6	455	PVC-25					
	Delta Elev	4																	
	Midpoint Elevation	456.9981												Pie 1	4004	1069313.8	516386.4	457.9981	PVC-25
														Pie2	5004	1069313.8	516386.4	455.9981	PVC-25
a	4005	1069322.2	516400.9	466.8904	PVC-25		From PVC-25 to WL-115					-23.22	-5.725	23.91535124					
	PVC-25	7	11		2026	1069345	516406.6	458.998	PVC-25	3026	1069345.4	516406.6	455	PVC-25					
	Delta Elev	4																	
	Midpoint Elevation	456.9981												Pie 1	4005	1069322.2	516400.9	457.9981	PVC-25
														Pie2	5005	1069322.2	516400.9	455.9981	PVC-25
a	4006	1069311.61	516410.5	467.4301	PVC-25		Perp to Perimeter from WL-115					-33.811	3.918	34.03725084					
	PVC-25	7	11		2026	1069345	516406.6	458.998	PVC-25	3026	1069345.4	516406.6	455	PVC-25					
	Delta Elev	4																	
	Midpoint Elevation	456.9981												Pie 1	4006	1069311.6	516410.5	457.9981	PVC-25
														Pie2	5006	1069311.6	516410.5	455.9981	PVC-25
a	4007	1069247.77	516447.1	471.5522	PVC-28		Perp to Limit from PVC-28					-7.249	-41.812	42.43602753					
	PVC-28	12	17		2029	1069255	516488.9	459.606	PVC-28	3029	1069255	516488.9	454.61	PVC-28					
	Delta Elev	5																	
	Midpoint Elevation	457.1061												Pie 1	4007	1069247.8	516447.1	458.3561	PVC-28
														Pie2	5007	1069247.8	516447.1	455.8561	PVC-28
a	4008	1069200.75	516455.2	471.2376	PVC-28		From PVC-28 to PVC-37					-54.27	-33.66	63.86100923					
	PVC-28	12	17		2029	1069255	516488.9	459.606	PVC-28	3029	1069255	516488.9	454.61	PVC-28					
	Delta Elev	5																	
	Midpoint Elevation	457.1061												Pie 1	4008	1069200.8	516455.2	458.3561	PVC-28
														Pie2	5008	1069200.8	516455.2	455.8561	PVC-28
a	4009	1069211.98	516499.7	471.8151	PVC-28		Perp to Limit from PVC-28					-43.042	10.856	44.38996138					
	PVC-28	12	17		2029	1069255	516488.9	459.606	PVC-28	3029	1069255	516488.9	454.61	PVC-28					
	Delta Elev	5																	
	Midpoint Elevation	457.1061												Pie 1	4009	1069212	516499.7	458.3561	PVC-28
														Pie2	5009	1069212	516499.7	455.8561	PVC-28

Area A1 Extrapolated RIM Worksheet

a	4010	1069232.68	516553.6	471.6224	Between PVC-28 and PVC 38				Perp to Perimeter from WL-111			-45.3293	29.98	54.34670024					
	Interpolation for Perimeter		Northing	1069278.009	Easting	516523.6													
	PVC-28	12	17		2029	1069255	516488.9	459.606	PVC-28	3029	1069255	516488.9	454.61	PVC-28					
	PVC-38	0	15		2033	1069316	516580.4	469.862	PVC-38	3033	1069315.6	516580.4	454.86	PVC-38					
		Point A	Point B	Point A Dist.	Total Dist.	Percent		Diff.	RIM 1 EL.				Diff.	RIM 2 EL.					
		PVC-28	PVC-38	41.6739	109.726	37.98%		10.2559	463.50				0.2559	454.70					
	Delta Elev	8.80																	
	Midpoint Elevation	459.10												Pie 1	4010	1069232.7	516553.6	461.3018	Between PVC-28 and PVC 38
														Pie2	5010	1069232.7	516553.6	456.9028	Between PVC-28 and PVC 38
a	4011	1069254.1	516594	470.981	PVC-38		Perp to Limit from PVC-38					-61.453	13.58	62.93547513					
	PVC-38	0	15		2033	1069316	516580.4	469.862	PVC-38	3033	1069315.6	516580.4	454.86	PVC-38					
	Delta Elev	15																	
	Midpoint Elevation	463.02												Pie 1	4011	1069254.1	516594	466.77	PVC-38
														Pie2	5011	1069254.1	516594	459.27	PVC-38
a	4012	1069277.22	516662.6	469.6133	Close to PVC-38				Perp to Perimeter from PVC-41			-63.8871	38.584	74.63445609					
	Interpolation for Perimeter		Northing	1069341.104	Easting	516624													
	WL-103	9	11		2003	1069407	516737.1	440.533	WL-103	3003	1069407.4	516737.1	438.53	WL-103					
	PVC-38	0	15		2033	1069316	516580.4	469.862	PVC-38	3033	1069315.6	516580.4	454.86	PVC-38					
		Point A	Point B	Point A Dist.	Total Dist.	Percent		Diff.	RIM 1 EL.				Diff.	RIM 2 EL.					
		WL-103	PVC-38	131.0336	181.5717	72.17%		29.329	461.70				16.329	450.32					
	Delta Elev	11.38																	
	Midpoint Elevation	456.01												Pie 1	4012	1069277.2	516662.6	458.8533	Close to PVC-38
														Pie2	5012	1069277.2	516662.6	453.1624	Close to PVC-38
a	4013	1069313.69	516713.6	474.215	Between PVC38 and WL103 Top Slope				PVC-38/WL-103 Top of Slope Perp. To Perimete			-59.4834	34.862	68.94670307					
	Interpolation for Perimeter		Northing	1069373.172	Easting	516678.7													
	WL-103	9	11		2003	1069407	516737.1	440.533	WL-103	3003	1069407.4	516737.1	438.53	WL-103					
	PVC-38	0	15		2033	1069316	516580.4	469.862	PVC-38	3033	1069315.6	516580.4	454.86	PVC-38					
		Point A	Point B	Point A Dist.	Total Dist.	Percent		Diff.	RIM 1 EL.				Diff.	RIM 2 EL.					
		WL-103	PVC-38	67.6125	181.5717	37.24%		29.329	451.45				16.329	444.61					
	Delta Elev	6.84																	
	Midpoint Elevation	448.03												Pie 1	4013	1069313.7	516713.6	449.7441	Between PVC38 and WL103 Top Slope
														Pie2	5013	1069313.7	516713.6	446.3237	Between PVC38 and WL103 Top Slope
a	4014	1069359.34	516777.4	451.7951	WL-103		Description					-48.021	40.357	62.72753978					
	WL-103	9	11		2003	1069407	516737.1	440.533	WL-103	3003	1069407.4	516737.1	438.53	WL-103					
	Delta Elev	2																	
	Midpoint Elevation	439.533												Pie 1	4014	1069359.3	516777.4	440.033	WL-103
														Pie2	5014	1069359.3	516777.4	439.033	WL-103
a	4015	1069373.73	516794.5	450.441	WL-103		Description					-33.6306	57.481	66.5960707					
	WL-103	9	11		2003	1069407	516737.1	440.533	WL-103	3003	1069407.4	516737.1	438.53	WL-103					
	Delta Elev	2																	
	Midpoint Elevation	439.533												Pie 1	4015	1069373.7	516794.5	440.033	WL-103
														Pie2	5015	1069373.7	516794.5	439.033	WL-103
a	4016	1069412.73	516763.7	449.979	WL-103		Description					5.37	26.67	27.20525317					
	WL-103	9	11		2003	1069407	516737.1	440.533	WL-103	3003	1069407.4	516737.1	438.53	WL-103					
	Delta Elev	2																	
	Midpoint Elevation	439.533												Pie 1	4016	1069412.7	516763.7	440.033	WL-103
														Pie2	5016	1069412.7	516763.7	439.033	WL-103

Area A1 Extrapolated RIM Worksheet

a	4017	1069483.41	516660.6	449.9263	Near WL-103 - Toe Slope				WL-103/WL-113 Toe of Slope Perp. To Perimete			50.2797	14.275	52.26685237					
	Interpolation for Perimeter		Northing	1069433.131	Easting	516646.3													
	WL-103	9	11		2003	1069407	516737.1	440.533	WL-103	3003	1069407.4	516737.1	438.53	WL-103					
	WL-113	3	5		2013	1069483	516470	462.964	WL-113	3013	1069483.2	516470	460.96	WL-113					
		Point A	Point B	Point A Dist.	Total Dist.	Percent		Diff.	RIM 1 EL.				Diff.	RIM 2 EL.					
		WL-103	WL-113	94.3661	277.6652	33.99%		22.4306	448.16				22.431	446.16					
	Delta Elev	2.00					REMOVED FROM DRAWING												
	Midpoint Elevation	447.16												Pie 1	4017	1069483.4	516660.6	447.6562	Near WL-103 - Toe Slope
														Pie2	5017	1069483.4	516660.6	446.6562	Near WL-103 - Toe Slope
a	4018	1069544.45	516516.4	466.1137	WL-113		Description					61.262	46.477	76.89678983					
	WL-113	3	5		2013	1069483	516470	462.964	WL-113	3013	1069483.2	516470	460.96	WL-113					
	Delta Elev	2																	
	Midpoint Elevation	461.9636												Pie 1	4018	1069544.5	516516.4	462.4636	WL-113
														Pie2	5018	1069544.5	516516.4	461.4636	WL-113
a	4019	1069565.07	516489.3	465.0609	WL-113		Description					81.88	19.3	84.12386344					
	WL-113	3	5		2013	1069483	516470	462.964	WL-113	3013	1069483.2	516470	460.96	WL-113					
	Delta Elev	2																	
	Midpoint Elevation	461.9636												Pie 1	4019	1069565.1	516489.3	462.4636	WL-113
														Pie2	5019	1069565.1	516489.3	461.4636	WL-113
b	4020	1069540.42	516440.8	463.1335	WL-113		Description					57.227	-29.131	64.21474159					
	WL-113	3	5		2013	1069483	516470	462.964	WL-113	3013	1069483.2	516470	460.96	WL-113					
	Delta Elev	2																	
	Midpoint Elevation	461.9636												Pie 1	4020	1069540.4	516440.8	462.4636	WL-113
														Pie2	5020	1069540.4	516440.8	461.4636	WL-113
										59.1	-30.0837	66.31505		Pie 1 Override	4020	1069542.3	516439.9	462.9636	WL-113
										80.5	-40.978	90.32992		Pie 2 Override	5020	1069563.7	516429	460.9636	WL-113
b	4021	1069507	516346.7	460.1067	PVC-26														
	PVC-26	3	10		2027	1069464	516376.1	462.039	PVC-26	3027	1069464.5	516376.1	455.04	PVC-26					
	Delta Elev	7																	
	Midpoint Elevation	458.5392												Pie 1	4021	1069507	516346.7	460.2892	PVC-26
														Pie2	5021	1069507	516346.7	456.7892	PVC-26
										28.12	-19.4672	34.19858		Pie 1 Override	4021	1069492.6	516356.7	462.0392	PVC-26
										65.04	-45.0304	79.10623		Pie 2 Override	5021	1069529.5	516331.1	455.0392	PVC-26
a	4022	1069433.83	516285.5	459.951	WL-118														
	WL-118	0	7		2018	1069411	516305	465.407	WL-118	3018	1069411.1	516305	458.41	WL-118					
	Delta Elev	7																	
	Midpoint Elevation	461.9069												Pie 1	4022	1069433.8	516285.5	463.6569	WL-118
														Pie2	5022	1069433.8	516285.5	460.1569	WL-118
										0	0	0		Pie 1 Override	4022	1069411.1	516305	465.4069	WL-118
										30.34	-25.9237	39.90925		Pie 2 Override	5022	1069441.4	516279	458.4069	WL-118
d	4023	1069329.92	516054.7	460.5032	WL-106B														
	WL-106	0	6		2006	1069317	516061.9	461.955	WL-106B	3006	1069317.3	516061.9	455.96	WL-106B					
	Delta Elev	6																	
	Midpoint Elevation	458.9552												Pie 1	4023	1069329.9	516054.7	460.4552	WL-106B
														Pie2	5023	1069329.9	516054.7	457.4552	WL-106B
										0.05	0	0.05		Pie 1 Override	4023	1069317.3	516061.9	461.9552	WL-106B
										25.33	-14.4994	29.18632		Pie 2 Override	5023	1069342.6	516047.4	455.9552	WL-106B

Area A1 Extrapolated RIM Worksheet

d	4024	1069275.57	515965.4	459.8313	WL-102														
	WL-102	0	6		2002	1069260	515974.1	461.887	WL-102	3002	1069260.5	515974.1	455.89	WL-102					
	Delta Elev	6																	
	Midpoint Elevation	458.8869												Pie 1	4024	1069275.6	515965.4	460.3869	WL-102
														Pie2	5024	1069275.6	515965.4	457.3869	WL-102
										0	0	0		Pie 1 Override	4024	1069260.5	515974.1	461.8869	WL-102
										30.22	-17.2982	34.82019		Pie 2 Override	5024	1069290.7	515956.8	455.8869	WL-102
a	4025	1069163.23	515832.4	464.9148	WL-105B														
	WL-105	3	12		2005	1069148	515889.5	461.294	WL-105B	3005	1069148.4	515889.5	452.29	WL-105B					
	Delta Elev	9																	
	Midpoint Elevation	456.7942												Pie 1	4025	1069163.2	515832.4	459.0442	WL-105B
														Pie2	5025	1069163.2	515832.4	454.5442	WL-105B
a	4026	1069098.4	515873.4	466.45	WL-105B														
	WL-105	3	12		2005	1069148	515889.5	461.294	WL-105B	3005	1069148.4	515889.5	452.29	WL-105B					
	Delta Elev	9																	
	Midpoint Elevation	456.7942												Pie 1	4026	1069098.4	515873.4	459.0442	WL-105B
														Pie2	5026	1069098.4	515873.4	454.5442	WL-105B
a	4027	1069143.24	516144.5	471.1338	PVC-36 influence				Perp to Perimeter from PVC-24			-59.6988	16.116	61.83579652					
	Interpolation for Perimeter		Northing	1069202.942	Easting	516128.4													
	PVC-36	6	9.5		2031	1069218	516193.8	460.085	PVC-36	3031	1069217.9	516193.8	456.58	PVC-36					
	WL-105	3	12		2005	1069148	515889.5	461.294	WL-105B	3005	1069148.4	515889.5	452.29	WL-105B					
		Point A	Point B	Point A Dist.	Total Dist.	Percent		Diff.	RIM 1 EL.				Diff.	RIM 2 EL.					
		PVC-36	WL-105	67.1707	312.1681	21.52%		1.2093	460.35				4.2907	455.66					
	Delta Elev	4.68																	
	Midpoint Elevation	458.00												Pie 1	4027	1069143.2	516144.5	459.1742	PVC-36 influence
														Pie2	5027	1069143.2	516144.5	456.8325	PVC-36 influence
a	4101	1069529.18	516536.4	466.2535	WL-113														
	WL-113	3	5		2013	1069483	516470	462.964	WL-113	3013	1069483.2	516470	460.96	WL-113					
	Delta Elev	2																	
	Midpoint Elevation	461.9636												Pie 1	4101	1069529.2	516536.4	462.4636	WL-113
														Pie2	5101	1069529.2	516536.4	461.4636	WL-113
a	4102	1069471.88	516490.1	466.5134	WL-113														
	WL-113	3	5		2013	1069483	516470	462.964	WL-113	3013	1069483.2	516470	460.96	WL-113					
	Delta Elev	2																	
	Midpoint Elevation	461.9636												Pie 1	4102	1069471.9	516490.1	462.4636	WL-113
														Pie2	5102	1069471.9	516490.1	461.4636	WL-113
a	4103	1069435.85	516489.6	467.2779	Close to WL-113														
	WL-113	3	5		2013	1069483	516470	462.964	WL-113	3013	1069483.2	516470	460.96	WL-113					
	Delta Elev	2																	
	Midpoint Elevation	461.9636												Pie 1	4103	1069435.8	516489.6	462.4636	Close to WL-113
														Pie2	5103	1069435.8	516489.6	461.4636	Close to WL-113
a	4104	1069435.56	516509.9	467.5567	Close to WL-113														
	WL-113	3	5		2013	1069483	516470	462.964	WL-113	3013	1069483.2	516470	460.96	WL-113					
	Delta Elev	2																	
	Midpoint Elevation	461.9636												Pie 1	4104	1069435.6	516509.9	462.4636	Close to WL-113
														Pie2	5104	1069435.6	516509.9	461.4636	Close to WL-113
a	4105	1069441.88	516625.7	462	Close to WL-103 top of slope														
	WL-113				2013	1069483	516470	458.964	WL-113	3013	1069483.2	516470	456.96	WL-113					
	Delta Elev	2																	
	Midpoint Elevation	457.9636												Pie 1	4105	1069441.9	516625.7	458.4636	Close to WL-103 top of slope
	Note: Elevation RIM 1 and 2 were determined by WL-113 minus 4' due to slope													Pie2	5105	1069441.9	516625.7	457.4636	Close to WL-103 top of slope

Area A1 Extrapolated RIM Worksheet

a		4106	1069445.42	516690.5	450	Close to WL-103 toe of slope														
	WL-103		9	11		2003	1069407	516737.1	440.533	WL-103	3003	1069407.4	516737.1	438.53	WL-103					
	Delta Elev		2																	
	Midpoint Elevation		439.533												Pie 1	4106	1069445.4	516690.5	440.033	Close to WL-103 toe of slope
															Pie2	5106	1069445.4	516690.5	439.033	Close to WL-103 toe of slope
a		4107	1069447.68	516732	449.0581	WL-103														
	WL-103		9	11		2003	1069407	516737.1	440.533	WL-103	3003	1069407.4	516737.1	438.53	WL-103					
	Delta Elev		2																	
	Midpoint Elevation		439.533												Pie 1	4107	1069447.7	516732	440.033	WL-103
															Pie2	5107	1069447.7	516732	439.033	WL-103

Additional Pie 2 Points for inclusion of overland gamma reading

5201	1069396.4	516154.6	457.9221	WL-106B Mod.
5202	1069387.5	516124.1	457.3991	WL-106B Mod.
5203	1069333.9	516032.2	455.9438	WL-106B Mod.
5204	1069450.8	516284.5	458.407	WL-118 Mod.

Attachment E:

Area 2 (Upper) Extrapolated RIM (Pie) Calculations

Area A2 Extrapolated RIM Worksheet

A2 (U) Pie Worksheet

Pie Calculation from known RIM Elevation

Insert Pie Data with Surface Elevation

Insert Well Data

Manually update relevant data (indicated by pink text box)

North./East. Proximity Check

	0	1069192.29	516219.2	469.7527	PVC-000	Directly Perpendicular to limit from PVC-36						-25.605	25.366	36.04261747	
PVC-000	6	9.5		2031	1069217.9	516193.8	460.085	PVC-000	3031	1069217.9	516193.8	456.58	PVC-000		
Delta Elev	3.5														
Midpoint Elevation	458.3349														

Pie 1	0	1069192.285	516219.21	459.2099	PVC-000
Pie2	1000	1069192.285	516219.21	457.4599	PVC-000

Location Results with Rim Elevations

Pie Calculation from Interpolated RIM Elevation

	10026	1070482.51	515256.9	463.95	Between PVC-12 and PVC-39	Perp to Perimeter from WL-215						-50.4913	2.8245	50.57024002	
Interpolation for Perimeter		Northing	1070533.001	Easting	515254.08										
PVC-12	0.5	5.5		8054	1070528.7	515176.8	463.718	PVC-12	9054	1070528.7	515176.8	458.72	PVC-12		
PVC-39	1.5	4		8062	1070540.5	515388.6	462.285	PVC-39	9062	1070540.5	515388.6	459.79	PVC-39		

Point A	Point B	Point A Dist.	Total Dist.	Percent
PVC-12	PVC-39	77.4361	212.1706	36.50%

Diff.	RIM 1 EL.
1.4326	463.20

Diff.	RIM 2 EL.
1.0674	459.11

Delta Elev	4.09
Midpoint Elevation	461.15

Pie 1	10026	1070482.51	515256.9	462.1731	Between PVC-12 and PVC-39
Pie2	11026	1070482.51	515256.9	460.1294	Between PVC-12 and PVC-39

Pie Calculation Using Manual Override for Daylighting

	4021	1069507	516346.7	460.1067	PVC-26								
PVC-26	3	10		2027	1069464.5	516376.1	462.039	PVC-26	3027	1069464.5	516376.1	455.04	PVC-26
Delta Elev	7												
Midpoint Elevation	458.5392												

P1 !!!

			Pie 1	4021	1069507	516346.67	460.2892	PVC-26
			Pie2	5021	1069507	516346.67	456.7892	PVC-26
28.12	-19.4672	34.19858	Pie 1 Override	4021	1069492.567	516356.66	462.0392	PVC-26
65.04	-45.0304	79.10623	Pie 2 Override	5021	1069529.489	516331.1	455.0392	PVC-26

Area A2 Extrapolated RIM Worksheet

b	10001	1070811.61	514583.2	465.4428	WL-222		From WL-222 Perp to Limit					12.234	-35.557	37.60233302					
	WL-222	0	7		8022	1070799.4	514618.7	457.8	WL-222	9022	1070799.4	514618.7	450.8	WL-222					
	Delta Elev	7																	
	Midpoint Elevation	454.3												Pie 1	10001	1070811.614	514583.18	456.05	WL-222
														Pie2	11001	1070811.614	514583.18	452.55	WL-222
										22.72	-66.043	69.84319		Pie 1 Override	10001	1070822.104	514552.7	457.8	WL-222
										28.73	-83.504	88.30894		Pie 2 Override	11001	1070828.112	514535.24	450.8	WL-222
a	10002	1070558.17	514503.7	461.4202	PVC-5		From PVC-5 to WL-221					9.18	-44.32	45.26074237					
	PVC-5	1	7		8047	1070549	514548	461.065	PVC-5	9047	1070549	514548	455.07	PVC-5					
	Delta Elev	6																	
	Midpoint Elevation	458.065												Pie 1	10002	1070558.17	514503.69	459.565	PVC-5
														Pie2	11002	1070558.17	514503.69	456.565	PVC-5
a	10003	1070530.95	514525.9	462.1659	PVC-5		From PVC-5 Perp. to Limit					-18.04	-22.065	28.50059228					
	PVC-5	1	7		8047	1070549	514548	461.065	PVC-5	9047	1070549	514548	455.07	PVC-5					
	Delta Elev	6																	
	Midpoint Elevation	458.065												Pie 1	10003	1070530.95	514525.95	459.565	PVC-5
														Pie2	11003	1070530.95	514525.95	456.565	PVC-5
a	10004	1070451.92	514636.7	467.7012	WL-209		From WL-209 Perp. to Limit					-40.627	-49.689	64.18402918					
	WL-209	0	11		8009	1070492.6	514686.3	466.308	WL-209	9009	1070492.6	514686.3	455.31	WL-209					
	Delta Elev	11																	
	Midpoint Elevation	460.8081												Pie 1	10004	1070451.923	514636.65	463.5581	WL-209
														Pie2	11004	1070451.923	514636.65	458.0581	WL-209
b	10005	1070322.25	514774.5	469.4247	PVC-8		From PVC-8 to PVC-18					-21.31	-97.265	99.57206599					
	PVC-8	0	1.5		8050	1070343.6	514871.7	471.244	PVC-8	9050	1070343.6	514871.7	469.74	PVC-8				P1 !!!	
	Delta Elev	1.5																P2 !!!	
	Midpoint Elevation	470.494												Pie 1	10005	1070322.25	514774.46	470.869	PVC-8
														Pie2	11005	1070322.25	514774.46	470.119	PVC-8
										0	0	0		Pie 1 Override	10005	1070343.56	514871.72	471.244	PVC-8
										-19.52	-89.0934	91.20665		Pie 2 Override	11005	1070324.04	514782.63	469.744	PVC-8
b	10006	1070178.78	514689.5	473.4903	WL-208		From WL-208 Perp. To Limit					37.593	-62.89	73.26892545					
	WL-208	0	10		8008	1070141.2	514752.4	474.294	WL-208	9008	1070141.2	514752.4	464.29	WL-208					
	Delta Elev	10																	
	Midpoint Elevation	469.2944												Pie 1	10006	1070178.783	514689.53	471.7944	WL-208
														Pie2	11006	1070178.783	514689.53	466.7944	WL-208
										27.22	-45.5374	53.05295		Pie 1 Override	10006	1070168.411	514706.88	474.2944	WL-208
										57.44	-96.0894	111.948		Pie 2 Override	11006	1070198.629	514656.33	464.2944	WL-208
b	10007	1070088.9	514624.7	474.4716	WL-211		From WL-211 Perp. To Limit					42.817	-59.375	73.20320938					
	WL-211	0	13		8011	1070046.1	514684.1	474.117	WL-211	9011	1070046.1	514684.1	461.12	WL-211					
	Delta Elev	13																	
	Midpoint Elevation	467.6171												Pie 1	10007	1070088.897	514624.69	470.8671	WL-211
														Pie2	11007	1070088.897	514624.69	464.3671	WL-211
										55.59	-77.0809	95.03246		Pie 1 Override	10007	1070101.665	514606.99	474.1171	WL-211
										66.47	-92.177	113.6443		Pie 2 Override	11007	1070112.551	514591.89	461.1171	WL-211

Area A2 Extrapolated RIM Worksheet

b	10008	1069940.88	514480.5	468.0416	PVC-10	From PVC-10 Perp. To Limit					24.528	-38.364	45.53498244					
	PVC-10	0	13	8052	1069916.4	514518.9	471.25	PVC-10	9052	1069916.4	514518.9	458.25	PVC-10					
	Delta Elev	13																
	Midpoint Elevation	464.75											Pie 1	10008	1069940.878	514480.5	468	PVC-10
													Pie2	11008	1069940.878	514480.5	461.5	PVC-10
									20.92	-32.7149	38.82973		Pie 1 Override	10008	1069937.266	514486.15	471.25	PVC-10
									35.13	-54.9501	65.22094		Pie 2 Override	11008	1069951.482	514463.91	458.25	PVC-10

b	10009	1069870.83	514419.2	462.4622	PVC-11	From PVC-11 Perp. To Limit					22.389	-34.429	41.06885566					
	PVC-11	0	10.5	8053	1069848.4	514453.6	473.06	PVC-11	9053	1069848.4	514453.6	462.56	PVC-11				P1 !!!	
	Delta Elev	10.5															P2 !!!	
	Midpoint Elevation	467.81											Pie 1	10009	1069870.829	514419.17	470.435	PVC-11
													Pie2	11009	1069870.829	514419.17	465.185	PVC-11
									1.724	-2.6509	3.162081		Pie 1 Override	10009	1069850.164	514450.95	473.06	PVC-11
									22.25	-34.221	40.82001		Pie 2 Override	11009	1069870.693	514419.38	462.56	PVC-11

b	10010	1069790.74	514383.1	469.6024	WL-234	From WL-234 Perp. To Limit					33.119	-44.981	55.8582181					
	WL-234	0	21	8033	1069757.6	514428.1	477.645	WL-234	9033	1069757.6	514428.1	456.64	WL-234				P1 !!!	
	Delta Elev	21																
	Midpoint Elevation	467.1446											Pie 1	10010	1069790.739	514383.14	472.3946	WL-234
													Pie2	11010	1069790.739	514383.14	461.8946	WL-234
									0	0	0		Pie 1 Override	10010	1069757.62	514428.12	477.6446	WL-234
									49.7	-67.498	83.821		Pie 2 Override	11010	1069807.319	514360.62	456.6446	WL-234

b	10011	1069670.1	514345.7	475.7879	WL-235	From WL-235 to Perp to Limit					54.869	-73.159	91.44876					
	WL-235	0	1	8034	1069615.2	514418.9	479.529	WL-235	9034	1069615.2	514418.9	478.53	WL-235				P1 !!!	
	Delta Elev	1															P2 !!!	
	Midpoint Elevation	479.0286											Pie 1	10011	1069670.099	514345.71	479.2786	WL-235
													Pie2	11011	1069670.099	514345.71	478.7786	WL-235
									47.23	-62.9792	78.724		Pie 1 Override	10011	1069662.464	514355.89	479.5286	WL-235
									49.58	-66.1106	82.63828		Pie 2 Override	11011	1069664.813	514352.76	478.5286	WL-235

b	10012	1069593.16	514305.9	473.743	WL-235	From WL-235 Perp. To Limit					-22.0698	-112.98	115.1164846					
	WL-235	0	1	8034	1069615.2	514418.9	479.529	WL-235	9034	1069615.2	514418.9	478.53	WL-235				P1 !!!	
	Delta Elev	1															P2 !!!	
	Midpoint Elevation	479.0286											Pie 1	10012	1069593.16	514305.89	479.2786	WL-235
													Pie2	11012	1069593.16	514305.89	478.7786	WL-235
									-14.11	-72.2451	73.61056		Pie 1 Override	10012	1069601.118	514346.62	479.5286	WL-235
									-16.31	-83.5131	85.09153		Pie 2 Override	11012	1069598.917	514335.36	478.5286	WL-235

b	10013	1069507.26	514401.5	479.0426	WL-235	From WL-235 to WL-236					-107.97	-17.37	109.3583001					
	WL-235	0	1	8034	1069615.2	514418.9	479.529	WL-235	9034	1069615.2	514418.9	478.53	WL-235				P1 !!!	
	Delta Elev	1																
	Midpoint Elevation	479.0286											Pie 1	10013	1069507.26	514401.5	479.2786	WL-235
													Pie2	11013	1069507.26	514401.5	478.7786	WL-235
									-100.2	-16.1184	101.4787		Pie 1 Override	10013	1069515.04	514402.75	479.5286	WL-235
									-116.1	-18.6802	117.6068		Pie 2 Override	11013	1069499.116	514400.19	478.5286	WL-235

a	10014	1069470.85	514496.7	484.7716	WL-233	From WL-233 to WL-236					-71.555	-112.53	133.3533611					
	WL-233	17	31	8032	1069542.4	514609.2	470.12	WL-233	9032	1069542.4	514609.2	456.12	WL-233					
	Delta Elev	14																
	Midpoint Elevation	463.1202											Pie 1	10014	1069470.845	514496.66	466.6202	WL-233
													Pie2	11014	1069470.845	514496.66	459.6202	WL-233

Area A2 Extrapolated RIM Worksheet

a	10015	1069416.45	514631.2	491.1177	WL_233		From WL-233 to Limit at Toe of Slope					-125.9486	22.029	127.860489					
	WL-233	17	31		8032	1069542.4	514609.2	470.12	WL-233	9032	1069542.4	514609.2	456.12	WL-233					
	Delta Elev	14																	
	Midpoint Elevation	463.1202												Pie 1	10015	1069416.451	514631.22	466.6202	WL_233
														Pie2	11015	1069416.451	514631.22	459.6202	WL_233

a	10016	1069502.55	514724.1	485.149	WL-233		From WL-233 to WL-218					-39.855	114.95	121.663156					
	WL-233	17	31		8032	1069542.4	514609.2	470.12	WL-233	9032	1069542.4	514609.2	456.12	WL-233					
	Delta Elev	14																	
	Midpoint Elevation	463.1202												Pie 1	10016	1069502.545	514724.14	466.6202	WL-233
														Pie2	11016	1069502.545	514724.14	459.6202	WL-233

a	10017	1069730.71	514889.3	476.1484	WL-210		From WL-210 Perp to Limit					-44.4428	77.706	89.51707771					
	WL-210	0	16.5		8010	1069775.2	514811.6	476.732	WL-210	9010	1069775.2	514811.6	460.23	WL-210					
	Delta Elev	16.5																	
	Midpoint Elevation	468.4815												Pie 1	10017	1069730.707	514889.26	472.6065	WL-210
														Pie2	11017	1069730.707	514889.26	464.3565	WL-210

a	10018	1069806.11	514977.4	475.6118	WL-216		From WL-216 Perp to Limit					-21.7644	46.041	50.92569053					
	WL-216	0	9		8016	1069827.9	514931.4	477.328	WL-216	9016	1069827.9	514931.4	468.33	WL-216					
	Delta Elev	9																	
	Midpoint Elevation	472.8276												Pie 1	10018	1069806.106	514977.39	475.0776	WL-216
														Pie2	11018	1069806.106	514977.39	470.5776	WL-216

a	10019	1069953.31	515099.6	472.1164	WL-217		From WL-217 Perp to Limit at Toe of Slope					-7.9912	17.344	19.09661098					
	WL-217	9	11		8017	1069961.3	515082.2	463.991	WL-217	9017	1069961.3	515082.2	461.99	WL-217					
	Delta Elev	2																	
	Midpoint Elevation	462.9908												Pie 1	10019	1069953.309	515099.55	463.4908	WL-217
														Pie2	11019	1069953.309	515099.55	462.4908	WL-217

a	10020	1070082.97	515140.9	471.6852	RIM offset 50' from WL-237				Perp to Perimeter from WL-237			9.1523	-14.185	16.88165183					
	Initial Interpolation		Northing	1070073.821	Easting	515155.06	Surf. El.	472.152											
	WL-217	9	11		8017	1069961.3	515082.2	463.991	WL-217	9017	1069961.3	515082.2	461.99	WL-217					
	WL-214	4	6		8014	1070206.9	515241.2	463.637	WL-214	9014	1070206.9	515241.2	461.64	WL-214					
		Point A	Point B	Point A Dist.	Total Dist.	Percent		Diff.	RIM 1 EL.				Diff.	RIM 2 EL.					
		WL-217	WL-214	134.0445	292.5309	45.82%		0.3534	463.83				0.3534	461.83					
	Offset RIM Surf. El.	471.591																	
	Offset RIM	8.32	10.32			1070096.5	515119.9	463.27	WL-217		1070096.5	515119.9	461.27	WL-217					
	Delta Elev	2																	
	Midpoint Elevation	462.267864												Pie 1	10020	1070082.974	515140.87	462.7679	RIM offset 50' from WL-237
														Pie2	11020	1070082.974	515140.87	461.7679	RIM offset 50' from WL-237

a	10021	1070155.98	515240.3	470.031	WL-214		From WL-214 Perp to Limit					-50.8815	-0.8639	50.88883341					
	WL-214	4	6		8014	1070206.9	515241.2	463.637	WL-214	9014	1070206.9	515241.2	461.64	WL-214					
	Delta Elev	2																	
	Midpoint Elevation	462.6374												Pie 1	10021	1070155.979	515240.33	463.1374	WL-214
														Pie2	11021	1070155.979	515240.33	462.1374	WL-214

Area A2 Extrapolated RIM Worksheet

a	10022	1070176.7	515285.4	469.5744	WL-214	From WL-214 Perp to Limit at Toe of Slope	-30.1643	44.187	53.5013424			
WL-214	4	6	8014	1070206.9	515241.2	463.637	WL-214	9014	1070206.9	515241.2	461.64	WL-214
Delta Elev	2											
Midpoint Elevation	462.6374						Pie 1	10022	1070176.696	515285.38	463.1374	WL-214
							Pie2	11022	1070176.696	515285.38	462.1374	WL-214

a	10023	1070215.36	515275.9	469.9658	WL-214	From WL-214 Perp to Limit	8.4966	34.729	35.75277505			
WL-214	4	6	8014	1070206.9	515241.2	463.637	WL-214	9014	1070206.9	515241.2	461.64	WL-214
Delta Elev	2											
Midpoint Elevation	462.6374						Pie 1	10023	1070215.357	515275.92	463.1374	WL-214
							Pie2	11023	1070215.357	515275.92	462.1374	WL-214

a	10024	1070409.16	515193.6	465.7927	PVC-9	From PVC-9 to WL-215	22.85	66.12	69.95696463			
PVC-9	1	6.5	8051	1070386.3	515127.5	466.374	PVC-9	9051	1070386.3	515127.5	460.87	PVC-9
Delta Elev	5.5											
Midpoint Elevation	463.6242						Pie 1	10024	1070409.16	515193.6	464.9992	PVC-9
							Pie2	11024	1070409.16	515193.6	462.2492	PVC-9

a	10025	1070480.35	515218.2	463.8401	PVC-12	From PVC-12 to WL-215	-48.335	41.48	63.69350536			
PVC-12	0.5	5.5	8054	1070528.7	515176.8	463.718	PVC-12	9054	1070528.7	515176.8	458.72	PVC-12
Delta Elev	5											
Midpoint Elevation	461.2179						Pie 1	10025	1070480.345	515218.24	462.4679	PVC-12
							Pie2	11025	1070480.345	515218.24	459.9679	PVC-12

a	10026	1070482.51	515256.9	463.9523	Between PVC-12 and PVC-39	Perp to Perimeter from WL-215	-50.4957	2.8222	50.57450476			
Interpolation for Perimeter	Northing	1070533.001	Easting	515254.08								
PVC-12	0.5	5.5	8054	1070528.7	515176.8	463.718	PVC-12	9054	1070528.7	515176.8	458.72	PVC-12
PVC-39	1.5	4	8062	1070540.5	515388.6	462.285	PVC-39	9062	1070540.5	515388.6	459.79	PVC-39
	Point A	Point B	Point A Dist.	Total Dist.	Percent	Diff.	RIM 1 EL.		Diff.	RIM 2 EL.		
	PVC-12	PVC-39	77.4361	212.1706	36.50%	1.4326	463.20		1.0674	459.11		
Delta Elev	4.09											
Midpoint Elevation	461.15						Pie 1	10026	1070482.506	515256.9	462.1731	Between PVC-12 and PVC-39
							Pie2	11026	1070482.506	515256.9	460.1294	Between PVC-12 and PVC-39

a	10027	1070497.45	515395.4	465.0689	PVC-39	From PVC-39 Perp to Limit	-43.0685	6.7661	43.59674072			
PVC-39	1.5	4	8062	1070540.5	515388.6	462.285	PVC-39	9062	1070540.5	515388.6	459.79	PVC-39
Delta Elev	2.5											
Midpoint Elevation	461.0353						Pie 1	10027	1070497.452	515395.37	461.6603	PVC-39
							Pie2	11027	1070497.452	515395.37	460.4103	PVC-39

a	10028	1070513.13	515495.2	467.3185	PVC-39	From PVC-39 to WL-224	-27.39	106.57	110.0286841			
PVC-39	1.5	4	8062	1070540.5	515388.6	462.285	PVC-39	9062	1070540.5	515388.6	459.79	PVC-39
Delta Elev	2.5											
Midpoint Elevation	461.0353						Pie 1	10028	1070513.13	515495.17	461.6603	PVC-39
							Pie2	11028	1070513.13	515495.17	460.4103	PVC-39

a	10029	1070558.73	515510.6	460.9311	PVC-39	From PVC-39 to WL-225	18.205	122.03	123.3804803				
PVC-39	1.5	4	8062	1070540.5	515388.6	462.285	PVC-39	9062	1070540.5	515388.6	459.79	PVC-39	P1 !!!
Delta Elev	2.5												
Midpoint Elevation	461.0353						Pie 1	10029	1070558.725	515510.63	461.6603	PVC-39	
							Pie2	11029	1070558.725	515510.63	460.4103	PVC-39	

Area A2 Extrapolated RIM Worksheet

a		10030	1070607.22	515471.7	461.696	PVC-40	From PVC-39 perp to limit						66.7041	83.1	106.5599847					
	PVC-39		1.5	4		8062	1070540.5	515388.6	462.285	PVC-39	9062	1070540.5	515388.6	459.79	PVC-39					
	Delta Elev		2.5																	
	Midpoint Elevation		461.0353												Pie 1	10030	1070607.224	515471.7	461.6603	PVC-40
															Pie2	11030	1070607.224	515471.7	460.4103	PVC-40

a		10031	1070715.26	515378	459.997	PVC-40	From PVC-40 perp to limit						75.6247	121.93	143.4742975					
	PVC-40		0.5	9.5		8063	1070639.6	515256.1	462.925	PVC-40	9063	1070639.6	515256.1	453.93	PVC-40				P1 !!!	
	Delta Elev		9																	
	Midpoint Elevation		458.4254												Pie 1	10031	1070719.265	515355.3	460.6754	PVC-40
															Pie2	11031	1070719.265	515355.3	456.1754	PVC-40

a		10032	1070754.66	515369.1	459.997	WL-230	From WL-227 perp to limit						68.6732	110.72	130.2859067					
	WL-227		4	6		8027	1070686	515258.4	457.575	WL-227	9027	1070686	515258.4	455.57	WL-227					
	Delta Elev		2																	
	Midpoint Elevation		456.5749												Pie 1	10032	1070755.975	515345.58	457.0749	WL-230
															Pie2	11032	1070755.975	515345.58	456.0749	WL-230

a		10033	1070904.13	515290.6	454.7295	WL-244	From WL-244 Perp to Limit						-36.2813	66.717	75.94364651					
	WL-244		0	1		8043	1070940.4	515223.9	449.805	WL-244	9043	1070940.4	515223.9	448.81	WL-244					
	Delta Elev		1																	
	Midpoint Elevation		449.305419												Pie 1	10033	1070904.131	515290.57	449.5554	WL-244
															Pie2	11033	1070904.131	515290.57	449.0554	WL-244

b		10034	1070944.91	515312.7	442.2219	WL-244	From WL-244 Perp to Limit						4.4933	88.89	89.00379306					
	WL-244		0	1		8043	1070940.4	515223.9	449.805	WL-244	9043	1070940.4	515223.9	448.81	WL-244				P1 !!!	
	Delta Elev		1																P2 !!!	
	Midpoint Elevation		449.305419												Pie 1	10034	1070944.905	515312.74	449.5554	WL-244
															Pie2	11034	1070944.905	515312.74	449.0554	WL-244
											4.472	8.312	9.43884		Pie 1 Override	10034	1070944.884	515232.17	449.8054	WL-244
											6.991	12.9929	14.75435		Pie 2 Override	11034	1070947.403	515236.85	448.8054	WL-244

b		10035	1070971.79	515231.8	443.2441	WL-244	From WL-244 Perp to Limit						31.3796	7.9695	32.37579692					
	WL-244		0	1		8043	1070940.4	515223.9	449.805	WL-244	9043	1070940.4	515223.9	448.81	WL-244				P1 !!!	
	Delta Elev		1																P2 !!!	
	Midpoint Elevation		449.305419												Pie 1	10035	1070971.792	515231.82	449.5554	WL-244
															Pie2	11035	1070971.792	515231.82	449.0554	WL-244
											6.667	1.6931	6.878625		Pie 1 Override	10035	1070947.079	515225.55	449.8054	WL-244
											10.31	2.6174	10.63318		Pie 2 Override	11035	1070950.718	515226.47	448.8054	WL-244

b		10036	1070978.55	515205.2	443.5865	WL-244	From WL-244 Perp to Limit						38.1365	-18.635	42.44613637					
	WL-244		0	1		8043	1070940.4	515223.9	449.805	WL-244	9043	1070940.4	515223.9	448.81	WL-244				P1 !!!	
	Delta Elev		1																P2 !!!	
	Midpoint Elevation		449.305419												Pie 1	10036	1070978.549	515205.22	449.5554	WL-244
															Pie2	11036	1070978.549	515205.22	449.0554	WL-244
											8.728	-4.2648	9.713973		Pie 1 Override	10036	1070949.14	515219.59	449.8054	WL-244
											12.85	-4.9135	13.76147		Pie 2 Override	11036	1070953.266	515218.94	448.8054	WL-244

Area A2 Extrapolated RIM Worksheet

a	10037	1070946.9	515093.1	459.7596	Between WL-244 and PVC-33				Perp to Perimeter from WL-215			31.3948	-6.2802	32.01678277					
	Interpolation for Perimeter		Northing	1070915.504	Easting	515099.34													
	WL-244	0	1		8043	1070940.4	515223.9	449.805	WL-244	9043	1070940.4	515223.9	448.81	WL-244					
	PVC-33	1.5	3.5		8059	1070857.8	514810.8	460.21	PVC-33	9059	1070857.8	514810.8	458.21	PVC-33					
		Point A	Point B	Point A Dist.	Total Dist.	Percent		Diff.	RIM 1 EL.				Diff.	RIM 2 EL.					
		WL-244	PVC-33	126.9791	421.2579	30.14%		10.4046	452.94				9.4046	451.64					
	Delta Elev	1.30																	
	Midpoint Elevation	452.29												Pie 1	10037	1070946.899	515093.06	452.6163	Between WL-244 and PVC-33
														Pie2	11037	1070946.899	515093.06	451.9656	Between WL-244 and PVC-33

a	10038	1070892.83	514835.5	461.5936	PVC-33 Influence				Perp to Perimeter from WL-239			28.9425	-5.7897	29.51590982					
	Interpolation for Perimeter		Northing	1070863.885	Easting	514841.3													
	WL-244	0	1		8043	1070940.4	515223.9	449.805	WL-244	9043	1070940.4	515223.9	448.81	WL-244					
	PVC-33	1.5	3.5		8059	1070857.8	514810.8	460.21	PVC-33	9059	1070857.8	514810.8	458.21	PVC-33					
		Point A	Point B	Point A Dist.	Total Dist.	Percent		Diff.	RIM 1 EL.				Diff.	RIM 2 EL.					
		WL-244	PVC-33	390.1338	421.2579	92.61%		10.4046	459.44				9.4046	457.52					
	Delta Elev	1.93																	
	Midpoint Elevation	458.48												Pie 1	10038	1070892.828	514835.51	458.9597	PVC-33 Influence
														Pie2	11038	1070892.828	514835.51	457.9967	PVC-33 Influence

a	10039	1070885.39	514803.5	461.3936	PVC-33		From PVC-33 Perp to Limit					27.6144	-7.2395	28.54759968					
	PVC-33	1.5	3.5		8059	1070857.8	514810.8	460.21	PVC-33	9059	1070857.8	514810.8	458.21	PVC-33					
	Delta Elev	2																	
	Midpoint Elevation	459.21												Pie 1	10039	1070885.394	514803.54	459.71	PVC-33
														Pie2	11039	1070885.394	514803.54	458.71	PVC-33

a	10040	1070827.07	514596.4	466.1486	WL-222		From WL-222 Perp to Limit at Toe Slope					27.6914	-22.307	35.55850053					
	WL-222	0	7		8022	1070799.4	514618.7	457.8	WL-222	9022	1070799.4	514618.7	450.8	WL-222					
	Delta Elev	7																	
	Midpoint Elevation	454.3												Pie 1	10040	1070827.071	514596.43	456.05	WL-222
														Pie2	11040	1070827.071	514596.43	452.55	WL-222
										43.76	-35.2519	56.19376		Pie 1 Override	10040	1070843.141	514583.49	457.8	WL-222
										55.39	-44.6227	71.13143		Pie 2 Override	11040	1070854.774	514574.12	450.8	WL-222

Additional Pie 2 points to include overland gamma detection

11101	1070345.743	514757.85	452.55	PVC-8 ext.
11102	1070270.415	514669.04	466.1181	PVC-8 ext.
11103	1070240.802	514698.8	466.127	PVC-8 ext.
11104	1069654.087	514833.81	462.766	WL-210 ext.
11105	1069724.276	514916.78	465.6556	WL-210 ext.
11106	1070461.076	515211.57	460.5854	PVC-12 ext.
11107	1070485.071	515346.19	460.309	PVC-12 ext.
11108	1070528.538	514504	456.565	PVC-5 ext.

Attachment F:

Area 2 (Lower) Extrapolated RIM (Pie) Calculations

Area A2 Lower Extrapolated RIM Worksheet

Pie Calculation from known RIM Elevation

Insert Pie Data with Surface Elevation

Insert Well Data

Manually update relevant data (indicated by pink text box)

North./East. Proximity Check

0	1069192.29	516219.2	469.7527	PVC-000		Directly Perpendicular to limit from PVC-36					-25.605	25.366	36.04261747	
PVC-000	6	9.5		2031	1069217.9	516193.8	460.085	PVC-000	3031	1069217.9	516193.8	456.58	PVC-000	
Delta Elev	3.5													
Midpoint Elevation	458.3349													

Pie 1	0	1069192.285	516219.21	459.2099	PVC-000
Pie2	1000	1069192.285	516219.21	457.4599	PVC-000

Location Results with Rim Elevations

Pie Calculation from Interpolated RIM Elevation (A)

10026	1070482.51	515256.9	463.95	Between PVC-12 and PVC-39				Perp to Perimeter from WL-215			-50.4913	2.8245	50.57024002	
Interpolation for Perimeter	Northing	1070533.001	Easting	515254.08										
PVC-12	0.5	5.5		8054	1070528.7	515176.8	463.718	PVC-12	9054	1070528.7	515176.8	458.72	PVC-12	
PVC-39	1.5	4		8062	1070540.5	515388.6	462.285	PVC-39	9062	1070540.5	515388.6	459.79	PVC-39	
	Point A	Point B	Point A Dist.	Total Dist.	Percent		Diff.	RIM 1 EL.			Diff.	RIM 2 EL.		
	PVC-12	PVC-39	77.4361	212.1706	36.50%		1.4326	463.20			1.0674	459.11		
Delta Elev	4.09													
Midpoint Elevation	461.15													

Pie 1	10026	1070482.51	515256.9	462.1731	Between PVC-12 and PVC-39
Pie2	11026	1070482.51	515256.9	460.1294	Between PVC-12 and PVC-39

Pie Calculation from Interpolated RIM Elevation (B)

10020	1070082.97	515140.9	471.6852	RIM offset 50' from WL-237				Perp to Perimeter from WL-237			9.1523	-14.185	16.88165183	
Initial Interpolation	Northing	1070073.821	Easting	515155.06	Surf. El.	472.152								
WL-217	9	11		8017	1069961.3	515082.2	463.991	WL-217	9017	1069961.3	515082.2	461.99	WL-217	
WL-214	4	6		8014	1070206.9	515241.2	463.637	WL-214	9014	1070206.9	515241.2	461.64	WL-214	
	Point A	Point B	Point A Dist.	Total Dist.	Percent		Diff.	RIM 1 EL.			Diff.	RIM 2 EL.		
	WL-217	WL-214	134.0445	292.5309	45.82%		0.3534	463.83			0.3534	461.83		
Offset RIM Surf. El.	471.591													
Offset RIM	8.32	10.32			1070096.5	515119.9	463.27	WL-217		1070096.5	515119.9	461.27	WL-217	
Delta Elev	2													
Midpoint Elevation	462.267864													

Pie 1	10020	1070082.974	515140.87	462.7679	RIM offset 50' from WL-237
Pie2	11020	1070082.974	515140.87	461.7679	RIM offset 50' from WL-237

Area A2 Lower Extrapolated RIM Worksheet

Pie Calculation Using Manual Override for Daylighting

	4021	1069507	516346.7	460.1067	PVC-26														
PVC-26		3	10		2027	1069464.5	516376.1	462.039	PVC-26	3027	1069464.5	516376.1	455.04	PVC-26				P1 !!!	
Delta Elev		7																	
Midpoint Elevation		458.5392												Pie 1	4021	1069507	516346.67	460.2892	PVC-26
														Pie2	5021	1069507	516346.67	456.7892	PVC-26
										28.12	-19.4672	34.19858		Pie 1 Override	4021	1069492.567	516356.66	462.0392	PVC-26
										65.04	-45.0304	79.10623		Pie 2 Override	5021	1069529.489	516331.1	455.0392	PVC-26

	15001	1069686.43	514423.5	479.25	WL-235		From WL-235 to WL-234					71.195	4.625	71.34506745					
WL-235		20.5	24.5		13034	1069615.2	514418.9	459.029	WL-235	14034	1069615.2	514418.9	455.03	WL-235					
Delta Elev		4																	
Midpoint Elevation		457.0286												Pie 1	15001	1069686.425	514423.5	458.0286	WL-235
														Pie2	16001	1069686.425	514423.5	456.0286	WL-235

	15002	1069670.1	514345.7	475.7879	WL-235		From WL-235 Perp to Limit					54.8694	-73.159	91.449					
WL-235		20.5	24.5		13034	1069615.2	514418.9	459.029	WL-235	14034	1069615.2	514418.9	455.03	WL-235					
Delta Elev		4																	
Midpoint Elevation		457.0286												Pie 1	15002	1069670.099	514345.71	458.0286	WL-235
														Pie2	16002	1069670.099	514345.71	456.0286	WL-235

	15003	1069593.16	514305.9	473.7429	WL-235		From WL-235 Perp to Limit					-22.0698	-112.98	115.1164846					
WL-235		20.5	24.5		13034	1069615.2	514418.9	459.029	WL-235	14034	1069615.2	514418.9	455.03	WL-235					
Delta Elev		4																	
Midpoint Elevation		457.0286												Pie 1	15003	1069593.16	514305.89	458.0286	WL-235
														Pie2	16003	1069593.16	514305.89	456.0286	WL-235

	15004	1069585.51	514416.8	480.2476	WL-235		From WL-235 Perp to Limit					-29.7154	-2.048	29.78589097					
WL-235		20.5	24.5		13034	1069615.2	514418.9	459.029	WL-235	14034	1069615.2	514418.9	455.03	WL-235					
Delta Elev		4																	
Midpoint Elevation		457.0286												Pie 1	15004	1069585.515	514416.82	458.0286	WL-235
														Pie2	16004	1069585.515	514416.82	456.0286	WL-235

	15005	1069566.6	514617.5	485.4016	WL-233				Perp to Perimeter from WL-233			20.8667	7.1274	22.05037414					
Initial Interpolation			Northing	1069545.731	Easting	514610.33	Surf. El.	486.839											
WL-218		39	41		8018	1069462.7	514839.1	448.32	WL-218	9018	1069462.7	514839.1	446.32	WL-218					
WL-235		20.5	24.5		13034	1069615.2	514418.9	459.029	WL-235	14034	1069615.2	514418.9	455.03	WL-235					
		Point A	Point B	Point A Dist.	Total Dist.	Percent		Diff.	RIM 1 EL.				Diff.	RIM 2 EL.					
		WL-218	WL-235	243.368	447.0495	54.44%		10.709	454.15				8.709	451.06					
Offset RIM Surf. El.		485.281																	
Offset RIM		32.69	35.78			1070096.5	515119.9	452.59	WL-217		1070096.5	515119.9	449.50	WL-217					
Delta Elev		3.08877429																	
Midpoint Elevation		451.047055												Pie 1	15005	1069566.598	514617.46	451.8192	WL-233
														Pie2	16005	1069566.598	514617.46	450.2749	WL-233

Area A2 Lower Extrapolated RIM Worksheet

	15006	1069441.26	514826.2	488.2768	W-218	From WL-218 Perp to Limit	-21.4336	-12.869	24.99995002				
WL-218	39	41	8018	1069462.7	514839.1	448.32	WL-218	9018	1069462.7	514839.1	446.32	WL-218	
Delta Elev	2												
Midpoint Elevation	447.3196							Pie 1	15006	1069441.256	514826.22	447.8196	W-218
								Pie2	16006	1069441.256	514826.22	446.8196	W-218

	15007	1069434.33	514837.8	488.7544	W-218	From WL-218 Perp to Limit	-28.3592	-1.3334	28.39052976				
WL-218	39	41	8018	1069462.7	514839.1	448.32	WL-218	9018	1069462.7	514839.1	446.32	WL-218	
Delta Elev	2												
Midpoint Elevation	447.3196							Pie 1	15007	1069434.331	514837.76	447.8196	W-218
								Pie2	16007	1069434.331	514837.76	446.8196	W-218

	15008	1069446.29	514862.4	487.2821	W-218	From WL-218 Perp to Limit	-16.3975	23.281	28.4763339				
WL-218	39	41	8018	1069462.7	514839.1	448.32	WL-218	9018	1069462.7	514839.1	446.32	WL-218	
Delta Elev	2												
Midpoint Elevation	447.3196							Pie 1	15008	1069446.293	514862.37	447.8196	W-218
								Pie2	16008	1069446.293	514862.37	446.8196	W-218

	15009	1069459.84	514863.9	486.1913	W-218	From WL-218 Perp to Limit	-2.8519	24.837	24.99999936				
WL-218	39	41	8018	1069462.7	514839.1	448.32	WL-218	9018	1069462.7	514839.1	446.32	WL-218	
Delta Elev	2												
Midpoint Elevation	447.3196							Pie 1	15009	1069459.838	514863.93	447.8196	W-218
								Pie2	16009	1069459.838	514863.93	446.8196	W-218

	15010	1069768.7	514867.7	476.3436	W-210	From WL-210 Perp to Limit	-6.4454	56.133	56.50193003				
WL-210	39	49.5	13010	1069775.2	514811.6	437.732	WL-210	14010	1069775.2	514811.6	427.23	WL-210	
Delta Elev	10.5												
Midpoint Elevation	432.4815							Pie 1	15010	1069768.705	514867.68	435.1065	W-210
								Pie2	16010	1069768.705	514867.68	429.8565	W-210

	15011	1069801.51	514871.5	476.9329	W-210	From WL-210 to WL-216	26.36	59.9	65.44356042				
WL-210	39	49.5	13010	1069775.2	514811.6	437.732	WL-210	14010	1069775.2	514811.6	427.23	WL-210	
Delta Elev	10.5												
Midpoint Elevation	432.4815							Pie 1	15011	1069801.51	514871.45	435.1065	W-210
								Pie2	16011	1069801.51	514871.45	429.8565	W-210

	15012	1069800.13	514810.3	476.6112	W-210	From WL-210 Perp to Limit	24.9783	-1.2444	25.00927832				
WL-210	39	49.5	13010	1069775.2	514811.6	437.732	WL-210	14010	1069775.2	514811.6	427.23	WL-210	
Delta Elev	10.5												
Midpoint Elevation	432.4815							Pie 1	15012	1069800.128	514810.31	435.1065	W-210
								Pie2	16012	1069800.128	514810.31	429.8565	W-210

	15013	1070558.17	514503.7	461.4202	PVC-5	From PVC-5 to WL-221	9.18	-44.32	45.26074237				
PVC-5	9.5	14.5	13047	1070549	514548	452.565	PVC-5	14047	1070549	514548	447.57	PVC-5	
Delta Elev	5												
Midpoint Elevation	450.065							Pie 1	15013	1070558.17	514503.69	451.315	PVC-5
								Pie2	16013	1070558.17	514503.69	448.815	PVC-5

Area A2 Lower Extrapolated RIM Worksheet

	15014	1070530.95	514525.9	462.1659	PVC-5	From PVC-5 Perp to Limit							-18.0402	-22.065	28.50071887					
PVC-5		9.5	14.5			13047	1070549	514548	452.565	PVC-5	14047	1070549	514548	447.57	PVC-5					
Delta Elev		5																		
Midpoint Elevation		450.065													Pie 1	15014	1070530.95	514525.95	451.315	PVC-5
															Pie2	16014	1070530.95	514525.95	448.815	PVC-5

	15015	1070451.92	514636.7	467.7012	WL-209	From WL-209 Perp to Limit							-40.6267	-49.689	64.18383928					
WL-209		24	26			13009	1070492.6	514686.3	442.308	WL-209	14009	1070492.6	514686.3	440.31	WL-209					
Delta Elev		2																		
Midpoint Elevation		441.3081													Pie 1	15015	1070451.923	514636.65	441.8081	WL-209
															Pie2	16015	1070451.923	514636.65	440.8081	WL-209

	15016	1070396.75	514681.8	468.0877	WL-209	From WL-209 to PVC-18							-95.805	-4.575	95.91417335					
WL-209		24	26			13009	1070492.6	514686.3	442.308	WL-209	14009	1070492.6	514686.3	440.31	WL-209					
Delta Elev		2																		
Midpoint Elevation		441.3081													Pie 1	15016	1070396.745	514681.77	441.8081	WL-209
															Pie2	16016	1070396.745	514681.77	440.8081	WL-209

	15017	1070392.51	514712	467.9693	PVC-7	From PVC-7 to PVC-18							-91.57	-34.765	97.94728238					
PVC-7		17	22			13049	1070484.1	514746.7	450.06	PVC-7	14049	1070484.1	514746.7	445.06	PVC-7					
Delta Elev		5																		
Midpoint Elevation		447.5597													Pie 1	15017	1070392.51	514711.96	448.8097	PVC-7
															Pie2	16017	1070392.51	514711.96	446.3097	PVC-7

	15018	1070457.85	514774.2	467.4368	PVC-7	From PVC-7 Perp to Limit							-26.2324	27.519	38.01864884					
PVC-7		17	22			13049	1070484.1	514746.7	450.06	PVC-7	14049	1070484.1	514746.7	445.06	PVC-7					
Delta Elev		5																		
Midpoint Elevation		447.5597													Pie 1	15018	1070457.848	514774.24	448.8097	PVC-7
															Pie2	16018	1070457.848	514774.24	446.3097	PVC-7

	15019	1070541.63	514854.1	467.1915	PVC-7	From PVC-7 to PVC-19							57.55	107.39	121.8340705					
PVC-7		17	22			13049	1070484.1	514746.7	450.06	PVC-7	14049	1070484.1	514746.7	445.06	PVC-7					
Delta Elev		5																		
Midpoint Elevation		447.5597													Pie 1	15019	1070541.63	514854.11	448.8097	PVC-7
															Pie2	16019	1070541.63	514854.11	446.3097	PVC-7

	15020	1070613.06	514861.1	466.0687	PVC-6	From PVC-6 to PVC-19							-13.88	100.36	101.3202232					
PVC-6		19	22.5			13048	1070626.9	514760.8	445.057	PVC-6	14048	1070626.9	514760.8	441.56	PVC-6					
Delta Elev		3.5																		
Midpoint Elevation		443.3073													Pie 1	15020	1070613.06	514861.13	444.1823	PVC-6
															Pie2	16020	1070613.06	514861.13	442.4323	PVC-6

	15021	1070670.02	514802.9	463.9973	PVC-6	From PVC-6 Perp to Limit							43.0842	42.181	60.29505359					
PVC-6		19	22.5			13048	1070626.9	514760.8	445.057	PVC-6	14048	1070626.9	514760.8	441.56	PVC-6					
Delta Elev		3.5																		
Midpoint Elevation		443.3073													Pie 1	15021	1070670.024	514802.94	444.1823	PVC-6
															Pie2	16021	1070670.024	514802.94	442.4323	PVC-6

Area A2 Lower Extrapolated RIM Worksheet

	15022	1070688.73	514783.8	462.6627	PVC-6	From PVC-6 to PVC-20			61.785	23.08	65.95508036	
PVC-6	19	22.5	13048	1070626.9	514760.8	445.057	PVC-6	14048	1070626.9	514760.8	441.56	PVC-6
Delta Elev	3.5											
Midpoint Elevation	443.3073		Pie 1	15022	1070688.725	514783.84	444.1823	PVC-6				
			Pie2	16022	1070688.725	514783.84	442.4323	PVC-6				

	15023	1070665.78	514740.3	462.2119	PVC-6	From PVC-6 Perp to Limit			38.8358	-20.467	43.8987594	
PVC-6	19	22.5	13048	1070626.9	514760.8	445.057	PVC-6	14048	1070626.9	514760.8	441.56	PVC-6
Delta Elev	3.5											
Midpoint Elevation	443.3073		Pie 1	15023	1070665.776	514740.29	444.1823	PVC-6				
			Pie2	16023	1070665.776	514740.29	442.4323	PVC-6				

	15024	1070574.45	514534.6	461.6259	PVC-5	From PVC-5 Perp to Limit			25.4645	-13.42	28.78427481	
PVC-5	9.5	14.5	13047	1070549	514548	452.565	PVC-5	14047	1070549	514548	447.57	PVC-5
Delta Elev	5											
Midpoint Elevation	450.065		Pie 1	15024	1070574.455	514534.59	451.315	PVC-5				
			Pie2	16024	1070574.455	514534.59	448.815	PVC-5				

	15025	1070256.86	515191.2	468.2744	WL-214	WL-214 100'x100'			50	-50	70.71067812	
WL-214	24	26	13014	1070206.9	515241.2	443.637	WL-214	14014	1070206.9	515241.2	441.64	WL-214
Delta Elev	2											
Midpoint Elevation	442.6374		Pie 1	15025	1070256.86	515191.19	443.1374	WL-214				
			Pie2	16025	1070256.86	515191.19	442.1374	WL-214				

	15026	1070156.86	515191.2	469.1387	WL-214	WL-214 100'x100'			-50	-50	70.71067812	
WL-214	24	26	13014	1070206.9	515241.2	443.637	WL-214	14014	1070206.9	515241.2	441.64	WL-214
Delta Elev	2											
Midpoint Elevation	442.6374		Pie 1	15026	1070156.86	515191.19	443.1374	WL-214				
			Pie2	16026	1070156.86	515191.19	442.1374	WL-214				

	15027	1070156.86	515291.2	469.9104	WL-214	WL-214 100'x100'			-50	50	70.71067812	
WL-214	24	26	13014	1070206.9	515241.2	443.637	WL-214	14014	1070206.9	515241.2	441.64	WL-214
Delta Elev	2											
Midpoint Elevation	442.6374		Pie 1	15027	1070156.86	515291.19	443.1374	WL-214				
			Pie2	16027	1070156.86	515291.19	442.1374	WL-214				

	15028	1070256.86	515291.2	467.6338	WL-214	WL-214 100'x100'			50	50	70.71067812	
WL-214	24	26	13014	1070206.9	515241.2	443.637	WL-214	14014	1070206.9	515241.2	441.64	WL-214
Delta Elev	2											
Midpoint Elevation	442.6374		Pie 1	15028	1070256.86	515291.19	443.1374	WL-214				
			Pie2	16028	1070256.86	515291.19	442.1374	WL-214				

APPENDIX C:

Off-site Disposal Facilities – Waste Acceptance Criteria

Appendix C-1:

U.S. Ecology, Inc. – Grandview, Idaho

C.3 WASTE ACCEPTANCE CRITERIA

C.3.1 Pre-acceptance Review

The preacceptance protocol has been designed to ensure that only hazardous and radioactive material that can be properly and safely stored, treated and/or disposed of by USEI are approved for receipt at the facility. A two-step approach is taken by USEI. The first step is the chemical and/or radiological and physical characterization of the candidate waste stream by the generator. The second step is the preacceptance evaluation performed by USEI to determine the acceptability of the waste for receipt at the facility. Figure C-2 presents a logic diagram of the preacceptance protocol that is utilized at the facility.

C.3.2 Radioactive Material Waste Acceptance Criteria

The following waste acceptance criteria are established for accepting radiological contaminated waste material that is generally or specifically exempted from regulation by the Nuclear Regulatory Commission (NRC) or an Agreement State under the Atomic Energy Act of 1954 ("AEA"), as amended. Material may also be accepted if it is not regulated or licensed by the NRC or has been authorized for disposal by the IDEQ and is within the numeric waste acceptance criteria. Waste acceptance criteria are consistent with these restrictions.

The following five tables establish types and concentrations of radioactive materials that may be accepted. These tables are based on categories and types of radioactive material not regulated by the NRC based on statute or regulation or specifically approved by the NRC or and Agreement State for alternate disposal. The criteria are consistent with these restrictions and detailed analyses set forth in *Waste Acceptance Criteria and Justification for FUSRAP Material*, prepared by Radiation Safety Associates, Inc. (RSA) as subsequently refined, expanded and updated in *Waste Acceptance Criteria and Justification for Radioactive Material*, prepared by USEI.

Material may be accepted if the material has been specifically exempted from regulation by rule, order, license, license condition, letter of interpretation, or specific authorization under the following conditions: Thirty (30) days prior to intended shipment of such materials to the facility, USEI shall notify IDEQ of its intent to accept such material and submit information describing the material's physical, radiological, and/or chemical properties, impact on the facility radioactive materials performance assessment, and the basis for determining that the material does not require disposal at a facility licensed under the AEA. The IDEQ will have 30 days from receipt of this notification to reject USEI's determination or require further information and review. No response by IDEQ within thirty (30) days following receipt of such notice shall constitute concurrence. IDEQ concurrence is not required for generally exempted material as set forth in Table C.4a.

Based on categories of waste described in the waste acceptance criteria, the concentration of the various radionuclides in the conveyance (e.g., rail car gondola, other container etc.) shall not exceed the concentration limits established in the WAC without the specific written approval of the IDEQ unless generally exempted as set forth in Table C.4a. Radiological surveys will be performed as outlined in ERMP-01 to verify compliance with the WAC. If individual "pockets" of activity are detected indicating the limits may be exceeded, the RSO or RPS shall investigate the discrepancy and estimate the extent or volume of the material with the potentially elevated radiation levels. The RPS or RSO shall then make a determination on the compliance of the entire conveyance load with the appropriate WAC limits. If the conveyance is determined not to meet the limits, USEI will notify IDEQ's RCRA Program Manager within 24 hours of a concentration based exceedance of the facility WAC to evaluate and discuss management options. The findings and resolution actions shall then be documented and submitted to the IDEQ.

The radioactive material waste acceptance criteria, when used in conjunction with an effective radiation monitoring and protection program as defined in the USEI *Radioactive Material Health and Safety Plan* and *Exempt Radioactive Materials Procedures* provides adequate protection of human health and the environment. Included within this manual are requirements for USEI to submit a written summary report of Table C.1 through C.2 radioactive material waste receipts showing volumes and radionuclide concentrations disposed at the USEI site on a quarterly basis. USEI will also submit a Table C.3 through C.4b annual report of exempted products devices, materials or items within 60 (sixty) days of year end (December 31st). The annual report will provide total volumes or mass of isotopes and total activity by isotope listing the activity of each radionuclide disposed during the preceding year, and the cumulative total of activity for each radionuclide disposed at the facility. The report will include an updated analysis of the impact on the facility performance assessment.

These criteria and procedures are designed to assure that the highest potential dose to a worker handling radioactive material at USEI shall not exceed 400 mrem/year TEDE dose, and that no member of the public is calculated to receive a potential dose exceeding 15 mrem/year TEDE dose, from the USEI program. TEDE is defined as the "Total Effective Dose Equivalent", which equals the sum of external and internal exposures. The public dose limit during operation activities is limited to 100 mrem/yr TEDE dose. An annual summary report of environmental monitoring results will be submitted to IDEQ by June 1st for the preceding year.

Materials that have a radioactive component that meets the criteria described in Tables C.1 through C.4b and are RCRA regulated material will be managed as described within this WAP for the RCRA regulated constituents.

Table C.1: Unimportant Quantities of Source Material Uniformly Dispersed* in Soil or Other Media**

	Status of Equilibrium	Maximum Concentration of Source Material	Sum of Concentrations Parent(s) and all progeny present***
a	Natural uranium in equilibrium with progeny	<500 ppm / 167 pCi/g (^{238}U activity)	≤ 3000 pCi/g
	Refined natural uranium (^{238}U, ^{235}U, ^{234}U; ^{234Th}, ^{234m}Pa, ^{231}Th)	<500 ppm / 333 pCi/g	≤ 2000 pCi/g
	Depleted Uranium (^{234Th}, ^{234m}Pa)	<500 ppm / 169 pCi/g	≤ 2000 pCi/g
b	Natural thorium (^{232}Th + ^{228}Th)	<500 ppm / 110 pCi/g	≤ 2000 pCi/g
	^{230}Th in equilibrium with progeny	<0.01 ppm / 200 pCi/g	≤2000 pCi/g
	^{230}Th (with no progeny)	0.1 ppm / ≤2000 pCi/g	
	Any mixture of Thorium and Uranium	Sum of ratios ≤ 1****	≤2000 pCi/g

Table C.2: Naturally Occurring Radioactive Material Other Than Uranium and Thorium Uniformly Dispersed* in Soil or Other Media**

	Status of Equilibrium	Maximum Concentration of Parent Nuclide	Sum of Concentrations of Parent and All Progeny Present***
a	^{226}Ra or ^{228}Ra with progeny in bulk form [1]	500 pCi/g	≤ 4500 pCi/g
b	^{226}Ra or ^{228}Ra with progeny in reinforced IP-1 containers [1]	1500 pCi/g	13,500 pCi/g
c	^{210}Pb with progeny(Bi & ^{210}Po)	1500 pCi/g	4500 pCi/g
	^{40}K	818 pCi/g	N/A
	Any other NORM		≤3000 pCi/g

[1] Any material containing ^{226}Ra greater than 222 pCi/g shall be disposed at least 6 meters from the external point on the completed cell.

Table C.3: Non-Production Particle Accelerator Produced Radioactive Material*****

Acceptable Material	Activity or Concentration
Any non-production particle accelerator produced radionuclide.	All materials shall be packaged in accordance with USDOT packaging requirements. Any packages containing iodine or volatile radionuclides will have lids or covers sealed to the container with gaskets. Contamination levels on the surface of the packages shall not exceed those allowed at point of receipt by USDOT rules. Gamma or x-ray radiation levels may not exceed 10 millirem per hour anywhere on the surface of the package. All packages received shall be directly disposed in the active cell. All containers shall be certified to be 90% full.

*Average over conveyance or container. The use of the phrase "over the conveyance or container is meant to reflect the variability on the generator side. The concentration limit is the primary acceptance criteria.

**Unless otherwise authorized by IDEQ, other Media does not include radioactively contaminated liquid (except for incidental liquids in materials). See radioactive contaminated liquid definition (definition section of Part B permit).

******* Diffuse waste with a total concentration (sum of concentrations of all radionuclides present) which is 2000 pCi/g or less may be accepted at the site (i.e., the controlling limit is 2000 pCi/g).

******** $$\frac{\text{Conc. of U in sample}}{\text{Allowable conc. of U}} + \frac{\text{Conc. of Th in Sample}}{\text{Allowable conc. of Th}} \leq 1$$

***** Any material that has been made radioactive by use of a non-production particle accelerator as set forth in Federal Register, Vol. 72, No. 189, Monday October 1, 2007, page 55868.

Table C.4a: NRC Exempted Products, Devices or Items

Exemption 10 CFR Part*	Product, Device or Item	Isotope, Activity or Concentration
30.15	As listed in the regulation	Various isotopes and activities as set forth in 30.15
30.14, 30.18	Other materials, products or devices specifically exempted from regulation by rule, order, license, license condition, concurrence, or letter of interpretation	Radionuclides in concentrations consistent with the exemption
30.19	Self-luminous products containing tritium, ^{85}Kr, ^{3}H or ^{147}Pm	Activity by Manufacturing license
30.20	Gas and aerosol detectors for protection of life and property from fire	Isotope and activity by Manufacturing license
30.21	Capsules containing ^{14}C urea for *in vivo* diagnosis of humans	^{14}C, one µCi per capsule
40.13(a)	Unimportant quantity of source material: see table above	≤0.05% by weight source material
40.13(b)	Unrefined and unprocessed ore containing source material	As set forth in rule
40.13(c)(1)	Source material in incandescent gas mantles, vacuum tubes, welding rods, electric lamps for illumination	Thorium and uranium, various amounts or concentrations, see rules
40.13(c)(2)	(i)Source material in glazed ceramic tableware (ii)Piezoelectric ceramic (iii) Glassware not including glass brick, pane glass, ceramic tile, or other glass or ceramic used in construction	≤20% by weight ≤2% by weight ≤10% by weight
40.13(c)(3)	Photographic film, negatives or prints	Uranium or Thorium
40.13(c)(4)	Finished product or part fabricated of or containing tungsten or magnesium-thorium alloys. Cannot treat or process chemically, metallurgically, or physically.	≤4% by weight thorium content.
40.13(c)(5)	Uranium contained in counterweights installed in aircraft, rockets, projectiles and missiles or stored or handled in connection with installation or removal of such counterweights.	Per stated conditions in rule.
40.13(c)(6)	Uranium used as shielding in shipping containers if conspicuously and legibly impressed with legend "CAUTION RADIOACTIVE SHIELDING – URANIUM" and uranium incased in at least 1/8 inch thick steel or fire resistant metal.	Depleted Uranium
40.13(c)(7)	Thorium contained in finished optical lenses	≤30% by weight thorium, per conditions in rule.
40.13(c)(8)	Thorium contained in any finished aircraft engine part containing nickel-thoria alloy.	≤4% by weight thorium, per conditions in rule.

Table C.4b: Materials Specifically Exempted by the NRC Or NRC Agreement State

Exemption	Materials	Isotope, Activity or Concentration*
10 CFR 30.11***	Byproduct material including production particle accelerator material exempted from NRC or Agreement State regulation by rule, order, license, license condition or letter of interpretation may be accepted as determined by specific NRC or Agreement State exemption.****	Byproduct material at concentrations consistent with the exemption**
10 CFR 40.14***	Source material exempted from NRC or Agreement State regulation by rule, order, license, license condition or letter of interpretation may be accepted as determined by specific NRC or Agreement State exemption.****	Source material at concentrations consistent with the exemption.
10 CFR 70.17	Special Nuclear Material (SNM) exempted from NRC regulation by rule, order, license, license condition or letter of interpretation may be accepted as determined by specific NRC or Agreement State exemption.****	SNM at concentrations consistent with the exemption.

*Sum of all isotopes up to a maximum concentration of 3,000 pCi/gm.

**Specifically exempted production beam accelerator may be received under Table C.3 provisions [10 CFR 20.2008 (b)]

***Also includes equivalent Agreement State regulation where applicable.

**** Similar material not regulated or licensed by the NRC may also be accepted. Sum of all isotopes up to a maximum concentration of 3,000 pCi/gm. IDEQ shall be notified prior to the receipt of Special Nuclear Material not regulated or licensed by the NRC.

Additional Information for USEI's Waste Analysis Plan

1. US Ecology Idaho, Inc. (USEI) may receive contaminated materials or other materials as described in Tables C.1 - C.4b above. USEI may not accept for disposal any material that by its possession would require USEI to have a radioactive material license from the Nuclear Regulatory Commission (NRC).

2. Unless approved in advance by USEI and IDEQ, average activity concentrations may not exceed those concentrations enumerated in Tables C.1 and C.2. Additionally, for Tables C.1 and C.2, individual pockets of material may exceed the WAC for the radionuclides present as long as the average concentration of all radionuclides within the package or conveyance remains at or below the WAC and the highest dose rate measured on the outside of the unshielded package or conveyance does not exceed those action levels enumerated in ERMP-01.

3. Other items, devices or materials listed in Table C.4a, which are exempted in accordance with 10 CFR Parts 30, 40 or equivalent Agreement State regulations or 10 CFR Part 70 may be accepted at or below the activities (per device or item) or concentrations specified in those exemptions.

4. The generator of the exempted or non-production particle accelerator produced waste must specify that the waste meets applicable acceptance criteria and/or exemption requirements.

5. In accordance with permit requirements, notification of any exceedance of the WAC will be provided to the RCRA Program Manager within 24 hours, in accordance with the permit.

STATE OF IDAHO
DEPARTMENT OF
ENVIRONMENTAL QUALITY

1410 North Hilton • Boise, Idaho 83706-1255 • (208) 373-0502

Dirk Kempthorne, Governor
Toni Hardesty, Director

Permittee: U.S. Ecology Idaho Inc.
Facility Identification/Permit Number: IDD073114654

INTRODUCTION AND SIGNATURE PAGE

Pursuant to the Idaho Hazardous Waste Management Act of 1983 (HWMA), as amended, Idaho Code 39-4401 et seq., and the *Rules and Standards for Hazardous Waste*, as amended, IDAPA 58.01.05.000 et seq., a Hazardous Waste Treatment, Storage, and Disposal Permit is hereby issued to U.S. Ecology Idaho Inc. (USEI or Permittee) for operation of USEI's Site B facility, located in Owyhee county near Grand View, Idaho, on Lemley Road, at latitude 43° 03° 056° North and longitude 116° 15° 044° West.

The Permittee shall comply with all terms and conditions of this Permit, including Attachments 1 through 26. The Permittee must comply with all applicable state and federal regulations, including IDAPA 58.01.05.004 through 58.01.05.008 and 58.01.05.010 through 58.01.05.013 [40 Code of Federal Regulations (CFR), Parts 260 through 266, 268, 270, and 124] and as specified in this Permit. Any reference in this Permit to the Resource Conservation and Recovery Act (RCRA) or the Hazardous and Solid Waste Amendments of 1984 (HSWA), or federal regulations promulgated thereunder in 40 CFR, shall be deemed to include the equivalent HWMA statute or state regulation promulgated thereunder.

Applicable state and federal regulations are those that are in effect on the date of final administrative action on this Permit and any self implementing statutory provisions and related regulations that, according to the requirements of HWMA and/or HSWA, as amended, are automatically applicable to the Permittee's hazardous waste management activities, notwithstanding the conditions of this Permit.

This Permit is based upon the Administrative Record, as required by IDAPA 58.01.05.013 [40 CFR § 124.9]. The Permittee's failure, in the application or during the permit issuance process, to disclose fully all relevant facts, or the Permittee's misrepresentation of any relevant facts, at any time, shall be grounds for the termination or modification of this Permit and/or initiation of an enforcement action. To the extent there are inconsistencies between the Permit and the attachments, the language of the Permit shall prevail. The Permittee must inform the Director of the Idaho Department of Environmental Quality (Director) of any deviation from the permit conditions, or changes in the information on which the application is based that would affect the Permittee's ability to comply, or actual compliance with the applicable regulations or permit conditions, or which alters any permit condition in any way.

The Director shall enforce all conditions of this Permit. Any challenges of any permit condition shall be appealed to the Idaho Board of Environmental Quality, in accordance with IDAPA 58.01.05.013 [40 CFR § 124.19], and in accordance with the Idaho Department of Environmental Quality "*Rules Governing Declaratory Rulings and Contested Case Proceedings*," IDAPA 58.01.23.043.

The United States Environmental Protection Agency (EPA) shall maintain an oversight role of the state-authorized program, and in such capacity, shall enforce any permit condition based on state requirements if, in the Agency's judgement, the Director should fail to enforce that permit condition. Any challenges to the Agency-enforced conditions shall be appealed to the Agency, in accordance with 40 CFR § 124.19.

This Permit is effective as of November 12, 2004 and shall remain in effect until November 12, 2014, unless, in accordance with IDAPA 58.01.05.012, the Permit is: revoked and reissued [40 CFR § 270.41], terminated [40 CFR § 270.43], modified [40 CFR § 270.42 Appendix I.A.6], or continued [40 CFR § 270.51].

November 12, 2004
Date

Toni Hardesty, Director
Department of Environmental Quality

This space intentionally left blank.

COPY

Approval For Disposal and Commercial Storage of Polychlorinated Biphenyl (PCB) Wastes

U.S. Environmental Protection Agency
Region 10
1200 Sixth Avenue, AT-083
Seattle, Washington 98101
Telephone: (206) 553-1270

Issued in accordance with the provisions of Section 6(e)(1) of the Toxic Substances Control Act of 1976, 15 USC §2605(e)(1), and the Federal PCB Regulations, 40 CFR §§761.65(d) and 761.75(c).

ISSUED TO:

Envirosafe Services of Idaho, Inc.
Missile Base Road
Grandview, Idaho 83624
Telephone: (208) 384-1500

This approval is effective as of November 29, 1991, and shall remain in effect until December 15, 1998, unless rescinded for failure to comply with the terms and conditions herein, failure to disclose all relevant facts or for any other reasons which the Regional Administrator of Environmental Protection Agency (EPA) Region 10 deems necessary to protect human health and the environment. This approval on its effective date supersedes, replaces and renders void the March 10, 1982, PCB Landfill Approval (including any subsequent revisions), and the May 22, 1987, Temporary PCB Landfill Approval (including any subsequent revisions).

ISSUED BY THE U.S. ENVIRONMENTAL PROTECTION AGENCY REGION 10

Charles E. Findley

Charles E. Findley, Director
Hazardous Waste Division
Environmental Protection Agency
Date Sept 20, 1991

TABLE OF CONTENTS

This space intentionally left blank.

LIST OF TABLES

This space intentionally left blank.

LIST OF FIGURES

This space intentionally left blank.

LIST OF ATTACHMENTS

The following documents are excerpts from the Permittee's RCRA Permit Application dated May 5, 2003. The Permit Application and applicable attachments from the previous RCRA Permit are part of the official Administrative Record for the facility. The documents listed below are hereby incorporated, in their entirety, by reference into this Permit. The Department has modified specific language in the attachments, as deemed necessary. These modifications are described in the permit conditions (Modules I through XIII) and, thereby, supersede the language of the original attachment. All references in these attachments to the Agency or to designated representatives of the Agency shall also refer to the Department or to designated representatives of the Department. All references in any of the attachments of this Permit to "Envirosafe Services of Idaho Inc. (ESII)" are superseded by reference to "U.S. Ecology Idaho (USEI)." These incorporated attachments are enforceable conditions of this Permit, as modified by the specific permit conditions.

∗ Taken from existing permit.
† This drawing is contained in Attachment 20, Master Book of Drawings.

Attachment 1	Facility Legal Description and Map of Facility Location, consisting of: Section B, Pages B-1 through B-4, of Permit Application, as last revised May 5, 2003. Appendix B.1, Corporate Warranty Deed of Correction, Pages B.1-1 through B.1-7, of Permit Application, as last revised May 30, 2006. Drawing PRMI-T03, Typical Facility Site Plan, Rev. D, of Permit Application, as last revised September 15, 2008. Drawing PRMI-T01, General Facility Topographic Plan Sheet 1, Rev. D, of Permit Application, as last revised September 15, 2008.
Attachment 2	Waste Analysis Plan, consisting of: Section C, Table of Contents and Pages C-1 through C-61, including Figures C.1 through C.11 and Tables C.1 through C.10, of Permit Application, as last revised July 24, 2009. Appendix C.1, Pages 1 through 3, of Permit Application, as last revised May 5, 2003. Appendix C.2, Page C.2-1 through C.2-20, of Permit Application, as last revised May 5, 2003.
Attachment 3	Security Procedures, consisting of: Subsection F.1, Pages F-1 through F-2, of Permit, as last revised September 3, 2008. Figure F-15a, of Permit Application, as last revised January 22, 2009.
Attachment 4	Inspection Plan, consisting of: Table of Contents and Subsection F.2 and F.3, Pages F-2 through F-12, including Table F-1 and Figures F-1 through F-15, as last revised May 17, 2009.
Attachment 5	Training Plan, consisting of: Section H, Table of Contents and Pages H-1 through H-3, including Tables H-1 through H-4 of Permit Application, as last revised May 5, 2003.

Attachment 6	Hazards Prevention Plan, consisting of: Subsections F.4 and F.5, Pages F-12 through F-19, as last revised May 5, 2003.
Attachment 7	Contingency Plan, consisting of: Section G, Table of Contents and Pages G-1 through G-13, including Tables G-1 through G-8 and Figures G-1 through G-9, of Permit, as last revised October 26, 2009.
Attachment 8	Response Action Plan, consisting of: Table of Contents and Appendix D.4.7, Pages 1-1 through 4-6, including Table 1 and Appendices A, B, and C, of Permit, as last revised May 17, 2009.
Attachment 9	Closure and Post-Closure Plans, consisting of: Section I, Table of Contents and Pages I-1 through I-44, including Tables I.1 through I.8 and Figures I.2 through I.5, of Permit, as last revised May 17, 2009. Drawing PRMI-T04, Facility Topographic Plan Existing Conditions, Rev. E, of Permit, as last revised September 15, 2008. Drawing PRMI-T13, Facility Typical Topographic Plan Final at Closure, Rev. D, of Permit, as last revised September 15, 2008. Drawing PRMI-T12, Facility Topographic Plan Interim Conditions, Rev. D, of Permit, as last revised September 15, 2008. Drawing PRMI-T11, Facility Typical Soil Sampling Plan, Rev. D, of Permit, as last revised September 15, 2008.
Attachment 9a	Alternative Final Cover Assessment Trenches 10 and 11 dated January 15, 1999, as revised July 15, 1999.*****
Attachment 9b	Alternative Cover Monitoring Program Plan Trenches 10 and 11 and Test Pad as revised July 15, 1999.*
Attachment 10	Surface Water Management Plan, consisting of: Table of Contents and Pages 1 through 38, Appendix D.4.7, including Tables 1 and 2, and Figure 2, of Permit, as last revised May 17, 2009. Drawing 52-01-09, Site Drainage Existing Conditions and Interim Phase, Rev. C, of Permit, as last revised September 15, 2008.† Figure 1, Facility Overall Drainage Areas Plan and Existing Conditions, Rev. E, of Permit, as last revised September 15, 2008. Drawing PRMI-D01, Rev. F, of Permit Application, as last revised September 15, 2008 Drawing PRMI-D03, Rev. E, of Permit Application, as last revised September 15, 2008.
Attachment 11	Ground Water Monitoring Plan, consisting of: Section E, Table of Contents and Pages E-1 through E-90, including Tables E-1 through E-23, Figures E-2 through E-36, of Permit, as last revised May 17, 2009. Appendix E.6, 2001 Re-evaluation of Rising Ground Water, of Permit Application, as last revised May 5, 2003. Appendix E.11, 1986 Vadose Zone Characteristics Report, of Permit Application, as last revised May 5, 2003.

Appendix E.14, Alternative Concentration Limit Demonstration Report, of Permit Application, as last revised May 5, 2003.
"Proposed Ground Water Monitoring Program Cell 15 U.S. Ecology Idaho Site B," Pages 1 through 4, Table 1, and Figure 1 (Proposed Ground Water Monitoring Wells for Cell 15), from Class 3 Permit Modification, dated June 2002.*
Groundwater Monitoring for Proposed Cell 15 Expansion and Proposed Location for Well L-47, dated September 16, 2008.
IDEQ Response to Proposed Location of Well L-47, dated November 18, 2008.

Attachment 12 — RCRA Part A Permit Application, consisting of:
RCRA Part A Permit Application, dated January 26, 2009.
Section A, Table of Contents and Pages A-1 through A-3, Figures A-1 through A-4, of Permit, as last revised January 22, 2009.

Attachment 13 — Container Management Units - Design and Operations, consisting of:
Section D.1, Table of Contents and Pages D-1 through D-12, including Tables D-1 and D-1A and Figure D-1, of Permit, as last revised January 22, 2009.
Drawing PRMI-R11, Rev. B, as last revised April 8, 2003.
Drawing PRMI-R21, Rev. B, as last revised April 16, 2003.
Additional Container Management Unit Drawings in Attachment 20 including:
Drawing 793P-R01, Rev. E, as last revised May 5, 2003.†
Drawing PRMI-R15, Rev. D, as last revised April 22, 2003.†
Drawing PRMI-R22, Rev. B, as last revised April 22, 2003.†
Drawing PRMI-C11, Rev. B, as last revised May 5, 2003. †
Drawing PRMI-C12, Rev. B, as last revised May 5, 2003. †
Drawing PRMI-C13, Rev. B, as last revised May 5, 2003. †
Drawing PRMI-C14, Rev. B, as last revised May 5, 2003. †
Drawing PRMI-C15, Rev. B, as last revised April 22, 2003. †

Attachment 14 — Bulk Material Tank Systems - Design and Operations, consisting of:
Subsection D-2, Pages D-12 through D-19, including Table D-2, and Figures D-3 through D-7, of Permit Application, as last revised September 3, 2008
Appendix D.2.5, Tank Operation Outline, Pages 1-5, of Permit Application, as last revised May 5, 2003.
Additional Tank Drawings in Attachment 20 including:
Drawing 720C-G02, Rev. D, as last revised May 5, 2003. †
Drawing 720C-G03, Rev. D, as last revised May 5, 2003. †
Drawing 720C-G04, Rev. D, as last revised May 5, 2003. †
Drawing 720C-G05, Rev. E, as last revised May 5, 2003. †
Drawing 720C-G06, Rev. C, as last revised May 5, 2003. †
Drawing 720C-P01, Rev. D, as last revised April 22, 2003. †
Drawing 720C-P02, Rev. B, as last revised April 22, 2003. †
Drawing 793P-C06, Rev. E, as last revised April 22, 2003. †
Drawing 793P-C07, Rev. E, as last revised May 5, 2003. †
Drawing 793P-C08, Rev. E, as last revised May 5, 2003. †
Drawing 793P-C12, Rev. 4, as last revised May 5, 2003. †
Drawing 793P-C13, Rev. L, as last revised April 22, 2003. †

Attachment 14a	Debris Building Bulk Material Tanks System – Design and Operations, consisting of: Tables D-2a, D-2b, and D-2c, as last revised September 3, 2008 Containment Building (Debris Portion) Process Flow Description, as last revised September 3, 2008. Drawing C-1, Rev. B, as last revised September 8, 2006. Drawing C-3, Rev. B, as last revised September 8, 2006. Drawing 1 of 4, Rev. A, as last revised September 15, 2006. Drawing 2 of 4, Rev. A, as last revised September 15, 2006. Drawing 3 of 4, Rev. A, as last revised September 15, 2006. Drawing 4 of 4, Rev. A, as last revised September 15, 2006. Drawing D2020-R02, as last revised November 2, 2006
Attachment 15	Outdoor Stabilization Facility - Design and Operation, consisting of: Figure D-2, Stabilization Facility Process Flow Diagram, of Permit Application, as last revised May 5, 2003. Drawing PRMI-R31, Rev. B, as last revised April 16, 2003.
Attachment 16	General Construction Specifications, consisting of: Appendix D.3.3, Cell 15 Design Specifications, of Permit Application, as last revised May 5, 2003.
Attachment 17	Surface Impoundment Units - Design and Operation, consisting of: Subsection D-4, Pages D-19 through D-33, including Figures D-8 and D-9, of Permit Application, as last revised May 5, 2003. Additional Surface Impoundment Drawings in Attachment 20 including: Drawing PRMI-D05, Rev. B, as last revised April 22, 2003. † Drawing PRMI-D06, Rev. B, as last revised April 22, 2003. † Drawing PRMI-D07, Rev. C, as last revised April 22, 2003. † Drawing PRMI-L41, Rev. B, as last revised April 16, 2003. †
Attachment 18	Engineering Report for Landfill Cell 15 and Drawings, consisting of: Appendix D.3.1, Table of Contents, Pages 1 through 37, Tables 5-1 through 8-2, Figures 1.1 through 7.1, of Permit Application, as last revised May 5, 2003. Appendix D.3.2, Construction Quality Assurance Plan, of Permit Application, as last revised May 5, 2003. Drawing 52-00-0, Rev. 0, of Permit Application, as last revised January 9, 2002. Drawing 52-01-01, Rev. 0, of Permit Application, as last revised January 11, 2002. Drawing 52-01-02, Rev. 0, of Permit Application, as last revised January 9, 2002. Drawing 52-01-03, Rev. 0, of Permit Application, as last revised January 9, 2002. Drawing 52-01-04, Rev. 0, of Permit Application, as last revised January 9, 2002. Drawing 52-01-05, Rev. 0, of Permit Application, as last revised January 10, 2002. Drawing 52-01-06, Rev. 0, of Permit Application, as last revised January 10, 2002. Drawing 52-01-07, Rev. 0, of Permit Application, as last revised January 10, 2002.

Drawing 52-01-08, Rev. A, of Permit Application, as last revised January 14, 2002.
Drawing 52-01-09, Rev. C, of Permit Application, as last revised September 15, 2008.
Drawing 52-01-10, Rev. B, of Permit Application, as last revised January 14, 2002.

Attachment 18a

Landfill Engineering Report Cell 15 Modifications, including:
Appendix A – Report Figures 1-4
Appendix B – Cell 15 Modification Drawing Set
- Drawing 15-08-00 Cell 15 Modification, revised January 29, 2009
- Drawing 15-08-01 Cell 15 Modification, revised September 30, 2008
- Drawing 15-08-02 Cell 15 Modification, revised September 30, 2008
- Drawing 15-08-03 Cell 15 Modification, revised September 30, 2008
- Drawing 15-08-04 Cell 15 Modification, revised September 30, 2008
- Drawing 15-08-05 Cell 15 Modification, revised January 29, 2009
- Drawing 15-08-06 Cell 15 Modification, revised January 29, 2009
- Drawing 15-08-07 Cell 15 Modification, revised January 29, 2009

Appendix C – Laboratory Interface Shear Test Results
Appendix D – Slope Stability Analysis
Appendix E – Specifications
Appendix F – Construction Quality Assurance Plan
Appendix G – Vertical Expansion Analysis
Appendix H – Geotechnical Engineering Report

Attachment 19

Landfill Units - Design and Operation, consisting of:
Subsections D-6 and D-11, Table of Contents, and Pages D-34 through D-60 and Pages D-88 through D-89, including Table D-3, and Figures D-8 through D-11, as last revised May 17, 2009.
Additional Drawings for Trench 10 and 11, Cell 5, and Cell 14 in Attachment 20, including:
Drawing 720C-G01, Rev. E, of Permit Application, as last revised May 5, 2003. †
Drawing 720C-G07, Rev. C, of Permit Application, as last revised May 5, 2003. †
Drawing PRMI-L01, Rev. F, of Permit Application, as last revised April 22, 2003. †
Drawing PRMI-L11, Rev. B, of Permit Application, as last revised April 23, 2003. †
Drawing PRMI-L12, Rev. B, of Permit Application, as last revised April 23, 2003. †
Drawing PRMI-L15, Rev. B, of Permit Application, as last revised April 23, 2003. †
Drawing PRMI-L16, Rev. B, of Permit Application, as last revised April 23, 2003. †
Drawing PRMI-L17, Rev. B, of Permit Application, as last revised April 23, 2003. †
Drawing PRMI-L18, Rev. B, of Permit Application, as last revised April 23, 2003. †
Drawing PRMI-L21, Rev. B, of Permit Application, as last revised April 23, 2003. †
Drawing PRMI-L22, Rev. C, of Permit Application, as last revised April 23,

2003. †
Drawing PRMI-L24, Rev. B, of Permit Application, as last revised April 23, 2003. †
Drawing PRMI-L25, Rev. B, of Permit Application, as last revised April 23, 2003. †
Drawing PRMI-L26, Rev. C, of Permit Application, as last revised April 23, 2003. †
Drawing PRMI-L27, Rev. B, of Permit Application, as last revised April 23, 2003. †

Attachment 20 — Master Book of Drawings, Overall Facility, consisting of:
Master Book of Drawings, as last revised January 29, 2009.

Attachment 21 — Closure Cover Design Details, consisting of:
Closure Drawings in Attachment 20 including:
Drawing PRMI-L13, Rev. D, of Permit Application, as last revised April 23, 2003. †
Drawing PRMI-L14, Rev. D, of Permit Application, as last revised April 23, 2003. †
Drawing PRMI-L19, Rev. B, of Permit Application, as last revised April 23, 2003. †
Drawing PRMI-L23, Rev. C, of Permit Application, as last revised April 23, 2003. †
Drawing PRMI-L28, Rev. B, of Permit Application, as last revised April 23, 2003. †
Drawing PRMI-L29, Rev. B, of Permit Application, as last revised April 23, 2003. †
Drawing PRMI-D08, Rev. B, of Permit Application, as last revised April 24, 2003. †

Attachment 21a — Closure Cover Design Detail Drawings for Alternative Cover Design consisting of:
Closure Drawings in Attachment 20 including:
Drawing PRMI-L02, Rev. F, of Permit Application, as last revised April 23, 2003. †
Drawing PRMI-L03, Rev. F, of Permit Application, as last revised April 23, 2003. †
Drawing PRMI-L04, Rev. F, of Permit Application, as last revised April 23, 2003. †
Drawing PRMI-L05, Rev. D, of Permit Application, as last revised April 23, 2003. †
Drawing PRMI-L06, Rev. D, of Permit Application, as last revised April 23, 2003. †

Attachment 22 — Past Practice Units, consisting of:
Section J, Table of Contents, and Pages J-1 through J-33, including Tables J-1 through J-8, as last revised May 17, 2009.
Drawing PRMI-T05a, Rev. D, of Permit, as last revised September 15, 2008. †
Underground Structures Capping Plan, Pages 1 through 5, Figures 1-3, and Appendix A, as prepared September 1987.*
Drawing 419-LT3, Rev. 2, as last revised October 30, 1989.*
Drawing 419-LT4, Rev. 2, as last revised October 30, 1989.*

Drawing F565L-LM2, Rev. 13, as last revised November 2, 2006.

Attachment 23 — Exempt Radiological Materials Procedures Manual, consisting of: Exempt Radiological Materials Procedures Manual, Table of Contents, and the following subsections: Exempt Radiological Procedures RESRAD Safety Assessment, SNM Safety Assessment, RESRAD Model, Increased Radium RESRAD Model, Material Receipt Procedures, Exempt Materials Procedures for Decontamination and Release of Empty Containers, Environmental Monitoring Procedures, Landfill Operations, Waste Acceptance Criteria Evaluation, Selection, Care, and Use of Portable Instrumentation, and Drawing No. 7 (Environmental Radiological Monitoring Locations), of Permit Application, as last July 24, 2009.

Attachment 24 — Containment Building and Debris Treatment, consisting of:
Section D.9, Pages D-61 through D-69, including Table D-1 and D-1A, of Permit Application, as last revised September 3, 2008.
Additional Drawings for Containment Building in Attachment 20, including:
Drawing PRMI-R31, Rev. F, of Permit Application, as last revised April 22, 2003. †
Drawing PRMI-R32, Rev. B, of Permit Application, as last revised April 23, 2003. †
Drawing PRMI-R33, Rev. B, of Permit Application, as last revised April 23, 2003. †
Drawing PRMI-R34, Rev. B, of Permit Application, as last revised April 16, 2003. †
Drawing PRMI-R35, Rev. B, of Permit Application, as last revised April 23, 2003. †
Drawing PRMI-D04, Rev. B, of Permit Application, as last revised April 23, 2003. †
Drawing 773C-S01, Rev. 6, of Permit Application, as last revised May 5, 2003. †
Drawing 773C-S02, Rev. 6, of Permit Application, as last revised May 5, 2003. †
Drawing 773C-S03, Rev. 6, of Permit Application, as last revised May 3, 2003. †
Drawing 773C-S04, Rev. 6, of Permit Application, as last revised May 5, 2003. †
Drawing D2020-R02, Rev. G, of Permit Application, as last revised April 24, 2003. †
Drawing D2020-A02, Rev. 12, of Permit Application, as last revised April 15, 2003. †
Drawing D2020-A03, Rev. 4, of Permit Application, as last revised April 23, 2003. †
Drawing D2020-A04, Rev. 8, of Permit Application, as last revised April 23, 2003. †
Drawing D2020-A05, Rev. 8, of Permit Application, as last revised April 23, 2003. †
Drawing D2020-A06, Rev. 8, of Permit Application, as last revised April 23, 2003. †
Drawing D2020-A07, Rev. 12, of Permit Application, as last revised April 24, 2003. †
Drawing D2020-C05, Rev. 9, of Permit Application, as last revised April 23, 2003. †

Drawing D2020-C08, Rev. 8, of Permit Application, as last revised April 24, 2003. †
Drawing D2020-H01, Rev. 4, of Permit Application, as last revised April 24, 2003. †
Drawing D2020-H03, Rev. 5, of Permit Application, as last revised April 15, 2003. †
Drawing D2020-H04, Rev. 9, of Permit Application, as last revised April 24, 2003. †
Drawing D2020-P01, Rev. 3, of Permit Application, as last revised April 24, 2003. †
Drawing D2020-R05, Rev. 4, of Permit Application, as last revised April 24, 2003. †
Drawing D2020-R07, Rev. 6, of Permit Application, as last revised April 24, 2003. †
Drawing D2020-R08, Rev. 9, of Permit Application, as last revised April 24, 2003. †
Drawing 793P-C05, Rev. E, of Permit Application, as last revised May 5, 2003. †
Drawing 793P-C09, Rev. E, of Permit Application, as last revised May 5, 2003. †
Drawing 793P-C14, Rev. F, of Permit Application, as last revised April 22, 2003. †
Drawing 793P-C15, Rev. E, of Permit Application, as last revised April 22, 2003. †
Drawing 793P-C16, Rev. E, of Permit Application, as last revised May 5, 2003. †
Drawing 793P-C17, Rev. D, of Permit Application, as last revised April 8, 2003. †
Drawing 793P-G01, Rev. E, of Permit Application, as last revised May 5, 2003. †
Drawing 793P-H01, Rev. E, of Permit Application, as last revised April 22, 2003. †
Drawing 793P-P03, Rev. E, of Permit Application, as last revised May 5, 2003. †
Drawing 793P-P04, Rev. E, of Permit Application, as last revised May 5, 2003. †
Drawing 793P-R01, Rev. E, of Permit Application, as last revised May 5, 2003. †
Drawing 793P-R02, Rev. E, of Permit Application, as last revised May 5, 2003. †

Attachment 25 — Treatment Processes Description:
Section D.10, Table of Contents and D-70 through D-89, including Table D-4, of Permit Application, as last revised May 5, 2003, including the following subsections:

D.10.a Stabilization
D.10.b Microencapsulation
D.10.c Macroencapsulation
D.10.d Chemical Oxidation
D.10.e Chemical Reduction
D.10.f Deactivation
D.10.g Neutralization
D.10.h Precipitation

* Taken from existing permit.
† This drawing is contained in Attachment 20, Master Book of Drawings.

DEFINITIONS

All definitions contained in IDAPA 58.01.05.004, .008 and .010 through .013 [40 CFR Parts 260, 264, 266, 268, 270, and 124] are hereby incorporated, in their entirety, by reference into this Permit, except that any of the definitions used below shall supersede any definition of the same term given in IDAPA 58.01.05.000 et seq. Where terms are not defined in the regulations or the Permit, the meaning associated with such terms shall be defined by a standard dictionary reference of the generally accepted scientific or industrial meaning of the term.

a "Application" shall mean Volumes 1 through 8 of the May 2003 HWMA/RCRA Permit Application containing Sections A through L.

b "Cell" shall mean the Landfill Units 5, 14 and 15. This includes, and supersedes, references to "Trench 5 or Trench 14."

c "Containment Building" shall mean the building consisting of the “debris portion” and the “stabilization portion” where hazardous waste management activities shall be conducted, for wastes which USEI is permitted to manage, including the handling and treatment/ stabilization of “fine wastes.”

d "Day," “Daily,” “Normal Working Day,” and “Business Day” shall mean any calendar working day(s) (excluding weekends and holidays) where waste management activities occur at the facility, unless otherwise specified. Any requirement of submittal, under the terms of this Permit, that would be due on a Saturday, Sunday, or a federal or state holiday shall be due on the following business day.

e "Department" shall mean the Idaho Department of Environmental Quality.

f "Director" shall mean the Director of the Idaho Department of Environmental Quality or his or her designee.

g "Facility or Site" shall mean (1) All contiguous land, structures, other appurtenances, and improvements on the land used for treating, storing, or disposing of hazardous waste. A facility may consist of several treatment, storage or disposal operational units (e.g., one or more landfills, surface impoundments, or combinations of these), (2) For the purpose of implementing corrective action under IDAPA 58.01.05.008 §264.101, all contiguous property under the control of the owner or operator seeking a permit under Subtitle C of RCRA. This definition also applies to facilities implementing corrective action under RCRA Section 3008(h). This facility description is as set forth in Attachment 1 of this Permit.

h “Fine Wastes” shall mean any waste containing fine particulate matter as determined by Exhibit A of the December 9, 1996 Consent Order (included as Figure C.11 of Attachment 2 of this Permit).

i "HWMA" shall mean the state of Idaho, Hazardous Waste Management Act of 1983, as amended, Idaho Code § 39-4401 et seq.

j "Hazardous Waste Constituent" means a constituent that could cause or has caused the EPA to list a waste as hazardous per 40 CFR Part 261, Subpart D, or any constituent listed in Appendix VIII of IDAPA 58.01.05.005 [40 CFR Part 261] or in Appendix IX of IDAPA 58.01.05.008 [40 CFR Part 264].

k "Hazardous Waste" shall mean a solid waste, or combination of solid wastes, due to its quantity, concentration, or physical, chemical, or infectious characteristics may cause, or significantly contribute to, an increase in mortality or an increase in serious irreversible or incapacitating reversible illness, or pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed in [42 USC § 6903(5)], or that meets the definition of hazardous waste as specified in IDAPA 58.01.05.005 [40 CFR § 261.3].

l "Hazardous Waste Management Unit (HWMU)" shall mean those operable units subject to the requirements of IDAPA 58.01.05.012 [40 CFR §§ 270.14 to 270.25].

m "IDAPA" shall mean the Idaho Administrative Procedures Act, Chapter 52, Title 67, Idaho Code.

n "Load," in reference to temporary storage of interim piles, shall mean one treatment load or batch equal to the capacity of a Containment Building mixing bin tank (not to exceed 100 cubic yards).

o "MCL(s)" shall mean Maximum Contaminant Levels promulgated under the Safe Drinking Water Act.

p "Owner" shall mean U.S. Ecology Idaho Inc.

q "Permit" shall mean this Permit issued by the Idaho Department of Environmental Quality.

r "Permittee" shall mean U.S. Ecology Idaho, Inc.

s "Radioactive contaminated liquids" shall mean those radioactive liquids that exhibit a dose rate which exceeds 40 ΦR/hr.

t "Release" shall mean any spilling, leaking, pouring, emitting, emptying, discharging, injecting, pumping, escaping, leaching, dumping, or disposing of hazardous wastes (including hazardous waste constituents) into the environment (including the abandonment or discarding of barrels, containers, and other closed receptacles containing hazardous wastes or hazardous waste constituents).

u "Schedule of Compliance" shall mean a schedule of remedial and/or closure measures included in a permit, including an enforceable sequence of interim requirements (i.e., actions, operations, or milestone events) leading to compliance with the HWMA and regulations.

v "Solid Waste Management Unit (SWMU)" shall mean any discernable unit at which solid wastes have been placed at any time, despite whether the unit was intended for the management of solid or hazardous wastes. Such units include any area at a facility at which solid wastes have been routinely and systematically released.

w "Stabilization Facility" shall mean the outdoor area at which USEI is permitted to perform hazardous waste treatment activities

x "SW 846" shall mean "Test Methods for Evaluating Solid Waste Chemical/Physical Methods" (latest edition published by EPA).

y "Trench" shall mean shallow Land Disposal Units such as Landfill Units 10 and 11.

z "UHC" shall mean Underlying Hazardous Constituent. UHC means any constituent listed in IDAPA 58.01.05.011 [40 CFR § 268.48], Table UTS – Universal Treatment Standards, except fluoride, selenium, sulfides, vanadium, and zinc, which can reasonably be expected to be present at the point of generation of the hazardous waste at a concentration above the constituent – specific UTS Treatment Standard.

This space intentionally left blank

ACRONYMS AND ABBREVIATIONS

For the purpose of this Permit the following acronyms and abbreviations shall apply:

AASHTO	American Association of State Highway and Transportation Officials
ABS	Acrylonitrile Butadiene Styrene
ACI	American Concrete Institute
ACGIH	American Conference of Governmental Industrial Hygienists
ACL	Alternate Concentration Limit
AGA	American Gas Association
AGST	Above Ground Storage Tank
ALR	Action Leakage Rate
ANSI	American National Standards Institute
APC	Air Pollution Control
APP	Aquifer Protection Permit
API	American Petroleum Institute
ASA	American Standards Association
ASME	American Society of Mechanical Engineers
AST	Aboveground Storage Tanks
ASTM	American Society for Testing and Materials
BACT	Best Available Control Technology
BAT	Best Available Technology
BMP	Best Management Practice
BOD	Biochemical or Biological Oxygen Demand
C	Celsius/Centigrade
CAO	Corrective Action Order
CAA	Clean Air Act, 42 USC Section 7401 et seq. (Federal)
CAMP	Corrective Action Monitoring Program
CAMU	Corrective Action Management Unit
CEG	Certified Engineering Geologist
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CESQG	Conditionally Exempt Small Quantity Generators
CFCs	Chlorofluorcarbons
CFR	Code of Federal Regulations
CGL	Comprehensive General Liability Insurance
CHP	Certified Health Professional
CIH	Certified Industrial Hygienist
cm	centimeter; 1/100 meter
CMP	Compliance Monitoring Program
CMU	Container Management Unit
CNCI	Cyanogen Chloride
CO	Carbon Monoxide
CSA	Container Storage Area
CQA	Construction Quality Assurance
CQAP	Construction Quality Assurance Plan
CSP	Certified Safety Professional
DMP	Detection Monitoring Program
DOE	Department of Energy (Federal)

DOI	Department of the Interior (Federal)
DOT	Department of Transportation
DRE	Destruction/Removal Efficiency
EC	Emergency Coordinator
EIR	Exposure Information Report
EMS	Emergency Medical Service
EMT	Emergency Medical Technician
EPA	Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
EPR	Ethylene Propylene Rubber
EP TOX	Extraction Procedure Toxicity Test (RCRA)
EQL	Estimated Quantitation Limit
ESA	Endangered Species Act, 15 USC Section 1531 et seq.
ESG	English Standard Gauge
ESH	Environmental Health and Safety
ESII	Envirosafe Services of Idaho, Inc.
ESP	Electrostatic Precipitators
F	Fahrenheit
ft.	feet / foot
FDA	Food and Drug Administration (U.S.A.)
FEMA	Federal Emergency Management Agency
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act, 7 USC
FOIA	Freedom of Information Act
FR	Federal Register
FUSRAP	Formerly Utilized Sites Remedial Action Plan
GC	Gas Chromatographic
GCL	Geosynthetic Clay Liner
GC/MS	Gas Chromatography/Mass Spectrometry
GPM	Gallons Per Minute
GPS	Ground Water Protection Standards.
GW	Ground Water
HAPs	Hazardous Air Pollutants
HCFCs	Hydrochlorofluorocarbons
HCS	Hazard Communication Standard (OSHA)
HDPE	High Density Polyethylene
HHW	Household Hazardous Waste
HMTA	Hazardous Materials Transportation Act
HOC	Halogenated Organic Compounds
HSWA	Hazardous and Solid Waste Amendment of 1984
HWMA	Hazardous Waste Management Act of 1983, Idaho Code § 39-4401 et seq.
HWMU	Hazardous Waste Management Unit
ICF	Internal Control Form
IDAPA	Idaho Administrative Procedures Act
IDEQ	Idaho Department of Environmental Quality
IECC	Idaho Emergency Communication Center
IMS	Ion Mobility Spectrometry
in	Inch
Inc.	Incorporated
IPDC	Idaho Poison and Drug Center
IR	Infrared
kg	Kilogram; 1,000 grams

km	Kilometer; 1,000 meters
lb	Pound
LD50	Lethal Dose Level 50%
LCR	Leachate Collection and Removal System
LDCR	Leachate Detection, Collection and Removal System
LDR	Land Disposal Restriction
LEL	Lower Explosive Limit
MACT	Maximum Available Control Technology
MCL	Maximum Contaminant Levels (SDWA)
MCLGs	Maximum Contaminant Level Goals (SDWA)
MDL	Minimum Detection Limit
mg/l	milligrams per liter
μrem	Microrem
mil	1/1000 in
mm	Millimeter; 1/1000 meter
MOU	Memorandum of Understanding
MS	Mass Spectrometry
MSDS	Material Safety Data Sheets
NARM	Nuclear Accelerator Radioactive Material
NCP	National Contingency Plan
NCSA	National Crushed Stone Association
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NIOSH	National Institute for Occupational Safety & Health
NORM	Naturally Occurring Radioactive Material
NOV	Notice of Violation
NOX	Oxides of Nitrogen
NPDES	National Pollutant Discharge Elimination System
NRC	Nuclear Regulatory Commission
OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response (US EPA)
O&M	Operation and Maintenance
oz	Ounce
PAH	Polynuclear Aromatic Hydrocarbons
PCB	Polychlorinated Biphenol
PCDF	Polychlorinated Dibenzofurans
PCE	Perchloroethylene
pCi	Picocurries
PE	Professional Engineer
PEL	Permissible Exposure Limits (OSHA)
PM10	Particulate Matter less than 10 microns in diameter
POTW	Publicly-Owned Treatment Works
ppb	Parts per billion
PPE	Personal Protective Equipment
ppm	Parts per million
ppmw	Parts per million by weight
QA/QC	Quality Assurance/ Quality Control
RCRA	Resource Conservation and Recovery Act of 1976
RG	Registered Geologist
RGN	Reactivity Group Numbers

RTK	Right-to-Know
SARA Title III	Emergency Preparedness and Community Right to Know
SCBA	Self-Contained Breathing Apparatus
SDWA	Safe Drinking Water Act
SOP	Standard Operating Procedures
STEL	Short Term Exposure Limit
SWMP	Stormwater Management Plan
SWMU	Solid Waste Management Unit
TCLP	Toxicity Characteristics Leaching Procedure
TLV	Threshold Limit Value
TCE	Trichloroethylene
TOC	Total Organic Carbon
TSCA	Toxic Substance Control Act
TSDF	Treatment Storage and Disposal Facility
UBC	Uniform Building Code
UFC	Uniform Fire Code
µg/l	Micrograms per liter
UHC	Underlying Hazardous Constituent
UL	Underwriter's Laboratories, Inc
USEI	US Ecology Idaho, Inc.
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UV	Ultraviolet Light
VO	Volatile Organics
VOC	Volatile Organic Compound
WAP	Waste Analysis Plan
WLR	Warning Leakage Rate
WPQ	Waste Product Questionnaire
WSID	Waste Stream Identification Number
yd	Yard
yd^2	Square yard
yd^3	Cubic yard

This space intentionally left blank

MODULE I - STANDARD PERMIT CONDITIONS

I.A. EFFECT OF PERMIT

I.A.1. The Permittee is authorized to store, treat, and dispose of hazardous waste in accordance with the conditions of this Permit. Any storage, treatment, or disposal of hazardous waste by the Permittee, at this facility, that is not authorized by this Permit or by IDAPA 58.01.05.006 [40 CFR § 262.34], and for which a permit is required under Idaho Code § 39-4409 or Section § 3005 of RCRA, is prohibited.

I.A.2. Pursuant to IDAPA 58.01.05.012 [40 CFR § 270.4], compliance with this Permit generally constitutes compliance, for purposes of enforcement, with the Idaho Hazardous Waste Management Act (HWMA), as amended, except for the requirements not included in this Permit, which become effective by future statute or regulatory changes, to include those requirements promulgated under IDAPA 58.01.05.011 [40 CFR Part 268] restricting the placement of hazardous waste in or on the land.

I.B. PERSONAL AND PROPERTY RIGHTS

This Permit does not convey any property rights of any sort, or any exclusive privilege; nor does this Permit authorize any injury to persons or property, or any invasion of other private rights, or any infringement of state or local laws.

I.C. ENFORCEABILITY

I.C.1. The terms and conditions of this Permit are enforceable pursuant to the HWMA or any other applicable federal, state, or local law. Violations of this Permit may result in civil penalties, in accordance with HWMA [Idaho Code § 39-4414] and the HWMA Civil Penalty Policy.

I.C.2. Any person who knowingly makes any false statement or representation in any application, label, manifest, record, report, permit, or other document filed, maintained, or used for the purposes of complying with the provisions of Idaho Code § 39-4415, shall be guilty of a misdemeanor and subject to a fine of not more than ten thousand dollars ($10,000) or to imprisonment not to exceed one (1) year, or to both, for each separate violation or for each day of a continuing violation.

I.D. OTHER AUTHORITY

The Department expressly reserves any right of entry provided by law, and any authority to order or perform emergency or other response activities as authorized by law.

I.E. PERMIT ACTIONS

I.E.1. This Permit may be modified, revoked, and reissued or terminated for cause, as specified in IDAPA 58.01.05.012 [40 CFR §§ 270.41, 270.42, and 270.43].

I.E.2. The filing of a request for a permit modification, or revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance on the part of the Permittee shall not stay the applicability or enforceability of any permit condition.

I.E.3. Except as provided by specific language in this Permit or except for the Director's approval of a Class 1 or 2 Permit Modification, in accordance with IDAPA 58.01.05.012 [40 CFR § 270.42 (a) and (b)], any modification that substantially alters the facility or its operation, as covered by this Permit, shall be administered as a Class 3 Permit Modification prior to such change taking place, in accordance with IDAPA 58.01.05.012 [40 CFR § 270.42(c)].

I.E.4. The Director may modify this Permit when the standards or regulations on which the Permit was based have been changed by statute, the standards or regulations have been amended, or the standards or regulations have changed by way of judicial decision after the effective date of this Permit.

I.E.5. Within forty-five (45) calendar days of a permit modification being put into effect or approved, the Permittee shall provide clean copies of the relevant portions of the Permit and revised Attachments (if not already reflected/provided in the change pages submitted with the Permit Modification Request), reprint the documents (as necessary), and submit to the Director. The Permittee shall submit an electronic version (in a format pre-approved by the Director) of all permit modifications and Permit Applications to the Director.

I.E.6. The Permittee shall ensure that Attachment 26, the permit modification tracking log, is up to date, consistent with Permit Condition I.E.5.

I.F. SEVERABILITY

I.F.1. The provisions of this Permit are severable, and if any provision of this Permit, or the application of any provision of this Permit to any circumstance, is held invalid, the application of such provision to other circumstances and the remainder of this Permit shall not be affected thereby. Invalidation of any state or federal statutory or regulatory provision that forms the basis for any condition of this Permit does not affect the validity of any other state or federal statutory, or regulatory basis for said condition.

I.F.2. In the event that a condition of this Permit is stayed for any reason, the Permittee shall continue to comply with the related applicable and relevant standards of the previous Permit until final resolution of the stayed condition, unless compliance with the related applicable and relevant standards would be technologically incompatible with compliance with other conditions of this Permit that have not been stayed.

I.G. DUTY TO COMPLY

I.G.1. The Permittee shall comply with all conditions of this Permit, except that the Permittee need not comply with the conditions of this Permit to the extent and for the duration such noncompliance is authorized in an emergency permit (issued under IDAPA 58.01.05.012 [40 CFR § 270.61]). Any permit noncompliance, except under the terms of an emergency permit, constitutes a violation of RCRA, amended by

HSWA, and/or of HWMA, and is grounds for enforcement action, permit termination, modification, or revocation and reissuance of the Permit and/or denial of a Permit Renewal Application.

I.G.2. Compliance with the terms of this Permit does not constitute a defense to any action brought under Sections §§ 3007, 3008, 3013, and 7003 of RCRA [42 U.S.C. §§ 6927, 6928, 6934, and 6973], 104, 106(a), or 107 of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) [42 U.S.C. § 9604, 9606(a), or 9607], as amended by the Superfund Amendments and Reauthorization Act of 1986, or any other federal or state law governing protection of public health or the environment from any imminent and substantial endangerment to human health or the environment. However, compliance with the terms of this Permit does constitute a defense to any action alleging failure to comply with the applicable standards upon which this Permit is based.

I.H. DUTY TO REAPPLY

The Permittee must apply for a new permit, in accordance with IDAPA 58.01.05.012 [40 CFR § 270.30(b)], at least 180 calendar days prior to the expiration date of this Permit, in accordance with IDAPA 58.01.05.012 [40 CFR § 270.10(h)].

I.I. PERMIT EXPIRATION

I.I.1. Except as renewed, modified, revoked, reissued, or terminated by the Director, this Permit shall automatically expire ten (10) years from the effective date of this Permit.

I.I.2. In accordance with IDAPA 58.01.05.012 [40 CFR § 270.50(d)], this Permit shall be reviewed five (5) years after the effective date and modified, as necessary, in accordance with IDAPA 58.01.05.012 [40 CFR § 270.41].

I.J. CONTINUATION OF EXPIRING PERMIT

This Permit and all conditions herein shall continue in force until the effective date of a new permit, if the Permittee has submitted a timely complete application in accordance with IDAPA 58.01.05.012 [40 CFR §§ 270.10, 270.13 through 270.29], and through no fault of the Permittee, the Director has neither issued nor denied a new permit under IDAPA 58.01.05.013 [40 CFR § 124.15] on or before the expiration date of this Permit.

I.K. NEED TO HALT OR REDUCE ACTIVITY NOT A DEFENSE

It shall not be a defense for the Permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this Permit.

I.L. DUTY TO MITIGATE

In the event of noncompliance with this Permit, the Permittee shall take all reasonable steps to minimize releases to the environment resulting from the noncompliance and shall carry out such measures, as are reasonable, to prevent significant adverse impacts on human health or the environment.

I.M PROPER OPERATION AND MAINTENANCE

The Permittee shall, at all times, properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) that are installed or used by the Permittee so as to achieve compliance with the conditions of this Permit. Proper operation and maintenance includes effective performance, adequate funding, adequate operator staffing and training, and adequate laboratory and process controls, including appropriate quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems, only when necessary, to achieve compliance with the conditions of this Permit.

I.N. DUTY TO PROVIDE INFORMATION

The Permittee shall furnish to the Director, within a reasonable time period established by the Director, any relevant information that the Director may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this Permit, or to determine compliance with this Permit. The Permittee shall also furnish to the Director, within five (5) days of the Director's request, copies of records required to be kept by this Permit.

I.O. INSPECTION AND ENTRY

Pursuant to IDAPA 58.01.05.012 [40 CFR § 270.30(i)], the Permittee shall allow the Director (or an authorized representative) upon the presentation of credentials and other documents, as may be required by law, to:

I.O.1. Enter (at reasonable times) upon the Permittee's premises where a regulated facility or activity is located or conducted, or where records are kept under the conditions of this Permit;

I.O.2. Have access to and copy (at reasonable times) any records that must be kept under the conditions of this Permit;

I.O.3. Inspect at reasonable times, any portion of the facility, equipment (including monitoring and control equipment), practices, or operations regulated or required under this Permit; and

I.O.4. Sample or monitor (at reasonable times), for the purposes of assuring permit compliance or as otherwise authorized by RCRA or state law, any substances or parameters at any location.

I.P. MONITORING AND RECORDS

I.P.1. The Permittee shall retain records of all monitoring information (including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation), copies of all reports required by this Permit, the certification required by IDAPA 58.01.05.008 [40 CFR § 264.73(b)(9)], and records of all data, used to complete the application for this Permit, for a period of at least three (3) years from the date of the sample, measurement, report, certification, or recording unless a longer retention period is required by other conditions of this

Permit. The three-year period may be extended by the Director (upon request), in writing, to the Permittee.

I.P.2. The Permittee shall retain (at the facility) all monitoring records from all surface water sampling, seep sampling, soil sampling, sediment sampling, and ground water monitoring wells and associated ground water surface elevations for the active life of the facility, and for disposal units for the active life of the facility and the Post-Closure Care Period. The retention periods may be extended by request of the Director, at any time, by written notification to the Permittee, and the retention times are automatically extended, during the course of any unresolved enforcement action regarding this facility, to three (3) years beyond the conclusion of the enforcement action.

I.P.3. Pursuant to IDAPA 58.01.05.012 [40 CFR § 270.30(j)(3)], records of monitoring information shall specify:

I.P.3.a. The date(s), exact place, and times of sampling or measurements;

I.P.3.b. The name(s), title(s), and affiliation of the individual(s) who performed the sampling or measurements;

I.P.3.c. The date(s) analyses were performed;

I.P.3.d. The name(s), title(s), and affiliation of the individual(s) who performed the analyses;

I.P.3.e. The analytical techniques or methods used; and

I.P.3.f. The results of such analyses, including Quality Assurance/Quality Control data.

I.P.4 Samples and measurements taken for monitoring purposes shall be representative of the monitored activity. The method used to obtain a representative sample of the waste, to be analyzed, shall be the appropriate method from IDAPA 58.01.05.005 [40 CFR Part 261, Appendix I], EPA's most recent edition of *Technical Enforcement Guidance Document* (hereinafter referred to as TEGD), or an equivalent method approved by the Director. Laboratory methods shall be those specified in the most recent edition of *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods SW-846* (herein referred to as SW-846), the most recent edition of *Standard Methods for the Examination of Wastewater*, or other alternate method approved in this Permit, or an equivalent method in accordance with Permit Condition I.P.5.

I.P.5. The Permittee may substitute analytical methods that are equivalent to those specifically approved for use in this Permit, in accordance with the following:

I.P.5.a. The Permittee submits to the Director a request for substitution of an analytical method(s) that is equivalent to the method(s) specifically approved for use in this Permit. The request shall provide information demonstrating that the proposed method(s) is equal or superior to the analytical method(s) requested to be substituted in terms of sensitivity, accuracy, and precision (i.e., reproducibility).

I.P.5.b. The Director notifies the Permittee (in writing, by certified mail, or hand delivery) that the substitution of the analytical method(s) is approved. Such approval shall not require a permit modification under IDAPA 58.01.05.012 [40 CFR § 270.42].

I.P.6. Results of all ground water analyses required by this Permit shall be submitted to the Director within thirty (30) calendar days of the Permittee's receipt of sample data from the laboratory, but in no case shall the period between the date of sampling and the date of submission of analytical results, to the Director, exceed one hundred twenty (120) calendar days.

I.Q. REPORTING PLANNED CHANGES

The Permittee shall give notice to the Director, as soon as possible, of any planned physical alterations or additions to the facility before such planned physical alterations or additions occur, in accordance with IDAPA 58.01.05.012 [40 CFR § 270.30(l)(1)].

I.R. CERTIFICATION OF CONSTRUCTION OR MODIFICATION

I.R.1. The Permittee may not commence storage, treatment, or disposal in a new Hazardous Waste Management Unit or in a modified portion of an existing Hazardous Waste Management Unit, except as provided in IDAPA 58.01.05.012 [40 CFR §270.42], until the Permittee has submitted a letter to the Director (by certified mail, express mail, or hand delivery) along with the attachments required under Permit Condition II.A.2, signed by the Permittee and a registered professional engineer, certifying that the permitted unit(s) have been constructed or modified in accordance with the approved plans and specifications in compliance with this Permit (IDAPA 58.01.05.012 [40 CFR §270.30(l)]); and

I.R.2. The Director has reviewed and inspected the modified or newly constructed Hazardous Waste Management Unit(s) and has notified the Permittee in writing that he finds the unit(s) to be in compliance with the conditions of this Permit; or

I.R.3. In accordance with IDAPA 58.01.05.012 [40 CFR § 270.30(l)(2)(ii)(B)], if within fifteen (15) calendar days of the date of submittal, required by I.R.1 of this Permit, the Permittee has not received notice from the Director of his or her intent to inspect, prior inspection is waived and the Permittee may commence treatment, storage, or disposal of hazardous waste.

I.S. REPORTING ANTICIPATED NONCOMPLIANCE

The Permittee shall give advance notice to the Director of any planned changes in the permitted facility or activity that may result in noncompliance with requirements of this Permit, in accordance with IDAPA 58.01.05.012 [40 CFR § 270.30(l)(2)]. Advance notice shall not constitute a defense for any noncompliance.

I.T. TRANSFER OF PERMIT

This Permit is not transferable to any person, except after notice to and acceptance by the Director. The Director may require modification or revocation and reissuance of the Permit, pursuant to IDAPA 58.01.05.012 [40 CFR § 270.40]. Before transferring ownership or operation of the facility during its operating life, or of a disposal facility during the Post-Closure Period, the Permittee must notify the new owner or operator (in writing) of the requirements of IDAPA 58.01.05.008, 58.01.05.012 [40 CFR Parts 264 and 270] and this Permit.

I.U. TWENTY-FOUR HOUR REPORTING

I.U.1. In accordance with IDAPA 58.01.05.012 [40 CFR § 270.30(l)(6)], the Permittee shall verbally report to the Director (or the Idaho Emergency Communication Center during off-hours) any noncompliance with this Permit that might endanger human health or the environment. Any such information shall be reported, as soon as possible, but not later than twenty-four (24) hours from the time the Permittee becomes aware of the noncompliance. Potential endangerment to human health and the environment may include, but not be limited to, information concerning:

I.U.1.a. A release of any hazardous waste that may endanger public drinking water supplies; or

I.U.1.b. A release or discharge of hazardous waste, or of a fire or explosion, at the facility that could threaten human health or the environment outside the facility; or

I.U.1.c. Noncompliance with Permit Condition II.A.1 of this Permit.

I.U.2. The verbal description of the occurrence and its cause, if available, shall include the following (at a minimum):

- Name, title, and telephone number of the individual reporting;
- Name, address, and telephone number of the owner or operator;
- Name, address, and telephone number of the facility;
- Date, time, and type of incident;
- Location and cause of the accident;
- Name and quantity of material(s) involved;
- The extent and description of injuries, if any;
- An assessment of actual or potential hazards to the environment and human health, where this is applicable;
- Description of any emergency action taken to minimize possible threat(s) to human health or the environment;
- Estimated quantity and disposition of recovered material that resulted from the incident; and
- Any other information necessary to fully evaluate the situation and to develop an appropriate course of action.

I.U.3. Within five (5) calendar days after the Permittee is required to provide verbal notification, as specified in Permit Condition I.U.1 and I.U.2 of this Permit, the Permittee shall provide (to the Director) a written submission that shall include, but not be limited to, the following:

- Name, address, and telephone number of the individual reporting;
- A description (including cause, location, extent of injuries, if any, and an assessment of actual or potential hazard(s) to the environment and human health outside the facility, where this is applicable) of the incident (noncompliance and/or release);
- The period(s) in which the incident (noncompliance and/or release) occurred

including exact dates and times;

- Whether the results of the incident remain a threat to human health and the environment (whether the noncompliance has been corrected and/or the release has been adequately remediated); and
- If not, the anticipated time it is expected to continue; the steps taken or planned to reduce, eliminate, and prevent recurrence of the noncompliance; and/or steps taken or planned to adequately remediate the release.

I.U.3.a. The Permittee need not comply with the five (5) calendar day, written notice requirement if the Director waives (in writing) the requirement, and the Permittee submits a written report within fifteen (15) calendar days from the time the Permittee is required to provide verbal notification, as specified in Permit Condition I.U.1 of this Permit.

Twenty-four (24) hour telephone number 1-800-632-8000
(Idaho Emergency Communication Center)
The address and telephone numbers listed above are current as of the effective date of this Permit and may be subject to change.

I.V. OTHER NONCOMPLIANCE

The Permittee shall report to the Director (on a quarterly basis) all other instances of noncompliance, not reported under Permit Condition I.U of this Permit, from the effective date of the Permit. The reports shall contain the applicable information listed in Permit Condition I.U of this Permit. Reporting shall not constitute a defense for any noncompliance.

I.W. OTHER INFORMATION

Whenever the Permittee becomes aware that he/she failed to submit any relevant facts in the Permit Application or submitted incorrect information in a Permit Application, or in any report to the Director, the Permittee shall promptly submit such facts or information to the Director, in accordance with Permit Condition I.Z of this Permit.

I.X. SIGNATURE AND CERTIFICATION

All applications, reports, or other information submitted to the Director (by the Permittee) shall be signed and certified in accordance with IDAPA 58.01.05.012 [40 CFR § 270.11 and § 270.30(k)].

I.Y. CONFIDENTIAL INFORMATION

The Permittee may be able to make a confidentiality claim regarding information submitted to the Department. Any such claim shall be governed by Sections 39-4411 and 39-337 to 39-350 of the Idaho Code, Sections 58.01.05.004 [40 CFR § 260.2], 58.01.05.012 [40 CFR § 270.12] and 58.01.05.997, and any other applicable state or local law. Pursuant to those authorities, if no claim of confidentiality is made at the time of submission, the Department may make the information available to the public without further notice.

I.Z. REPORTS, NOTIFICATIONS, AND SUBMISSIONS TO THE DIRECTOR

All reports, notifications, or other submissions that are required by this Permit and IDAPA 58.01.05.012 [40 CFR § 270.5] shall be sent or given to the Director (in duplicate) by certified mail, or express mail, or hand delivered to:

Director, c/o Hazardous Waste Program Manager
Idaho Department of Environmental Quality
1410 North Hilton
Boise, Idaho 83706-1255
Telephone No. (208) 373-0502

I.AA. DOCUMENTS TO BE MAINTAINED AT THE FACILITY

I.AA.1. The Permittee shall maintain at the facility (until closure is completed and certified by an independent, registered professional engineer) the following documents and amendments, and revisions or modifications to these documents:

I.AA.1.a. A complete copy of this Permit, including all attachments, figures, tables, and modifications (at a minimum) including the following:

- Waste Analysis Plan, as required by IDAPA 58.01.05.008 [40 CFR § 264.13] and this Permit (Attachment 2).
- Inspection Procedures, Schedules, Logs, and Records, as required by IDAPA 58.01.05.008 [40 CFR §§ 264.15(b)(2) and 264.73(b)(5)] and this Permit.
- Personnel training requirements for each position and personnel training records for each individual, involved with the management of hazardous waste, as required by IDAPA 58.01.05.008 [40 CFR § 264.16(d)] and this Permit.
- Contingency Plan, as required by IDAPA 58.01.05.008 [40 CFR § 264.53(a)] and this Permit (Attachment 7).
- Operating Record, as required by IDAPA 58.01.05.008 [40 CFR § 264.73] and this Permit.
- Closure Plan and Closure Cost Estimate, as required by IDAPA 58.01.05.008 [40 CFR § 264.112(a) and § 264.142] and this Permit.

This space intentionally left blank.

MODULE II - GENERAL FACILITY CONDITIONS

II.A. DESIGN AND OPERATION OF FACILITY

II.A.1. The Permittee shall design, construct, maintain, and operate the facility to minimize the possibility of a fire, explosion, or any unplanned sudden or non-sudden release of hazardous waste constituents to air, soil, ground water, or surface water that could threaten human health or the environment.

II.A.2. The Permittee shall construct all future and maintain all existing Hazardous Waste Management Units in accordance with the approved designs, specifications, and maintenance schedules that are included in Attachments 10, 11, 13 through 20, 24, and 25 of this Permit, except for minor changes deemed necessary by the Permittee to facilitate proper construction of the Hazardous Waste Management Units. Minor deviations from the approved designs or specifications necessary to accommodate proper construction, and the substitution of the use of equivalent or superior materials or equipment, must be noted on the as-built drawings and the rationale for those deviations must be provided in narrative form. After completion of construction of each future Hazardous Waste Management Unit, the Permittee shall submit to the Director final as-built drawings and the narrative report as part of the construction certification document specified in Permit Condition I.R.1.

II.A.3. A 100-foot wide strip of land, located within the outside perimeter (i.e., the fenceline) of the facility's legal boundaries as defined in Attachment 1 of this Permit, shall be set aside as a buffer strip for any hazardous waste treatment, storage, or disposal. New hazardous waste treatment, storage, or disposal units shall not be constructed within the buffer strip (except as relating to inspection requirements) nor shall the buffer strip be subdivided for the hazardous waste disposal site.

II.A.3.a. The company-owned land surrounding the Facility to the west, east, and south is subject to the Hazardous Waste Facility Siting Act (Idaho Code §§ 39-5801 through 5820).

II.A.3.b. The company-owned land along the northern boundary of the Facility, as defined in Permit Condition II.A.3.b.(1), shall remain undeveloped land and no application under the Hazardous Waste Facility Siting Act (Idaho Code §§ 39-5801 through 5820) shall be made to utilize this land for any activities permitted by the Act. This land shall be set aside as a buffer zone where no new hazardous waste treatment, storage, or disposal units, or ancillary structures, shall be constructed (except as relating to inspection requirements and other permit-required activities, such as corrective action) nor shall the buffer zone be subdivided for use as a hazardous waste disposal site. Except as specified above, the buffer zone, as defined in Permit Condition II.A.3.b.(1), will be maintained in a natural state and will not be developed or used in a manner that will impair the historic viewshed or cultural and natural resources. This Permit Condition shall bind USEI, its successors, and assigns.

II.A.3.b.(1) The buffer zone subject to the requirements of Permit Condition II.A.3.b shall encompass approximately 309 acres and is located as follows:

T4S, R1E, Owyhee County
Section 13: E1/2 SE1/4

T4S, R2E, Owyhee County
Section 18: Lots 3 and 4, E1/2 SW1/4, S1/2 SE1/4

II.A.4. The Permittee shall comply with all applicable requirements of the Land Disposal Restrictions of IDAPA 58.01.05.011 [40 CFR Part 268].

II.B. REQUIRED NOTICES FOR RECEIPT OF OFF-SITE HAZARDOUS WASTE

II.B.1. The Permittee may receive hazardous waste from a foreign source provided that the Permittee notify the Director (in writing) at least four (4) weeks in advance of the date hazardous waste, from a foreign source, is expected to arrive at the facility, as required by IDAPA 58.01.05.008 [40 CFR § 264.12(a)]. Notice of subsequent shipments of the same waste from the same foreign source is not required.

II.B.2. When the Permittee is to receive hazardous waste from an off-site source (except where the Permittee is also the generator), it must inform the generator in writing that it has the appropriate permits for and will accept the waste the generator is shipping. The Permittee must keep a copy of this written notice as part of the Operating Record, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.12(b) and § 264.73(b)(7)] and this Permit.

II.B.3. The Permittee shall notify the Department in writing, within three (3) business days of the occurrence, that the Permittee has rejected for acceptance a hazardous waste shipment. This notice shall contain the following information:

II.B.3.a. Generator name, EPA ID Number, address, and telephone number;

II.B.3.b. Transporter name and EPA ID Number;

II.B.3.c. Waste description and quantity;

II.B.3.d. Reason for rejection;

II.B.3.e. Date of generator signature;

II.B.3.f. Date of receipt and rejection; and

II.B.3.g. Copy of manifest.

II.C. GENERAL WASTE ANALYSIS

II.C.1. The Permittee shall comply with the procedures and requirements of the Waste Analysis Plan, in accordance with IDAPA 58.01.05.008 and 58.01.05.011 [40 CFR § 264.13 and § 268.7], and Attachments 2 and 23 of this Permit.

II.C.2. For every waste stream received, the Permittee shall have on file (at the site), the generator-provided “Waste Product Questionnaire” (Figure C-1 of Attachment 2).

II.C.3. The Permittee may revise Figure C-1, as designated in Permit Conditions II.C.3.a and II.C.3.b, without first obtaining a permit modification under IDAPA 58.01.05.012 [40 CFR § 270.42]. The procedures designated under Permit Condition II.S shall be followed to implement these revisions:

II.C.3.a. The Permittee may add information requirements to Figure C-1 in cases where such additional information will result in a more comprehensive Figure C-1.

II.C.3.b. The Permittee may delete information from Figure C-1 if the information is not essential for determining the acceptability of a waste stream for management at the Permittee's site (i.e., revisions made to Figure C-1 to comply with IDAPA 58.01.05.011 [40 CFR Part 268] restrictions).

II.C.4. The Permittee shall ensure that the wastes are not managed at the facility in violation of the provisions of the Land Disposal Restrictions rule as contained in IDAPA 58.01.05.011 [40 CFR Part 268] with the exception of CAMU-eligible wastes, per section II.C.5 of this permit. To the extent that modifications to the Permittee’s Waste Analysis Plan are needed to comply with future self implementing provisions of IDAPA 58.01.05.011 [40 CFR Part 268], the Permittee must submit a Permit Modification Request to the Director within ninety (90) calendar days of the effective date of the self-implementing provisions.

II.C.4.a. The Permittee is authorized to accept CAMU-eligible wastes for disposal. The Permittee shall ensure CAMU-eligible wastes are managed in accordance with the provisions contained in IDAPA 58.01.05.008 [40 CFR Part 264] and Attachment 2 of this Permit.

II.C.5. All waste analysis procedures designated in Attachment 2 and 17 of this Permit shall be adhered to for the placement of on-site-generated landfill leachate and any other wastes into the evaporation pond.

II.C.6 The Permittee shall maintain a copy of the latest approved Waste Analysis Plan, included as Attachment 2 of this Permit, at the facility until the facility is fully closed and certified per IDAPA 58.01.05.008 [40 CFR § 264 Subpart G].

II.C.7. The Permittee shall comply with the requirements of IDAPA 58.01.05.008 [40 CFR § 264.17(a)] and follow the procedures for handling ignitable, reactive, and incompatible wastes set forth in Attachment 2 of this Permit.

II.C.8. The Permittee shall comply with the 40 CFR 264 Subpart CC waste determination procedures, as required by IDAPA 58.01.05.008 [40 CFR § 264.1083].

II.D. SECURITY PROCEDURES

The Permittee shall comply with the security provisions of IDAPA 58.01.05.008 [40 CFR § 264.14(b)] and as described in Attachment 3 of this Permit.

II.E. INSPECTION PLAN

The Permittee shall follow the procedures of the approved Inspection Plan included as Attachment 4 of this Permit. The Permittee shall comply with the inspection provisions of IDAPA 58.01.05.008 [40 CFR § 264.15], and as follows:

II.E.1. The Permittee shall maintain the inspection records and results, in accordance with Permit Condition I.AA. The Permittee shall record inspections on the Inspection Log sheet (included in Attachment 4 of this Permit) or an equivalent, approved log sheet, as specified in IDAPA 58.01.05.008 [40 CFR § 264.15(d)].

II.E.2. The Permittee shall record on the Inspection Logs and Inspection Log Sheets (required by Permit Condition II.E.1) as specified in IDAPA 58.01.05.008 [40 CFR § 264.15(d)]. At a minimum, the following shall be recorded:

- The date and time of the inspection;
- The name and title of the inspector;
- A notation of the observations made; and
- The date and nature of any repairs or other remedial actions.

II.E.3. The Permittee shall remedy, as required by IDAPA 58.01.05.008 [40 CFR § 264.15(c)], on a schedule approved by the Director, any deterioration or malfunction discovered by an inspection.

II.E.4. The Permittee shall retain the Inspection Logs and Inspection Log Sheets required by Permit Condition II.E.1 until closure is completed and certified, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.73(b)(5)] and Permit Condition I.AA.

II.E.5. In the event of a facility shutdown or an extended holiday, no more than seventy-two (72) hours shall elapse between inspections listed at a frequency of “normal working day” on the inspection schedule (Table F-1 in Attachment 4).

II.E.6. The Permittee may make only the following revisions to the Inspection Plan, without first obtaining a permit modification, in accordance with IDAPA 58.01.05.012 [40 CFR § 270.42]. The procedures designated under Permit Condition II.S shall be followed to implement these revisions.

II.E.6.a. Upon certification of closure of an individual Waste Management Unit, any portion of the Inspection Plan, specific to that unit, may be deleted from the Inspection Plan (Attachment 4 of this Permit).

II.E.6.b. The Permittee may modify orientations of inspection-related items on inspection figures.

II.E.6.c. The Permittee may add inspection requirements to an existing inspection form, table, figure, or disposal record form in cases where such additional requirements will result in a more comprehensive or detailed Inspection Plan.

II.E.6.d. The Permittee may create additional inspection forms, tables, figures, or disposal record forms to address inspection requirements for equivalent replacement equipment that must be routinely inspected.

II.F. TRAINING PLAN

II.F.1. The Permittee shall ensure that all personnel who handle hazardous waste are trained in hazardous waste management, safety and emergency procedures (as applicable to their job description) in accordance with the Permittee's Training Plan. These personnel shall be trained in accordance with the Training Plan, as included in Attachment 5 of this Permit, and documentation of training shall be maintained, as specified in Attachment 5 of this Permit.

II.G. PREPAREDNESS AND PREVENTION

II.G.1. The Permittee shall comply with the preparedness and prevention procedures included as Attachment 6 of this Permit, and in accordance with IDAPA 58.01.05.008 [40 CFR § 264 Subpart C] and as follows:

II.G.2. The Permittee shall operate the permitted units so as to minimize the possibility of a fire, explosion or sudden or non-sudden releases to the air or soil, which could threaten human health or the environment, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.31] and Attachment 6 of this Permit.

II.G.3. The Permittee shall maintain the communications and alarm systems, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.34] and Attachment 6 of this Permit.

II.G.4. The Permittee shall maintain the aisle space necessary to allow the unobstructed movement of personnel, fire protection equipment, spill control equipment, and decontamination equipment, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.35] and Attachment 6 of this Permit.

II.G.5. The Permittee shall maintain arrangements with state and local authorities, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.37] and Attachment 7 of this Permit. If state or local officials refuse to enter into preparedness and prevention arrangements with the Permittee for a given HWMU, the Permittee must document this refusal in the Operating Record.

II.H. CONTINGENCY PLAN

II.H.1. The Permittee shall follow the procedures outlined in the Contingency Plan, included as Attachment 7 of this Permit, and comply with IDAPA 50.01.05.008 [40 CFR 264 Subpart D] and as follows:

II.H.2. The Permittee shall notify the Department by calling the Idaho Emergency Communication Center's 24-hour phone number (1-800-632-8000), as soon as practical, but in no event more than 24 hours after the discovery of any release of hazardous waste that may pose an immediate threat to the Permittee's personnel or the environment, or that requires the Permittee to take corrective action to mitigate the effects of the release, including implementing the Contingency Plan. Releases requiring such notification shall include, but are not limited to, incidents such as personnel exposure or contamination for which outside medical attention is sought; storm events that result in run-off leaving the active areas of the site; or any fire or explosion at the site that requires use of emergency equipment to extinguish or control the fire.

II.H.3. The Permittee shall review and immediately amend, as necessary, the Contingency Plan whenever:

II.H.3.a. This Permit is revised;

II.H.3.b. The Contingency Plan fails in an emergency;

II.H.3.c. The Permittee changes the facility design, construction, operation, maintenance, or other circumstances in a way that materially increases the potential for fires, explosions, or releases of hazardous waste or hazardous waste constituents, or changes the response necessary in an emergency;

II.H.3.d. The list of emergency coordinators changes; or

II.H.3.e. Major changes to the list of emergency equipment occur.

II.H.4. The Permittee shall submit to the Director the names, addresses, and phone numbers of all persons qualified to act as emergency coordinators. The Permittee shall ensure that a trained emergency coordinator be available at all times in case of an emergency.

II.H.5. The Permittee shall submit a copy of the Contingency Plan, and all revisions to the plan, to all local police departments, fire departments, hospitals, and state and local emergency response teams that may be called upon to provide emergency services, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.53(b)].

II.H.6. The Permittee shall document the time, date, and details of any incident that requires implementing the Contingency Plan in the Facility Operating Record. Within fifteen (15) days after the incident, the Permittee shall submit a written report of the incident to the Director.

II.I. MANIFEST SYSTEM

II.I.1. The Permittee shall follow the procedures for using the Manifest System and identifying and resolving manifest discrepancies, in accordance with IDAPA 58.01.05.008, 58.01.05.012 [40 CFR §§ 264.71, 264.72, and 270.30(1)(7)] and the Waste Analysis Plan, included as Attachment 2 of this Permit.

II.I.2. The Permittee shall submit an unmanifested waste report to the Director, in accordance with IDAPA 58.01.05.008, IDAPA 58.01.05.012 [40 CFR §§ 264.76 and 270.30(1)(8)], within fifteen (15) calendar days of receipt of unmanifested waste.

II.J. RECORD KEEPING AND REPORTING

In addition to the record keeping and reporting requirements specified elsewhere in this Permit, the Permittee shall comply with the following:

II.J.1. The Permittee shall maintain a written Operating Record at the facility, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.73(a)], for all records identified in IDAPA 58.01.05.008 [40 CFR §§ 264.73(b)(1) through 264.73(b)(16)].

II.J.2. The Permittee shall, by March 1st of each year, submit to the Director a certification pursuant to IDAPA 58.01.05.008 [40 CFR § 264.73(b)(9)], that the Permittee has a program in place to reduce the volume and toxicity of hazardous waste generated, to the degree determined to be economically practicable; and that the proposed method of treatment, storage, or disposal is the most practicable method currently available to the Permittee, which minimizes the present and future threat to human health and the environment.

II.J.3. The Permittee shall, by March 1st of each even-numbered year, submit to the Director a Biennial Report covering the facility activities during the previous calendar year, pursuant to IDAPA 58.01.05.008, 58.01.05.006, 58.01.05.012 [40 CFR §§ 264.75(a) through (j), 262.41, 270.30(l)(9)].

II.J.4. The Permittee shall retain all hazardous waste management records, including data collected in accordance with procedures of the Response Action Plans, and make such records available to the Director (at reasonable times) for inspection, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.74(a)].

II.J.5. The retention period for all records required by this Permit is extended automatically during the course of any unresolved enforcement action regarding the Permittee or as directed by the Director, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.74(b)].

II.J.6. The Permittee shall submit a survey plat of waste disposal locations to the local land authority and to the Director in accordance with the closure requirements of Permit Condition II.K.8 and IDAPA 58.01.05.008 [40 CFR § 264.116].

II.J.7. The Permittee shall submit additional reports to the Director in accordance with IDAPA 58.01.05.008 [40 CFR § 264.77].

II.K. CLOSURE

II.K.1. The Permittee shall meet the general closure performance standard, as specified in IDAPA 58.01.05.008 [40 CFR § 264.111], during closure of all Hazardous Waste Management Units at the facility. Compliance with IDAPA 58.01.05.008 [40 CFR § 264.111] shall require closure of each Hazardous Waste Management Unit in accordance with the Closure Plan, included as Attachment 9 of this Permit and all applicable requirements of Permit Condition II.K.

II.K.2. For all Hazardous Waste Management Units, other than landfills and surface impoundments, minor deviations from the permitted closure procedures, necessary to accommodate proper closure, must be described in a narrative form with the closure certification statements. The Permittee shall describe the rationale for implementing minor changes as part of this narrative report. Within sixty (60) calendar days after completion of closure of each Hazardous Waste Management Unit, other than Landfill and Surface Impoundment Units, the Permittee shall submit the certification statements and narrative report to the Director.

II.K.3. The Permittee shall amend the Closure Plan, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.112(c)], whenever necessary, by submitting a written request for a permit modification to the Director.

II.K.4. The Permittee shall notify the Director at least sixty (60) calendar days prior to the date it expects to begin closure of any surface impoundment or landfill unit, and at least forty-five (45) calendar days prior to the date it expects to begin closure of any tanks, container storage units, or containment buildings.

II.K.5. The Permittee shall close all Hazardous Waste Management Units within the time limits specified in the Closure Plan in Attachment 9 of this Permit, with the exception that the closure time for the surface impoundments shall be 1,460 days after receiving the final volume of hazardous wastes, unless extended, pursuant to Permit Condition V.B.

II.K.6. The Permittee shall decontaminate or dispose of all facility equipment as specified in the Closure Plan included in Attachment 9 of this Permit.

II.K.7. The Permittee shall provide certification statements attesting that each Hazardous Waste Management Unit at the facility has been closed in accordance with the applicable specifications in the Closure Plan included in Attachment 9 of this Permit, as required by IDAPA 58.01.05.008 [40 CFR § 264.115].

II.K.8. The Permittee shall submit to the local land use authority, and to the Director, upon submission of the certification of closure of each hazardous waste disposal unit, a survey plat indicating the waste disposal locations and dimensions, with respect to permanently surveyed benchmarks, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.116].

II.K.9. In the event that any Hazardous Waste Management Unit, other than the Landfill and Surface Impoundment Units, cannot be closed by removing hazardous waste, hazardous constituents, contaminated subsoil, and any contaminated ground water (i.e., clean-closed) as specified in Permit Condition II.K.1, the Permittee shall revise the Facility Post-Closure Plan to include a Post-Closure Plan for that Hazardous Waste Management Unit. The Permittee shall submit to the Director the Post-Closure Plan for that Hazardous Waste Management Unit, as a Permit Modification Request, within ninety (90) calendar days of the date that the Director notifies the Permittee in writing that the unit must be closed as a landfill, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.118(a)].

II.L. COST ESTIMATE FOR FACILITY CLOSURE

II.L.1. The Permittee shall comply with the requirements of IDAPA 58.01.05.008 [40 CFR § 264.142(a)]. The Permittee shall maintain a current closure cost estimate for each individual Hazardous Waste Management Unit. The costs shall be summarized, by the Permittee, for final closure of the entire facility.

II.L.2. In accordance with IDAPA 58.01.05.008 [40 CFR § 264.142(b)], the Permittee shall annually adjust the closure cost estimate for inflation, prior to June 1st, the anniversary date of the establishment of the original financial instrument(s) used to comply with Permit Condition II.O and IDAPA 58.01.05.008 [40 CFR § 264.143].

II.L.3. During the active life of the facility, the Permittee shall submit to the Director a revised closure cost estimate within thirty (30) calendar days of an approved modification to the Closure Plan, if such modification results in an increase in the closure cost estimate, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.142(c)].

II.L.4. During the operating life of the facility, the Permittee shall keep a copy of each closure cost estimate and adjustment made at the facility, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.142(a), (b), and (c)].

II.L.5. The Permittee shall maintain an updated summary of current closure costs for the entire facility closure, based on the Hazardous Waste Management Units that have received RCRA waste but have not yet been certified as closed, and have not been released from the financial responsibility requirements as specified in Permit Condition II.O (i.e., active units).

II.L.6. Prior to placement of waste in any new Hazardous Waste Management Unit, the Permittee must amend, as necessary, the summary of current closure costs to reflect the estimated closure cost of that new unit. Such amended closure costs shall be annually adjusted for inflation, as required by IDAPA 58.01.05.008 [40 CFR § 264.142(b)].

II.L.7. Upon certification for closure of any Hazardous Waste Management Unit, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.115], and after the Director has released the Permittee from the financial responsibility requirements for that unit as specified in Permit Condition II.O, the Permittee may adjust the summary of current closure costs to reflect the closure cost of that unit. The Permittee shall submit to the Director a current version of the closure cost estimate for the facility, indicating cost estimates for each remaining unit to be closed.

II.M. POST-CLOSURE CARE

II.M.1. The Permittee shall comply with the approved Post-Closure Plan, included in Attachment 9 of this Permit. In addition, the Permittee shall comply with all modifications to the Post-Closure Plan, and with all provisions of IDAPA 58.01.05.008 [40 CFR §§ 264.117, .118, .119, and .120].

II.M.2. Except as the period may be shortened or extended, as provided in IDAPA 58.01.05.008 [40 CFR § 264.117(a)(2)], the period of Post-Closure Care for each Landfill and Surface Impoundment Unit and any other Hazardous Waste Management Unit, as applicable, shall be thirty (30) years after Director approval of closure certification.

II.N. COST ESTIMATE FOR POST-CLOSURE CARE

II.N.1. The Permittee shall comply with IDAPA 58.01.05.008 [40 CFR § 264.144(a)]. The Permittee shall maintain a current post-closure cost estimate for each post-closure activity.

II.N.2. The Permittee shall annually adjust the post-closure cost estimate for inflation, prior to June 1st, the anniversary date of the establishment of the original financial instrument(s) used to comply with Permit Condition II.P and IDAPA 58.01.05.008 [40

CFR § 264.144(b)].

II.N.3. During the active life of the facility, the Permittee shall submit to the Director a revised post-closure cost estimate, within thirty (30) days of an approved modification to the Post-Closure Plan, if such modification results in an increase in the post-closure cost estimate, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.144(c)].

II.N.4. During the operating life of the facility, the Permittee shall keep a copy at the facility of each post-closure cost estimate and adjustments prepared, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.144(a), (b), and (c)].

II.O. FINANCIAL ASSURANCE FOR FACILITY CLOSURE

II.O.1. The Permittee shall comply with IDAPA 58.01.05.008 [40 CFR § 264.143] by providing documentation of financial assurance, as required by IDAPA 58.01.05.008 [40 CFR § 264.151], in the amount of the cost estimates required by Permit Condition II.L.1.

II.O.2. Prior to placement of waste in any new Hazardous Waste Management Unit, the Permittee shall update the closure financial assurance mechanism, as necessary, and demonstrate that an adequately, funded financial assurance mechanism for closure of the facility, including the new Hazardous Waste Management Unit, is in effect. A copy of the updated, financial assurance mechanism shall be approved by the Director before waste is placed in the new unit. (See Permit Condition II.L.6.)

II.O.3. Changes in financial assurance mechanisms for closure must be approved by the Director, pursuant to IDAPA 58.01.05.008 [40 CFR § 264.143].

II.P. FINANCIAL ASSURANCE FOR FACILITY POST-CLOSURE

II.P.1. The Permittee shall comply with IDAPA 58.01.05.008 [40 CFR § 264.145 or 264.146] by providing documentation of financial assurance, as required by IDAPA 58.01.05.008 [40 CFR § 264.151], in the amount of the cost estimates required by Permit Condition II.N.1.

II.P.2. Changes in financial assurance mechanisms for post-closure must be approved by the Director, pursuant to IDAPA 58.01.05.008 [40 CFR § 264.145].

II.Q. LIABILITY REQUIREMENTS

II.Q.1. The Permittee shall comply with the requirements of IDAPA 58.01.05.008 [40 CFR § 264.147(a)] and the documentation requirements of IDAPA 58.01.05.008 [40 CFR § 264.151], including the requirements to have and maintain liability coverage for sudden accidental occurrences in the amount of at least $1 million per occurrence, with an annual aggregate of at least $2 million, exclusive of legal defense costs.

II.Q.2. The Permittee shall comply with the requirements of IDAPA 58.01.05.008 [40 CFR § 264.147(b)] and the documentation requirements of IDAPA 58.01.05.008 [40 CFR § 264.151], including the requirements to have and maintain liability coverage for non-sudden accidental occurrences in the amount of at least $3 million per occurrence, with an annual aggregate of at least $6 million, exclusive of legal defense costs.

II.R. INCAPACITY OF OWNERS OR OPERATORS GUARANTORS, OR FINANCIAL INSTITUTIONS

The Permittee shall comply with IDAPA 58.01.05.008 [40 CFR § 264.148].

II.S. EQUIVALENT MATERIALS/INFORMATION

II.S.1. If certain equipment, materials, and administrative information (such as names, phone numbers, addresses) are specified in this Permit, the Permittee is allowed to use an equivalent or superior substitute. Use of such equivalent or superior items, within the limits (e.g. ranges, tolerances, and alternatives) already specified in sufficient detail in this Permit and the Permit Attachments, shall not be considered a modification of the Permit. However, the Permittee must place in the Operating Record (prior to the institution of such revision) the revision, accompanied by a narrative explanation, and the date the revision became effective. Documentation of the substitution shall be submitted to the Director on a quarterly basis (at a minimum). The Department may judge the soundness of the revision and take appropriate action. The format of tables and forms are not subject to the requirements of this Permit, and may be revised at the Permittee's discretion.

II.S.2. If the Department determines that the substitution was not equivalent to the original, it will notify the Permittee that the Permittee's claim of equivalency has been denied, the reasons for the denial, and that the original material or equipment must be used. If the product substitution is denied, the Permittee shall comply with the original, approved product specification, find an acceptable substitution, or apply for a permit modification, in accordance with IDAPA 58.01.05.012 [40 CFR § 270.42].

II.T. AIR EMISSION STANDARDS

II.T.1. The Permittee shall comply with the Phase 1 Organic Air Emission Standards of IDAPA 58.01.08.008 [40 CFR Part 264] for hazardous waste treatment, storage, and disposal (TSD) facilities including:

- IDAPA 58.01.08.008 [40 CFR Part 264, Subpart AA] for emission standards of total organics from process vents associated with distillation, fractionation, thin-film evaporation, solvent extraction, and air or steam-stripping operations that process hazardous waste, with an annual average total organic concentration of at least ten (10) parts per million by weight (ppmw).
- IDAPA 58.01.08.008 [40 CFR Part 264, Subpart BB] for emission standards that address leaks of total organics from specific equipment (i.e., pumps, valves, compressors, etc.) that contains or contacts hazardous waste that has a total organic concentration of at least 10% by weight.
- IDAPA 58.01.08.008 [40 CFR Part 264, Subpart CC] for emission standards that address the management of hazardous waste, containing an average volatile organic (VO) concentration at the point of waste origination of more than 500 ppmw, in tanks, surface impoundments, and containers.

II.T.2. The Permittee shall not treat, store, or dispose of hazardous wastes subject to

IDAPA 58.01.05.008 [40 CFR § 264.1082] (e.g., wastes that exceed an average volatile organic (VO) concentration at the point of waste origination of more than 500 ppmw) in tanks, surface impoundments, or containers, unless the appropriate emission control requirements are met, as specified in IDAPA 58.01.05.008 [40 CFR Subpart CC]. Prior approval from the Director is required for the treatment or disposal of wastes exceeding an average VO concentration at the point of waste origination of 500 ppmw in tanks, surface impoundments, or containers.

II.T.3. Prior to installing or using any additional equipment (including air emission controls) subject to the requirements of IDAPA 58.01.05.008 [40 CFR Part 264, Subpart CC], the Permittee shall supply the specific Part B information required, pursuant to IDAPA 58.01.05.012 [40 CFR § 270.27], and shall obtain a permit modification in accordance with the provisions of IDAPA 58.01.05.012 [40 CFR § 270.42].

II.T.4. Prior to installing or using any equipment with process vents subject to the requirements of IDAPA 58.01.05.008 [40 CFR Part 264, Subpart AA], the Permittee shall supply the specific Part B information required, pursuant to IDAPA 58.01.05.012 [40 CFR § 270.24], and shall obtain a permit modification in accordance with the provisions of IDAPA 58.01.05.012 [40 CFR § 270.42].

II.T.5. Prior to installing or using any equipment subject to the requirements of IDAPA 58.01.05.008 [40 CFR Part 264, Subpart BB], the Permittee shall supply the specific Part B information required pursuant to IDAPA 58.01.05.012 [40 CFR § 270.25] and shall obtain a permit modification, in accordance with the provisions of IDAPA 58.01.05.012 [40 CFR § 270.42].

II.T.6. The Permittee shall record the information required in accordance with IDAPA 58.01.05.008 [40 CFR § 264.1089] in a log kept in the Facility Operating Record for use in determining exemptions, as provided in the Applicability Section of IDAPA 58.01.05.008 [40 CFR § 264.1050].

II.U. QUARTERLY REPORTS

II.U.1. The following reports shall be submitted to the Department on a quarterly basis:

- Minor discrepancies and items not requiring 24-hour reporting, including documentation of equivalent or superior items, treatment failures (i.e., failed stabilization results), and other noncompliance items under Permit Condition I.V.;
- Summary of NORM/FUSRAP waste receipts, providing volumes and concentrations of waste disposed; and
- Alternative Cover data summary for Test Pad and Trenches 10 and 11.

Note: Ground Water Monitoring Reports shall be submitted per the schedule stated in Module IX of this Permit.

II.V. COMPLIANCE SCHEDULE

II.V.1. Within 180 days of the April following the effective Permit date, the Pug Mill shall be closed in accordance with IDAPA 58.01.08.008 [40 CFR Part 264 Subpart G] and Attachment 9.

II.V.2. Within 180 days of the April following the effective Permit date, landfill Cell 5 shall be closed in accordance with IDAPA 58.01.08.008 [40 CFR Part 264 Subpart G] and Attachment 9.

This space intentionally left blank

MODULE III - CONTAINER STORAGE AND TREATMENT

III. Subject to the terms of this Permit, the Permittee may store and/or treat hazardous wastes in permitted Container Management Units, as follows:

III.A. DESIGN AND OPERATION

III.A.1. The Permittee's compliance with the requirements of Permit Conditions III.A through III.C shall constitute compliance with the requirements of IDAPA 58.01.05.008 [40 CFR Part 264, Subpart I] for the management of hazardous waste in containers.

III.A.2. The Container Management Units are identified as follows: Container Storage Pad 4; Container Storage Pad 5; Container Storage Area 1; Stabilization Facility; Truck Unloading Apron Nos. 1, 2, and 3; and the RCRA portion of the RCRA/PCB Building. In these Container Management Units and in the Containment Building, the Permittee may store and/or treat containerized wastes, as listed on the Part A Permit Application (included as Attachment 12 of this Permit) except that the limitations designated on Table C-8 and Table C-10 of Attachment 2 of this Permit apply to the wastes stored in containers at any time.

III.A.3. The Permittee shall not store waste using glass as the primary container.

III.A.4. The quantity of 55-gallon containers stored in each designated storage unit, or its volumetric equivalent, shall be limited to the maximum storage capacities designated on Tables D-1 and D-1A of Attachment 13 of this Permit.

III.A.5. The Permittee shall store and/or treat containerized waste, in Container Management Units and in the Containment Building, in the manner described in Attachment 13 of this Permit, except as otherwise specified in this Permit, and in accordance with Permit Condition II.A.I. Additionally, the Permittee shall comply with all applicable sections of Attachments 2, 4, 6, 7, 15, 24, and 25 of this Permit.

III.A.6. The Permittee shall assure that the ability of the container to contain the waste is not impaired, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.172].

III.A.7 If a container holding hazardous waste is not in good condition (e.g., severe rusting, apparent structural defects) or if it begins to leak, the Permittee shall transfer the hazardous waste from such container to a container that is in good condition, or otherwise manage the waste in compliance with the conditions of this Permit and IDAPA 58.01.05.008 [40 CFR § 264.171].

III.A.8 The Permittee shall maintain all Secondary Containment Systems, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.175] and the attached plans and specifications in Attachment 13 of this Permit.

III.A.9. The Permittee shall inspect the Container Management Units weekly, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.174] and the inspection schedules in Attachment 4 of this Permit, to detect leaking containers and deterioration of containers and the Containment System caused by corrosion and other factors. The Permittee shall document the results of all inspections and wastes analyses performed in the Operating Record.

III.A.10. The Permittee shall keep all relevant figures, drawings, and diagrams, related to the Container Management Units, readily available for inspection at the facility, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.74].

III.B. INCOMPATIBLE WASTE

III.B.1. The Permittee shall not place incompatible wastes, or wastes and materials which are incompatible in the same container, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.177].

III.B.2. The Permittee shall not place hazardous waste or materials in an unwashed container that previously held an incompatible waste or material.

III.B.3. The Permittee shall not store a container holding hazardous waste that is incompatible with any waste, or any materials stored nearby in containers, without separating these incompatible wastes or materials by protecting the wastes from commingling by means of a dike, berm, or wall.

III.C. SPECIAL REQUIREMENTS

III.C.1. The Permittee shall keep all containers closed during storage and shall not open, handle, or store containers in a manner which may rupture the container or cause it to leak, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.173]. The Permittee shall provide temporary cover for all water-reactive, containerized wastes (meeting Permit Condition II.C) that are stored in the Container Management Units located outside, including Container Storage Pad 4, Container Storage Pad 5, Container Storage Area 1, and the Stabilization Facility. This temporary cover may be in the form of any structure, tarp, or other device that serves to prevent precipitation from accumulating on the tops of containers. Such containers shall be covered at all times except when being removed, rearranged, inspected or otherwise managed as part of routine operation.

III.C.2. The RCRA/PCB Storage Building (100 feet x 100 feet) shall be used for storage of containerized waste materials that do not contain free liquids, as measured with the following test method: Method 9095 (Paint Filter Test). All containerized waste (as described in Attachment 13 of this Permit) shall be placed on pallets with adequate aisle space to facilitate inspection. All spills shall be managed in accordance with the applicable sections of the Contingency Plan (Attachment 7 of this Permit).

III.C.3. The Permittee shall not locate containers holding ignitable or reactive waste within fifteen (15) meters (50 feet) of the facility's property line. The Permittee shall take precautions to prevent accidental ignition or reaction of ignitable or reactive wastes by following the procedures of Attachment 13 of this Permit. In accordance with Section D.1.b of Attachment 13 of this Permit, the Permittee shall designate all containers that are to be transported off-site for disposal (i.e., trans-shipped and brokered waste) with a unique marking (e.g "red label/mark) on the container.

III.C.4. The Permittee shall comply with Permit Condition II.T. of this Permit, for all hazardous wastes subject to IDAPA 58.01.05.008 [40 CFR 264 Subpart CC] in containers.

III.C.4.a For storage of containers of hazardous waste exceeding an average VO concentration at the point of origin of 500 ppmw, the Permittee shall comply with all applicable regulations of 40 CFR 264 Subpart CC, including the container standards in IDAPA 58.01.05.008 [40 CFR § 264.1086] as specified in Permit Condition II.T.2

III.C.4.b For containers within the Containment Building and the Container Management Units that contain organic materials, with a volatile organic concentration at the point of origin less than 500 ppmw, and are therefore exempt from using air emission control equipment, documentation shall be recorded that includes the information that was used by the Permittee for each waste determination (e.g., test results, measurements, calculations, and other documentation) in the Facility Operating Record. If analytical results for waste samples are used for the waste determination, then the Permittee shall record the date, time, and location that each waste sample is collected, in accordance with applicable requirements of 40 CFR § 264.1083, and keep this information in the Operating Record for a minimum of three (3) years.

III.C.5. Reporting Requirements:

If the Permittee does not comply with Permit Condition III.C.4., a report shall be submitted to the Director on each occurrence when hazardous waste is placed in the Waste Management Unit in noncompliance with the conditions of 40 CFR §§ 264.1082(c)(1) or 264.1082(c)(2), as applicable. A written report shall be submitted within fifteen (15) calendar days of the time that the Permittee becomes aware of the occurrence. The written report shall contain: the EPA Identification Number, facility name and address, a description of the noncompliance event and the cause, the dates of the noncompliance, and corrective actions taken to prevent reoccurrence of the noncompliance. The report shall be signed and dated by an authorized representative of the Permittee per IDAPA 58.01.05.008 [40 CFR § 264.1090].

III.D. CLOSURE AND POST-CLOSURE

Closure and Post-Closure Care of all Container Management Units shall be completed in accordance with IDAPA 58.01.05.008 [40 CFR § 264.178], and the applicable sections of Attachment 9 of this Permit.

This space intentionally left blank.

MODULE IV - TANK STORAGE AND TREATMENT

IV. Subject to the terms of this Permit, the Permittee may store and /or treat hazardous wastes in the permitted HWMA tanks, as follows:

IV.A. GENERAL OPERATING REQUIREMENTS

IV.A.1 The Permittee's compliance with the requirements of Permit Conditions IV.A through IV.F shall constitute compliance with the requirements of IDAPA 58.01.05.008 [40 CFR Part 264, Subpart J], pertaining to the management of hazardous wastes in tanks.

IV.A.2 The Permittee shall comply with the tank operating requirements of IDAPA 58.01.05.008 [40 CFR § 264.194] and Attachments 14 and 24 of this Permit.

IV.A.3 The Permittee shall inspect the tank systems according to IDAPA 58.01.05.008 [40 CFR § 264.195], and the inspection schedule contained in Attachment 4 of this Permit.

IV.A.4 The Permittee shall maintain all Secondary Containment Systems in accordance with IDAPA 58.01.05.008 [40 CFR § 264.193] and the attached plans and specifications, as contained in Attachments 14 and 24 of this Permit.

IV.A.5. The Permittee shall remove any spilled or leaked wastes and any accumulated precipitation from the Secondary Containment Systems of each tank within 24 hours of detection, unless the waste or precipitation in the Secondary Containment System is frozen. The Permittee shall manage said wastes and precipitation as hazardous wastes. Within two (2) normal working days after the waste or precipitation in the Secondary Containment System is no longer frozen, the contained liquids will be characterized and removed.

IV.A.6. The Permittee shall respond to leaks or spills and disposition of leaking or unfit-for-use tank systems, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.196].

IV.A.7. Ignitable or reactive wastes must not be placed in tank systems unless the special requirements of IDAPA 58.01.05.008 [40 CFR § 264.198] are met.

IV.A.8. Incompatible wastes and materials must not be placed in the same tank system unless the special requirements of IDAPA 58.01.05.008 [40 CFR § 264.199] are met.

IV.A.9. The Permittee shall comply with Permit Condition II.T of this Permit, for all hazardous waste subject to IDAPA 58.01.05.008 [40 CFR Subpart CC] in tanks.

IV.A.9.a. For tanks that manage organic materials with a volatile organic concentration at the point of origin less than 500 ppmw, and are therefore exempt from using air emission control equipment, documentation shall be recorded that includes the information that was used by the Permittee for each waste determination (e.g., test results, measurements, calculations, and other documentation) in the Facility Operating Record. If analytical results for waste samples are used for the waste determination, then the Permittee shall record the date, time, and location that each waste sample is collected in accordance with applicable requirements of 40

CFR § 264.1083, and keep this information in the Operating Record for a minimum of three (3) years.

IV.A.9.b. Reporting Requirements: If the Permittee does not comply with Permit Condition IV.9.a., a report shall be submitted to the Director on each occurrence when hazardous waste is placed in the Waste Management Unit in noncompliance with the conditions of 40 CFR § 264.1082(c)(1) or § 264.1082(c)(2), as applicable. A written report shall be submitted within fifteen (15) calendar days of the time that the Permittee becomes aware of the occurrence. The written report shall contain: the EPA Identification Number, facility name and address, a description of the noncompliance event and the cause, the dates of the noncompliance, and corrective actions taken to prevent reoccurrence of the noncompliance. The report shall be signed and dated by an authorized representative of the Permittee, per IDAPA 58.01.05.008 [40 CFR § 264.1090].

IV.A.10. The Permittee shall keep all relevant figures, drawings, and diagrams, related to the tank systems, readily available for inspection at the facility, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.74].

IV.B. BULK LIQUID STORAGE TANKS

IV.B.1. The Bulk Liquid Storage Tanks shall be defined as four (4) existing storage tank units designated as Nos. 1, 2, 3, and 4. References to the Bulk Liquid Storage Tanks shall also include any associated piping, appurtenances, and the Secondary Containment Systems for these units.

IV.B.2. The Bulk Liquid Storage Tanks shall be designed and operated in accordance with Attachment 14 of this Permit, except as otherwise specified in this Permit, and in accordance with Permit Condition II.A. Additionally, the Permittee shall comply with all applicable sections of Attachments 2, 4, 6, and 7 of this Permit.

IV.B.3. The Permittee may store, in liquid form, any of the hazardous wastes listed on the Part A Form (included as Attachment 12 of this Permit), except that the limitations designated on Table C-8 and Table C-10 of Attachment 2 of this Permit apply to the wastes stored in any Bulk Liquid Storage Tank at any time.

IV.B.4. Since the Secondary Containment Systems for Tank Nos. 1 and 4 are common and shared, the Permittee shall not at any time store incompatible wastes in Tanks Nos.1 and 4. Similarly, since the Secondary Containment Systems for Tank Nos. 2 and 3 are common and shared, the Permittee shall not at any time store incompatible wastes in Tank Nos. 2 and 3.

IV.C. STABILIZATION MIXING BIN TANKS

IV.C.1. The Stabilization Mixing Bin Tanks shall be defined as four (4) existing, open-topped tank units located in the Containment Building. Two tank units are located in the Stabilization Portion of the building and two tank units are located in the Debris Portion of the building. References to the above-defined Mixing Bin Tanks shall also include any appurtenances and the Secondary Containment Systems for these units.

IV.C.2. The Mixing Bin Tanks shall be designed and operated in accordance with

Attachments 14 and 24 of this Permit, except as otherwise specified in this Permit, and in accordance with Permit Condition II.A. Additionally, the Permittee shall comply with all applicable sections of Attachments 2, 4, 6, and 7 of this Permit.

IV.C.3. The storage capacity of each installed Mixing Bin Tank located in the Stabilization Portion of the building shall not exceed 120 cubic yards. The storage capacity of each installed Mixing Bin Tank located in the Debris Portion of the building shall not exceed 226 cubic yards for wastes in solid form. The storage capacity of each installed Mixing Bin Tank located in the Debris Portion of the building shall not exceed 12,000 gallons for waste in liquid form.

IV.C.4. The Permittee shall manage non-containerized waste in the Mixing Bin Tanks such that the height and location of the waste does not allow these materials to overflow.

IV.D. CLOSURE AND POST-CLOSURE

Closure and Post-Closure Care of the tank systems shall be completed in accordance with IDAPA 58.01.05.008 [40 CFR § 264.197], and all applicable sections of Attachment 9 of this Permit.

This space intentionally left blank.

MODULE V - SURFACE IMPOUNDMENT STORAGE, TREATMENT, AND DISPOSAL

V. Subject to the terms of this Permit, the Permittee may store, treat, and/or dispose of hazardous wastes in permitted surface impoundments, as follows:

V.A. DESIGN AND OPERATION

V.A.1. Surface impoundments shall consist of Collection Ponds 1, 2, and 3, and Evaporation Pond 1.

V.A.2. The Permittee may store and treat (by evaporation and physical settling) any of the liquid or semi-solid wastes that are listed on the Part A Permit Application, included as Attachment 12 of this Permit, in Evaporation Pond 1, except that the following limitations apply:

V.A.2.a. The Permittee shall not store or treat in the impoundments any wastes that are currently restricted from land disposal under IDAPA 58.01.05.011 [40 CFR Part 268] unless that waste has been granted an exemption, extension, or variance, or unless the applicable treatment standard as specified in IDAPA 58.01.05.011 [40 CFR Part 268] has been achieved prior to placement in the units. In addition, as new wastes are specified for Land Disposal Restriction under IDAPA 58.01.05.011 [40 CFR Part 268], the Permittee shall immediately cease introducing such wastes for storage and treatment in the impoundment upon the effective date of the IDAPA 58.01.05.011 [40 CFR Part 268] regulation unless the waste has been granted an exemption, extension, or variance, or meets the treatment standard as specified in IDAPA 58.01.05.011 [40 CFR Part 268], prior to placement in the units;

V.A.2.b. The Permittee shall not store or treat any wastes that are restricted from placement in the impoundments by the limitations designated on Table C-8 and Table C-10 of Attachment 2 of this Permit;

V.A.2.c. The Permittee shall not place hazardous wastes F020, F021, F022, F023, F026, and F027 in any surface impoundment unless the special requirements of IDAPA 58.01.05.008 [40 CFR § 264.231] are met by submitting a permit modification, in accordance with of IDAPA 58.01.05.012 [40 CFR § 270.42], for the addition of a management plan for handling these wastes.

V.A.3. The Permittee shall comply with Permit Condition II.T of this Permit for all hazardous wastes subject to IDAPA 58.01.05.008 [40 CFR Subpart CC] in surface impoundments.

V.A.3.a. For surface impoundments that receive organic wastes, with a volatile organic concentration at the point of origin less than 500 ppmw, and are therefore exempt from using air emission control equipment, documentation shall be recorded in the Facility Operating Record that includes the information that was used by the Permittee for each waste determination (e.g., test results, measurements, calculations, and other documentation). If analytical results for waste samples are used for the waste determination, then the Permittee shall record the date, time, and location that each waste sample is collected, in accordance with applicable requirements of 40 CFR § 264.1083. This information shall be kept in the Operating Record for a minimum of three (3) years.

V.A.3.b. Reporting Requirements: If the Permittee does not comply with Permit Condition V.A.3.a, a report shall be submitted to the Director on each occurrence when hazardous waste is placed in the Waste Management Unit in noncompliance with the conditions of 40 CFR § 264.1082(c)(1) or § 264.1082(c)(2), as applicable. A written report shall be submitted within fifteen (15) calendar days of the time that the Permittee becomes aware of the occurrence. The written report shall contain: the EPA Identification Number, facility name and address, a description of the noncompliance event and the cause, the dates of the noncompliance, and corrective actions taken to prevent reoccurrence of the noncompliance. The report shall be signed and dated by an authorized representative of the Permittee, per IDAPA 58.01.05.008 [40 CFR § 264.1090].

V.A.4. The Permittee may store and treat (by evaporation and physical settling) in Collection Ponds 1, 2, and 3, any of the following:

V.A.4.a. Surface run-off from the site;

V.A.4.b. Leachate from on-site landfills; and

V.A.4.c. Liquid from Evaporation Pond 1 only under the following condition:

V.A.4.c.(1). Evaporation Pond 1 is required to be taken out of service and emptied as specified by the Contingency Plan (Attachment 7 of this Permit) or the Response Action Plan (Attachment 8 of this Permit).

V.A.5. The Permittee shall maintain the design of Collection Ponds 1, 2, and 3 and Evaporation Pond 1 in accordance with IDAPA 58.01.05.008 [40 CFR § 264.221] and Attachments 17 and 20 of this Permit, except as otherwise specified in this Permit, and in accordance with Permit Condition II.A.

V.A.6. The Permittee shall operate Collection Ponds 1, 2, and 3 and Evaporations Pond 1, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.221 and § 264.227] and Attachments 2, 6, 7, 8, and 17 of this Permit, except as otherwise specified in this Permit, and in accordance with Permit Condition II.A.

V.A.7. The Permittee shall inspect and monitor the surface impoundments in accordance with IDAPA 58.01.05.008 [40 CFR § 264.226] and the inspection schedule contained in Attachment 4 of this Permit.

V.A.8. In accordance with IDAPA 58.01.05.008 [40 CFR § 264.223] and Attachment 8 of this Permit, the Permittee shall follow the Response Action Plan for any exceedance of the action leakage rate.

V.A.9. The Permittee shall sample and analyze all liquid removed from the leak detection, collection, and removal system sump for the surface impoundments, to determine whether the liquid is derived from hazardous waste. The Permittee shall determine the list of parameters for analysis, based on its knowledge of the wastes placed in the unit. Results of analyses shall be maintained in the Operating Record. Alternatively, the Permittee may delete this sampling and analysis requirement if all liquid removed from any leachate detection, collection, and removal system sump is properly managed as hazardous waste.

V.A.10. Ignitable or reactive wastes must not be placed in surface impoundments unless the special requirements of IDAPA 58.01.05.008 [40 CFR § 264.229] are met.

V.A.11. Incompatible wastes and materials must not be placed in surface impoundments unless the special requirements of IDAPA 58.01.05.008 [40 CFR § 264.230] are met.

V.A.12. The Permittee shall keep all relevant figures, drawings, and diagrams related to surface impoundments readily available for inspection at the facility, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.74].

V.B. CLOSURE AND POST-CLOSURE

V.B.1. Closure and Post-Closure Care of the Surface Impoundment Units (Evaporation Pond 1, Collection Ponds 1, 2, and 3) shall be completed in accordance with IDAPA 58.01.05.008 [40 CFR § 264.228] and the applicable sections of Attachments 9, 18, and 21, and Permit Condition II.K.

V.B.1.a. If a soil cover is used during surface impoundment closure, prior to construction of the soil cover of Evaporation Pond 1 and Collection Ponds 1, 2, and 3, the Permittee shall (for clay sources not previously tested) perform field/in-situ hydraulic conductivity testing on a test fill, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.19] and EPA/600/R-93/182, September 1993, *Quality Assurance and Quality Control for Waste Containment Facilities*. The field/in-situ testing shall be done in addition to laboratory testing.

V.B.2. For all Surface Impoundment Units, minor deviations from the permitted closure design specifications or procedures necessary to accommodate proper closure, must be noted on the as-built drawings and the rationale for those deviations in designs, specifications, or procedures must be provided in narrative form with the closure certification statements. Within sixty (60) calendar days after completion of closure of each Surface Impoundment Unit, the Permittee shall submit to the Director the final as-built drawings of the closed unit, the narrative report, and certification statement.

This space intentionally left blank.

MODULE VI - LANDFILL DISPOSAL

VI. Subject to the terms of this Permit, the Permittee may dispose of hazardous wastes in permitted Landfill Units, as follows:

VI.A. LANDFILL DESIGN AND OPERATION

VI.A.1. Landfills shall consist of existing units: Cell 5, Trench 10, Trench 11, and Cell 14, and Cell 15.

VI.A.2. The Permittee may dispose of any waste listed on the Part A Application (included as Attachment 12 of this Permit), in Landfill Units Cell 14, and Cell 15, except that the following limitations apply:

VI.A.2.a. The Permittee shall not dispose any waste that is restricted from placement in landfills by the limitations designated on Table C-8 and Table C-10 of Attachment 2 of this Permit.

VI.A.2.b. The Permittee shall not dispose of wastes containing free liquids. Free liquids analyses shall be performed in accordance with the applicable procedures in Attachment 2 of this Permit.

Note: Liquid wastes that are contained in lab packs (packaged in accordance with IDAPA 58.01.05.008 [40 CFR § 264.316]) or very small containers, ampules, capacitors, or batteries (in accordance with IDAPA 58.01.05.008 [40 CFR § 264.314]) may be disposed without stabilization and related stabilization testing and verification procedures, provided other restrictions, as specified in this Permit or by other laws or regulations, do not prohibit the land disposal of such wastes. However, no regulated quantities of hazardous waste lab packs can be disposed in Landfill Units unless the Land Disposal Restriction Standards of IDAPA 58.01.05.011 [40 CFR § 268.42(c)] are met.

VI.A.2.c. The Permittee shall not dispose of any bulk waste that was generated as a liquid and was then stabilized by the generator (or another off-site treatment facility) unless the Permittee has conducted analytical testing to ensure that the waste has been properly stabilized and the applicable treatment standard, as specified in IDAPA 58.01.05.011 [40 CFR Part 268], has been achieved. Such testing shall be done by the Permittee, using sampling and analytical methods consistent with Permit Condition II.C, Attachments 2, 15, 24, and 25 of this Permit. Records of such analyses shall be maintained in the Operating Record for a minimum period of three (3) years. This Permit Condition (VI.A.2.c) shall not apply if the Permittee complies with Permit Condition VI.A.2.d.

Note: Liquid wastes that are contained in lab packs (packaged in accordance with IDAPA 58.01.05.008 [40 CFR § 264.316]) or very small containers, ampules, capacitors, or batteries (in accordance with IDAPA 58.01.05.008 [40 CFR § 264.314]) may be disposed without stabilization and related stabilization testing and verification procedures, provided other restrictions, as specified in this Permit or by other laws or regulations, do not prohibit the land disposal of such wastes. However, no regulated quantities of hazardous waste lab packs can be disposed in Landfill Units unless the Land Disposal Restriction Standards of IDAPA 58.01.05.011 [40 CFR § 268.42(c)] are met.

VI.A.2.d. As an alternative to the bulk waste testing by the Permittee specified in Permit Condition VI.A.2.c, the Permittee shall maintain documentation supplied by the generator (or another off-site treatment facility) that proper stabilization has been achieved. Documentation from the generator (or another off-site treatment facility) must contain a description of the stabilization procedures used, including a signed certification that the stabilized waste achieved the applicable treatment standard, as specified in Attachment 2 of this Permit and in accordance with IDAPA 58.01.05.011 [40 CFR Part 268]. The Permittee shall maintain such documentation in the Operating Record for a minimum period of three (3) years.

VI.A.2.e. The Permittee shall not dispose of any wastes that are restricted from land disposal under IDAPA 58.01.05.011 [40 CFR Part 268] unless that waste has been granted an exemption, extension, or variance, or unless the applicable treatment standard, as specified in IDAPA 58.01.05.011 [40 CFR Part 268], has been achieved prior to placement in the units. In addition, as new wastes are specified for Land Disposal Restriction under IDAPA 58.01.05.011 [40 CFR Part 268], the Permittee shall immediately cease disposing of such wastes upon the effective date of the regulation, unless the waste has been granted an exemption, extension, or variance, or meets the treatment standard specified in IDAPA 58.01.05.011 [40 CFR Part 268], prior to placement in the Landfill Units.

VI.A.2.f. The Permittee shall not dispose of ignitable or reactive wastes (Waste Numbers D001 or D003, respectively) or any listed waste for which the basis for listing is ignitability or reactivity, unless the waste has been treated to render it non-ignitible or non-reactive. For such wastes, the Permittee shall follow testing procedures used to determine ignitability and reactivity as specified in Attachment 2 of this Permit.

Note: Cyanide or sulfide bearing waste, as defined in IDAPA 58.01.05.005 [40 CFR § 261.23(a)(5)], may be packaged in accordance with IDAPA 58.01.05.008 [40 CFR § 264.316], and disposed without first being treated to render it non-reactive. Ignitable wastes in containers may be landfilled without first being treated to render it non-ignitable, if they are disposed in accordance with IDAPA 58.01.05.008 [40 CFR § 264.312].

VI.A.2.g. The Permittee shall limit the number of Interim Processing Loads for storage in the active portion of disposal Cell 14 and Cell 15 to a maximum of 50 loads at any one time (50 loads combined). The Permittee shall manage the storage of Interim Processing Loads in accordance with Attachments 4 and 19 of this Permit.

VI.A.2.h. The Permittee shall comply with IDAPA 58.01.05.008 [40 CFR § 264.317], the 1995 Dioxin Management Plan, and all applicable Land Disposal Restriction treatment standards under IDAPA 58.01.05.011 [40 CFR § 268.40] for disposal of hazardous wastes F020, F021, F022, F023, F026, and F027 in landfills. The Permittee shall make a written request for pre-approval from the Director for the storage, treatment, or disposal of these dioxin-listed wastes.

VI.A.3. The Permittee shall maintain the approved designs of Trench 10, Trench 11, Cell 14, and Cell 5 in accordance with Attachments 19 and 20 of this Permit, except as otherwise specified in this Permit, and in accordance with Permit Condition II.A.1.

VI.A.4. The Permittee shall construct the modified Cell 15, in accordance with Attachments 16, 18, 18a, 19, and 20 of this Permit, except as otherwise specified in this Permit, and in accordance with Permit Conditions II.A.1 and II.A.2.

VI.A.5. Prior to construction of any soil liner for a Landfill Unit, a test fill (using materials characterized the same as those used in the new Landfill Unit) shall be required. The Permittee shall, except as noted below, construct and test the soil liner in accordance with the procedures contained in Attachment 16, 18, 18a, and 19 of this Permit. The exception to these procedures shall be that the Permittee shall perform field/in-situ hydraulic conductivity testing on a test fill, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.19] and EPA/600/R-93/182, September 1993, *Quality Assurance and Quality Control for Waste Containment Facilities*. The field/in-situ testing shall be done in addition to laboratory testing.

VI.A.6. The Permittee shall operate Cells 14 and 15 in accordance with IDAPA 58.01.05.008 [40 CFR § 264.301] and the operating practices described in Attachments 2, 6, 7, 19, and 23 of this Permit, except as otherwise specified in this Permit, and in accordance with Permit Condition II.A.1.

VI.A.6.a. The Permittee shall cease landfilling operations when the sustained wind speed conditions exceed 25 miles per hour (25 mph average for an hour) and apply asphaltic emulsion or soil cover on the freshly spread landfill surface. Waste placement operations in the landfill cells shall resume only after the sustained wind speed is below 25 mph (25 mph average for an hour).

VI.A.7. The Permittee shall monitor and inspect the landfill in accordance with IDAPA 58.01.05.008 [40 CFR § 264.303] and Attachments 4 and 19 of this Permit.

VI.A.8. The Permittee shall maintain a permanent and accurate record of the three-dimensional location of each waste type, based on grid coordinates, within units Cell 5, Trench 11, Cell 14, Cell 15, Trench 10 (to the extent the records exist for Trench 10), and records for all previous disposal areas for which the records exist, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.309]. This record shall include the information necessary to locate a specific waste and shall be based on information contained in the manifest (Generator Identification Number, waste code, and date of disposal). This condition shall apply to all wastes placed in existing units Cell 5, Trench 11, Cell 14, and Cell 15 irrespective of the date of disposal. Upon final closure of the facility, the Permittee shall submit, to the Director, copies of these records for units Cell 5, Trench 11, Cell 14, Cell 15, and for Trench 10 (to the extent the records exist for Trench 10),.

VI.A.9. Liquid in the primary Leachate Collection System of units Cell 5, Cell 14, and Cell 15 shall not exceed 30 cm (one foot) in depth over the primary liner after waste has been placed, as specified in IDAPA 58.01.05.008 [40 CFR § 264.301(c)(2)]. (This does not include the area of the sump used to accumulate sufficient quantities of liquid for pumping). Liquid in the secondary Leachate (leak) Collection System of units Cell 5, Cell 14, and Cell 15 will be removed, when pumpable quantities exist (to the extent practicable) within 24 hours after those quantities are found. The liquid from both the primary and secondary Leachate Collection Systems shall be managed as a hazardous waste. During the Post-Closure Period, after final facility closure, liquid from the secondary Leachate (leak) Collection Systems must be pumped (as described above) within 72 hours after such liquid is found.

VI.A.10. For all Landfill Units, the Permittee shall establish Action Leakage Rates (included in Table VI-1 of this Permit) and follow the Response Action Plan (included as Attachment 8 of this Permit), in accordance with IDAPA 58.01.05.008 [40 CFR § 264.302 and § 264.304].

VI.A.11. The Permittee shall keep all relevant figures, drawings, and diagrams, related to Landfill Disposal Units, readily available for inspection at the facility, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.74].

VI.B. CLOSURE AND POST-CLOSURE

VI.B.1. The Permittee shall close units Cell 5, Trench 10, Trench 11, Cell 14, and Cell 15 in accordance with IDAPA 58.01.05.008 [40 CFR § 264.310(a)] and the applicable sections of Attachment 9, 9a, 9b, 18, 18a, 19, 20, and 21, and Permit Condition II.K and II.V.2.

VI.B.2. The Permittee shall follow the requirements for Post-Closure Care of units Cell 5, Trench 10, Trench 11, Cell 14, and Cell 15 in accordance with IDAPA 58.01.05.008 [40 CFR § 264.310(b)], and the applicable sections of Attachment 9 and Permit Condition II.M. Post-Closure Care for each unit shall begin at the time of receipt of the closure certification statements by the Department.

VI.B.3. Final cover designs for Landfill Cells 5, 14 and 15, and Trenches 10 and 11 shall be specified in Attachments 9, 18a, 20, 21, and 23 of this Permit. These cover designs incorporate a geosynthetic clay liner (GCL) and, where applicable, the following conditions apply:

VI.B.3.a. The gas venting layer shall consist of either a Geosynthetic Drainage System (i.e., geonet), as specified in Attachment 16, or six (6) inches of coarse aggregate meeting the American Association of State Highway & Transportation Officials (AASHTO) Standards and a geotextile above and below the geonet or aggregate layer, or an equivalent alternate approved by the Department, that will provide adequate venting. The procedures designated under Permit Condition II.S shall be followed to implement the use of equivalent materials.

VI.B.3.b. A rock cover meeting the approval of the Department shall be placed over all cover areas where vegetation is not established within two (2) years after placement of the cover, and where significant erosion is occurring. Significant erosion for this item will be defined as the formation of erosion gullies greater than six (6) inches deep for lengths of ten (10) feet or more.

VI.B.3.c. The Temporary Alternative cover design for Landfill Trenches 10 and 11 shall be specified in Attachments 9a, 9b, and 21a. The final cover design for Trenches 10 and 11, if the Alternative Cover Demonstration Program fails, shall be specified in Attachment 9, 20, and 21 of this Permit, except the changes specified in Permit Conditions VI.B.3.a and VI.B.3.b are hereby made to Attachments 9, 20, and 21.

VI.B.3.d. If a GCL is not used, prior to construction of a soil cover for any landfill unit, the Permittee shall (for clay sources not previously tested) perform field/in-situ hydraulic conductivity testing on a test fill, in accordance with IDAPA

58.01.05.008 [40 CFR § 264.19] and EPA/600/R-93/182, September 1993, *Quality Assurance and Quality Control for Waste Containment Facilities*. The field/in-situ testing shall be done in addition to laboratory testing.

VI.B.4. For all Landfill Units, minor deviations from the permitted closure design specifications, or procedures necessary to accommodate proper closure, must be noted on the as-built drawings and the rationale for those deviations in designs, specifications, or procedures must be provided in narrative form with the closure certification statements. Within sixty (60) calendar days after completion of closure of each Landfill Unit, the Permittee shall submit, to the Director, the final as-built drawings of the closed unit, the narrative report, and certification statement. All other deviations from the permitted closure design specifications shall be approved in advance by the Director, in accordance with IDAPA 58.01.05.012 [40 CFR § 270.42].

VI.B.5. The Permittee shall provide certification statements attesting that each Landfill Unit at the facility has been closed in accordance with the applicable specifications in the Closure Plan included as Attachment 9 of this Permit, as required by IDAPA 58.01.05.008 [40 CFR § 264 Subpart G].

VI.B.6. The Permittee shall submit to the local land use authority and to the Director, a survey plat indicating the location and dimensions of closed Landfill Units, with respect to permanently surveyed benchmarks, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.116].

VI.B.7 In the event that any Hazardous Waste Management Unit, other than the Landfill and Surface Impoundment Units listed in Permit Condition V.B.1 and VI.B.1, cannot be closed by removing hazardous waste, hazardous constituents, contaminated subsoil, and any contaminated ground water (i.e., clean-closed) as specified in Permit Condition II.K.1, the Permittee shall revise the Facility Post-Closure Plan to include a Post-Closure Plan for that Hazardous Waste Management Unit. The Permittee shall submit the Post-Closure Plan for that Hazardous Waste Management Unit to the Director, as a Permit Modification Request, within ninety (90) calendar days of the date that the Director notifies the Permittee in writing that the unit must be closed as a landfill, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.118(a)].

VI.B.8 The Permittee may complete the five-year Alternative Cover Demonstration Program for Trench 10 and 11, for the purpose of demonstrating equivalency to the performance standards of IDAPA 58.01.05.008 [40 CFR § 264.111]. The Alternative Cover Demonstration Program for Trench 10 and 11 started in August, 2000. If approved by the Department, the alternative cover, as specified in Attachment 9a and 9b, would displace the approved final cover design specified in Attachment 9. If the Alternative Cover Demonstration Test Pad fails, Trench 10 and 11 shall be closed under the traditional landfill closure specifications on a schedule approved by the Director, as detailed in Section I.2.h of Attachment 9. Completion of the Alternative Cover Demonstration Program for closure of Trench 10 and Trench 11 shall be in accordance with Attachment 9a, Attachment 9b, and as follows:

VI.B.8.a. The Permittee shall perform maintenance of the temporary alternative cover during the demonstration period, as specified in Section I.2.h.(5)(c) of Attachment 9.

VI.B.8.b. Landfill Units 10 and 11 shall be evaluated by the Department during the demonstration period. The demonstration period commenced following Department approval of the Construction Quality Assurance Report, and shall be completed within a period not to exceed five (5) years, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.113(b)(1)(i)].

VI.B.8.c. The Permittee shall monitor the results of the Test Pad for this demonstration, as described in Attachment 9a and 9b and shall provide monitoring data results to the Department on a quarterly basis.

VI.B.8.d. Failure of the Alternative Cover Demonstration Test Pad to demonstrate equivalence shall be defined as follows:

- The bromide concentrations in the Test Pad sub-base material (at a depth of five (5) feet below ground surface) are high (twice background concentrations or higher), providing direct evidence of wetting front movement through the cover and into the underlying sub-base soils; or
- Measured water potentials at the base of the Test Pad (at a depth of five (5) feet below ground surface) exceed an equivalent flux of 3.2 mm/year.

VI.B.8.e. Within ninety (90) days following the completion of the demonstration period of the temporary alternative cover, the Permittee shall submit to the Department a final comprehensive report summarizing all the Test Pad Monitoring Data results and evaluating whether the performance criteria, as specified in Attachment 9a and 9b of this Permit, have been met.

VI.B.8.f. If, at any time during the Trench 10 and 11 Alternative Cover Demonstration Period, the Department determines that the Permittee has failed to achieve the performance criteria, as specified in Permit Condition VI.B.8.d and in Attachment 9a and 9b of this Permit, for the demonstration of the equivalency of the temporary alternative cover, the Department shall provide the Permittee written notification. Within thirty (30) days of Permittee's receipt of written notification by the Department that the Permittee has failed to achieve the performance criteria, the Permittee shall perform Closure and Post-Closure Care, in accordance with Permit Condition II.K and II.M and as follows:

VI.B.8.f.(i). In accordance with 58.01.05.008 [40 CFR §§ 264.112(c) and 264.301(g), (h) & (i)], the Permittee shall submit a Permit Modification Request to the Department to address the following:

VI.B.8.f.(i)(a). An amendment to Attachments 9a, 9b, and 21a of this Permit, to incorporate the traditional closure requirements for Landfill Trenches 10 and 11, as specified in Attachment 9, 19, 20, and 21 of this Permit; and

VI.B.8.f.(i)(b). An update to Attachment 10 of this Permit for changes to the Surface Water Management Plan, as affected by the partial closure of Landfill Trenches 10 and 11. Additionally, the Permittee shall update all applicable drawings to reflect these changes.

VI.B.8.f.(i)(c). Upon Departmental approval of the permit modification in Permit Condition VI.B.8.f.(i), Attachments 9a, 9b, and 21a will be removed and, hence, superseded by Attachments 9, 20, and 21, incorporating the traditional landfill closure design and specifications.

VI.B.8.g. If the Department determines that the Permittee has successfully achieved the performance criteria for the demonstration of the equivalency of the temporary alternative cover, the Permittee shall perform closure and Post-Closure Care, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.310], as specified in Attachment 9 of this Permit, and shall provide notification to the Department in accordance with Permit Condition II.K.4 of this Permit. In addition, in accordance with Permit Condition II.S of this Permit, the Permittee shall submit to the Department notification identifying Attachments 9a, 9b, and 21a as the approved Closure Plan.

TABLE VI-1. ACTION LEAKAGE RATES (ALR)

Disposal Unit	Area (acres)	ALR * (gal/day)	WLR ** (gal/day)
Surface Impoundment 1 (Evaporation Pond)	2.31	2310	1732
Collection Pond 1	0.38	380	285
Collection Pond 2	0.34	340	255
Collection Pond 3	0.54	540	405
Landfill Trench 5 –Phase 1 (Zones 1 and 2)	1.82	182	136
Landfill Trench 5 –Phase 2 (Section 2)	1.92	192	144
Landfill Trench 5 – (Section 3)	1.62	162	121
Landfill Trench 14 – Subcell 1	4.47	447	335
Landfill Trench 14 – Subcell 2	2.32	232	174
Landfill Trench 14 – Subcell 3	2.75	275	206
Landfill Trench 14 – Subcell 4	3.00	300	225
Landfill Trench 14 – Subcell 5	3.00	300	225
Landfill Trench 14 – Subcell 6	5.17	517	388
Landfill Cell 15 – Phase 1	12.1	1,210	907
Landfill Cell 15 – Phase 2	8.5	850	637
Landfill Cell 15 – Phase 3/4 ***	17.3	1,730	1,297

***** Based on a 7-day average
****** Measured on any given day
******* When constructed, adjust for as-built
Note: ALR's based on EPA Guidance of 100 gallons per acre day (gpad) and 1,000 gpad for surface impoundments
Note: WLR's = 75% of ALR measured on any given day

MODULE VII - SURFACE WATER MANAGEMENT PLAN

VII.A. DESIGN, OPERATION, AND MAINTENANCE OF SURFACE WATER MANAGEMENT SYSTEM

VII.A.1. The Permittee shall construct the Surface Water Management System in accordance with the design, description and specifications in Attachments 10, 16, and 18 of this Permit and in accordance with Permit Condition II.A of this Permit.

VII.A.2. The Permittee shall operate and maintain the Surface Water Management System in the manner specified in Attachment 10 of this Permit and in accordance with Permit Condition II.A.1.

VII.A.3. The Permittee shall be allowed to implement changes to the Surface Water Management Plan, in the event of emergency conditions, without obtaining a permit modification from the Department. Any emergency changes to the Surface Water Management System must be documented and reported to the Director, in writing, within thirty (30) calendar days of such changes. If the Director determines that such changes constitute a significant deviation from the Permit (Attachment 10), the Director shall notify the Permittee that a permit modification, in accordance with IDAPA 58.01.05.012 [40 CFR § 270.42], will be required. The Permittee shall submit any required Permit Modification Request within thirty (30) calendar days of such notification.

VII.A.4. The Permittee shall be allowed to implement changes to the Surface Water Management Plan, consistent with the criteria specified in Permit Conditions VII.A.4.a and VII.A.4.b, after providing revisions to narrative, tables, and drawings in Attachment 10 necessary to incorporate these changes, and providing calculations necessary to support these changes, and upon receipt of written acceptance (by certified mail or hand delivery) of these changes by the Department. These changes and their acceptance by the Department shall not require a permit modification, pursuant to IDAPA 58.01.05.012 [40 CFR § 270.42].

VII.A.4.a. The collection ponds shall be operated to maintain available capacity for the volume from the greater of either the 25-year, 24-hour storm event, plus two (2) feet of freeboard or a 100 year, 24-hour storm; and

VII.A.4.b. Run-off from on-site areas, which are designated within a development phase of the Surface Water Management System, to be contained on-site, shall not be diverted off-site during that development phase.

VII.A.5. The Permittee shall keep all relevant figures, drawings, and diagrams related to the Surface Water Management Plan readily available for inspection at the facility, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.74].

VII.B. COMPLIANCE SCHEDULE

The portion of the facility Surface Water Management System that is designed to serve proposed Waste Management Units must be installed and operational prior to placement of waste into that unit. The Permittee shall follow the provisions of Permit Condition I.R for new system construction.

MODULE VIII - PAST PRACTICE UNITS

VIII.A. POST-COVER CARE

VIII.A.1. The Permittee shall maintain ground water monitoring wells and implement a Ground Water Monitoring Program for Past Practice Units Silo 1, Silo 2, and Silo 3, Exhaust Shaft, the Radar Silos, the Elevator Shaft and the Control Center (the locations of which are designated on Drawing PRMI-T05 in Attachment 22 of this Permit) and Past Practice Units PCB 1, PCB 2, PCB 3, and PCB 4, Chem 1, Chem 1B, Chem 2, Chem 2B, Chem 2C, Chem 2D, Chem 2E, Chem 3, Chem 4, Chem 4B, Chem 5, Chem 5B, Chem 6, Chem 6A, Chem 6B, Chem 7, Chem 8, Chem 9, Buried Drum Area 1 (NW corner - near Silo 2), Buried Drum Area 2 (middle of site - near Silo 3), Acid Disposal Pits, Chemical Area 1, Disposal Area 9A, and the Electrical Vault (the locations of which are designated on drawings in Attachment 22 of this Permit).

VIII.A.2. The Permittee shall conduct Post-Cover Care, inspection, and maintenance of the Past Practice Units Silo 1, Silo 2, and Silo 3 with their ancillary equipment, exhaust and propellant shafts, the Radar Silos, the Elevator Shaft, and the openings to the powerhouse dome (the locations of which are designated on Drawing PRMI-T05 in Attachment 22 of this Permit) and Past Practice Units PCB 1, PCB 2, PCB 3, and PCB 4, Chem 1, Chem 1B, Chem 2, Chem 2B, Chem 2C, Chem 2D, Chem 2E, Chem 3, Chem 4, Chem 4B, Chem 5, Chem 5B, Chem 6, Chem 6A, Chem 6B, Chem 7, Chem 8, Chem 9, and the Electrical Vault (the locations of which are designated on drawings in Attachment 22 of this Permit), as specified in Attachment 9 [Section I.3.h.(3)] of this Permit for closed Land Disposal Units, with the following exceptions:

VIII.A.2.a. Prior to final closure, the Permittee shall inspect the leachate collection/ observation wells for Past Practice Units PCB 1, PCB 2, PCB 3, and PCB 4, Chem 1, Chem 1B, Chem 6 and Chem 6B as specified in Attachment 4 of this Permit. All pumpable quantities of liquids found in the leachate collection/ observation wells shall be removed (to the extent practical), within 24 hours of the time such liquid is found. After facility closure, the requirement for removal of leachate shall be to the extent practical within 72 hours of the time such liquid is found.

VIII.A.2.b. The Permittee shall install and maintain the Carbon Adsorption Units for the exhaust vents of Past Practice Units Silo 1, Silo 2, Silo 3, Powerhouse Dome, the Radar Silos, and the Control Center, in accordance with the approved Capping Plan in Attachment 22. The Permittee shall monitor the Carbon Adsorption Units and determine a replacement frequency as specified in Permit Condition VIII.D.1.

VIII.A.3. The period of Post-Cover Care for the Past Practice Units, designated in Permit Condition VIII.A.2, shall be at least thirty (30) years after Director approval of closure certification.

VIII.A.4. The Director reserves the right to re-open Permit Condition VIII.A.3 and extend the Post-Cover Period for any applicable unit at any time during the life of this Permit, as deemed necessary to protect human health and the environment. In such a case, re-opening the Permit would be done as a major permit modification, in accordance with

IDAPA 58.01.05.012 [40 CFR § 270.42].

VIII.A.5. The Permittee shall keep all relevant figures, drawings, and diagrams (related to Past Practice Units) readily available for inspection at the facility, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.74].

VIII.B. POST-COVER MAINTENANCE COST ESTIMATE

VIII.B.1. The Permittee shall prepare a detailed cost estimate for inspection and maintenance of the cover systems for the Past Practice Units identified in Permit Condition VIII.A to be submitted to the Department, along with the cost estimates prepared under Permit Conditions II.L and II.N.

VIII.B.2. The Permittee shall adjust the cost estimate for inflation within sixty (60) calendar days prior to the anniversary date on which the first cost estimate was prepared under Permit Condition VIII.B.1.

VIII.B.3. The Permittee shall revise the post-cover cost estimate for the Past Practice Units within thirty (30) calendar days of an approved modification to the Past Practice Units.

VIII.C. POST-COVER FINANCIAL ASSURANCE

The Permittee shall, within sixty (60) calendar days of preparation of the cost estimates required by Permit Condition VIII.B.1, establish and maintain financial assurance by one of the forms provided for under IDAPA 58.01.05.008 [40 CFR §§ 264.143 and 264.145], in the amount of the cost estimates required by Permit Condition VIII.B.

VIII.D. COMPLIANCE SCHEDULE

VIII.D.1. In accordance with IDAPA 58.01.05.008 [40 CFR § 264.101(a)], the Permittee shall institute corrective action to address air emissions from the six (6) Past Practice Units (PPUs): Silo 1, Silo 2, Silo 3, Powerhouse Dome, Control Room, and Radar Silo. The Permittee shall submit to the Department, within 180 days of the effective date of this Permit, a Plan describing the Carbon Unit System used to treat air emissions, including maintenance of the activated carbon (i.e., replacement frequency).

VIII.D.2. Failure on the part of the Permittee to complete the total scope of work approved under Permit Condition VIII.D.1, in the time frame specified within the approved Work Plan, shall constitute a permit violation unless granted a written extension from the Department.

This space intentionally left blank.

MODULE IX – GROUND WATER MONITORING

IX.A. GROUND WATER MONITORING PROGRAM

The Ground Water Monitoring Program, applicable under the terms of this Permit, shall be undertaken in accordance with IDAPA 58.01.05.008 [40 CFR §§ 264.97, 264.98, 264.99 and 264.100]. Table IX-1 summarizes key components of the Ground Water Monitoring Program. The Ground Water Monitoring Program shall consist of and be implemented as follows:

IX.A.1. A Detection Monitoring Program (DMP) shall be put into effect immediately and shall remain in effect until:

IX.A.1.a. The detection monitoring criteria, as listed in Permit Condition IX.F.1 as the Estimated Quantitation Limits (EQL), for any single constituent(s) are exceeded. The EQL for all parameters shall be one (1) microgram per liter for any single Volatile Organic Constituent (VOC) or as specified in Table IX-2. At that time, the Permittee shall comply with Permit Condition IX.G and proceed in accordance with Permit Condition IX.A.2; or

IX.A.1.b. The Post-Closure Period is over.

IX.A.2. A Compliance Monitoring Program (CMP) shall be put into effect at such time as the detection monitoring criteria are demonstrated, through Permit Condition IX.G, to have been exceeded. A CMP is currently in effect for monitoring Wells U-1, U-5, U-6, U-7, U-20, U-21, U-23, U-24, and U-25. The CMP shall remain in effect until:

IX.A.2.a. The detection monitoring criteria are demonstrated, through Permit Condition IX.G, to not have been exceeded during four (4) consecutive CMP sampling events, at which time the Permittee shall reactivate the DMP specified in Permit Condition IX.F; or

IX.A.2.b. The compliance monitoring criteria, demonstrated through Permit Condition IX.G, have been exceeded, at which time the Permittee shall proceed in accordance with Permit Condition IX.A.3 (Corrective Action); or

IX.A.3. A Corrective Action Monitoring Program (CAMP), which shall be put into effect at such time as any Ground Water Protection Standard (GPS) criteria are exceeded. The CAMP shall remain in effect until: a) the compliance monitoring criteria are not exceeded during four (4) consecutive CAMP events. At such time the CMP shall be reactivated; or b) until such time as a Corrective Measures Implementation Plan is submitted to meet the requirements of IDAPA 58.01.05.008 [40 CFR § 264.100] and is approved by the Director.

TABLE IX-1. GROUND WATER MONITORING CRITERIA FOR THE GROUND WATER MONITORING PROGRAMS

MONITORING PROGRAM	BEGIN	MONITORING CRITERIA
Corrective Action Monitoring Program	In accordance with Permit Condition IX.A.3.	Exceedance of Ground Water Protection Standard for one or more constituent(s).
Compliance Monitoring Program	At Permit issuance for the following monitoring wells: U-1, U-5, U-6, U-7, U-20, U-21, U-23 U-24, U-25; or in accordance with Permit Condition IX.A.2, when the detection monitoring criteria are exceeded.	Constituent concentrations less than, or equal to, the Ground Water Protection Standards, but are greater than the Estimated Quantitation Limit of 1 microgram per liter (1 µg/l). [Refer to Table IX-6]
Detection Monitoring Program	At Permit issuance for all monitoring wells except: U-1, U-5, U-6, U-7, U-20, U-21, U-23, U-24, and U-25; or in accordance with Permit Condition IX.A.1.	Analytical results indicate constituent concentrations are below the Estimated Quantitation Limit (EQL), as shown in Table IX-2. EQLs for all constituents shall be 1 µg/l.

IX.B. GROUND WATER MONITORING WELLS

IX.B.1. The Ground Water Monitoring Network shall consist of the Upper and Lower Aquifer monitoring wells and piezometers listed in Table IX-3, and shown on Figures 1 and 2 of this Permit. The sampling frequencies for all ground water monitoring wells are listed in Table IX-3. For each regulated unit, the point of compliance monitoring wells are listed in Table IX-4 and Figures E-27 and E-28 of Attachment 11 of this Permit.

IX.B.2. All changes to the Ground Water Monitoring Network and sampling frequencies shall require a permit modification, in accordance with IDAPA 58.01.05.012 [40 CFR § 270.42] and Permit Condition I.E.3. The only exceptions to this are the monitoring wells addressed in Permit Condition IX.B.3.

IX.B.3. Lower Aquifer Monitoring Wells L-43, L-44, and L45 were installed during construction of Cell 15, Phases 2 and 3. Monitoring well L-47 was installed as part of the Cell 15, Phase 4 construction, as specified in Permit Condition IX.D.3 and Attachment 11 of this permit, and replaced L-46, which was abandoned due to its proximity to the Phase 4 construction area. The location of L-47 is shown on Figure 2.

IX.B.4. The Permittee shall calculate the ground water elevations, flow directions, and rates for the Ground Water Monitoring Network on a semi-annual basis, during the spring and fall monitoring events. The methods, calculations, and parameters used shall be provided in the Ground Water Monitoring Reports required under Permit Conditions IX.F.6 and IX.G.9. Ground water flow rates, directions, contour maps, and summary tables shall be submitted annually to the Director with the analytical results of the spring sampling event. Additionally, the Permittee shall submit, at this time, a written review of the adequacy of the Ground Water Monitoring System.

IX.C. MONITORING WELL MAINTENANCE

IX.C.1. The Permittee shall maintain all monitoring wells in good working order, making necessary repairs in a timely manner so that the sampling program is not unreasonably hindered or delayed.

IX.C.2. A Monitoring Well Maintenance Program consisting of wellhead monitoring, well sounding, well yield and specific capacity determination and well redevelopment will be conducted for the facility as part of the Ground Water Monitoring Program as follows:

IX.C.2.a. The Permittee shall perform well maintenance activities in accordance with the schedule set forth in Attachment 11 of this Permit.

IX.C.2.b. The Permittee shall maintain complete records of all well maintenance activities for the term of this Permit, in accordance with Permit Condition I.P.

IX.C.2.c. The Permittee shall inspect and maintain all monitoring wells throughout operation, closure and post-closure, in accordance with Permit Condition II.E and Attachments 4 and 11 of this Permit.

IX.C.3. The Permittee shall maintain borehole integrity of each monitoring well, as required by IDAPA 58.01.05.008 [40 CFR § 264.97(c)]. The Permittee shall maintain the wells utilized solely as piezometers, in accordance with Permit Condition IX.C.4.

IX.C.3.a. Monitoring wells shall be sounded every two years. If the well has a build up of one (1) foot or more of sediment, USEI will note the build up in the resulting monitoring report. If build up of two (2) feet or more is measured, or if the well is unable to yield sufficient water for analysis, the well shall be redeveloped and the sediment removed prior to the next monitoring event.

IX.C.3.b. The Permittee shall perform a slug test or pumping test for all new monitoring wells during construction/development to determine hydraulic conductivity. This data may be used at a later date to determine adequate performance of the monitoring well.

IX.C.4. Wells utilized solely as piezometers shall only be subject to the maintenance requirements of well head inspection and sounding. Redevelopment of these wells is only required if the buildup of sediment interferes with the Permittee’s ability to take water-level measurements.

IX.C.5. The need for maintenance shall not constitute grounds for missing a sampling event. The only reason this would constitute grounds for missing a scheduled sampling event would be the accidental destruction of the well. Under no circumstances shall a monitoring well remain out of commission for two (2) consecutive sampling events. The construction of the repair or replacement shall be in accordance with Attachment 11 of this Permit.

IX.C.6. In the event a monitoring well is destroyed, the Permittee shall:

- Notify the Director within seven (7) calendar days of discovery of the destroyed well.
- The Permittee shall immediately propose a new location for a replacement well that is neither less than twenty (20) feet nor more than fifty (50) feet from the original destroyed well, or other suitable location upon approval from the Director.
- The Permittee shall plug and abandon the destroyed well in accordance with the Idaho Department of Water Resources' abandonment criteria.
- The Permittee shall notify the Director at least five (5) days before installation of any replacement wells. Replacement wells shall be constructed in accordance with Permit Condition IX.D and Attachment 11 of this Permit.

IX.C.7. If a monitoring well/piezometer must be replaced for any reason during the term of this Permit, it shall be replaced within ninety (90) calendar days of the date taken out of service, and/or be fully operational at the time of the next sampling event.

IX.D. MONITORING WELL CONSTRUCTION

IX.D.1. All monitoring wells will be constructed and developed in accordance with EPA's *Technical Enforcement Guidance Document* (latest edition), Attachment 11 of this Permit, and as follows:

IX.D.2. The Permittee shall submit to the Director a copy of the well construction record and boring logs, with the as-built drawings for each well, within sixty (60) days after completion of each well.

IX.D.3. The monitoring wells specified in Table IX-4 of this Permit for proposed units (Cell 15 Phase 4) shall not be required to be constructed until ninety (90) calendar days prior to the placement of waste in the unit. Sampling shall have taken place and analytical results evaluated prior to waste placement in these units. The following exceptions to the requirements for installation of the future monitoring wells, listed in Table IX-4 of this Permit, shall also apply as follows:

IX.D.3.a. Prior to the placement of any waste in Phase 4 of Cell 15, as described in Attachment 18a, monitoring well L-47, as specified in Table IX-3 and Attachment 11, shall be fully operational. At least one sampling event shall be completed and analytical results evaluated by the director a minimum of thirty (30) days prior to any waste placement into this unit. Also, the Monitoring Well Construction Report for L-47 shall be submitted to and approved by the Director, prior to waste placement into this unit.

IX.D.4. If at anytime, perched water is identified (whether seasonal or manmade), the Permittee shall submit a Monitoring Plan, within sixty (60) calendar days, of the discovery for the Department's review and approval. The Monitoring Plan shall propose additional perched zone monitoring wells, for the purpose of determining (but not limited to) the perched water characteristics, flow path(s) and a proposed schedule for the drilling and completion of the proposed wells.

IX.E. GROUND WATER SAMPLING AND ANALYSIS

IX.E.1. The Permittee shall sample (semi-annually) all monitoring wells designated in Table IX-3 of this Permit. The Permittee shall perform this sampling in accordance with Permit Condition IX.A and Attachment 11 of this Permit.

IX.E.1.a. The spring monitoring event shall take place during the months of April, May, or June of each year.

IX.E.1.b. The fall monitoring event shall take place during the months of September, October, or November of each year.

IX.E.1.c. The fall and spring monitoring events shall be separated by at least one hundred twenty (120) days.

IX.E.2. The Permittee shall notify the Director of all planned sampling events at least five (5) working days in advance of the planned sampling, and shall notify the Director of all other sampling events, as soon as possible prior to the event.

IX.E.3. The Permittee shall analyze the ground water samples obtained for the volatile organic compounds (VOC) or other constituents as defined on Table IX-2 of this Permit. The Permittee shall perform this analysis in accordance with Method 8260 of the Third Edition, or latest, of EPA SW-846 "Test Methods for evaluating Solid Waste, Physical/Chemical Methods" or an equivalent or superior method, with prior Director approval.

IX.E.4. Sample Collection Procedures

IX.E.4.a. Wellhead Inspection and Organic Vapor Screening
On arrival at each wellhead, the sampling team shall determine background organic vapor levels in the breathing zone and at the level of the wellhead, in accordance with Attachment 11 of this Permit.

IX.E.4.b. Measurement of Static Water Elevation
Prior to purging or sampling any monitoring wells, the elevation of the ground water shall be determined as required by IDAPA 58.01.05.008 [40 CFR § 264.97(f)] and Attachment 11. Ground water elevations shall be measured to the nearest 0.01 foot. A registered surveyor shall survey the elevation datum and water level measurement point, relative to mean sea level, for all monitoring wells. This datum shall be related to a fixed reference point on the well casing, prior to the first monitoring event for each well.

IX.E.4.c. Field Measurements for field parameters including temperature, pH, and specific conductivity shall be measured and recorded at each monitoring well, in accordance with Attachment 11.

IX.E.4.d. Pre-sample Purging

Monitoring wells shall be purged of standing water in the casing. Low-yield wells shall be evacuated to dryness, and a minimum of three casing volumes shall be removed from higher yielding wells. Casing volumes shall be calculated prior to each monitoring event. Field parameter readings shall be stabilized to within 10% for temperature and specific conductance; pH shall stabilize to within 0.1 units.
For low-yielding wells purged to dryness, samples shall be collected as soon as a sufficient volume of water is available for collection. Under no circumstances shall collection of the sample take place more than 24 hours after evacuation. If adequate water is not available to sample within 24 hours, the Permittee shall notify the Director and redevelop or replace the well within ninety (90) days. The Permittee may, with prior Director approval, substitute purging stabilization parameters without effecting a modification to this Permit.

The Permittee shall store all purge water in properly labeled, secure containers until analytical results are obtained and the appropriate method of disposal of the containerized ground water is identified. Alternatively, the Permittee may assume that all purge water is hazardous waste and immediately treat the waste in an appropriate manner.

IX.E.4.e. Sample Collection

The Permittee shall conduct sample collection and preservation in accordance with Attachment 11 of this Permit.

IX.E.4.f. Chain-of-Custody Control

As required by IDAPA 58.01.05.008 [40 CFR § 264.97(d)(4)], and Attachment 11 of this Permit, the Ground Water Monitoring Program shall include chain-of-custody control to maintain integrity of samples.

IX.E.4.f.(1). Field Log Book

A field log book shall be kept for each sampling event. A copy of the field log book shall be kept at the facility and shall be available for inspection. The field log book shall include those items in accordance with Attachment 11.

IX.E.4.f.(2). Sample Receipt

Upon receipt of the samples at the contract laboratory, the security of the shipping containers shall be checked. Outer seals that are broken or missing shall be noted, and reported to the Permittee's facility contact.

IX.E.4.g. Quality Assurance/Quality Control (QA/QC)

Quality Assurance of sampling, analysis, and reporting of data to the Department shall be the responsibility of the Permittee. The Permittee shall be responsible for the QA/QC activities of the samplers, drillers, and analytical laboratories.

Components of the QA/QC Program shall be in accordance with Attachment 11 of this Permit; and

IX.E.4.g(1). A full laboratory QA/QC Report shall accompany each data report and shall be kept on file at the facility.

IX.E.4.g(2). Sample Collection: A standardized field log book shall be kept for each sampling event, including the information described in Attachment 11 of this Permit. It shall include documentation of all QA/QC procedures related to sample collection and the type and number of QA/QC samples. QA/QC samples may include (but are not limited to) duplicate, field, trip, lab, equipment, and blind/spike, and shall be consistent with the Third (*or latest)* Edition of EPA SW-846 "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods."

IX.E.4.g(3). QA/QC of Raw Data: The raw data from the analytical laboratory, as reported, shall be reviewed to determine that it is correctly and accurately reported. If outliers are identified and can be documented, they shall be flagged and included in the data submission.

IX.F. DETECTION MONITORING PROGRAM

IX.F.1. The detection monitoring criteria for evaluating data from each sampling event for any volatile organic compound, shall be the EQL, of 1 microgram per liter for any single VOC, or as specified in Table IX-2 for any other constituent.

IX.F.2. Upon detection of any VOC or other constituents exceeding an EQL for any monitoring well, the Permittee shall, within seven (7) calendar days, notify the Director in writing of the findings, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.98(g)(1)]. At this time, the Permittee may elect to immediately collect two (2) verification samples from any affected well(s), purging the well(s) between samples, and reanalyze for all VOCs or other constituents included in the Detection Monitoring Program.

IX.F.3. If analytical results from either verification sample, described in Permit Condition IX.F.2, confirm the detection of VOCs or other constituents above the detection monitoring criteria, described in Permit Condition IX.F.1, the affected well(s) shall be sampled and analyzed for the constituents identified in IDAPA 58.01.05.008 [40 CFR Part 264, Appendix IX]. The Permittee shall notify the Director, in writing, within seven (7) days of making this finding and submit all analytical results. Within 90 (ninety) calendar days of confirmation of an exceedance, as described in Permit Condition IX.F.2, the Permittee shall submit to the Director either of the following:

IX.F.3.a. A report summarizing the analytical results from the monitoring events described in Permit Conditions IX.F.2 and IX.F.3, and the notification that the affected well(s) is being removed from the Detection Monitoring Program and is being incorporated into the CMP or CAMP; or

IX.F.3.b. A report demonstrating that a source, other than a regulated unit or Past Practice Unit, caused the detection or that the detection resulted from an error in sampling, analysis, or evaluation. This demonstration report must be submitted to the Director for approval.

IX.F.4. If the Permittee is unable to verify that the source of contamination is from other than a regulated unit or Past Practice Unit (in accordance with Permit Condition IX.F.3.b), or if the report submitted in accordance with Permit Condition IX.F.3.b is not approved by the Director, then the Permittee shall, within 90 (ninety) days of receiving notice the demonstration report of Section IX.F.3 has been denied, remove the affected well(s) from the Detection Monitoring Program and incorporate the affected well and all other monitoring wells associated with the applicable Hazardous Waste Management Unit or Past Practice Unit into the Compliance Monitoring Program, in accordance with Permit Condition IX.G.

IX.F.5. If analytical results from both verification samples, described in Permit Condition IX.F.2, fail to confirm the detection of VOCs or other constituents above an EQL, the Director shall be notified in writing that the Detection Monitoring Program is being resumed.

IX.F.6. Data Reporting for Detection Monitoring

While in the Detection Monitoring Program, the Permittee shall submit to the Director a semi-annual Detection Monitoring Report, in accordance with Permit Condition IX.E.1. This report shall contain a narrative summary of ground water monitoring data that has been collected to date, and a detailed listing of the monitoring and analytical data obtained since submitting the previous report, including (at a minimum) all QA/QC information, a table summary of ground water elevations, all equations, calculations, and parameters used to calculate ground water velocities and flow direction, in accordance with Permit Condition IX.B.4.

IX.G. COMPLIANCE MONITORING PROGRAM

IX.G.1. As of the effective date of this Permit, Monitoring Wells U-1, U-5, U-6, U-7, U-20, U-21, U-23, U-24, and U-25 shall be in the Compliance Monitoring Program. All other compliance monitoring wells shall be determined in accordance with Permit Condition IX.A.2.

IX.G.2. The Permittee shall sample the monitoring wells in the Compliance Monitoring Program semi-annually, during the compliance monitoring period.

IX.G.3. The Permittee shall perform this sampling in accordance with Permit Condition IX.E, and as follows:

IX.G.3.a. The Permittee shall sample the CMP wells for the VOCs or other constituents outlined in Table IX-2.

IX.G.3.b. On an annual basis, the Permittee shall sample all monitoring wells in the CMP and analyze for the constituents identified in IDAPA 58.01.05.008 [40 CFR Part 264, Appendix IX], in lieu of the parameters outlined in Permit Condition IX.G.3.a. Upon detection of any additional monitoring constituents, as a result of the annual Appendix IX sampling, the permittee may resample within thirty (30) days and repeat the Appendix IX analysis. The Permittee shall submit the resample analytical results to the Director, and if the second analysis confirms the presence of the new constituents, the Permittee shall, within seven (7) calendar days of receiving the data that identifies new constituents, notify the Director in writing of the findings and the new constituents shall be included in the Detection and Compliance Monitoring Programs.

IX.G.3.c. All analytical results shall meet the established reporting limit or EQL. If the reporting limit is greater than the established EQL, the Director may require the analysis to be rerun.

IX.G.4. The Permittee shall obtain water-level measurements from the CMP wells prior to each sampling event. Measurements for each monitoring well shall be obtained prior to purging the well. The Permittee shall incorporate this data in determining the rate and direction of ground water flow annually, in accordance with Permit Condition IX.B.5.

IX.G.5. Data Evaluation for Compliance Monitoring

IX.G.5.a. Data in the CMP will be evaluated by comparing the analytical results to the GPS(s) presented in Table IX-6. Level 1 monitoring well criteria was established by the Alternate Concentration Limits (ACL) presented in Table IX-6. The GPSs for Level 2 monitoring wells shall be those established in Table IX-6 of this Permit and determined by Permit Conditions IX.G.5.b through IX.G.5.e, IX.G.8, and IX.G.9, and as follows:

IX.G.5.b. The down-gradient monitoring wells have been divided into two (2) categories as follows:

IX.G.5.b.(1). Level 1 Compliance Wells:
Level 1 Compliance Wells consist of interior monitoring wells located down-gradient of designated Solid Waste Management Units and regulated units and include the following Wells: U-1, U-17, U-18, U-19, U-20, U-21, U-22, U-23, U-24, U-25, L-31, L-32, L-33, L-37, L-39, L-41, and L-42.

IX.G.5.b.(2). Level 2 Compliance Wells:
Level 2 Compliance Wells consist of down-gradient wells on the eastern and northern site boundaries where ground water flow paths will potentially carry impacted ground water off the facility. Level 2 Compliance Wells consist of the following wells: U-5, U-6, U-7, U-8, U-9, U-10, U-11, U-12, L-28, L-29, L-30, L-43, L-44, L-45, and L-47.

IX.G.5.c. The compliance monitoring criteria (GPS) for evaluating data collected from Level 1 and Level 2 Compliance Wells for each monitoring event for any anthropogenic organic compound, shall be as follows:

IX.G.5.c.1. Level 1 Compliance Wells
Any single Table IX-2 organic compound equal to one-half percent (0.5%) of its solubility in water, as presented in Table IX-6. If multiple constituents are present, a cumulative total of 0.5% solubility based on the summation of solubility percentages, presented by the concentration of each constituent detected.

IX.G.5.c.2. Level 2 Compliance Wells
For any single Table IX-2 organic constituent equal to the Maximum Concentration Limit (MCL), as established by EPA, for drinking water presented in Table IX-6; or

IX.G.5.c.2(a). Where an MCL has not been established, a concentration equal to 1 x 10^{-5} industrial cancer risk for carcinogenic constituents will apply. This will be calculated in accordance with Permit Condition IX.G.5.e.

IX.G.5.c.2(b). If multiple carcinogenic compounds are present, but none exceed their respective MCL (if appropriate), a cumulative 1 x 10^{-5} industrial cancer risk will apply; or

IX.G.5.c.2(c). For individual non-carcinogenic hazardous constituents, the compliance monitoring criteria shall be a hazard quotient of 1 based upon the calculation of the hazard quotient, in accordance with Permit Condition IX.G.5.d.

IX.G.5.c.2(d). If multiple non-carcinogenic hazardous constituents are present, but none exceed their respective MCL (if available), the cumulative hazard quotient shall be calculated in accordance with the equation presented in Permit Condition IX.G.5.d. The action criteria shall be based upon a cumulative hazard quotient of 1.

IX.G.5.c.2.(e). In the event additional anthropogenic compounds are identified through Appendix IX sampling, GPSs for Level 1 and Level 2 Monitoring Wells shall be established and incorporated into this Permit through a modification.

IX.G.5.d. Calculation for determination of the Hazard Quotient (Index) using standard default factors.

Industrial Non-Carcinogenic Hazard Quotient Determination:

HQ={C * 1 mg/1000 ug * EFr * EDr *[(IRWa/RfDo) + (VFw * IRAa/RfDi)]} / (BWa * ATn)

Where:

HQ	=	Hazard Quotient
C	=	Chemical Concentration in the ground water (ug/L) of the specific constituent
RfD_O	=	Oral reference dose in mg/kg-day (Table IX-7)
IRWa	=	Ingestion Rate, water, adult (2 L/day)
IRAa	=	Inhalation Rate, adult (20 m^3/day)
EFr	=	Exposure Frequency, occupational (250 days/year)
EDr	=	Exposure Duration, occupational (25 years)
BWa	=	Body weight, adult (70 kg)
RfDi	=	Inhalation Reference Dose, in mg/kg-day (Table IX-7)
ATn	=	Averaging time, 9125 days (25 yr*365 days/yr)
VFw	=	Volatilization Factor for water (0.5 L/ m^3)

Refer to Table IX-7, *Toxicity Values for RfDo and RfDi values for calculating the Industrial Non-Carcinogenic Hazard Quotient*. Note: N-A means that no oral and/or inhalation reference dose is available for use.

Non-cancer Hazard Determination for multiple constituents:
For each non-carcinogenic constituent from Permit Condition IX.I.G.a, detected at or above the EQL limit, calculate the Hazard Quotient as shown above and sum as follows:

Hazard Index = $HQ_1 + HQ_2 + HQ_3 + ...$

IX.G.5.e. Calculation for determination of the Total Cancer Risk using standard default factors.

Calculating the Estimated Industrial Cancer Risk for Each Constituent:

CR={C * 1 mg/1000 ug * EFr[(IFWadjo * SFo)+(VFw * InhFadjo * SFi)]} / (ATc)

Where:

CR = Constituent Cancer Risk (based on industrial exposure factors)
C = Chemical Concentration in the ground water (ug/L) of the specific constituent
EFr = Exposure Frequency (250 days/year)
ATc = Averaging Time, carcinogenic (25550 days)
IFWadjo = Ingestion Factor, water, occupational (0.714 L-yr/Kg-day)
*Calculated as follows: IFWadjo = IRWa*1/BWa*EDo = 2 L/day*1/70kg* 25 yrs*
SF_0 = Oral slope factor in kg-day/mg (Table IX-8)
VFw = Volatilization Factor for water (0.5 L/m^3)
InhFadjo = Inhalation Factor, occupational (7.14 m^3-yr/Kg-day)
*Calculated as follows: InhFadjo = IRAa*1/BWa*EDo = 20 m3/day*1/70kg*25 yrs*
SF_i = Inhalation slope factor in kg-day/mg (Table IX-8)

Refer to Table IX-8, *Toxicity Values for SFo and SFi values for calculating Total Cancer Risk*. Note: *N-A* means that no oral and/or inhalation reference dose is available for use.

Calculating the Total Industrial Cancer Risk:

For each constituent from Permit Condition IX.G.3.a, detected at or above the EQL limit, calculate the Cancer Risk as shown above and sum as follows:

Total Cancer Risk = $CR_1 + CR_2 + CR_3 + ...$

IX.G.5.f. The toxicity values in Table IX-7 and Table IX-8 will be updated during the Permit Reopener five (5) years from the effective date of permit issuance per IDAPA 58.01.05.012 [40 CFR § 270.50(d)]. Toxicity factors will be updated, based on the published values in: 1) Integrated Risk Information System (IRIS); 2) Health Effects Assessment Summary Tables (HEAST), databases maintained by the U.S. EPA; and 3) EPA Region 9, Preliminary Remediation Goals (PRGs). The Permittee shall use the updated, toxicity values for all calculations.

IX.G.5.g. Upon detection of VOC concentrations at concentrations exceeding the GPS, set forth in Permit Condition IX.G.5.a and/or listed in Table IX-6 of this Permit, the Permittee shall:

IX.G.5.g(1). Notify the Director of the finding (in writing) within seven (7) calendar days of receipt of the analytical results, identifying the presence of contaminants at or above the established GPSs, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.99(h)(1)]. At this time, the Permittee may elect to immediately collect two (2) verification samples from any affected well(s), purging the well(s) between samples, and reanalyze for all compounds required in the Compliance Monitoring Program. If analytical results from either verification sample confirm the detection of compounds above the Compliance Monitoring Criteria, as specified in Permit Condition IX.G.5.a, then the Permittee shall:

IX.G.5.g(2). Submit to the Director a Corrective Action Plan, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.100], applicable to the affected area(s) and constituents, within 120 calendar days of receipt of the analytical results, identifying the presence of contaminants at or above the established GPSs; or

IX.G.5.g(3). Submit to the Director, a report demonstrating that a source (other than a Past Practice Unit or regulated unit) caused the contamination and/or that the reported contaminant concentrations resulted from an error in sampling, analysis, or evaluation. In making this demonstration, the Permittee shall follow procedures in accordance with IDAPA 58.01.05.008 [40 CFR § 264.99(i)]:

- Notify the Director, in writing, within seven (7) calendar days of the Permittee's intent to make such a demonstration;
- Within ninety (90) days, submit a report to the Director that demonstrates that a source (other than the Past Practice Unit or regulated unit) caused the standard to be exceeded or that the apparent noncompliance with the standards resulted from an error in sampling, analysis, or evaluation;
- Within ninety (90) days, submit to the Director an application for a permit modification to make any appropriate changes to the Compliance Monitoring Program at the facility; and
- Continue ground water monitoring for the affected well(s), in accordance with the Compliance Monitoring Program.

IX.G.6. The Permittee shall continue the Compliance Monitoring Program at the affected well(s) until:

IX.G.6.a. Constituents identified in the affected well(s) do not exceed the limit specified in Permit Condition IX.G.5.a for four (4) consecutive sampling events; or

IX.G.6.b. The Permittee enters into a Corrective Action Program under IDAPA 58.01.05.008 [40 CFR § 264.101] for the affected area(s).

IX.G.7. If the Permittee determines that the Compliance Monitoring Program no longer satisfies the requirements of the IDAPA 58.01.05.008 [40 CFR § 264.99], the Permittee shall, within ninety (90) days, submit an application for permit modification to make any appropriate changes to the program, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.99(j)].

IX.G.8. In the event VOCs are detected above an EQL in an up-gradient or background monitoring well, the well shall be incorporated in the Compliance Monitoring Program, as a Level 1 Compliance Well, in accordance with Permit Condition IX.G.

IX.G.9. Data Reporting for Compliance Monitoring

While in the Compliance Monitoring Program, the Permittee shall submit a semi-annual Compliance Monitoring Report, to the Director, in accordance with Permit Condition I.P.6. This report shall contain a narrative summary of ground water monitoring data that has been collected over the past five (5) years, a detailed listing of the monitoring, and analytical data obtained since the previous report (including any/all newly identified compounds from the Appendix IX Sampling), and (at a minimum) all QA/QC information, a table summary of ground water elevations, all equations, calculations, and parameters used to calculate ground water velocities, and ground water flow direction, in accordance with Permit Condition IX.B.4.

IX.H. POST-CLOSURE AND POST-COVER CARE MONITORING

IX.H.1. All procedures described in Part IX of this Permit for inspection, maintenance, and monitoring shall apply to the Post-Closure Care Period, as well as the active life of each regulated unit, and to the Post-Cover Care Period for each Past Practice Unit.

IX.H.2. The period of Post-Closure for each regulated unit shall be as specified in Permit Condition II.M.2. The period of Post-Cover Care for each Past Practice Unit shall be as specified in Permit Conditions VIII.A.3 and VIII.A.4.

IX.I. UNSATURATED ZONE MONITORING

Upon the Director's request, the Permittee shall prepare a Work Plan for the design, construction, operation, and maintenance of an Unsaturated Zone Monitoring System for the facility, capable of detecting changes from unsaturated to saturated conditions that could move contaminants laterally above the monitored aquifer. The Director shall reserve the right to reopen this permit condition, at any time, to include a specific design and implementation schedule, if the Director determines that the Permittee is not making all reasonable efforts to meet this permit condition. The reopening of this permit condition would be done as an agency-initiated permit modification under IDAPA 58.01.05.012 [40 CFR § 270.41].

IX.J. COMPLIANCE SCHEDULE — RISING WATER TABLE STUDY

IX.J.1. On December 17, 1998, the Department approved the Rising Water Table Study Work Plan. The Department evaluated the Rising Ground Water Study's results and issued a conditional approval on November 23, 1999. As stated in the approval, the Permittee shall submit in reports to the Director (every two years) the continuing evaluations of the rising ground water, beginning in 2001. After submittal of the third such report, the Permittee may request a five (5) -year interval for evaluation of the rising ground water. These reports shall include a summary of current rising ground water conditions, an assessment of the probable scenarios causing the rising ground water, an evaluation of the potential consequences to the Ground Water Monitoring Network (due to the rising ground water), and a description of proposed future tasks to address the situation.

IX.J.2. Failure on the part of the Permittee to carry out the approved Work Plan in the time specified shall be deemed as a violation of this Permit unless the Permittee has been granted a written extension from the Department.

TABLE IX-2. CONSTITUENTS FOR DETECTION MONITORING PROGRAM		
Constituent	**CAS No.**	**EQL (ug/l)**
Benzene	71-42-2	1
Bromodichloromethane	75-27-4	1
Bromoform	75-25-2	1
Bromomethane	74-83-9	1
Carbon Tetrachloride	56-23-5	1
Chlorobenzene	108-90-7	1
Chloroethane	75-00-3	1
Chloroform	67-66-3	1
Chloromethane	74-87-3	1
Cis-1,3-Dichloropropene	10061-01-5	1
Trans-1,3-Dichloropropene	10061-02-6	1
Cis-1,2-Dichloroethene	156-59-2	1
Trans-1,2-Dichloroethene	156-60-5	1
Dibromochloromethane	124-48-1	1
1,1-Dichloroethane	75-34-3	1
1,2-Dichloroethane	107-06-2	1
1,1-Dichloroethene	75-35-4	1
1,2-Dichloropropane	78-87-5	1
Ethylbenzene	100-41-4	1
Methylene Chloride	75-09-2	1
1,1,2,2-Tetrachloroethane	79-34-5	1
Tetrachloroethene	127-18-4	1
Toluene	108-88-3	1
1,1,1-Trichloroethane	71-55-6	1
1,1,2-Trichloroethane	79-00-5	1
Trichloroethene	79-01-6	1
1,1,2-Trichlor-1,2,2-Triflouroethane (CFC 113)	76-13-1	1
Vinyl chloride	75-01-4	1

This space intentionally left blank

TABLE IX-3. GROUND WATER MONITORING NETWORK

Well ID	Description	Sampling Frequency
U-1	Level 1	Semiannual
U-2	Upgradient	Semiannual
U-3	Upgradient	Semiannual
U-4	Upgradient	Semiannual
U-5	Level 2	Semiannual
U-6	Level 2	Semiannual
U-7	Level 2	Semiannual
U-8	Level 2	Semiannual
U-9	Level 2	Semiannual
U-10	Level 2	Semiannual
U-11	Level 2	Semiannual
U-12	Level 2	Semiannual
U-17	Level 1	Semiannual
U-18	Level 1	Semiannual
U-19	Level 1	Semiannual
U-20	Level 1	Semiannual
U-21	Level 1	Semiannual
U-22	Level 1	Semiannual
U-23	Level 1	Semiannual
U-24	Level 1	Semiannual
U-25	Level 1	Semiannual
L-28	Level 2	Semiannual
L-29	Level 2	Semiannual
L-30	Level 2	Semiannual
L-31	Level 1	Semiannual
L-32	Level 1	Semiannual
L-33	Level 1	Semiannual
L-35	Upgradient	Semiannual
L-36	Upgradient	Semiannual
L-37	Level 1	Semiannual
L-38	Upgradient	Semiannual
L-39	Level 1	Semiannual
L-41	Level 1	Semiannual
L-42	Level 1	Semiannual
L-43	Level 2	Semiannual
L-44	Level 2	Semiannual
L-45	Level 2	Semiannual
L-47	Level 2	Semiannual
LP-11, LP-12, LP-13, LP-14, LP-15, LP-27	Piezometer	Semiannual Water Levels Only
UP-1, UP-2, UP-3, UP-4, UP-5,UP-6, UP-7, UP-8, U-13, U-14, U-26, UP-26, UP-28, UP-29	Piezometer	Semiannual Water Levels Only

TABLE IX-4. MONITORING WELL SUMMARY		
UPPER AQUIFER		
Well No.[a]	Old Well No.[b]	Well Material[c]
Background Wells		
U-2 U-3 U-4	UMW-38 UMW-150 UMW-37	SS SS SS
Regulated Units Trench 11 and Collection Pond 1		
U-5 U-6 U-7	None MW-9 UMW-47	SS SS SS
Regulated Unit Collection Pond 3 and Past Practice Units PCB 1, 2, and 3, Acid Disposal Pits, CHEM Area 1, CHEM-1, CHEM-2, CHEM-2B, CHEM-2C, CHEM-2D, CHEM-2E, CHEM-3, CHEM-4, CHEM4B, CHEM-5, CHEM5B, CHEM-6, CHEM-6A, CHEM-6B		
U-9 U-10	None MW-11	SS SS
Regulated Unit Evaporation Pond 1		
U-11 U-12	None None	SS SS
Regulated Units Trench 10 and Collection Pond 2		
U-8	UMW-46	SS
Past Practice Unit Silo 3		
U-20	SW-3	SS
Past Practice Unit Silo 2		
U-21	SW-2	SS
Past Practice Unit Silo 1		
U-22	SW-1	SS
Past Practice Unit Trench PCB-4		
U-17 U-18 U-19	UWL-41 UMW-40 UMW-39	SS SS SS
Past Practice Unit Buried Drum Area 2 (Near Silo 2)		
U-18 U-19	UMW-40 UMW-39	SS SS
Past Practice Unit Buried Drum Area 1 (Near Silo 3)		

a Well No. – designates the Monitoring Well Numbering System pursuant to this Permit, and as designated on Figures 1 and 2 of this Permit.
b Old Well No. – designates ESII Well Numbering System.
c Well Materials = Materials below static water level: SS – Either 304 stainless steel or Schedule 80 PVC: PVC = Schedule 40 polyvinyl chloride.

TABLE IX-4. MONITORING WELL SUMMARY		
UPPER AQUIFER		
Well No.[a]	Old Well No.[b]	Well Material[c]
U-19	UMW-39	SS
Past Practice Unit Control Center		
U-17	UWL-41	SS
Past Practice Unit Elevator Shaft and Disposal Area 9		
U-17	UWL-41	SS
U-18	UMW-40	SS
Past Practice Unit Electrical Vault		
U-17	UWL-41	SS
Regulated Unit Cell 5		
U-1	UMW-16	PVC
U-23	UPCB-1	PVC
U-24	PCB-3	SS
U-25	UMW-36	SS
LOWER AQUIFER		
Regulated Unit Cell 14		
L-28 Subcell 1	LMW-49	SS
L-29 Subcell 2	LMW-50	SS
L-30 Subcell 3	LMW-51	SS
L-39 Subcell 4	None	SS
L-32 Subcell 5	LMW-53	SS
L-33 Subcell 6	LMW-31	SS
L-34 Subcell 7	LMW-54	SS
Past Practice Units Radar (Antenna) Silos		
L-31	UML-42	SS
Background Wells		
L-35	LMW-30	PVC
L-38	LMW-13	PVC
Regulated Unit Cell 15		
L-36	LMW-27	PVC
L-37	LMW-28	PVC
L-41	*N-A*	SS
L-42	*N-A*	SS
L-43	*N-A*	SS
L-44	*N-A*	SS
L-45	*N-A*	SS
L-47	*N-A*	SS

TABLE IX-5. EXISTING PIEZOMETERS

Upper Aquifer		**Lower Aquifer**	
Well No.	**Old Well No.**	**Well No.**	**Old Well No.**
UP-1	D-19	LP-11	D-29
UP-2	D-23	LP-12	MW-21
UP-3	PCB-2	LP-13	MW-25
UP-4	MW-21	LP-14	MW-14
UP-5	MW-10	LP-15	MW-24
UP-6	SW-3-2	LP-27	
UP-7	MW-1		
UP-8	SW-1-2		
UP-26			
UP-28			
UP-29			

This space intentionally left blank

TABLE IX-6. ALTERNATE CONCENTRATION LIMITS AND GROUND WATER PROTECTION STANDARDS, LEVEL 1 AND LEVEL 2 COMPLIANCE MONITORING WELLS

Compliance Monitoring Constituent	Level 1 Compliance Wells	Level 2 Compliance Wells			Applicable Criteria for Level 2 Compliance Wells
	Concentration @ 0.5% Solubility ug/L	Concentration @ Industrial HQ = 1 ug/L	Concentration @ 1 x 10-5 Cancer Risk ug/L	MCL ug/L	
Acetone	5.00E+06	8.52E+02	N-A	N-A	HQ
Acrolein	1.04E+06	5.83E-02	N-A	N-A	HQ
Acrylonitrile	3.68E+05	5.23E+00	5.30E+00	N-A	CR
Allyl chloride	1.80E+04	2.96E+00	N-A	N-A	HQ
Benzene	8.90E+03	N-A	9.87E+01	5E+0	MCL
Bromodichloromethane	2.25E+04	1.70E+02	4.62E+01	1E+2	MCL
Bromoform (Tribromomethane)	1.60E+04	1.70E+02	3.62E+02	1E+2	MCL
Bromomethane	6.50E+04	1.19E+01	N-A	N-A	HQ
2-Butanone (Methyl ethyl ketone)	1.38E+06	2.70E+03	N-A	N-A	HQ
Carbon disulfide	1.45E+04	1.46E+03	N-A	N-A	HQ
Carbon tetrachloride	4.00E+03	N-A	2.20E+01	5E+0	MCL
Chlorobenzene	2.44E+03	5.51E+01	N-A	1E+2	MCL
Chlorodibromomethane	2.00E+04	1.70E+02	3.41E+01	1E+2	MCL
Chloroethane (Ethyl chloride)	2.87E+04	N-A	N-A	N-A	N-A
2-Chloroethyl vinyl ether	7.50E+04	N-A	N-A	N-A	N-A
Chloroform	4.65E+04	8.52E+01	4.69E+02	1E+2	MCL
Chloromethane	3.18E+04	N-A	2.20E+02	N-A	CR
1,2-Dibromo-3-chloropropane	5.00E+03	4.85E-01	2.04E+00	2E-01	MCL
1,2-Dibromoethane (EDB)	5.85E+04	4.85E-01	3.37E-01	5E-01	MCL
1,1-Dichloroethane	2.75E+04	1.12E+03	N-A	N-A	HQ
1,2-Dichloroethane (EDC)	4.35E+04	N-A	3.14E+01	5E+0	MCL
1,1-Dichloroethylene	2.00E+03	7.67E+01	4.77E+00	7E+0	MCL
Cis-1,2-Dichloroethylene	3.00+03	1.70E+02	N-A	1E+2	MCL
Trans-1,2-Dichloroethylene	3.00E+03	1.70E+02	N-A	1E+2	MCL
1,4-Dichloro-2-butene		N-A	3.08E-01	N-A	CR
Dichlorodifluoromethane	1.40E+03	5.51E+02	N-A	N-A	HQ
1,2-Dichloropropane	1.35E+04	9.37E+00	4.21E+01	5E+0	MCL
Cis-1,3-Dichloropropene	1.35E+04	1.21E+01	1.59E+01	N-A	CR
Trans-1,3-Dichloropropene	1.40E+04	1.21E+01	1.59E+01	N-A	CR
Ethylbenzene	7.60E+02	1.88E+03	N-A	7E+2	MCL
Ethyl methacrylate	1.00E+02	7.67E+02	N-A	N-A	HQ
2-Hexanone	1.75E+05	N-A	N-A	N-A	N-A
Iodomethane (Methyl iodide)	7.00E+04	N-A	N-A	N-A	N-A
Methacrylonitrile	1.25E+05	1.46E+00	N-A	N-A	HQ
Methylene bromide	2.15E+04	8.52E+01	N-A	N-A	HQ

TABLE IX-6. ALTERNATE CONCENTRATION LIMITS AND GROUND WATER PROTECTION STANDARDS, LEVEL 1 AND LEVEL 2 COMPLIANCE MONITORING WELLS

Compliance Monitoring Constituent	Level 1 Compliance Wells	Level 2 Compliance Wells			Applicable Criteria for Level 2 Compliance Wells
	Concentration @ 0.5% Solubility ug/L	Concentration @ Industrial HQ = 1 ug/L	Concentration @ 1 x 10-5 Cancer Risk ug/L	MCL ug/L	
Methylene chloride	8.35E+04	2.27E+03	3.82E+02	5E+0	MCL
Methyl methacrylate	8.00E+04	1.99E+03	N-A	N-A	HQ
Methyl Isobutyl Ketone	9.55E+04	2.22E+02	N-A	N-A	HQ
Propiononitrile	5.15E+05	N-A	N-A	N-A	N-A
Styrene	1.50E+03	2.30E+03	N-A	1E+2	MCL
1,1,1,2-Tetrachloroethane	1.00E+03	2.56E+02	1.10E+02	N-A	CR
1,1,2,2-Tetrachloroethane	1.45E+04	N-A	1.43E+01	N-A	CR
Tetrachloroethylene (PCE)	7.50E+02	N-A	N-A	5E+0	MCL
Toluene	2.55E+03	1.01E+03	N-A	1E+3	MCL
1,1,1-Trichloroethane	2.20E+04	N-A	N-A	2E+2	MCL
1,1,2-Trichloroethane	2.25E+04	3.41E+01	5.02E+01	5E+0	MCL
Trichlorofluoromethane	5.50E+03	1.80E+03	N-A	N-A	HQ
1,1,2-Trichlor-1,2,2-trifluoroethane (CFC-113)	1.57	E+03	N-A	N-A	HQ
1,2,3-Trichloropropane	9.50E+03	4.38E+01	4.09E-01	N-A	CR
Trichloroethylene (TCE)	5.50E+03	N-A	N-A	5E+0	MCL
Vinyl acetate	1.00E+05	5.76E+02	N-A	N-A	HQ
Vinyl chloride	5.50E+03	N-A	1.51E+00	2E+0	MCL
Xylene	9.95E+02	N-A	N-A	1E+4	MCL

This space intentionally left blank

Table IX-7. Toxicity Values for Calculating Industrial Non-Carcinogenic Hazard Quotient

CONSTITUENT	CAS #	RfD_0	RfDi
Acetone	67-64-1	0.9	0.1
Acrolein	107-02-8	0.0005	0.0000057
Acrylonitrile	107-13-1	0.001	0.00057
Allyl chloride	107-05-1	0.05	0.000286
Benzene	71-43-2	0.004	0.00857
Bromodichloromethane	75-27-4	0.02	0.02
Bromoform	75-25-2	0.02	0.02
Bromomethane	74-83-9	0.0014	0.0014
2-Butanone (MEK, methyl ethyl ketone)	78-93-3	0.6	0.29
Carbon disulfide	75-15-0	0.1	0.2
Carbon Tetrachloride	56-23-5	0.0007	0.0007
Chlorobenzene	108-90-7	0.02	0.0017
Chloroethane (ethyl chloride)	75-00-3	0.4	2.86
2-Chloroethylvinyl ether	110-75-8	N-A	N-A
Chloroform	67-66-3	0.01	0.00086
Chloromethane (or Methyl Chloride)	74-87-3	N-A	0.03
1,3 Dichloropropene	542-75-6	0.03	0.00571
Dibromochloromethane (or Chlorodibromomethane)	124-48-1	0.02	0.02
1,2 Dibromo-3-chloropropane (DBCP)	96-12-8	0.000057	0.0000571
Dibromomethane	74-95-3	0.01	0.01
1,2-Dibromoethane	106-93-4	0.000057	0.000057
1,1-Dichloroethane	75-34-3	0.1	0.14
1,2-Dichloroethane	107-06-2	0.03	0.0014
1,1-Dichloroethene	75-35-4	0.05	0.0571
cis-1,2-Dichloroethene (or cis-1,2-Dichloroethylene)	156-59-2	0.01	0.01
trans-1,2-Dichloroethene (or trans-1,2-Dichloroethylene)	156-60-5	0.02	0.02
1,2-Dichloropropane	78-87-5	0.0011	0.0011
1,4-Dichloro-2-butene	764-41-0	N-A	N-A
Dichlorodifluoromethane (CFC-12)	75-71-8	0.2	0.057
Ethylbenzene	100-41-4	0.1	0.0286
Ethyl methacrylate	97-63-2	0.09	0.09
2-Hexanone (Methyl butyl ketone)	591-78-6	N-A	N-A
Iodomethane	74-88-4	N-A	N-A
Methacrylonitrile	126-98-7	0.0001	0.0002
Methylene Chloride	75-09-2	0.06	0.86
Methyl methacrylate	80-62-6	1.4	0.2
4-Methyl-2-pentanone (methyl isobutyl ketone)	108-10-1	0.08	0.857
Propionitrile	107-12-0	N-A	N-A
Styrene	100-42-5	0.2	0.286
1,1,1,2-Tetrachloroethane	630-20-6	0.03	0.03
1,1,2,2-Tetrachloroethane	79-34-5	0.06	0.06
Tetrachloroethene (or Tetrachloroethylene)	127-18-4	0.01	0.17
Toluene	108-88-3	0.2	0.114
Trichlorofluoromethane (CFC-11)	75-69-4	0.3	0.2
1,2,3-Trichloropropane	96-18-4	0.006	0.0014
1,1,2-Trichlor-1,2,2-trifluoroethane (CFC-113)	76-13-1	30	8.6
1,1,1-Trichloroethane	71-55-6	0.28	0.63
1,1,2-Trichloroethane	79-00-5	0.004	0.004
Trichloroethene	79-01-6	0.0003	0.01
Vinyl Acetate	108-05-4	1.0	0.0571
Vinyl Chloride	75-01-4	0.003	0.0286
Xylenes (total)	1330-20-7	0.2	0.0286

Note: N-A means that no oral and/or inhalation reference dose is available for use.

TABLE IX-8. TOXICITY VALUES FOR CALCULATING TOTAL CANCER RISK

CONSTITUENT	CAS #	SF_0	SF_i
Acetone	67-64-1	N-A	N-A
Acrolein	107-02-8	N-A	N-A
Acrylonitrile	107-13-1	0.54	0.24
Allyl chloride	107-05-1	N-A	N-A
Benzene	71-43-2	0.055	0.029
Bromodichloromethane	75-27-4	0.062	0.062
Bromoform	75-25-2	0.0079	0.0039
Bromomethane	74-83-9	N-A	N-A
2-Butanone (MEK, methyl ethyl ketone)	78-93-3	N-A	N-A
Carbon disulfide	75-15-0	N-A	N-A
Carbon Tetrachloride	56-23-5	0.13	0.053
Chlorobenzene	108-907	N-A	N-A
Chloroethane (ethyl chloride)	75-00-3	0.0029	0.0029
2-Chloroethylvinyl ether	110-75-8	N-A	N-A
Chloroform	67-66-3	0.031	0.019
Chloromethane (or Methyl Chloride)	74-87-3	0.013	0.0063
1,3 Dichloropropene	542-75-6	0.1	0.014
Dibromochloromethane (or chlorodibromomethane)	124-48-1	0.084	0.084
1,2 Dibromo-3-chloropropane (DBCP)	96-12-8	1.4	0.0024
Dibromomethane	74-95-3	N-A	N-A
1,2-Dibromoethane	106-93-4	85.0	0.77
1,1-Dichloroethane	75-34-3	N-A	N-A
1,2-Dichloroethane	107-06-2	0.091	0.091
1,1-Dichloroethene	75-35-4	N-A	N-A
Cis-1,2-Dichloroethene (or cis-1,2-Dichloroethylene)	156-59-2	N-A	N-A
Trans-1,2-Dichloroethene (or trans-1,2-Dichloroethylene)	156-60-5	N-A	N-A
1,2-Dichloropropane	78-87-5	0.068	0.068
1,4-Dichloro-2-butene	764-41-0	9.3	9.3
Dichlorodifluoromethane (CFC-12)	75-71-8	N-A	N-A
Ethylbenzene	100-41-4	0.00385	.00385
Ethyl methacrylate	97-63-2	N-A	N-A
2-Hexanone (Methyl butyl ketone)	591-78-6	N-A	N-A
Iodomethane	74-88-4	N-A	N-A
Methacrylonitrile	126-98-7	N-A	N-A
Methylene Chloride	75-09-2	0.0075	0.0016
Methyl methacrylate	80-62-6	N-A	N-A
4-Methyl-2-pentanone (methyl isobutyl ketone)	108-10-1	N-A	N-A
Propionitrile	107-12-0	N-A	N-A
Styrene	100-42-5	N-A	N-A
1,1,1,2-Tetrachloroethane	630-20-6	0.026	0.026
1,1,2,2-Tetrachloroethane	79-34-5	0.2	0.2
Tetrachloroethene (or Tetrachloroethylene)	127-18-4	0.052	0.01
Toluene	108-88-3	N-A	N-A
Trichlorofluoromethane (CFC-11)	75-69-4	N-A	N-A
1,2,3-Trichloropropane	96-18-4	2.0	2.0
1,1,2-Trichlor-1,2,2-trifluoroethane (CFC-113)	76-13-1	N-A	N-A
1,1,1-Trichloroethane	71-55-6	N-A	N-A
1,1,2-Trichloroethane	79-00-5	0.057	0.056
Trichloroethene	79-01-6	0.21	0.4
Vinyl Acetate	108-05-4	N-A	N-A
Vinyl Chloride	75-01-4	0.75	0.016
Xylenes (total)	1330-20-7	N-A	N-A

Note: N-A means that no oral and/or inhalation reference dose is available for use.

MODULE X - CONTAINMENT BUILDING AND DEBRIS TREATMENT

X. Subject to the terms of this Permit, the Permittee may store and/or treat hazardous wastes in the Containment Building, as follows:

X.A. CONTAINMENT BUILDING

X.A.1. Containment Building Design and Equipment

The Permittee shall maintain the containment building, in accordance with the design standards for a containment building, as provided in IDAPA 58.01.05.008 [40 CFR § 264.1101], Attachment 24 of this Permit, and Permit Condition II.A.1 of this Permit. The containment building houses a Size Reduction System that consists of a Crusher System and associated equipment. The Permittee shall maintain the Crusher System in accordance with the requirements of IDAPA 58.01.05.008 [40 CFR § 264 Subpart X] and as provided by Permit Module XII. The arrangement of the equipment is depicted in Drawings D2020-R05, D2020-R07, and D2020-R08 of Attachment 20 of this Permit. The containment building is enclosed; and in areas where waste could become mobile, air pollution control equipment has been installed. Drawings D2020-H01, D2020-H03, and D2020-H04 in Attachment 20 of this Permit provide design details of the Air Handling and Pollution Control System for the containment building. The debris portion of the containment building contains three (3), steel-lined sort floors and two (2) Mixing Bin Tanks. The steel lined sort floors will not be in use when the Mixing Bin Tanks are in place. The stabilization portion of the containment building contains two (2) Mixing Bin Tanks. The Mixing Bin Tanks are further described in Permit Module IV. The permitted storage areas are depicted in drawings in Attachment 20 of this Permit.

X.A.1.a. The Permittee shall keep all relevant figures, drawings, and diagrams related to the containment building readily available for inspection at the facility, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.74].

X.A.1.b. Within forty-five (45) days after approval of the CQA Report for Mixing Bin Tanks 3 and/or 4, the Permittee shall submit all relevant updated drawings, which were not included in the CQA Report, illustrating current conditions in the Debris Portion of the Containment Building.

X.A.2. Containment Building Operation

X.A.2.a. The Permittee shall follow the approved containment building operation procedures, included as Attachments 2, 4, 6, 7, 13, 14, 24, and 25 of this Permit, and as provided by Permit Conditions X.A.2.a.(1) through (8).

X.A.2.a.(1). The Permittee shall operate the containment building so as not to exceed the maximum waste processing rate for the containment building (stabilization portion and debris portion) of 300 tons of waste per hour for the building based on a daily average, nor exceed 2,628,000 tons of waste per year for the building.

X.A.2.a.(2). The maximum waste processing rate for the other operations performed in the containment building shall not exceed 50 tons per hour for the Crusher System and

100 tons per hour for the sort floor, based on daily averages.

X.A.2.a.(3). The Permittee shall maintain non-containerized waste in the containment building sort floors such that the height and location of the waste does not allow these materials to escape or overflow the walls of the containment building.

X.A.2.a.(4). In the event of a power outage, or other event that reduces the operating efficiency below the manufacturer's specifications of the air pollution control equipment for the sort floors and mixing bins, the Permittee shall cease all hazardous waste and debris treatment operations on the sort floors and mixing bins that generate a “fine waste” until such time as the power is restored, or the air pollution control equipment is repaired.

X.A.2.a.(5). In the event of a power outage, or other event that reduces the operating efficiency below the manufacturer's specifications of the air pollution control equipment for the general floor area, the Permittee shall cease all hazardous debris treatment operations that generate a “fine waste” (including crushing and movement of non-containerized hazardous debris/waste and all operations on the general floor area other than storage or movement of closed containers of hazardous debris/waste, in the Containment Building on the general floor area) until such time as the power is restored or the air pollution control equipment is repaired.

X.A.2.a.(6). Containers of hazardous wastes removed from the Containment Building must be managed in accordance with IDAPA 58.01.05.008 [40 CFR § 264.173]. Prior to the transportation of any crushed wastes from the Containment Building, a determination for the presence of ‘fine wastes’ shall be made.

X.A.2.a.(7). The Permittee shall operate, service, and maintain the air pollution control equipment listed and/or depicted in Attachment 24 of this Permit according to the manufacturers' recommended instructions and/or specifications, which shall be maintained on-site.

X.A.2.a.(8). Closure of the Containment Building and associated areas and equipment shall be conducted in accordance with Attachment 9 of this Permit.

X.B. HAZARDOUS DEBRIS TREATMENT

X.B.1. All hazardous waste and debris-processing operations including unloading, staging, storing, sorting, pre-treating, or treating shall be conducted in compliance with IDAPA 58.01.05.011 [40 CFR Part 268] and Attachment 25 of this Permit. The hazardous waste and debris treatment processes include, but are not limited to, the following (as described in Attachment 25): stabilization, microencapsulation, macroencapsulation, chemical oxidation, chemical reduction, deactivation, solidification, neutralization, precipitation, adsorption, bioremediation, size reduction, decanting, and mechanical processing (sorting/crushing).

X.B.2. Hazardous waste and debris processing, treatment, and storage shall be in accordance with Attachments 2, 4, 6, 7, 13, 14, 15, 24, and 25 of this Permit.

X.B.3. Hazardous waste and debris processing, treatment, and storage shall be in accordance with Permit Condition II.T and IDAPA 58.01.05.008 [40 CFR 264 Subpart CC].

X.B.4. Hazardous waste and debris treated by the Permittee, using macroencapsulation or microencapsulation technologies, shall meet the requirements of IDAPA 58.01.05.011 [40 CFR § 268.45, Table 1] and the following permit conditions.

X.B.5. Macroencapsulation

X.B.5.a. The Permittee shall conduct macroencapsulation treatment of hazardous debris in the Containment Building and in Container Storage Pads 4 and 5 and at the Outdoor Stabilization Facility in accordance with Attachment 13, 15, and 25 of this Permit, and as provided by Permit Conditions X.B.4.a.(1) through X.B.4.a.(3).

X.B.5.a.(1). For macroencapsulation of hazardous debris, the Permittee shall use only high density polyethylene liner materials or polyethylene drums as specified in Attachment 25 of this Permit.

X.B.5.a.(2). For macroencapsulation of large pieces of debris that are wrapped or coated with an inert surface coating material, the Permittee shall demonstrate to the Director that the requirements of IDAPA 58.01.05.011 [40 CFR § 268.45, Table 1] have been met.

X.B.5.a.(2)(a). Upon the Director's approval of the demonstration in Permit Condition X.B.5.a.(2), the Permittee may begin utilizing the requested macroencapsulation process.

X.B.5.a.(3). Landfill placement of containers of macroencapsulated hazardous debris shall be in accordance with Attachments 19 and 25 of this Permit.

X.B.6. Microencapsulation

X.B.6.a. The Permittee shall conduct microencapsulation treatment of hazardous debris in accordance with Attachment 25 of this Permit, and as provided by the following permit conditions.

X.B.6.b. The Permittee shall conduct microencapsulation of hazardous debris at the Stabilization Facility or the Containment Building.

X.B.6.c. All size reduction operations of hazardous debris, prior to microencapsulation treatment, shall be performed in the containment building. Additional locations for size reduction operations, such as Container Management Units, may be utilized upon the Director's approval.

X.B.6.d. Landfill placement of microencapsulated hazardous debris shall be in accordance with Attachment 19 and 25 of this Permit.

X.C. CYANIDE DESTRUCTION

X.C.1. Cyanide destruction shall be conducted in accordance with all applicable sections of Attachments 2, 4, 6, 7, and 25 of this Permit.

X.C.2. Cyanide destruction performed by the Permittee shall be limited to chemical oxidation (e.g., alkaline chlorination), and shall be limited to the following parameters in order to protect human health and the environment:

- Waste containing less than 10,000 ppm of total cyanide may be accepted for cyanide destruction provided that the appropriate safety controls and procedures are followed. Prior approval from the Director is required for the receipt of any cyanide wastes exceeding 10,000 ppm.

- Cyanide destruction shall be performed in the Stabilization Facility and/or the Containment Building in containers and/or the Mixing Bin Tanks.

X.D. CLOSURE AND POST-CLOSURE

Closure and Post-Closure Care of the Containment Building shall be completed in accordance with IDAPA 58.01.05.008 [40 CFR § 264.1102], and all applicable sections of Attachment 9 of this Permit.

This space intentionally left blank

MODULE XI - STABILIZATION OPERATIONS

XI.A. GENERAL OPERATING REQUIREMENTS

XI.A.1. The Permittee shall remove spilled or leaked wastes and accumulated liquid from the Secondary Containment Systems of the Stabilization Facility and the containment building (stabilization and/or debris portion) within 24 hours of detection, unless the waste or liquid in the Secondary Containment System is frozen. The Permittee shall manage these wastes and liquid as hazardous wastes. Within two (2) normal working days after the waste or liquid in the Secondary Containment System is no longer frozen, the contained liquids will be characterized and removed.

XI.A.2. The Permittee shall keep all relevant figures, drawings, and diagrams related to the Stabilization Facility and Containment Building (stabilization portion) readily available for inspection at the facility, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.74].

XI.B. STABILIZATION FACILITY

XI.B.1. The outdoor Stabilization Facility includes rolloffs (stabilization bins) of 25 to 52 cubic yards in capacity and shall be designed, constructed, and operated by the Permittee in accordance with Attachments 2, 4, 6, 7, 13, 15, 24, and 25 of this Permit, except as otherwise specified in this Permit, and in accordance with Permit Conditions II.A.1 and II.A.2.

XI.B.2. The Permittee may conduct treatment utilizing stabilization at the Stabilization Facility on all hazardous wastes listed in the Part A Permit Application (included as Attachment 12 of this Permit), except for "fine wastes" as defined in Attachment 2, and subject to any other applicable conditions in Attachment 2 of this Permit that apply to hazardous wastes to be stabilized.

XI.C. CONTAINMENT BUILDING (STABILIZATION OPERATIONS)

XI.C.1. Containment Building Design and Construction

XI.C.1.a. The Containment Building includes four (4) Mixing Bin Tanks, and the building shall be equipped with air pollution control equipment to control particulate emissions. Two (2) tanks are located in the Stabilization Portion and two (2) tanks are located in the Debris Portion of the building.

XI.C.1.b. The Containment Building includes container storage capacity, as shown in Attachment 13 of this Permit. The maximum waste processing rate for the Containment Building shall not exceed 300 tons of waste per hour based on a daily average, nor exceed 2,628,000 tons of waste per year.

XI.C.2. Containment Building Operation

XI.C.2.a. The Permittee may conduct stabilization, microencapsulation, macroencapsulation, and size reduction within the stabilization portion of the containment building.

XI.C.2.b. The Permittee shall follow, as appropriate, the operating procedures for stabilization, microencapsulation, macroencapsulation, and size reduction as provided in Attachments 2, 4, 6, 7, 13, 24, and 25 of this Permit and as provided by Permit Conditions X.B and XI.B.2.

XI.C.2.c. The Permittee shall operate each Stabilization Portion mixing bin tank so as not to exceed the maximum capacity of 120 cubic yards. The Permittee shall operate each Debris Portion mixing bin tank so as not to exceed the maximum capacity of 226 cubic yards for wastes in solid form. The Permittee shall operate each Debris Portion mixing bin tank so as not to exceed the maximum capacity of 12,000 gallons for wastes in liquid form.

XI.C.2.d. The Permittee shall manage non-containerized waste in the Containment Building such that the height and location of the waste does not allow these materials to overflow any mixing bin tank.

XI.C.2.e. In the event of a power outage, or other event that reduces the required operating efficiency of the air pollution control equipment, the Permittee shall cease all unloading and treatment operations of “fine wastes” until such time as the power is restored or the air pollution control equipment is returned to normal operation. Other treatment and storage operations not involving “fine wastes” may continue.

XI.C.2.f. The Permittee shall maintain and operate the air pollution control equipment, provided in Attachment 24 of this Permit, in accordance with the manufacturers' instructions and/or specifications, and shall keep these on-site.

XI.D. CLOSURE AND POST-CLOSURE

Closure and Post-Closure Care of the Containment Building (stabilization portion and debris portion) and Stabilization Facility, and associated equipment, shall be completed in accordance with IDAPA 58.01.05.008 [40 CFR § 264 Subpart G] and all applicable sections of Attachment 9 of this Permit.

This space intentionally left blank.

MODULE XII - MISCELLANEOUS UNITS UNDER SUBPART X

XII.A. APPLICABILITY OF RULES

The Permittee's compliance with the requirements of Permit Conditions XII.A through XII.G shall constitute compliance with the requirements of IDAPA 58.01.05.008 [40 CFR Parts 264.601 - 603] pertaining to the treatment, storage, or disposal of hazardous waste in miscellaneous units.

XII.B. DESCRIPTION OF MISCELLANEOUS UNIT

The miscellaneous unit consists of the Crusher System and associated equipment. An equipment list for the Crusher System and associated equipment is provided as Table I-2 of Attachment 24 of this Permit. The arrangement of the equipment is depicted in Drawings D2020-A02, -R07, and –R08 of this Permit.

XII.C. APPROVED WASTE

The Permittee may process waste meeting the general waste acceptance criteria in Permit Condition II.C and Attachment 2 of this Permit.

XII.C.1. The Permittee shall comply with Permit Condition II.T of this Permit, and the requirements of IDAPA 58.01.05.008 [40 CFR § 264.601] by not accepting or managing hazardous waste subject to the 40 CFR 264 Subpart CC requirements (e.g. wastes exceeding a volatile organic concentration of 500 ppmw at the point of origin).

XII.C.2. For miscellaneous units that receive organic wastes with a volatile organic concentration at the point of origin less than 500 ppmw, and are therefore, exempt from using air emission control equipment, documentation shall be recorded, in the Facility Operating Record, that includes the information that was used by the Permittee for each waste determination (e.g., test results, measurements, calculations, and other documentation). If analytical results for waste samples are used for the waste determination, then the Permittee shall record the date, time, and location that each waste sample is collected, in accordance with applicable requirements of 40 CFR § 264.1083. This information shall be kept in the Operating Record for a minimum of three (3) years.

XII.C.3. Reporting Requirements: If the Permittee does not comply with Permit Condition V.A.3.a, a report shall be submitted to the Director on each occurrence when hazardous waste is placed in the Waste Management Unit in noncompliance with the conditions of 40 CFR §§ 264.1082(c)(1) or 264.1082(c)(2), as applicable. A written report shall be submitted within fifteen (15) calendar days of the time that the Permittee becomes aware of the occurrence. The written report shall contain: the EPA Identification Number, facility name and address, a description of the noncompliance event and the cause, the dates of the noncompliance, and corrective actions taken to prevent reoccurrence of the noncompliance. The report shall be signed and dated by an authorized representative of the Permittee per IDAPA 58.01.05.008 [40 CFR § 264.1090].

XII.D. PROCESS DESIGN CAPACITY

The maximum waste processing rate for the Crusher System in the containment building shall not exceed 50 tons per hour or 50,000 tons per year.

XII.E. GENERAL MISCELLANEOUS UNIT MANAGEMENT PRACTICES

XII.E.1. The Permittee shall not place waste, treatment reagents, or other material in the miscellaneous unit that may cause the unit to rupture, leak, corrode, or otherwise fail.

XII.E.2. The Permittee shall maintain the Operating Record in accordance with IDAPA 50.01.05.008 [40 CFR § 264.73] and Permit Condition II.J of this Permit.

XII.E.3. The Permittee shall track waste processed through the miscellaneous unit, in accordance with Permit Condition XII.D.

XII.E.4. The Permittee shall maintain the Environmental Performance Standards for the miscellaneous unit, in accordance with IDAPA 50.01.05.008 [40 CFR § 264.601], as described in Attachments 24 and 25 of this Permit.

XII.E.5. In the event of a power outage, or other event that reduces the operating efficiency below the manufacturer's specifications of the air pollution control equipment for the Crusher System, all crushing operations shall cease until such time as the power is restored or the air pollution control equipment is repaired.

XII.E.6. The satellite accumulation container under the crusher discharge chute may remain uncovered/open under the following conditions:

XII.E.6.a. The immediate area around the crusher discharge chute must fully enclose the container on all four sides and above, with suspended tarps or an equivalent or superior curtain or structural material; and

XII.E.6.b. The containment building overhead door, adjacent to the crusher discharge chute, remains closed.

XII.F. INSPECTIONS

XII.F.1. The Permittee shall inspect the Crusher System, including the crusher discharge chute, the transfer vertical conveyor, Dust Collector System, and feed hopper for waste accumulation, in accordance with IDAPA 50.01.05.008 [40 CFR § 264.601], as described in Attachment 4 of this Permit.

XII.F.2. The Permittee shall keep all relevant figures, drawings, and diagrams related to the miscellaneous unit readily available for inspection at the facility, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.74].

XII.G. CLOSURE AND POST-CLOSURE

Closure and Post-Closure Care of the miscellaneous unit shall be completed in accordance with IDAPA 58.01.05.008 [40 CFR § 264.603] and all applicable sections of Attachment 9 of this Permit.

MODULE XIII – CORRECTIVE ACTION

XIII.A. SOLID WASTE MANAGEMENT UNITS

XIII.A.1. The Director may require corrective action, as specified in the following permit conditions for any newly identified Solid Waste Management Units (SWMUs), where newly identified SWMUs are those not documented in the facility Administrative Record, maintained by the Department, as having undergone corrective action.

XIII.A.2. The Permittee shall conduct a corrective action investigation, in accordance with Permit Conditions XIII.B through XIII.H of this Permit, for each newly identified SWMU.

XIII.B. STANDARD CONDITIONS

XIII.B.1. Failure to submit the information required by the permit conditions within Module XIII of this Permit, or falsification of any submitted information, is grounds for termination of this Permit in accordance with IDAPA 58.01.5012 [40 CFR § 270.43], and for an enforcement action pursuant to Permit Condition I.C of this Permit.

XIII.B.2. All plans, reports, notifications, and other submissions to the Director, as required by the permit conditions within Module XIII of this Permit, shall be signed and certified in accordance with Permit Condition I.R of this Permit.

XIII.B.3. The Permittee shall submit to the Director (by certified mail, express mail, or hand delivered to the address specified in Permit Condition I.Z of this Permit) a minimum of three (3) copies of each plan, report, notification, or other submissions required by the permit conditions within Module XIII of this Permit.

XIII.B.4. All plans and schedules, as required by the permit conditions in Module XIII of this Permit (upon written approval from the Director) shall be incorporated into Module XIII of this Permit, in accordance with Permit Condition XIII.H of this Permit. Any noncompliance with such approved plans and schedules shall be deemed noncompliance with this Permit.

XIII.B.5. The Permittee shall only receive extension(s) of the specified Compliance Schedule due date(s) for the submittal(s), required by the permit conditions within Module XIII of this Permit, upon written approval from the Director, in accordance with Permit Condition XIII.H of this Permit.

XIII.B.6. If the Director determines that further actions beyond those provided by the permit conditions within Module XIII of this Permit, or changes to permit conditions stated herein, are warranted, the Director shall modify the permit condition in Module XIII, in accordance with Permit Condition XIII.H of this Permit.

XIII.B.7. All raw data (such as laboratory reports, drilling logs, bench-scale or pilot-scale data, and other supporting information gathered or generated during activities undertaken, pursuant to the permit conditions in Module XIII of this Permit) shall be maintained at the facility during the effective term of this Permit.

XIII.C. NOTIFICATION REQUIREMENTS & ASSESSMENT OF NEWLY-IDENTIFIED SWMUs

XIII.C.1. The Permittee shall notify the Director in writing (by certified mail, express mail, or hand delivery) of any newly identified SWMU(s). The Permittee shall submit written notification within thirty (30) calendar days of discovering the SWMU(s). The notification shall include the location of the new SWMU(s) and information on the suspected or known wastes at the site.

XIII.C.2. Within one hundred fifty (150) calendar days following discovery of the SWMU(s), the Permittee shall submit to the Director (by certified mail or hand delivery)a SWMU Assessment Plan.

XIII.C.3. The SWMU Assessment Plan shall include the information or the means by which the following information will be obtained:

XIII.C.3.a. Information concerning past and present operations at the unit(s); and

XIII.C.3.b. Any ground water, surface water, soil (surface or subsurface strata), or air sampling and analysis data needed to determine whether a release of hazardous waste and/or hazardous waste constituent(s) from such unit(s) has occurred, is occurring, or is likely to occur. The SWMU Assessment Plan shall demonstrate that the Sampling and Analysis Program (if applicable) is capable of yielding representative samples, and must include parameters sufficient to identify migration of hazardous waste and/or hazardous waste constituent(s) from the newly discovered SWMUs to the environment.

XIII.C.4. The Permittee shall receive written approval from the Director for the SWMU Assessment Plan; or

XIII.C.5. The Permittee shall receive written notice from the Director of the SWMU Assessment Plan's deficiencies, and the written notice will specify a due date for submittal of a revised Assessment Plan; or

XIII.C.6. The Permittee shall receive written notice from the Director of the revisions incorporated, by the Director, in the SWMU Assessment Plan. The revised Assessment Plan shall become the approved SWMU Assessment Plan.

XIII.C.7. The SWMU Assessment Plan, as approved by the Director and as specified in Permit Conditions XIII.C.4, XIII.C.5, or XIII.C.6 of this Permit, shall be incorporated within Module V of this Permit, in accordance with Permit Condition XIII.H of this Permit. The Permittee shall be notified in writing of the approval of the permit modification.

XIII.C.8. The Permittee shall implement the approved SWMU Assessment Plan within thirty (30) calendar days of receiving written notice of the permit modification approval, specified in Permit Condition XIII.C.7 of this Permit.

XIII.C.9. The SWMU Assessment Plan shall contain a schedule, including the submission date for a SWMU Assessment Report.

XIII.C.10. The SWMU Assessment Report shall describe all results obtained from the implementation of the approved SWMU Assessment Plan. At a minimum, the report shall provide the following information for each newly SWMU identified:

XIII.C.10.a. The SWMU location, identified on a map;

XIII.C.10.b. The type and function of the unit, including general dimensions and a structural description;

XIII.C.10.c. The period during which the unit was operated; and

XIII.C.10.d. All wastes that were or are being managed at the SWMU, including results of any sampling and analysis used to determine whether releases of hazardous wastes and/or hazardous waste constituent(s) have occurred, are occurring, or are likely to occur from the unit.

XIII.C.11. Based on the results of SWMU Assessment Report, the Director shall determine the need for further investigations at specific unit(s) included in the SWMU assessment. If the Director determines that such investigations are needed, the Director will require the Permittee to prepare a plan for such investigations. This plan shall be reviewed for approval in accordance with the requirements of Permit Condition XIII.D of this Permit.

XIII.C.12. The Permittee shall notify the Director (in writing by certified mail, express mail, or hand delivery) of any release(s) of hazardous waste and hazardous waste constituent(s) discovered during the course of ground water monitoring, field investigation, environmental auditing, or other activities undertaken during the RCRA Facility Investigation (RFI) and Permit Condition XIII.D of this Permit. The written notification shall be received by the Director no later than fifteen (15) calendar days after discovery. Such releases may be from already documented or newly identified units. The Director may require further investigation of the new releases. Further investigation, if required, shall be performed in accordance with the requirements of Permit Condition XIII.D of this Permit.

XIII.D. RCRA FACILITY INVESTIGATION (RFI)

XIII.D.1. The Permittee shall conduct a RFI, as deemed necessary by the Director, to determine the nature and extent of known and suspected releases of hazardous wastes and/or hazardous waste constituent(s) from each SWMU at the facility, identified in accordance with Permit Condition XIII.C of this Permit, and to gather data to support a Corrective Measures Study. The Permittee shall conduct the RFI in accordance with an approved Work Plan, completed in accordance with current guidance documents from EPA (*RCRA Facility Investigation Guidance, Volumes I through IV*, or equivalent).

XIII.D.2. The Permittee shall conduct the RFI for each newly identified SWMU, in accordance with the schedule specified in Table XIII-1 of this Permit.

XIII.D.3. The RFI Compliance Schedules, specified in Table XIII-1 of this Permit, may be modified in accordance with Permit Condition XIII.H of this Permit.

XIII.E. INTERIM MEASURES

XIII.E.1. If, during the course of any activity initiated in compliance with the permit conditions of Module XIII of this Permit, the Director determines that a release or potential release of hazardous waste and/or hazardous waste constituent(s) from a SWMU poses a threat to human health or the environment, the Director may require the Permittee to perform specific interim measures.

XIII.E.2. The Director shall notify the Permittee in writing of the requirement to perform the interim measures specified in the Interim Measures Plan, in accordance with Permit Condition XIII.E.3 of this Permit. The Permittee shall comply with the specified Interim Measures Plan alternative (Permit Condition XIII.E.3.a or XIII.E.3.b of this Permit) designated in the written notification.

XIII.E.3. The Permittee shall perform the requirements of the Interim Measures Plan, in accordance with the alternative specified in either Permit Condition XIII.E.3.a or XIII.E.3.b of this Permit.

XIII.E.3.a. The Director shall determine specific actions to implement the interim measures. The Director shall provide an Interim Measures Plan with the written notification specified in Permit Condition XIII.E.2 of this Permit; or

XIII.E.3.b. Within thirty (30) calendar days of receiving the written notification requiring the Interim Measures Plan, as specified in Permit Condition XIII.E.2 of this Permit, the Permittee shall provide (by certified mail, express mail, or hand delivery) the Interim Measures Plan to the Director for approval.

XIII.E.4. The Interim Measures Plan shall identify specific action(s) to be taken to implement the interim measures and a schedule for implementing the required measures. At a minimum, the Interim Measures Plan shall consider (but not be limited to) the following factors:

XIII.E.4.a. Time required to develop and implement a final remedy;

XIII.E.4.b. Actual and potential exposure of human and environmental receptors;

XIII.E.4.c. Actual and potential contamination of drinking water supplies and sensitive ecosystems;

XIII.E.4.d. The potential for further degradation of the medium absent of interim measures;

XIII.E.4.e. Presence of hazardous waste in containers that may pose a threat of release;

XIII.E.4.f. Presence and concentration of hazardous waste, including hazardous waste constituent(s) in solids that have the potential to migrate to ground water or surface water;

XIII.E.4.g. Weather conditions that may affect the current levels of contamination;

XIII.E.4.h. Risks of fire, explosion, or accident; and

XIII.E.4.i. Other situations that may pose threats to human health and the environment.

XIII.E.5. The Interim Measures Plan shall be incorporated into this Permit, in accordance with Permit Condition XIII.H of this Permit.

XIII.F. CORRECTIVE MEASURES STUDY AND IMPLEMENTATION

XIII.F.1. Based on the results of the RFI, the Permittee shall identify, screen, and develop the alternative or alternatives for removal, containment, treatment and/or other remediation of the contamination. The Permittee shall conduct the Corrective Measures Study in accordance with an approved Work Plan, completed in accordance with current guidance documents from EPA (*RCRA Corrective Action Interim Measures Guidance – Interim Final, RCRA Facility Investigation Guidance, Volumes I through IV*, or equivalent).

XIII.F.2. Upon the Director's approval of the Corrective Measures Study, pursuant to Permit Condition XIII.F.1 of this Permit, the Permittee shall prepare and submit to the Director for approval (by certified mail, express mail, or hand delivery), the Corrective Measures Implementation Program Plan, in accordance with an approved Work Plan.

XIII.F.3. Upon the Director's approval of the Corrective Measures Implementation Program Plan, pursuant to Permit Condition XIII.F.2 of this Permit, the Permittee shall conduct the Corrective Measures Implementation Program Plan, in accordance with the approved Work Plan for the corrective measures design and construction.

XIII.F.4. The Permittee shall conduct the Corrective Measures Study and prepare the Corrective Measures Implementation Program Plan, as specified in Permit Conditions XIII.F.1 and XIII.F.2 of this Permit, in accordance with the schedule specified in Table XIII-2.

XIII.F.5. The Permittee shall prepare and submit to the Director for approval a Compliance Schedule for conducting the Corrective Measures Implementation Program Plan, as required by Permit Condition XIII.F.3 of this Permit.

XIII.F.5.a. The Permittee shall provide a justification for each compliance date in the Compliance Schedule, based on the complexity of the Corrective Measures Implementation Program Plan, and reasonable contract and administrative time requirements.

XIII.F.5.b. On or before the compliance date for submittal of the draft Corrective Measures Implementation Program Plan specified in Table XIII-2 of this Permit, the Permittee shall submit to the Director for approval (by certified mail, express mail, or hand delivery) the Compliance Schedule and subsequent justification, pursuant to Permit Condition XIII.F.5 of this Permit,.

XIII.F.5.c. Upon the Director's approval of the Corrective Measures Implementation Program Plan Compliance Schedule, the Compliance Schedule shall be incorporated into this Permit concurrently with the final Corrective Measures Implementation Program Plan, in accordance with IDAPA 58.01.5012 [40 CFR §§ 270.41 and 270.42].

XIII.F.6. The Permittee shall conduct the Corrective Measures Implementation, as specified in Permit Condition XIII.F.3 of this Permit, in accordance with Permit Condition XIII.F.5 of this Permit.

XIII.F.7. The Corrective Measures Study and Corrective Measures Implementation Compliance Schedules, specified in Table XIII-2 of this Permit, shall be modified in accordance with Permit Condition XIII.H of this Permit.

XIII.G. REPORTING REQUIREMENTS

XIII.G.1. The Permittee shall submit to the Director signed quarterly progress reports of all activities (i.e., SWMU Assessments, Interim Measures, RFIs, and/or Corrective Measures Studies) conducted, pursuant to the permit conditions of Module V of this Permit. The Permittee shall initially submit the quarterly progress reports no later than ninety (90) calendar days after being notified in writing that the approved SWMU Assessment Plan has been incorporated within Module XIII of this Permit, through a permit modification, in accordance with Permit Condition XIII.H of this Permit.

XIII.G.2. At a minimum, the quarterly progress reports shall contain the following:

XIII.G.2.a. A description of the work completed;

XIII.G.2.b. Summaries of all findings and all raw data;

XIII.G.2.c. Summaries of all problems or potential problems encountered during the reporting period, and actions taken or to be taken to rectify the problems; and

XIII.G.2.d. Projected work for the next reporting period.

XIII.G.3. The Permittee shall maintain copies of other reports, drilling logs, etc. at the facility during the effective period of this Permit. The Permittee shall provide copies of the said reports, logs, etc. to the Director upon request.

XIII.G.4. As specified under Permit Condition XIII.B.5 of this Permit, the Director may require the Permittee to conduct new or more extensive assessments, investigations, or studies (as needed) based on information provided in these progress reports or other supporting information.

XIII.H. MODIFICATION OF THE CORRECTIVE ACTION SCHEDULE OF COMPLIANCE

XIII.H.1. Requests for modifications of the final compliance dates, pursuant to the permit conditions in Module XIII of this Permit, shall be submitted to the Director for approval, in accordance with IDAPA 58.01.5012 [40 CFR §§ 270.41 and 270.42]. The Corrective Action Schedule of Compliance (final compliance dates), subject to modification, includes the following:

XIII.H.1.a. The compliance date(s), as specified in Table XIII-1 of this Permit, for submittal of the RFI Final Report;

XIII.H.1.b. The compliance date(s), as specified in Table XIII-2 of this Permit, for submittal of the Corrective Measures Study Report;

XIII.H.1.c. The compliance date(s), as specified in Table XIII-2 of this Permit, for submittal of the final Corrective Measures Implementation Program Plan, in accordance with Permit Condition XIII.F.2 of this Permit;

XIII.H.1.d. Once established in accordance with Permit Condition XIII.F.5 of this Permit, the compliance date(s) for submittal of the corrective measures final (100% completion) Design and Construction Plans, in accordance with Permit Condition XIII.F.3 of this Permit;

XIII.H.1.e. Compliance dates, as specified in Tables XIII-1 and XIII-2 of this Permit, for implementing the approved plans and/or reports; and

XIII.H.1.f. Compliance dates for quarterly submittal of progress reports.

XIII.H.2. Pursuant to IDAPA 58.01.5012 [40 CFR § 270.42(a)], the Compliance Schedules, specified by the Director, shall be modified if the Director determines that good cause exists for which the Permittee had no control, and for which there is no reasonable available remedy.

XIII.H.3. If adequate funds for Corrective Measures Implementation are not available, the Director and the Department reserve the right to pursue any actions deemed necessary to protect human health and the environment, not excluding judicial recourse or termination of this Permit.

XIII.H.4. The Permittee shall submit to the Director for approval a request for modifications of the interim compliance dates that do not affect the final compliance dates. If the Director approves the interim compliance date modifications, Tables XIII-1 and/or XIII-2 of this Permit shall incorporate the modified compliance dates as approved, and such change shall not be considered a permit modification under IDAPA 58.01.5012 [40 CFR § 270.41].

TABLE XIII-1. RCRA FACILITY INVESTIGATION (RFI) COMPLIANCE SCHEDULE FOR NEWLY IDENTIFIED SOLID WASTE MANAGEMENT UNITS (SWMUs)

RFI ACTIVITY	DUE DATE
Submit Draft RFI-Phase II (Task II & III) Work Plan and Schedule	Within ninety (90) calendar days of the Director's notification that an RFI is needed, in accordance with Permit Condition XIII.C.11 of this Permit.
Initiate RFI-Phase II (Task II & III) Activities	Within forty-five (45) calendar days of the Director's approval of the Task II and III Work Plan and Schedule.
Submit Task IV Draft Report	As specified in the Director's approved RFI-Phase II (Task II & III) Work Plan and Schedule.
Submit Task IV Final & Summary Reports	As specified in the Director's approved RFI-Phase II (Task II & III) Work Plan and Schedule.
Progress Reports on Tasks II through IV	Quarterly (every 90 days) beginning ninety (90) calendar days after the Director's approved RFI-Phase II (Task II & III) activities.

TABLE XIII-2. CORRECTIVE MEASURES STUDY AND IMPLEMENTATION COMPLIANCE SCHEDULE
SOLID WASTE MANAGEMENT UNITS (SWMUs)

CMS SUBMISSION/CMI SUBMISSION	**DUE DATES**
Submit CMS Work Plan (Appendix B, Task I & II)	Within sixty (60) calendar days of the RFI Final Report.
Submit Draft CMS Report (Appendix B, Task I, II & III)	Within three hundred (300) calendar days of the Director's approval of the CMS Work Plan.
Submit Final CMS Report (Appendix B, Task I, II & III)	Within sixty (60) calendar days of receiving the Director's comments on the Draft CMS Report.
Submit Draft CMS Program Plan (Appendix B, Task IV)	Within ninety (90) calendar days of the Director's approval of the Final CMS Report.
Submit Final CMS Program Plan (Appendix B, Task IV)	Within sixty (60) calendar days of receiving the Director's comments on the Draft CMI Program Plan.
Submit Corrective Measures Design Preliminary Design Approximately 30% Complete	As specified in the Director's approved CMI Program Plan.
Submit Corrective Measures Design Preliminary Design Approximately 60% Complete	As specified in the Director's approved CMI Program Plan.
Submit Corrective Measures Design Preliminary Design Approximately 95% Complete	As specified in the Director's approved CMI Program Plan.
Submit Final Corrective Measures Design	As specified in the Director's approved CMI Program Plan.
Progress Reports on Appendix B, Tasks I through IV	Quarterly, every ninety (90) calendar days, beginning 90 calendar days after the Director's approval of the Final RFI Report.
Submit Draft CQA Program Plan	As specified in the Director's approved CMI Program Plan.
Submit Final CQA Program Plan	Within sixty (60) calendar days of the Director's approval of the Draft CQA.
Construction of Corrective Measures	Within sixty (60) calendar days of the Director's approval of the Final CQA.
Pre-Final Inspection	Forty-five (45) calendar days following report of pre-final inspection.
Corrective Measures Construction Report	Within ninety (90) calendar days following completion of construction.
Corrective Measures Implementation Quarterly Progress Reports	Quarterly, every ninety (90) calendar days, beginning 90 calendar days after the Director's approval of the Final RFI Report.

FIGURES

[Place figure here]

Figure 11. Ground Water Monitoring Well Network for Upper Aquifer.

[Place figure here]

Figure 22. Ground Water Monitoring Well Network for Lower Aquifer

SECTION C
WASTE ANALYSES PLAN (WAP)
TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICIES

C.1 INTRODUCTION

The purpose of this Waste Analysis Plan (WAP) is to provide guidance on the necessary waste characterization, sampling methodologies, analytical techniques, and overall procedures which are undertaken during hazardous waste management activities including treatment, storage and/or disposal. Treatment and disposal activities include but are not limited to stabilization[1], solidification, chemical oxidation, chemical reduction, neutralization, deactivation, evaporation, macro/micro encapsulation, adsorption (clay, carbon, etc.) and subsequent landfilling of hazardous and non-hazardous wastes. As a general rule, USEI use the term stabilization in the more industry wide generic sense, which implies the treatment of a waste material to make it physically and chemically stable. In this sense, stabilization consists of those treatment processes (including but not limited to all the treatment types described above), which are used to meet applicable LDR treatment standards or other applicable standard(s). The specific treatment technologies utilized by USEI are defined in more detail in Section C.8.3. Process operation descriptions for hazardous waste management units are provided in Section D.10. Specifically and in accordance with IDAPA 58.01.05.008 {40 CFR § 264.13(b)}, this plan delineates the following:

- Waste determination procedures (Section C.2);
- Waste Acceptance Criteria and associated review procedures for radioactive materials (Section C. 3);
- Sampling Methodologies and associated sampling equipment (Section C.4);
- The parameters for which each hazardous waste will be analyzed and the rationale for the selection of these parameters [i.e.; how analysis for these parameters will provide sufficient information on the properties of the waste (Section C.5)];
- Test methods which will be used to test for these parameters (Section C.5);
- The frequency with which the initial analysis of the waste will be reviewed or repeated to assure the analysis is accurate and up to date (Section C.6.3);
- The methods which will be used to meet the additional waste analysis requirements for specific waste management methods as specified in IDAPA 58.01.05.008 {40 CFR § 264.17, 264.314, 264.341, 268.7} (Section C.5.2);
- Waste receipt and acceptance procedures (Section C.6 & C.7);
- The types of treatment technologies (Section C.8);
- The treatment units (Section C.9);

[1] The term "stabilization" is defined by the EPA under 40 CFR 268.42 as "Stabilization with the following reagents (or waste reagents) or combination of reagents (1) Portland Cement; or (2) lime/pozzolans (e.g., fly ash and cement kiln dust) – this does not preclude the addition of reagents (e.g., iron salts, silicates, and clays) designed to enhance the set/cure time and/or compressive strength, or to overall reduce the leachability of the metal or organic. USEI uses the term Stabilization in a more generic sense to mean the treatment of a waste material to make it physically and chemically stable. In this sense, it consists of those processes, which make the material conform to applicable LDR treatment standards or other applicable standard(s).

- The quality control and quality assurance procedures (Section C.10); and
- Other general considerations for treatment, storage and disposal operations.

It is USEI's policy that all wastes managed on-site will adhere to the procedures outlined in this WAP. This document will ensure facility compliance with applicable permits and regulations. For the purpose of implementation and performance of this WAP, "USEI" means any US Ecology Idaho laboratory, subsidiary/affiliated laboratory, or designated contract laboratory.

USEI maintains, as part of its WAP required records, generator/internally developed information. This documentation may be received, stored, transmitted, and/or retrieved electronically in addition to, or in lieu of, hard (paper) copy.

"Facility Management" includes the General Manager and the managers of the major facility functions, such as Laboratory, Technical, Operations, Health and Safety, Environmental, and/or their designees.

References are made throughout this plan to regulations promulgated by the EPA regarding waste analysis requirements for hazardous waste management facilities. These requirements are found in IDAPA 58.01.05.008 and 40 CFR Part 264, Subpart B, which have been adopted by reference in the rules of the Idaho Department of Environmental Quality (IDEQ). Unless otherwise specified herein, cited federal regulations have been adopted by the IDEQ. USEI strives to maintain full compliance with the hazardous waste regulations. New testing requirements, such as those promulgated under the Land Disposal Restrictions (LDRs), often become effective prior to the time WAP revisions can be formally executed and approved by all appropriate agencies. Accordingly, the WAP utilizes references to the most recent appropriate EPA and ASTM methods and analytical procedures. If WAP revisions are necessary because of a new regulatory rule, they will be submitted as appropriate within 90 days after their effective date.

C.2 WASTE DETERMINATION

Waste determinations will be conducted in accordance with IDAPA 58.01.05.006 {40 CFR § 262.11}. In general, generators are required to conduct waste determination as follows:

- Determine if the waste is excluded from regulation under IDAPA 58.01.05.005 {40 CFR § 261.4};

- Determine if the waste is listed as a hazardous waste in subpart D of IDAPA 58.01.05.005 {40 CFR Part 261};

- Determine if the waste is identified in subpart C of IDAPA 58.01.05.005 {40 CFR Part 261} by either testing the waste using analytical methods or applying knowledge of the hazard characteristics of the waste;

- Determine if the waste is regulated by a state other than Idaho and associated manifesting requirements; and

- If the waste is determined to be hazardous, the generator must refer to IDAPA 58.01.05.005/008/009/010/016 {40 CFR parts 261, 264, 265, 266, 268, and 273} for possible exclusions or restrictions pertaining to management of the specified waste.

The waste characterization on the Waste Product Questionnaire (WPQ) provides information concerning the distribution/concentration, as well as the characteristics of the waste components. An example of the WPQ is provided in Figure C.1.

Certain generators will not utilize USEI's WPQ and insist on using their own waste characterization form. This is often the case with large generators that are trying to reduce the amount of paperwork associated with the characterization process. Under these circumstances, USEI will transfer the waste characterization information to USEI's WPQ and identify data deficiencies, if any. Any data deficiencies necessary for the treatment, storage and disposal of the waste will be added to USEI's WPQ by contacting the generator and requesting the deficient information. USEI will then include both USEI's WPQ and the generator supplied waste characterization form as part of the profile package.

When a waste shipment arrives on-site for treatment, storage, or disposal, a determination has usually been made by the generator that the waste is either:

- Excluded as a solid waste under IDAPA 58.01.05.005 {40 CFR § 261.4(a)};

- A listed hazardous waste, as defined in Subpart D of IDAPA 58.01.05.005 {40 CFR Part 261};

- A characteristic hazardous waste, as defined in Subpart C of IDAPA 58.01.05.005 {40 CFR Part 261};

- A solid waste, which is not hazardous waste, as defined by IDAPA 58.01.05.005 {40 CFR § 261.4(b)}; and

- A Corrective Action Management Unit (CAMU)-eligible waste, as defined by IDAPA 58.01.05.008 {40 CFR 264.552(a)(1) & (2)

C.3 WASTE ACCEPTANCE CRITERIA

C.3.1 Pre-acceptance Review

The preacceptance protocol has been designed to ensure that only hazardous and radioactive material that can be properly and safely stored, treated and/or disposed of by USEI are approved for receipt at the facility. A two-step approach is taken by USEI. The first step is the chemical and/or radiological and physical characterization of the candidate waste stream by the generator. The second step is the preacceptance evaluation performed by USEI to determine the acceptability of the waste for receipt at the facility. Figure C-2 presents a logic diagram of the preacceptance protocol that is utilized at the facility.

C.3.2 Radioactive Material Waste Acceptance Criteria

The following waste acceptance criteria are established for accepting radiological contaminated waste material that is generally or specifically exempted from regulation by the Nuclear Regulatory Commission (NRC) or an Agreement State under the Atomic Energy Act of 1954 ("AEA"), as amended. Material may also be accepted if it is not regulated or licensed by the NRC or has been authorized for disposal by the IDEQ and is within the numeric waste acceptance criteria. Waste acceptance criteria are consistent with these restrictions.

The following five tables establish types and concentrations of radioactive materials that may be accepted. These tables are based on categories and types of radioactive material not regulated by the NRC based on statute or regulation or specifically approved by the NRC or and Agreement State for alternate disposal. The criteria are consistent with these restrictions and detailed analyses set forth in *Waste Acceptance Criteria and Justification for FUSRAP Material*, prepared by Radiation Safety Associates, Inc. (RSA) as subsequently refined, expanded and updated in *Waste Acceptance Criteria and Justification for Radioactive Material*, prepared by USEI.

Material may be accepted if the material has been specifically exempted from regulation by rule, order, license, license condition, letter of interpretation, or specific authorization under the following conditions: Thirty (30) days prior to intended shipment of such materials to the facility, USEI shall notify IDEQ of its intent to accept such material and submit information describing the material's physical, radiological, and/or chemical properties, impact on the facility radioactive materials performance assessment, and the basis for determining that the material does not require disposal at a facility licensed under the AEA. The IDEQ will have 30 days from receipt of this notification to reject USEI's determination or require further information and review. No response by IDEQ within thirty (30) days following receipt of such notice shall constitute concurrence. IDEQ concurrence is not required for generally exempted material as set forth in Table C.4a.

Based on categories of waste described in the waste acceptance criteria, the concentration of the various radionuclides in the conveyance (e.g., rail car gondola, other container etc.) shall not exceed the concentration limits established in the WAC without the specific written approval of the IDEQ unless generally exempted as set forth in Table C.4a. Radiological surveys will be performed as outlined in ERMP-01 to verify compliance with the WAC. If individual "pockets" of activity are detected indicating the limits may be exceeded, the RSO or RPS shall investigate the discrepancy and estimate the extent or volume of the material with the potentially elevated radiation levels. The RPS or RSO shall then make a determination on the compliance of the entire conveyance load with the appropriate WAC limits. If the conveyance is determined not to meet the limits, USEI will notify IDEQ's RCRA Program Manager within 24 hours of a concentration based exceedance of the facility WAC to evaluate and discuss management options. The findings and resolution actions shall then be documented and submitted to the IDEQ.

The radioactive material waste acceptance criteria, when used in conjunction with an effective radiation monitoring and protection program as defined in the USEI *Radioactive Material Health and Safety Plan* and *Exempt Radioactive Materials Procedures* provides adequate protection of human health and the environment. Included within this manual are requirements for USEI to submit a written summary report of Table C.1 through C.2 radioactive material waste receipts showing volumes and radionuclide concentrations disposed at the USEI site on a quarterly basis. USEI will also submit a Table C.3 through C.4b annual report of exempted products devices, materials or items within 60 (sixty) days of year end (December 31st). The annual report will provide total volumes or mass of isotopes and total activity by isotope listing the activity of each radionuclide disposed during the preceding year, and the cumulative total of activity for each radionuclide disposed at the facility. The report will include an updated analysis of the impact on the facility performance assessment.

These criteria and procedures are designed to assure that the highest potential dose to a worker handling radioactive material at USEI shall not exceed 400 mrem/year TEDE dose, and that no member of the public is calculated to receive a potential dose exceeding 15 mrem/year TEDE dose, from the USEI program. TEDE is defined as the "Total Effective Dose Equivalent", which equals the sum of external and internal exposures. The public dose limit during operation activities is limited to 100 mrem/yr TEDE dose. An annual summary report of environmental monitoring results will be submitted to IDEQ by June 1st for the preceding year.

Materials that have a radioactive component that meets the criteria described in Tables C.1 through C.4b and are RCRA regulated material will be managed as described within this WAP for the RCRA regulated constituents.

Table C.1: Unimportant Quantities of Source Material Uniformly Dispersed* in Soil or Other Media**

	Status of Equilibrium	Maximum Concentration of Source Material	Sum of Concentrations Parent(s) and all progeny present***
a	Natural uranium in equilibrium with progeny	<500 ppm / 167 pCi/g (^{238}U activity)	≤ 3000 pCi/g
	Refined natural uranium (^{238}U, ^{235}U, ^{234}U; ^{234Th}, ^{234m}Pa, ^{231}Th)	<500 ppm / 333 pCi/g	≤ 2000 pCi/g
	Depleted Uranium (^{234Th}, ^{234m}Pa)	<500 ppm / 169 pCi/g	≤ 2000 pCi/g
b	Natural thorium (^{232}Th + ^{228}Th)	<500 ppm / 110 pCi/g	≤ 2000 pCi/g
	^{230}Th in equilibrium with progeny	<0.01 ppm / 200 pCi/g	≤2000 pCi/g
	^{230}Th (with no progeny)	0.1 ppm / ≤2000 pCi/g	
	Any mixture of Thorium and Uranium	Sum of ratios ≤ 1****	≤2000 pCi/g

Table C.2: Naturally Occurring Radioactive Material Other Than Uranium and Thorium Uniformly Dispersed* in Soil or Other Media**

	Status of Equilibrium	Maximum Concentration of Parent Nuclide	Sum of Concentrations of Parent and All Progeny Present***
a	^{226}Ra or ^{228}Ra with progeny in bulk form [1]	500 pCi/g	≤ 4500 pCi/g
b	^{226}Ra or ^{228}Ra with progeny in reinforced IP-1 containers [1]	1500 pCi/g	13,500 pCi/g
c	^{210}Pb with progeny(Bi & ^{210}Po)	1500 pCi/g	4500 pCi/g
	^{40}K	818 pCi/g	N/A
	Any other NORM		≤3000 pCi/g

[1] Any material containing ^{226}Ra greater than 222 pCi/g shall be disposed at least 6 meters from the external point on the completed cell.

Table C.3: Non-Production Particle Accelerator Produced Radioactive Material*****

Acceptable Material	Activity or Concentration
Any non-production particle accelerator produced radionuclide.	All materials shall be packaged in accordance with USDOT packaging requirements. Any packages containing iodine or volatile radionuclides will have lids or covers sealed to the container with gaskets. Contamination levels on the surface of the packages shall not exceed those allowed at point of receipt by USDOT rules. Gamma or x-ray radiation levels may not exceed 10 millirem per hour anywhere on the surface of the package. All packages received shall be directly disposed in the active cell. All containers shall be certified to be 90% full.

*Average over conveyance or container. The use of the phrase “over the conveyance or container is meant to reflect the variability on the generator side. The concentration limit is the primary acceptance criteria.

**Unless otherwise authorized by IDEQ, other Media does not include radioactively contaminated liquid (except for incidental liquids in materials). See radioactive contaminated liquid definition (definition section of Part B permit).

******* Diffuse waste with a total concentration (sum of concentrations of all radionuclides present) which is 2000 pCi/g or less may be accepted at the site (i.e., the controlling limit is 2000 pCi/g).

******** $$\frac{\text{Conc. of U in sample}}{\text{Allowable conc. of U}} + \frac{\text{Conc. of Th in Sample}}{\text{Allowable conc. of Th}} \leq 1$$

***** Any material that has been made radioactive by use of a non-production particle accelerator as set forth in Federal Register, Vol. 72, No. 189, Monday October 1, 2007, page 55868.

Table C.4a: NRC Exempted Products, Devices or Items

Exemption 10 CFR Part*	Product, Device or Item	Isotope, Activity or Concentration
30.15	As listed in the regulation	Various isotopes and activities as set forth in 30.15
30.14, 30.18	Other materials, products or devices specifically exempted from regulation by rule, order, license, license condition, concurrence, or letter of interpretation	Radionuclides in concentrations consistent with the exemption
30.19	Self-luminous products containing tritium, ^{85}Kr, ^{3}H or ^{147}Pm	Activity by Manufacturing license
30.20	Gas and aerosol detectors for protection of life and property from fire	Isotope and activity by Manufacturing license
30.21	Capsules containing ^{14}C urea for *in vivo* diagnosis of humans	^{14}C, one µCi per capsule
40.13(a)	Unimportant quantity of source material: see table above	≤0.05% by weight source material
40.13(b)	Unrefined and unprocessed ore containing source material	As set forth in rule
40.13(c)(1)	Source material in incandescent gas mantles, vacuum tubes, welding rods, electric lamps for illumination	Thorium and uranium, various amounts or concentrations, see rules
40.13(c)(2)	(i)Source material in glazed ceramic tableware (ii)Piezoelectric ceramic (iii) Glassware not including glass brick, pane glass, ceramic tile, or other glass or ceramic used in construction	≤20% by weight ≤2% by weight ≤10% by weight
40.13(c)(3)	Photographic film, negatives or prints	Uranium or Thorium
40.13(c)(4)	Finished product or part fabricated of or containing tungsten or magnesium-thorium alloys. Cannot treat or process chemically, metallurgically, or physically.	≤4% by weight thorium content.
40.13(c)(5)	Uranium contained in counterweights installed in aircraft, rockets, projectiles and missiles or stored or handled in connection with installation or removal of such counterweights.	Per stated conditions in rule.
40.13(c)(6)	Uranium used as shielding in shipping containers if conspicuously and legibly impressed with legend “CAUTION RADIOACTIVE SHIELDING – URANIUM” and uranium incased in at least 1/8 inch thick steel or fire resistant metal.	Depleted Uranium
40.13(c)(7)	Thorium contained in finished optical lenses	≤30% by weight thorium, per conditions in rule.
40.13(c)(8)	Thorium contained in any finished aircraft engine part containing nickel-thoria alloy.	≤4% by weight thorium, per conditions in rule.

Table C.4b: Materials Specifically Exempted by the NRC Or NRC Agreement State

Exemption	Materials	Isotope, Activity or Concentration*
10 CFR 30.11***	Byproduct material including production particle accelerator material exempted from NRC or Agreement State regulation by rule, order, license, license condition or letter of interpretation may be accepted as determined by specific NRC or Agreement State exemption.****	Byproduct material at concentrations consistent with the exemption**
10 CFR 40.14***	Source material exempted from NRC or Agreement State regulation by rule, order, license, license condition or letter of interpretation may be accepted as determined by specific NRC or Agreement State exemption.****	Source material at concentrations consistent with the exemption.
10 CFR 70.17	Special Nuclear Material (SNM) exempted from NRC regulation by rule, order, license, license condition or letter of interpretation may be accepted as determined by specific NRC or Agreement State exemption.****	SNM at concentrations consistent with the exemption.

*Sum of all isotopes up to a maximum concentration of 3,000 pCi/gm.

**Specifically exempted production beam accelerator may be received under Table C.3 provisions [10 CFR 20.2008 (b)]

***Also includes equivalent Agreement State regulation where applicable.

**** Similar material not regulated or licensed by the NRC may also be accepted. Sum of all isotopes up to a maximum concentration of 3,000 pCi/gm. IDEQ shall be notified prior to the receipt of Special Nuclear Material not regulated or licensed by the NRC.

Additional Information for USEI's Waste Analysis Plan

1. US Ecology Idaho, Inc. (USEI) may receive contaminated materials or other materials as described in Tables C.1 - C.4b above. USEI may not accept for disposal any material that by its possession would require USEI to have a radioactive material license from the Nuclear Regulatory Commission (NRC).

2. Unless approved in advance by USEI and IDEQ, average activity concentrations may not exceed those concentrations enumerated in Tables C.1 and C.2. Additionally, for Tables C.1 and C.2, individual pockets of material may exceed the WAC for the radionuclides present as long as the average concentration of all radionuclides within the package or conveyance remains at or below the WAC and the highest dose rate measured on the outside of the unshielded package or conveyance does not exceed those action levels enumerated in ERMP-01.

3. Other items, devices or materials listed in Table C.4a, which are exempted in accordance with 10 CFR Parts 30, 40 or equivalent Agreement State regulations or 10 CFR Part 70 may be accepted at or below the activities (per device or item) or concentrations specified in those exemptions.

4. The generator of the exempted or non-production particle accelerator produced waste must specify that the waste meets applicable acceptance criteria and/or exemption requirements.

5. In accordance with permit requirements, notification of any exceedance of the WAC will be provided to the RCRA Program Manager within 24 hours, in accordance with the permit.

C.4 SAMPLING METHODOLOGY

Sampling is performed by the generator and/or their representatives to make the initial waste determination and/or by USEI to identify incoming waste shipments. Waste generators are referred to IDAPA 58.01.05.005 {40 CFR Part 261}, Appendix I, II and III for sampling procedures. IDAPA 58.01.05.005 {40 CFR Part 261, Appendix I, II and III} describes sampling and analysis method selection procedures generators should consult when determining the specific sample analysis situation. Sampling is usually conducted as described in EPA document SW-846.
The sampling strategy employed for a given WAP activity is dependent on the nature of the waste being sampled, the type of container/vehicle in which it has been shipped, or the type of hazardous waste management unit in which the waste resides. Hazardous waste is received at the facility in various containers/vehicles including, but not limited to, bulk tanks, end dump trucks, drums, and boxes. Inside the facility, hazardous wastes are contained in landfills, surface impoundments, tanks, waste bins, containers, and other hazardous waste management units. Access to the container/vehicle or hazardous waste management unit influences sampling strategy.

This section presents sampling methodologies to be utilized by USEI personnel when collecting representative samples for analysis pursuant to IDAPA 58.01.05.008 {40 CFR §§264.13(a), 264.13(b), and 264.13(c)}.

The waste shipment is inspected, sampled, and/or analyzed to ensure it matches the overall identity of the waste designated on the accompanying manifest (or shipping paper) and the pre-acceptance paperwork (WPQ, etc). If examination indicates strata in the waste, then each layer may be composited in proportion to its estimated volume or analyzed separately.

The sampling equipment and procedures described in this WAP represent USEI's recommended sampling protocol for general types of waste materials and containment. Specific waste materials or shipments may require different sampling techniques as outlined in the Waste Analysis at Facilities That Generate, Treat, Store, and Dispose of Hazardous Wastes: A Guidance Manual, USEPA OSWER 9938.4-03, April 1994. Therefore, deviations from the recommended protocol do not constitute violations of acceptable sampling practices or conditions of this WAP. USEI personnel follow the QA/QC procedures outlined in Section C.10 when collecting samples for characterization.

C.4.1 Sampling Materials

At a minimum, the methodologies utilized for specific materials correspond to those referenced in IDAPA 58.01.05.005 {40 CFR Part 261, Appendix I}. The types of sampling methods and the most common equipment utilized for different materials are presented in the following table.

Table C.5 Sampling Methods and Equipment

Material	**Equipment**
Extremely viscous liquid	Thief or COLIWASA/tube sampler
Crushed or powdered material	Tube sampler, trier, auger, scoop, or shovel
Soil-like material	Tube sampler, trier, auger, scoop, or shovel
Fly ash-like material	Tube sampler, trier, auger, scoop, or shovel
Containerized liquids	COLIWASA/tube sampler, weighted bottle, cup, bomb, or tank sampling port

C.4.2 Sampling of Containers

USEI has instituted specific methodologies for taking samples from various container types. The type of container may be stationary or transportable, such as drums, tanks, portable transport units (e.g., tote bins, drums, roll-off boxes, lugger boxes), tankers, or dump-type trucks. Sampling devices are selected depending on the size and type of the container and on the specific material involved.

Access to a container influences the location from which samples can be taken. Specific sampling procedures are dependent on both the distribution and the nature of the waste components in the container. Due to these variations, minor modifications may be needed to the recommended sampling procedure in order to obtain a sample.

C.4.2.1 Sampling Containers and Tanks

Sampling small containers (e.g., drums, boxes, cartons, & other small units) varies with the nature of the waste. For flowable materials, the sampling device of choice is either a Coliwasa or tubing (or other device noted in Table C.5). For non-flowable wastes, a tubing or trier is typically used to obtain a representative sample (or other device noted in Table C.5).

Large containers and tanks of flowable materials and bulk containers of solid materials may be either stationary or mobile. Liquids may be sampled with Coliwasa, tubing, weighted bottle, or bomb sampler to allow for sampling at various depths. Tank sampling may be accomplished through ports or taps located along the side of the tank or sampling through pumps or fittings at the tank inlet or outlet.

Under some circumstances, multiple samples collected from a single container/tank or hazardous waste management unit are composited prior to analysis. For example, multiple point samples obtained from a bulk truckload can be composited so long as there are no obvious physical differences among the samples. In all cases, wastes exhibiting distinctly different visual physical characteristics that are inconsistent with the approved WPQ and/or Internal Control Form (ICF) are sampled and analyzed independently.

C.4.3 Compositing Samples

Compositing of samples is conducted at the facility laboratory. Each composited sample is composed of equal portions, by weight, of each sample. The individual sample portions are combined and mixed until homogenous (i.e., the sample visually appears uniform in texture, particle size distribution, and color). The weight of sample portions utilized for the composited sample is determined with consideration of the sample size required by the analytical method to be performed. The appropriate sized sample, in accordance with the analytical procedures to be utilized, is then randomly removed from the homogenous composited sample for analysis.

Where the composited samples of separate batches of treated waste are to be further composited for additional testing, the composited sample from each batch is stored for inclusion in the final composited sample for additional testing. At the time of additional testing, each composited batch sample is particle size reduced and mixed until homogeneous, as necessary, in accordance with the analytical procedures to be utilized. The individual composited samples of each treated batch are then composited, as described above, to produce the final composited sample for additional testing.

C.5 ANALYTICAL RATIONALE

Waste characterization information is obtained by USEI on a WPQ. An example of the WPQ is provided in Figure C.1. USEI obtains all the information required by IDAPA 58.01.05.008 {40 CFR §§264.13(a)(1) and 264.13(a)(2)} to treat, store, or dispose of a waste. At a minimum, the analysis must contain all the information necessary to treat, store, or dispose of the waste.

Analyses are provided by USEI to augment the waste characterization, when necessary, and to identify incoming waste shipments. Analyses are utilized to provide data necessary for proper waste handling.

Analytical parameters are classified as Fingerprint Analyses and Supplemental Analyses.

Fingerprint Analyses – Fingerprint Analyses are performed on incoming waste shipment samples, except as noted in Section C.5.1 and C.7.1.6, in order to: 1) identify a waste shipment; and 2) ensure the appropriate waste management technique will be utilized. Fingerprint Analyses will be performed on a waste sample, when necessary for pre-acceptance purposes, if the generator-supplied information is not sufficient.

Supplemental Analyses – Facility management may select additional supplemental analyses to obtain information required for efficient process control or to further evaluate a positive result from a screening test (for example, a flash point may be run to provide more specific waste data when a positive flammability potential is reported during the initial testing). Supplemental analyses are performed on incoming waste shipment and in-process samples as specified by this WAP or facility management to:

- Confirm and/or augment existing information on the waste;
- Further identify a waste;
- Further ensure the appropriate treatment, storage, or disposal process(es) can be utilized to provide operations information utilized for control of these processes; and
- Supplemental Analyses may also be performed on any waste sample, when necessary for pre-acceptance purposes, if the generator-supplied information is not sufficient.

This arrangement allows a tiered approach to waste identification, enabling USEI to structure the analyses to adequately identify the waste or to define operational parameters for various treatment processes. At a minimum, all wastes, except as noted in Section C.7.1.6, are subjected to the Fingerprint Analyses as a 1st step in the analytical scheme. Supplemental Analyses are performed at the direction of facility management. The parameters which constitute the Fingerprint Analyses and Supplemental Analyses are described below and primarily consist of "standard" analytical techniques (recognized by the EPA, ASTM or other authoritative sources). In addition to the identified Fingerprint and Supplemental Analyses, USEI may utilize other "standard" analytical techniques and "unique" analyses (developed by USEI) for analysis of wastes. A summary of the analytical parameters and their usage is provided herein. Analyses will be consistent with the QA/QC procedures outlined in Section C.10.

C.5.1 Fingerprint Analyses

Fingerprint Analyses consist of basic screening procedures performed to provide general waste identification and associated waste confirmation. The Fingerprint Analyses is compared with the WPQ/ICF and pre-acceptance evaluation data to confirm that the waste is the same waste that was characterized during the pre-acceptance process (e.g., WPQ, manifest and/or shipping papers). These analyses may be used in conjunction with other waste analyses and information to further identify a waste and/or ensure the type of on-site management chosen is suitable for that particular waste.

During the Pre-Acceptance process, USEI personnel develop a fingerprint analysis based on the characteristics of the waste in question as well as the limits of fingerprint parameter variability. Parameters that are applicable to the waste stream will be specified for fingerprinting. Certain types of waste streams that are not conducive to fingerprint sampling (e.g., debris, solid resins) are not readily sampled and as a result fingerprint parameters may be limited to field-testing and observations. Also, due to the diversity of potential waste streams, the selection of discretionary parameters for waste receipt (and process control) is made on a case-by-case evaluation. If a discretionary fingerprint is no longer needed for proper waste receipt control, it may be suspended or eliminated. USEI will conduct a visual inspection on 100% of all waste received.

Table C.6 provides a default list of fingerprint control parameters and the allowable variability for fingerprint parameters. Unless otherwise specified by the Lab Manager (or his/her designee) or on the WPQ/ICF the default values from Tables C.6 will apply.

The primary parameters and associated rationale of the Fingerprint Analyses are as follows:

- **Physical Description** (appearance) is used to determine the general properties of the waste. This facilitates comparison of the sampled waste with prior waste descriptions or samples. It is also used to verify the presence or absence of free standing liquid, as well as any obvious change in physical properties. Typical physical properties include color, physical description, texture, and percent water (free liquids).

- **pH Screen** is undertaken to indicate the pH and, in general, the corrosive nature of the waste. pH may not apply to certain waste types, (e.g., organic wastes, oil waste, or wastes which are not water soluble).

- **Water Reactivity Screen (Water Compatibility)** is used to determine whether the waste has a potential to vigorously react with water to form gases or other products, or whether it generates significant heat. This testing does not apply to wastes that are already in contact with excess water, or for which sufficient analytical data indicate no potential reactivity with water.

- **Flammability Potential Screen** is used to indicate the fire-producing potential of the waste. This testing can be applied to all waste liquids, semi-solids or solids. It is used to identify obvious changes in a waste such as flammable waste substituted for an inert solid. This test is not performed on solids unless the waste contains free liquids.

- **Cyanides Screen** is used to indicate whether the waste has the potential to produce hydrogen cyanide gas upon acidification below pH 2. It is not required if the pH of the waste is < 5.0, or if the waste is not water-soluble.

- **Sulfide Screen** is used to indicate whether the waste has the potential to produce hydrogen sulfide gas upon acidification below pH 2. It is not required if the pH of the waste is < 5.0, or if the waste is not water-soluble.

- **Radioactive Screen** is used on material that are considered radioactive (per the WPQ) to ensure the compliance with the WAC. A radioactive screen is not required on non-radioactive waste streams.

C.5.2 Supplemental Analyses

Supplemental Analyses are performed to further identify wastes, verify treatment standards, provide safety information, and/or to provide process control information, as directed by facility management. The results of these analyses provide additional confidence concerning the proper management methods. Most of the parameters, which constitute the Supplemental Analyses utilize the most recent analytical techniques recognized by EPA, ASTM and other authoritative sources or have been developed by USEI through its operating experience for general waste identification and / or proper waste management and which meet USEI performance standards. Standard supplemental analytical parameters are identified in Table C.7. The referenced method or equivalent standard method will be used for analyses of these parameters. Table C.7 provides a list of available test methods.

TABLE C.7 – Test Methods

Sample Work Up Techniques:	
Method	Reference
General Extractions	
EP Toxicity	1-1310A
TCLP	1-1311
Metals Acid Digestion	
Flame atomic absorption spectroscopy (AAS) or inductively coupled plasma spectroscopy (ICP)	1-3005, 3010
Microwave assisted	1-3015, 2-3030, 3-D4309, D5258
Graphite furnace atomic absorption spectroscopy (GFDAA)	1-3020
Oils, greases, or waxes	1-3031
Dissolution procedure for oils, greases, waxes	1-3040
Sludge's, soils, and oils	1-3050
Microwave assisted	1-3051
Alkaline digestion	1-3060
Parr acid bomb digestion	3-E886, E926
Organic Extractions and Cleanups	
Extraction Procedure for Oily Wastes	1-1330
Organic Extraction and Sample Preparation	1-3500
Waste Dilution	1-3580, 3585
Separatory funnel liquid-liquid extraction	1-3510
Continuous liquid-liquid extraction	1-3520
Soxhlet extraction	1-3540, 3541
Sonication extraction	1-3550
Purge and Trap	1-5030
Solid phase extraction (SPE)	1-3535
Hexadecane Extraction and Screening of purgeable organics	1-3820
Alumina cleanup	1-3610, 3611
Florisil cleanup	1-3620
Silica gel cleanup	1-3630
Gel-permeation cleanup	1-3640
Acid-base partition cleanup	1-3650
Sulfur cleanup	1-3660
Sulfuric acid / permanganate cleanup	1-3665
Inorganic analytical methods:	
Inductively coupled plasma atomic emission spectroscopy/Mass spec.	1-6010, 6020
Antimony	
Atomic absorption, direct aspiration method	1-7040, 4-204.1
Atomic absorption, furnace method	1-7041, 4-204.2
Arsenic	
Atomic absorption, furnace method	1-7060, 4-206.2
Atomic absorption, gaseous hydride method	1-70614-206.3
Barium	
Atomic absorption, direct aspiration method	1-7080, 4-208.1
Atomic absorption, furnace method	1-7081, 4-208.2
Beryllium	
Atomic absorption, direct aspiration method	1-70904-210.1
Atomic absorption, furnace method	1-7091, 4-210.2
Cadmium	
Atomic absorption, direct aspiration method	1-7130, 4-213.1
Atomic absorption, furnace method	1-7131, 4-213.2
Calcium	
Atomic absorption, direct aspiration method	1-7130, 4-213.1
Atomic absorption, furnace method	1-7131, 4-213.2
Chromium	
Atomic absorption, direct aspiration method	1-7190, 4-218.1
Atomic absorption, furnace method	1-7191, 4-218.2
Hexavalent chromium: Co-precipitation	1-7195

Sample Work Up Techniques:	
Method	Reference
Hexavalent chromium: Colorimetric	1-7196, 2-3500CrD
Hexavalent chromium: Chelation-extraction	1-7197, 4-218.4
Hexavalent chromium: Diff. phase polarography	1-7198
Copper	
Atomic absorption, direct aspiration method	1-7210, 4-220.1
Atomic absorption, furnace method	1-7211, 4-220.2
Iron	
Atomic absorption, direct aspiration method	1-7380, 4-236.1
Atomic absorption, furnace method	1-7381, 4-236.2
Phenanthroline method (ferrous)	2-3500FeD
Lead	
Atomic absorption, direct aspiration method	1-7420, 4-239.1
Atomic absorption, furnace method	1-7421, 4-239.2
Magnesium	
Atomic absorption, direct aspiration method	1-7450, 4-242.1
Manganese	
Atomic absorption, direct aspiration method	1-7460, 4-243.1
Atomic absorption, furnace method	1-7461, 4-243.2
Mercury (manual cold-vapor technique	
In liquid waste	1-7470
In solid or semisolid waste	1-7471
Nickel	
Atomic absorption, direct aspiration method	1-7520, 4-249.1
Atomic absorption, furnace method	1-7521, 4-249.2
Osmium	
Atomic absorption, direct aspiration method	1-7550
Atomic absorption, furnace method	1-7551
Selenium	
Atomic absorption, furnace method	1-7740, 4-270.2
Atomic absorption, gaseous hydride method	1-7741, 4-270.3
Atomic absorption, gaseous hydride method	1-7742, 4-206.3
Silver	
Atomic absorption, direct aspiration method	1-7760, 4-272.1
Atomic absorption, furnace method	1-7761, 4-272.2
Thallium	
Atomic absorption, direct aspiration method	1-7840, 4-279.1
Atomic absorption, furnace method	1-7841, 4-279.2
Vanadium	
Atomic absorption, direct aspiration method	1-7910
Atomic absorption, furnace method	1-7911
Zinc	
Atomic absorption, direct aspiration method	1-7950, 4-289.1
Atomic absorption, furnace method	1-7951, 4-289.2
Organic Analytical Methods:	
Gas Chromatographic Methods	
Halogenated volatile organics	1-8010, 8021
Non-halogenated Volatile Organics	1-8015
Aromatic Volatile Organics	1-8020, 8021
Acrolein, Acrylonitrile, Acetonitrile	1-8031
Phenols	1-8040, 8041
Phthalate Esters	1-8060, 8061
Nitrosamines	1-8070
Organochlorine pesticides, halowaxes, and PCB's	1-8080, 8081
PCBs	1-8080, 8082
Nitroaromatics and cyclic ketones	1-8090, 8091
Polynuclear Aromatic Hydrocarbons	1-8100
Haloethers	1-8110, 8111
Chlorinated Hydrocarbons	1-8120, 8121

Sample Work Up Techniques:			
	Method		Reference
	Organophosphate Pesticides		1-8140, 8141
	Chlorinated Herbicides		1-8150, 8151
Gas Chromatographic/Mass Spectroscopy Methods			
	Volatile Organics		1-8240, 8260, 7-624
	Semi-volatile Organics:		1-8250, 8270, 7-625
Other Organic Methods			
	Qualitative infrared (IR) spectroscopy method		1-8410, 8430, 8440, 3-D2621, D4053
	GC/FTIR method		1-8410
	Heating value, bomb combustion method		1-5050, 3-D240, D2015
	Halogen and Sulfur Content		
		Chlorine content	3-D808, D2361, D4327
		Halogen content	3-D808, D2361, D4327
		Sulfur content	3-D129, D3177, D4327
	Oil and Grease		1-4030, 9070, 9071, 2-5520, 4-413.1, 413.2
	Petroleum hydrocarbons, total recoverable		2-5520, 4-418.1
	Solvent distillation		4-D86, D1078
	Total organic carbon		1-9020, 9060, 2-5310, 3-D2579
	Total Organic Halides (TOX)		2-506
Screening Methods			
	Physical description		3-D4979
	Flammability potential screen		3-D4982
	Water compatibility		3-D5058
	Oxidizer screen		3-D4981
	pH screen		3-D4980
	Sulfide screen		3-D4978
			Gas Detection Tubes (e.g. Dragger, Sensidyne, MSA
	Cyanide screen		3-D5049
			Gas Detection Tubes (e.g. Drager, Sensidyne, MSA
	Commingled liquid waste compatibility test		3-D5058
	Polymerization potential		3-D5058
	Paint filter test		1-9095
	Bulk density and apparent specific gravity screen		3-D5057
	Polychlorinated biphenyl's (PCBs) screen		1-4020, 9097
	Liner compatibility determination		1-9090
Miscellaneous Analytical Methods:			
	Acidity		2-2310
	Alkalinity		2-2320
	Ammonia		2-4500NH_3, 4-350.3
	Anions		
		By ion chromatography	1-9056, 3-D4327, 4-300.0
		Chlorides	1-9250, 9251, 9252, 9253, 2-4500Cl^-, 4-300.0, 325.3
		Sulfates	1-9035, 9036, 9038, 2-4500SO_4^{2-}, 4-300.0, 375.3
		Nitrates	1-9200, 9210, 2-4500NO_3^-, 4-300.0, 352.1, 353.2
		Fluoride	1-9214, 2-4500F^-, 4-300.0, 340.2, 340.3
		Bromides	1-9211, 2-4500Br^-, 4-300.0, 320.1
		Phosphates	2-4500P, 4-300.0, 365.1
	% Ash		2-2540, 3-D482, D3174
	Conductivity / conductance		1-9050, 2-2510, 3-D1125, 4-120.1
	Cyanides		
		Total and amenable cyanides	1-9010, 9012, 9013, 2-4500CN^-, 4-335.1
		Dissociable cyanides	1-9213, 2-4500CN^-
		Test Method to Determine Hydrogen Cyanide Released from Wastes (Reactive Cyanides)	1-7.3.3.2
	Flash point / Ignitability		

Sample Work Up Techniques:	
Method	Reference
Pensky-Martens closed-cup method	1-1010, 3-D93
Setaflash closed-cup method	1-1020, 3-D3278
Cleveland open-cup method	3-D1498
Oxidation / reduction (redox) potential (ORP)	3-D1498
PH measurement	1-9040, 9041, 9045, 2-4500H$^-$, 3-E70, 4-150.1
Solids	
Total (TS) at 103/105^{O}C	2-2540, 4-160.3
Dissolved (TDS) at 180^{O}C	2-2540, 4-160.1
Total suspended (TSS) at 103/1`05^{O}C	2-2540, 4-150.2
Fixed and volatile at 500^{O}C	2-2540, 4-160.4
Total Solids (moisture content)	e.g., Ohaus, Microwave, Oven
Specific Gravity	1-9030, 2-2710F, 3-D70, D891, D1217, D1429
Sulfides	
Extractable sulfides	1-9031
Soluble sulfides	1-9215, 2-4500S^{2-}
Test Method to Determined Hydrogen Sulfide Released from Wastes (Reactive Sulfides)	1-7.3.4.2
Total sulfides	1-9030A, 2-4500S^{2-}
Viscosity	3-D88, D446, D2983
Water Content	3-D95, D3173, D4006, E203

The above referenced procedures are described in the following publications (the latest update to any of the below referenced documents are acceptable). The first digit of the reference numbers above are keyed to the numbers shown below:

1.	***Test Methods for Evaluating Solid Waste***, SW-846, U.S. Environmental Protection Agency, Office of Water and Waste Management, Washington, D.C. 20406
2.	***Standard Methods for the Examination of Water and Waste Water***, American Public Health Association (APHA), American Water Works Associations, Water Environment Federation
3.	***Annual Book of ASTM Standards***, American Society for Testing Materials (ASTM), 100 Barr Harbor Drive, West Conshohocken, PA 19428
4.	***Methods for Chemical Analysis of Water and Wastes***, EPA-600/4-79-020, U.S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory (EMSL), Cincinnati, Ohio 45268
5.	“Infrared Analysis Method,” IERL-RTP Procedures Manual: level I Environmental Assessment, EPA-600/7-78-201
6.	“Acid Digestion Bombs,” Bulletin 4745, Parr Instrument Company, Moline, IL 61265
7.	“Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater,” Title 40, Part 136, Appendix A, CFR, USEPA, EMSL
8.	Bellar, T.A., and Lichtenberg, J.J., “The Determination of Polychlorinated Biphenyls in Transformer Fluid and Waste Oils,” EPA-600/4-81-045, USEPA, EMSL

Standard analytical procedures not listed here, which may be needed, will be taken from the above-referenced sources or other recognized sources (e.g.; Official Methods of Analysis of the Association of Official Analytical Chemist (AOAC), 15th Edition, AOAC, Arlington Virginia, 1990) or more recent supplements or editions.

The following list provides a general explanation of various analytical methods that may be used:

- **Beilstein Screen** is used to indicate the presence of halogenated organics in aqueous and organic wastes.

- **Bench-Scale Treatment Evaluation** to determine the appropriate ratios of wastes to reagents or waste-to-waste to be used in the treatment process to produce the desired reaction / result.

- **Chlorides** determine if the major acid component is hydrochloric acid or its salt.

- **Cyanides Peroxide Amenability** determines the effectiveness of H_2O_2 for cyanide treatment.

- **Cyanides Chlorination Amenability** (Sodium Hypochlorite or direct Chlorination) is run to determine the effectiveness of hypochlorite for cyanide treatment.

- **Cyanides Conversion Amenability** is performed to determine the effectiveness of other types of reagents treatment for cyanides.

- **Filter time** is used to determine filterability of waste.

- **Filterable Residue** quantifies the suspended solids present to determine filtration requirements in process operations.

- **Flash Point/Ignitability** further identifies ignitable wastes to establish proper storage mode and conformance with permit conditions.

- **Gas Chromatographic Scan** is used to identify specific organic compounds.

- **Qualitative IR Spectroscopy** is run to provide a fingerprint spectrum of organic wastes.

- **Liquid Waste Compatibility** determines whether liquid wastes which are to be combined together are compatible. This is a required supplemental analysis when combining different wastes.

- **Metals Content** may be determined to quantify metals concentrations for process operating parameters or potential salt precipitation for monitoring certain processes.

- **Nitrates** determine if the major acid component is nitric acid or its salt.

- **Non-Filterable Residue** quantifies the dissolved solids present to determine acceptability for certain processes.

- **Oil and Grease** quantifies the amount of oil and grease so as not to impact certain processes.

- **Organic Content** (OC) provides a conservative measure of organic carbon in a waste. This determination may use the procedure for Total Organic Carbon (for suitable waste forms), or my be calculated based on the results of a water content test using Karl Fisher or Dean Stark methods. Organic content is conservatively determined as the difference of water and ash from the total sample.

- **Oxidizer Screen** is used to indicate the oxidation characteristics of a waste stream.
- **Paint Filter Test** is used to indicate if free liquids are present in a solid or semi-solid material.
- **PCB Screening** indicates whether or not PCBs are present in a waste.
- **PCBs in Aqueous Liquids** determines whether PCBs are present in a liquid waste.
- **Percent Acidity** determines the acidity in the waste. It may be performed if the waste is aqueous and below a pH of 4.
- **Percent Alkalinity** determines the amount of alkalinity in the waste. It may be performed if the waste is aqueous and above a pH of 7.
- **Percent Ash** is used to determine the ash content in waste feeds to the indirect thermal desorber.
- **Percent Solids by Centrifuge** determines the percentage of suspended solids by centrifugation.
- **pH** provides a more precise measurement of pH and an indication of corrosivity when determining process parameters.
- **Phosphates** determine if the major acid component is phosphoric acid or its salt.
- **Soluble Sulfides** are analyzed to provide quantitative backup to the reactive sulfides screen.
- **Solvent Screen** is used to identify the presence of LDR solvent constituents.
- **Specific Gravity / Bulk Density** indicates density of the waste. This information is used to convert weight of materials to volumes (and vice versa).
- **Stabilization Treatment Studies** are run to determine if a waste is amenable to stabilization and to determine the appropriate reagent-to-waste ratio.
- **Sulfates** determine if the major acid component is sulfuric acid or its salt.
- **Sulfide** Peroxide Amenability determines the effectiveness of H_2O_2 for sulfide treatment.
- **Sulfide Conversion Amenability** is tested to determine the effectiveness of other types of reagents treatment for sulfides.
- **Sulfur Content** determines the sulfur content of waste to be incinerated and thus its capability to generate SO_2 (SO_x) gases.

- **Total and Amenable Cyanides** quantifies the concentration of all free and most complexed cyanides (total cyanides) and/or cyanide species amenable to alkaline chlorination (amenable cyanides). Results may be used for treatability determinations, to monitor treatment processes, and/or to meet disposal restrictions including Land Disposal Restrictions.

- **TOC** may be used to determine the organic concentration in waste.

- **TOX** may be used to determine the organic-chloride concentration in waste.

- **Total Solids** quantifies suspended and dissolved solids and moisture content for selected processes.

- **Total Sulfides** is used to quantify the concentration of total sulfides to back up the sulfides screen.

- **Viscosity** determines the waste pumpability.

- **Visual Oil and Grease** provides a qualitative assessment of filterability and organic contents.

- **Waste Compatibility** is tested to determine whether wastes stored or processed together are compatible.
- **Water Compatibility** is used to deter whether the waste has a potential to react vigorously with water, to form gases, other products, or to generate extreme heat and to determine if it is soluble in water. This test does not apply to wastes already in contact with excess water or to wastes known to be water reactive.

- **Water Content** is used to determine the percent of water present in a waste.

Other standard analytical techniques not listed here may be added as required by changes in regulations, company policy, etc. These techniques will be taken from recognized sources (e.g., SW-846, ASTM, AWWA, etc.).

C.6 PRE-ACCEPTANCE PROCEDURES

The generator is responsible for characterizing the waste (IDAPA 58.01.05.006) (40 CFR §262.11) and determining the applicability of IDAPA 58.01.05.008 {40 CFR Part 264, Subpart CC} via an associated certification of subpart CC compliance. The generator is also responsible for presenting the waste characterization results on a completed WPQ. Although USEI cannot require generators to submit a certification by regulation, USEI asks waste generators to provide a certification on the WPQ as follows:

> "I hereby certify that as an authorized representative of the generator named above, all information submitted in this and all attached documents are true and accurate. Pre-shipment and all other samples provided and a true representative sample of the waste and were samples in accordance with 40 CFR Part 261.20. Any analysis of the waste was conducted in accordance with the approved test methods in 40 CFR Part 261 on a representative sample as defined in 40 CFR Part 261.20. To the best of my knowledge all known and suspected hazardous components have been included in this documentation. All material, descriptions, and packaging will comply with current regulations".

The generator's waste characterization normally includes an analysis of at least one representative sample of the waste for hazardous characteristics and chemical composition. In some cases, generator knowledge of the waste is sufficient. The generator or an independent laboratory (including USEI) may perform analyses. Testing and analyses are performed using standard test methods (EPA, ASTM, AWWA, or other approved standards) or alternative methods approved in the facility's RCRA permit.

The generator also evaluates the candidate waste for additional characteristics that may prohibit the waste from acceptance at USEI and certifies that the waste does not exhibit any of these characteristics. Table C.8 provides a complete list of materials that are restricted from on-site disposal. .

USEI has developed a series of criteria to determine the acceptability of specific wastes for management at USEI. These criteria are referred to as pre-acceptance reviews and dictate what information USEI must have available in order to determine the acceptability of the waste for on-site management. At a minimum, USEI will obtain all the information required by IDAPA 58.01.05.008 {40 CFR §264.13(a)(1)}.

The pre-acceptance review is the mechanism for deciding to reject or accept a particular type of waste, prior to its acceptance at the facility, based on the conditions or limitations of existing permits, the waste's compatibility with other wastes being managed on-site, and the waste's suitability for management utilizing the process options available on-site. The pre-acceptance review for USEI may be carried out on-site, or upon receipt of the load prior to (or in conjunction with) waste acceptance. Accordingly, and consistent with EPA guidance and this WAP, USEI will obtain applicable information, either during the pre-acceptance, incoming load review, or prior to on-site disposal to confirm the concentration level of constituents of concern (those reasonably expected to be in the waste).

C.6.1 Procedural Requirements

For each new waste stream that is a candidate for on-site management, except where noted herein, the following procedures are implemented:

During the pre-acceptance process USEI will obtain:

- Pertinent chemical and physical data (i.e., waste characteristics) and associated certification on the WPQ.
- A representative sample, if required (a representative sample may not be required by USEI if facility management determines the pre-acceptance documentation gives sufficient information to maintain compliance with permit and operational constraints and submittal of a sample for analysis would not aid in the disposal decision process).
- Land Disposal Restriction Notification/Certification and/or data (IDAPA 58.01.05.011) (40 CFR §268.7) unless submitted on a load-by-load basis or the certification required by IDAPA 58.01.05.008 (40 CFR § 264.555) if the waste is received under a CAMU-eligibility determination.
- Other supporting documentation as appropriate, including any information such as process description, additional analytical results, Material Safety Data Sheets (MSDS), product ingredients, etc.

As required, USEI will perform the Fingerprint Analyses and any Supplemental Analyses necessary on a pre-acceptance sample of the waste. These analyses are performed to provide the information needed to determine if the waste can be managed on-site and/or to determine if it matches the identity of the waste from the pre-acceptance review. The analyses will be performed utilizing the parameters outlined in Section C.5.

After evaluating the above information and any information obtained from the Fingerprint Analyses or Supplemental Analyses, USEI will determine the acceptability of the waste based on:

- The permit conditions for the facility, and
- The availability of the proper waste management techniques.

USEI maintains, as part of its pre-acceptance information, generator-supplied and USEI-developed information. This information may be accessed either electronically or via hard copy.

C.6.2 Pre-Acceptance Evaluation

USEI is responsible for the pre-acceptance evaluation decision (i.e., whether to accept or reject the waste). Samples of waste necessary for pre-acceptance consideration are subjected to Fingerprint Analyses. USEI may require Supplemental Analyses to screen samples for other contaminants or properties, which indicate possible treatment or disposal modes. Figure C.2 provides a flow diagram for the pre-acceptance evaluation. The basis for requiring these additional analyses is:

- Determination of waste management technique(s) to be used;
- Facility management's experience and judgment;
- WPQ description of the chemical and physical properties of the waste;
- WPQ description of the process generating the waste;
- Any additional documentation supplied by the generator, including information that the waste is subject to the Land Disposal Restrictions of IDAPA 58.01.05.011 {40 CFR Part 268}, or the treatment standards referenced in IDAPA 58.01.05.008 {40 CFR § 264.555) if appropriate; and
- Results of any Fingerprint Analyses and any previous Supplemental Analyses, including LDR confirmatory analyses.

The pre-acceptance evaluation is concluded with documentation of the decision regarding the acceptability of the waste and the proposed method of management. Included within the documentation is the required notification to the generator that the waste is approved for management in accordance with the facility's permit and IDAPA 58.01.05.008 {40 CFR §264.12(b)}. A Waste Shipment Identification Number (WSID) is assigned to the waste shipment upon approval for acceptance.

USEI's technical disposal decisions are based on:

- Management methods available;
- Conditions or limitations of existing permits and regulations;
- Capability to manage the waste in a safe and environmentally sound manner;
- WPQ description of the process generating the waste;
- WPQ description of the chemical and physical properties of the waste;
- Any additional documentation supplied by the generator, including information that the waste is subject to a Land Disposal Restriction of IDAPA 58.01.05.011 {40 CFR Part 268}, or the treatment standards referenced in IDAPA 58.01.05.008 {40 CFR § 264.555) if appropriate;
- Results of Fingerprint Analyses, if necessary;
- Results of Supplemental Analyses, as appropriate; and
- Management's technical experience and judgment.

Table C.8 provides a list of restricted waste for on-site disposal and the management response if this type of material is received.

C.6.3 Waste Profile/WPQ Re-evaluation

In accordance with IDAPA 58.01.05.008 {40 CFR §264.13(a)(3)}, a WPQ/waste profile re-evaluation will be repeated as necessary to ensure that it is accurate and up to date. At a minimum, the analysis must be conducted when one of the following occurs:

- A generator notifies USEI that the process generating the waste has changed; or
- The results of inspection or analysis indicate the waste received at the facility does not match the identity of the waste designated on the accompanying manifest (or shipping paper).

When this occurs USEI will review the available information, if existing analytical/knowledge of the waste is not sufficient, the generator may be asked to review and update the current WPQ, supply a new WPQ, and/or to submit a sample for analysis, or USEI may utilize a sample obtained from a load of the waste. Figure C.3 provides a flow chart for waste/process changes management methods.

C.6.4 Requirements for Ignitable, Reactive, or Incompatible Wastes

USEI takes precautions to prevent the accidental ignition or reaction of ignitable or reactive waste per the requirements of IDAPA 58.01.05.008 {40 CFR §264.17}. This waste must be separated and protected from sources of ignition or reaction including but not limited to: open flames, smoking, cutting, and welding hot surfaces, frictional heat, sparks, spontaneous ignition, and radiant heat.

Any time USEI treats, stores, or disposes of ignitable or reactive wastes, or mixes reactive incompatible wastes, USEI will take precautions to prevent reactions which:

- Generate extreme heat or pressure, fire or explosions, or violent reactions;
- Produce uncontrolled toxic mists, fumes or gasses in sufficient quantities to threaten human health or environment;
- Produce uncontrolled flammable fumes or gasses in sufficient quantities to threaten human health or environment;
- Damage the structural integrity of the device or facility;
- Through other means threaten human health or environment.

USEI will document compliance with these requirements through references to published literature, data from test trials (e.g., treatability studies), waste analysis or the results from similar treatment processes under similar conditions.

Highly reactive wastes and other wastes identified in Table C.8 are restricted from on-site disposal at the facility.

C.6.5 Compatibility Groups

Establishing waste compatibility and identifying potential incompatibilities are important components of the pre-acceptance evaluation. The waste compatibility evaluation accomplishes the following:

- Prevents the intermingling of incompatible wastes;
- Prevents the contact of waste streams or leachate from wastes with incompatible process equipment; and
- Establishes handling, storage, treatment, and disposal requirements consistent with regulatory compliance, worker safety and health, and the protection of human health and the environment.

To achieve these objectives, waste compatibility information and processing requirements for each waste stream are required. The basic waste compatibility characteristics for a given candidate waste stream are established using the generator's waste characterization information as reviewed and approved by USEI. The key compatibility concerns at this stage of the pre-acceptance evaluation are compatibility groupings as follows:

- Waste/waste compatibility;
- Waste/tank compatibility;
- Waste/container compatibility;
- Waste/stabilization equipment compatibility;
- Waste/landfill liner compatibility;
- Waste/evaporation pond liner compatibility; and
- Waste/containment building barrier compatibility.

The pre-acceptance waste/waste compatibility determination identifies:

- Drum storage, landfill disposal, and laboratory pack segregation requirements;
- Storage tanks or the stabilization unit decontamination requirements; and
- Preliminary classifications for tank storage and evaporation pond scheduling (confirmed by waste-to-waste testing).

Waste/waste compatibility is determined by categorizing a waste's reactive characteristics. The USEPA guidance document "A Method for Determining the Compatibility of Hazardous Wastes" (EPA-600/2-80-076) is used as a guide to group the wastes listed in the Part A of this Document into the 41 different reactivity groups established in the USEPA guidance manual. An example of the Hazardous Waste Compatibility Chart provided in EPA-600/2-80-076 is included in Appendix

C.1 for reference. The 41 reactivity groups established in the guidance document have been composited into eight compatibility groupings (Groups A through H). A majority of the USEPA-listed wastes accepted by the facility are listed by both reactivity group numbers (RGNs) and by USEI compatibility groupings in Table C.9 and Appendix C.2. Additional wastes not listed on this compatibility chart will be placed in the appropriate compatibility grouping based on the characteristics of the material in question. Chemical composition plays an important role in classifying wastes into compatibility groups. The major constituents of the waste determine the primary compatibility characteristics of the waste. Minor components are screened and assessed on the basis of their relative proportion to the total waste and the potential incompatibilities they might present. If the hazardous constituent contained in the USEPA waste listing is a minor component, and if the major component(s) is of a different compatibility group than that indicated for the listing constituent, then the major components will generally determine the compatibility group. If necessary, analyses for compatibility are conducted to assist in the proper compatibility group classification.

Waste/waste compatibility is typically determined using the following three steps:

1. Initially, all data regarding the waste are compared with the waste compatibility chemical listings in Appendix C.2 and with USEPA guidance document EPA-600/2-80-076 to determine waste/waste compatibility.

2. If necessary, a representative sample of the candidate waste is submitted by the generator to the facility for compatibility testing. The waste is tested for compatibility with a mixture of laboratory reagent chemicals representing each reactivity group (in equal proportion) within the candidate waste's compatibility group. If the compatibility group mixture results in separate liquid or solid phases, waste compatibility testing is performed on each phase.

3. The information generated in Steps 1 and 2 is evaluated to verify that no excessive, flammable, or toxic gas is generated, that fire and/or explosions do not occur, and that violent polymerization or uncontrolled reactions do not occur. Should the data indicate any of these conditions, testing may be conducted to identify the correct reactivity group.

The compatibility group determination is used to segregate drummed wastes and laboratory pack wastes for storage and landfill disposal, to segregate bulk wastes for landfill disposal, and to determine the probable compatibility for direct contact of liquids in tank storage and evaporation pond treatment. Should a waste be suspected of having any storage, treatment, or disposal incompatible with other wastes within its assigned compatibility group, additional compatibility tests will be performed.

There are multiple methods and schemes for determining compatibility. As a result, USEI may submit an alternate method for compatibility for Department review.

C.7 INCOMING WASTE SHIPMENT PROCEDURES

Each shipment of waste will be inspected, sampled and analyzed as defined herein before acceptance, except as noted in Section C.7.1.6. This serves two purposes. First, it compares the actual waste identity with that determined in the pre-acceptance phase and the waste manifest. Second, it further ensures proper disposition of the waste for treatment, storage, and/or disposal. Other USEI personnel (or USEI-approved subcontractor) can provide the Fingerprint and/or Supplemental Analyses required for acceptance. Waste shipments, which have arrived on-site, are considered to be in the receiving process until a final decision regarding waste acceptability is made; at such time the wastes are considered “accepted” or “rejected”. Waste may be stored at the "staging area" or one of waste management units while awaiting receipt determination. Figure C.4 provides a flow chart for waste receipt control procedures.

In addition, all initial waste shipments which are subject to the Land Disposal Restrictions of IDAPA 58.01.05.011 {40 CFR Part 268}, or the CAMU-eligible treatment standards referenced at IDAPA 58.01.05.008 {40 CFR § 264.555}, and which have been treated, exempted, subject to a variance, or already meet the appropriate treatment standard may be accompanied by a one-time form from the treater or generator certifying the waste meets the appropriate treatment standard, treated with the prescribed treatment method, prohibition exemption, or variance. This form must include the applicable analytical data or reference to such data, in accordance with IDAPA 58.01.05.011 {40 CFR §268.7}. Furthermore, initial waste shipments subject to the Land Disposal Restrictions of IDAPA 58.01.05.011 {40 CFR Part 268} that require treatment may be supported by one-time written documentation notifying USEI of the appropriate treatment standard or prohibition including any applicable data or reference to such data or documentation which must be met in accordance with IDAPA 58.01.05.011 {40 CFR §268.7}, except as otherwise allowed.

C.7.1 Receiving Procedures

Upon receipt of a waste shipment, samples are assigned an internal tracking number. If the waste is a routine waste stream, it has an associated Internal Control Form (ICF)/load number assigned. The sample identification number consists of an ICF/load number followed by the ICF item number and a specific container designation. Non-routine sample (those without an ICF number) are consecutively numbered based upon yearly sequential numbers as follows:

03-0001

- “03” indicates the year the received and/or sample collected and
- “0001” is a consecutive number that progresses upwards throughout the year.

The type of tracking system may change depending on the type of waste management tracking software and other operational considerations, however, the facility will have a waste tracking system in place at all times.

The sampling and analysis of the incoming waste will utilize appropriate methods (Section C.4) and parameters (Section C.5). Inspections are performed as described in Section F. Upon arrival of a waste shipment at USEI, the accompanying manifest is reviewed for completeness and the shipment is inspected for agreement with the manifest information (see Section C.11.8 for resolution of significant manifest discrepancies).

All shipments arriving on-site will be visually inspected. The visual inspection is the first step in the fingerprint process. The intent of the visual is to identify any obvious discrepancies such as unidentified liquids or other physical properties.

Incoming shipments are also sampled and analyzed for the Fingerprint Parameters as identified in Section C.5 and any Supplemental Analyses specified by facility management, except as noted in Section C.7.1.6.

C.7.1.1 Debris Receipt

For Debris, a visual inspection will be utilized to determine if the waste meets the definition of debris. Debris refers to solid material exceeding 60 mm in particle size that is a manufactured object, plant or animal matter, or natural geologic material. However, the following materials are not debris:

- Any material for which a specific treatment standard is provided in Subpart D, Part 268 (e.g., lead acid batteries, cadmium batteries, radioactive lead solids);
- Process residuals such as smelter slag and residues from the treatment of waste, wastewater, sludge's, or air emission residues; and
- Intact containers of hazardous waste that are not ruptured and contain at least 75% of their original volume.

A mixture of debris that has not been treated to the standards provided by IDAPA 58.01.05.011 {40 CFR §268.45} and other material is subject to regulation as debris if the mixture is comprised primarily of debris, by volume based on the visual inspection. Figure C.5 provides a flow chart describing the decision process for the pre-acceptance of debris and debris loads.

C.7.1.2 Bulk Receipt

Subject to the exceptions in Section C.7.1.6, bulk waste loads are sampled and analyzed, except where large volumes from a campaign shipment of a single waste stream are received from a single source, (e.g., a site cleanup, a large volume generator, etc.). In such cases, all shipments are visually inspected and at least 10% of such loads are sampled and analyzed except as otherwise noted in Section C.5.1. Bulk waste may also be sampled in an original bulk container (e.g., rail tanker, gondola car, etc.).

For campaign shipments, 50 percent of the first 10 truckloads are sampled for fingerprint analysis. In addition, every truck comprising a campaign shipment is visually inspected (per Waste Receipt Control procedures) and any truckload of waste showing unexpected variations in color, texture, or moisture content is subject to sampling. If the sampled truckloads show variation, the 50 percent sampling frequency is continued for the next 10 truckloads. If there are no variations among the sampled truckloads, the sample regime is reduced to 10 percent of the truckloads for the remainder of the campaign shipment, thereafter. If variations are later found during the 10 percent sampling regime, the 50 percent sampling frequency is re-instituted for the next 10 truck loads. If these do not show variation, then the frequency is returned to 10 percent of the next 10 truckloads.

Bulk solids are sampled by obtaining point samples using the sampling equipment indicated in Table C.5. These samples are collected from the following three points:

- The front 1/3 of the truck/container load;
- The center 1/3 of the truck/container load; and
- The rear 1/3 of the truck/container load, within one (1) to two (2) feet of the rear tailgate or container wall, if possible.

Samples are collected in a manner that is best representative of the vertical composition of the waste within the limitations of the available sampling equipment and container configuration. If the physical characteristics of the hazardous waste are such that a full vertical section of the load cannot be reasonably sampled with the equipment listed in Table C.5 then a sample is collected at an approximate depth of one foot at each sampling point. The three point samples are composited prior to analysis. If a truckload is domed and easily accessible to within one (1) to two (2) feet of the bottom of the load, then one of the samples is collected near the bottom to obtain a more appropriate vertical sample of the waste.

In addition, all visible areas of each bulk hazardous waste load are inspected for physical differences and for variations from the characterization of the hazardous waste presented in the WPQ. The load is also visually observed during off-loading for any such variations. Any portion of the waste that exhibits such variations is sampled and analyzed separately, if possible.

A hazardous waste bulk load (e.g., truck and trailer or two truck-mounted rolloffs) manifested as a single item is considered one shipment for sampling purposes. Each container is sampled per the previous paragraph, and the six sample points are composited into one sample for analysis. Alternatively, a hazardous waste bulk load (i.e., truck and trailer or two truck-mounted rolloffs) manifested on separate distinct manifests or presented as two waste streams is considered two units for sampling and analysis purposes.

C.7.1.3 Bulk Liquid Receipt

Liquids are sampled utilizing the appropriate sampling equipment as shown in Table C.5. Shipments of bulk liquid are generally received in tanker trucks. For each tanker, a single sample is removed for analysis from each segregated compartment within the tanker. If the compartments all hold the same waste stream, the samples may be composited at a rate of five samples per composite. This presumes that all samples are visually equivalent and match the characteristics expected from information on the WPQ.

A tanker may be sampled by withdrawing a sample from available valves on the tanker. This necessitates that the waste within the tanker is either homogenous or that the tanker is adequately circulated/mixed prior to sampling to ensure a representative sample is obtained.

C.7.1.4 Sludge Receipt

Bulk shipments of sludge are sampled as either liquids in bulk or solids in bulk depending on the physical characteristics of the sludge. If the sludge is primarily liquid in nature, then it is sampled as appropriate for a liquid in bulk. Conversely, if the sludge is essentially a solid, then it is sampled as appropriate for a solid in bulk.

C.7.1.5 Non-Bulk Receipt

In the case of shipments of non-bulk containers, at least 10% of the containers from each waste stream in the shipment are sampled, except as provided in Section C.7.1.6. Container samples from the same profile may be composited prior to analysis, providing the individual samples are similar. Any composited samples will be composited as described in Section C.4.3. At a minimum, all remaining unopened containers are visually inspected for container integrity and consistent labeling. If a significant discrepancy in waste type is discovered, the contents of all of the containers for that waste stream are inspected. In some cases, where the waste stream is consistent but packaged for ease of transportation or disposal (e.g., multiple yd^3 bags containing the same waste) the load may be managed as a bulk load.

C.7.1.6 Exceptions

Exceptions to the foregoing requirements include the following:

- Waste contained in a lab-Pack (combination packaging). Combination packaging is defined in 49 CFR §171.8 as "......one or more inner packaging secured in a non-bulk outer packaging" and is subject to the Department of Transportation shipping package requirements of 49 CFR Part 173.

- Commercial products or chemicals: off-specification, outdated, unused, or banned. This also includes products voluntarily removed from the market place by a manufacturer or distributor.

- "Empty" containers of waste materials, commercial products or chemicals. This applies to portable containers which have been emptied, but which may hold residues of the product, chemical, or containers containing other empty containers. Examples of containers are: tanks, drums, barrels, cans, bags, liners, etc. A container shall be determined "empty" according to the criteria specified at IDAPA 58.01.05.005 {40 CFR §261.7}. These empty containers may be crushed, shredded, or intact.

- Residue and debris from the cleanup of spills or releases of chemical substances, previously approved wastes, commercial products, or a waste, which would otherwise qualify as an exception.

- Wastes, which are visually identifiable through an inspection process. (Examples may include cathode ray tubes, batteries, fluorescent light tubes, filters and filter cartridges, wire or tubing, paper products, metal sheeting and parts, crushed glass, piping, etc.)

- Demolition wastes. This consists of waste produced from the demolition or dismantling of industrial process equipment or facilities contaminated with chemicals from the process. Knowledge of the process and chemicals used in the process allows characterization of the waste sufficient for safe management.

- Articles, debris, non-RCRA wastes, equipment and clothing containing or contaminated with polychlorinated biphenyl's (PCBs). This includes PCB capacitors, transformers, gloves or aprons from draining operations, empty drums that formerly held PCBs, etc.

- PCB draining and flushing removed from PCB articles. This includes PCB articles flushed with a substance (e.g. toluene or unused diesel).

- USEI site generated waste, including hazardous and non-hazardous waste.

- Controlled substances regulated by government agencies including drugs and/or materials from clandestine labs.

- Materials that are brokered for management at an alternate facility. These materials are received for storage and subsequent offsite management only. If it is determined USEI will process a waste previously designated for storage and subsequent off-site shipment, the waste will be reviewed utilizing the normal approval process prior to on-site processing. For materials received at another regulated company and subsequently shipped to USEI, the other facility may transmit the relevant information to USEI for use in the pre-acceptance or load arrival review programs, as is appropriate.

- Wastes from remedial projects in which the waste characterization is known through a sampling plan that was approved by a federal or state agency (e.g.; CERCLA or Potentially Responsible Party type project) or other well-developed plan.

- Debris as defined at IDAPA 58.01.05.011 {40 CFR §268.2}. These materials will be visually inspected prior to acceptance in order to ensure the waste meets the definition of debris. Detailed procedures are provided in Section C.7.1.1.

- Contaminated personnel protective equipment (PPE) (e.g., gloves, tyveks, respirator cartridges).

- Aerosol cans.

- Vitrified, Cemented, and Other Materials Exhibiting High Structural Integrity. There are several materials which are not conducive to sampling which must be recognized. Structural steel, tanks, pipe, cement, glass, empty drums, machinery, equipment, manufactured items, monolithic / cemented materials, and several other materials are managed which do not allow for normal sampling protocols. By necessity, these materials must be managed on a case-by-case basis. In some cases a clean-up agency (e.g., EPA, IDEQ, etc.), generator, or contractor has established a rational basis of data and waste characterization information. In those cases, this information may be utilized in lieu of pre-acceptance analytical and incoming load analytical information, and the physical appearance screen will be utilized to confirm material acceptability upon arrival;

- Non- RCRA Radioactive Waste (including NORM, NARM, etc) and waste as described below:

- Sampling and analysis of the above waste materials is not required: unless specifically requested by USEI. These materials are not sampled and analyzed because if the chemical and physical characteristics of the waste are known in sufficient and reliable detail or if the waste has been previously characterized and shipped from another generator, broker or TSDF, or visual inspection of these shipments is sufficient for verification of their identity. USEI will obtain and evaluate all the information required by IDAPA 58.01.05.008 {40 CFR §§264.13(a)(1) and 264.13(a)(2)} necessary to characterize, treat, store, or dispose of the waste.

- In addition, USEI may waive incoming waste load sampling and analysis where the pre-acceptance documentation supplies sufficient information to assure compliance with permit conditions and operational constraints, or any of the following conditions exist:

    - A sample cannot be reasonably obtained, such as filter cartridges, tank clean-out sludge (prior to the clean-out), large pieces of contaminated material, or contaminated debris;

    - In these cases, the shipment will still be inspected for conformance with manifest and pre-acceptance documentation as previously described;

    - Obtaining a representative sample poses an unnecessary or unavoidable hazard of acute or chronic exposure of USEI employees to carcinogenic, mutagenic, neoplasticgenic, teratogenic, or sensitizing materials (e.g., asbestos); or.

C.7.2 Decision Evaluation Logic

There are major decision points regarding the need for evaluation of whether a waste found to be dissimilar to the pre-acceptance evaluation can still be accepted. USEI decides whether additional analyses are required for a particular waste based on the following:

- Results of Fingerprint Analyses;

- Knowledge of generator and/or waste-generating process;

- Results of pre-acceptance evaluation; and

- Waste codes.

Further testing will be conducted as necessary if the results indicate unexpected characteristics with respect to pre-acceptance analytical results, or if there is suspicion the waste composition has changed. Effectiveness of the waste identification step is dependent on the following components:

- Inspection;
- Sampling (where required);
- Analytical results (where required);
- Waste Product Questionnaire;
- Hazardous Waste Manifest;
- Waste Screening Analytical Results;
- Facility management's judgment.

To facilitate the waste identification process, fingerprint analytical data is compared to the corresponding pre-acceptance analysis (WPQ, ICF, etc.). The Fingerprint Analysis verifies the waste is indeed the same waste as represented by the pre-acceptance analysis. When a load is received, the pre-acceptance information is reviewed. USEI classifies waste as being in non-conformance when it is significantly different in composition from the information shown in the WPQ or the pre-acceptance results, or if there is a significant discrepancy between the waste shipment and the manifest (as defined in IDAPA 58.01.05.008 and 40 CFR §264.72), unless the discrepancy can be clarified. Figure C.6 provides a flow chart for waste reevaluation procedures.

Wastes found to be in non-conformance may be rejected immediately, or may be re-evaluated for possible acceptance despite the variance. Re-evaluation will be based on any or all of the following criteria:

- Permit authorization;
- Land Disposal Restrictions;
- Discussions with the generator; and
- Facility conditions.

Pursuant to IDAPA 58.01.05.008 {40 CFR §264.72}, USEI must attempt to resolve with the generator or transporter significant discrepancies between the actual waste and that shown on the manifest. Changes to the manifest or WPQ may be made with the customer's concurrence or at the customer's request. Any corrections or other changes made to the manifest or WPQ will be initialed by the person making the change. Other discrepancies noted (such as improper mailing addresses, identification numbers, telephone numbers) may be either corrected or noted in manifest block 19.

For bulk loads manifested by weight, the load is typically weighed on-site. However, if the scale is out of service, other methods may be employed to estimate the weight of the delivery. Other methods include utilization of nearby (off-site) scales, weight estimation techniques, and utilization of tare weights to calculate approximate net weights. If a significant weight discrepancy is noted, the procedures of IDAPA 58.01.05.008 {40 CFR §264.72} are employed. For piece count deliveries (e.g., vans of containers, etc.), the piece count is confirmed. Under typical conditions all of these activities are conducted upon delivery to the facility or within a short time thereafter. However, there are situations when these conditions are not satisfied upon delivery (e.g., a load is delivered and staged prior to being approved or accepted, small containers are contained within heat shrink material and cannot be counted prior to breaking the load, etc.). In these instances and consistent with IDAPA 58.01.05.008 {40 CFR §264.71(a)(3)}, the transporter is given a signed copy of the manifest. If a significant weight or piece count discrepancy is later discovered, an attempt to reconcile it will be made. If a significant manifest discrepancy cannot be resolved within 15 days of discovery, notification of the discrepancy will be sent to the IDEQ, along with the steps taken to resolve the discrepancy.

C.8 PROCESS OPERATIONS PROCEDURES

Each movement of a waste within the facility, during which any change in its characteristics may occur, may make the waste subject to additional inspection, sampling, and analysis to determine appropriate handling and management of the waste. Many of the analyses needed for the treatment, storage, and/or disposal functions are performed during incoming shipment identification and are not repeated unless it is known or believed that waste characteristics may have significantly changed during storage or processing and/or such information is deemed necessary for the safe management of the waste.

Existing and anticipated process operations at the facility, for which current and periodic sampling and analyses are important, include the following:

- Treatment, including stabilization;
- Storage; and
- Disposal, consisting of landfilling and/or solar evaporation.

The analytical procedures for each of these processes are described in the following Sections.

C.8.1 Storage

Before any waste is placed into storage USEI will assess the compatibility of the waste with wastes already in storage as described in Section C.6.5.

C.8.1.1 Liquid Storage / Transfer / Management

Liquid wastes may be transferred from containers to tanks or to trucks although a waste may be fed directly to the designated treatment unit (e.g.; tanks). Upon arrival, liquid waste will be subjected to the appropriate waste identification analyses, plus a commingled waste compatibility test, if appropriate, to assure safe storage. If a liquid load is exempted from sampling, as described in Section C.7.1.6, the waste will be segregated from other wastes based on USEI's technical assessment of the waste (e.g., compatibility class).

C.8.1.2 Containerized Storage

Using the predominant hazard classification on incoming containerized waste, the proper storage area will be designated to insure segregation of stored incompatible waste.

Based on the initial hazard determination made by the generator on the WPQ and/or the final identification of the waste shipment, containerized waste will be segregated in the following manner: flammable, corrosive, and oxidizing waste materials will be separated from incompatible materials or stored in separate areas. Wastes are separated/maintained in separate storage areas until they are treated, transferred, or disposed as described in Section C.6.5.

C.8.2 Brokering and Material Transfer Operations

This section discusses process analyses associated with the brokering of materials. Transfer of materials for off-site disposition is discussed, since this process may involve consolidation/bulking of waste materials to meet the receiving facility's specifications.

C.8.2.1 Consolidation/Bulking for Off-Site Transfer

This activity involves the consolidation/bulking of solid wastes into rolloffs or other appropriate containers or the pumping of containerized liquid wastes into tank trucks or other large containers for delivery off-site. Additionally, liquid waste containing sufficient heating values for combustion are bulked with other suitable waste. The resultant liquid bulked materials are used to provide heat content for combustion processes (either as hazardous waste derived fuel or as a hazardous waste, as applicable) at off-site lime kilns, incinerators, or similar operations (e.g. disposal).

According to IDAPA 58.01.05.004 {40 CFR §260.10}, treatment is defined as "Any method, technique, or process, including neutralization, designed to change the physical, chemical, or biological character or composition of any hazardous waste so as to neutralize such waste, or so as to recover energy or material resources from the waste, or so as to render such wastes non-hazardous; safer to transport, or dispose of; or amenable for recovery, amenable for storage or reduced volume". In short, if an activity does not change a hazardous waste, it is not treatment. Waste bulking or otherwise containerizing multiple hazardous wastes for transportation will not typically change the physical and chemical properties of the waste.

The EPA has provided guidance (Faxback 13308, 13720, 11281, 11497, 12458, and 13764) that activities such as bulking, containerizing, and consolidation are not considered treatment, as long as no blending (e.g., selective mixing to meet a fuel standard) is taking place. Incidental mixing of wastes that occurs when several waste streams of similar waste types are bulked is not considered treatment. Also, if the intent of consolidation is to make it more efficient and cost effective to transport the shipment, the activity is not considered treatment. The important point in this discussion is that as long as the intent of the consolidation/bulking in question is not intended as treatment and the material is still sent to an appropriate TSD facility for treatment, then the activity is not considered treatment (i.e., intent of the consolidation/bulking is not to conduct treatment).

When evaluating hazardous waste for consolidation/bulking, the pre-acceptance analyses is used to determine the acceptability of each waste stream. Additional analysis for heat value may be required for materials destined for supplemental fuels, depending on the regulatory status of the potential receiving BIF(s), to evaluate sham-recycling restrictions. For materials destined for incineration, or other processes this analysis is not necessary.

In-process analyses may be performed to assure the aggregation / bulking of wastes is within the receiving facility's specifications, if any. This is necessary because acceptance criteria for the USEI facility may be different than the receiving facility's specifications, which are based upon that facility's permits, regulations, or other needs. For example, if the receiving facility has a minimum requirement for heat value and a maximum requirement for chlorides, then the bulked material requirements will be a function of the receiving facility's requirements for both parameters.

Post-consolidation analyses may consist of tests necessary to confirm that the bulked material is suitable for offsite disposal. Consolidation activities will occur in the CMU's as described in Section D.1.

C.8.3 Treatment Technologies

USEI utilizes several different treatment technologies in order to meet the applicable land disposal restriction (LDR) or other standard as applicable. USEI utilizes the term "stabilization" throughout this document in a generic sense to mean the treatment of a waste material to make it physically and chemically stable. In this sense, it consists of those processes, which make the material pass applicable LDR standards or other applicable standard(s).

In this process, waste is treated to meet land disposal restrictions (e.g., elimination of free liquids, chemical and/or physical stabilization to remove or immobilize hazardous constituents, micro-encapsulation, macro-encapsulation, etc) or to meet other appropriate requirements (e.g., permit or regulatory requirements). IDAPA 58.01.05.011 {40 CFR §268.42} provides specific definitions for several potentially distinct treatment technologies including Stabilization, Chemical Oxidation, Chemical Reduction, Deactivation, Macro/Micro Encapsulation, Neutralization, Adsorption, Bio-remediation, Evaporation, and Precipitation. Although the above treatment technologies may be considered distinct processes, the stabilization process is defined in the more generic sense due to the overlap of the associated treatment technologies and methods.

Pre-treatment analyses consist of tests necessary to insure the wastes can be treated to meet the applicable treatment requirement. In-process analyses are generally not required. Post-treatment analyses are performed, as necessary, to ensure restricted wastes meet applicable treatment standards.

The following technologies, defined as "stabilization" within this WAP and associated documents are utilized by USEI:

C.8.3.1 Stabilization

Stabilization is defined by IDAPA 58.01.05.011 {40 CFR §268.42} as stabilization with the following reagents (or waste reagents) or combinations of reagents (1) Portland Cement; or (2) lime/pozzolans (e.g., fly ash and cement kiln dust) – this does not preclude the addition of reagents (e.g., iron salts, silicates, and clays) designed to enhance the set/cure time and/or compressive strength, or to overall reduce the leachability of the metal or organic. Stabilization is the treatment of appropriate waste streams by use of pozolonic materials or wastes with pozolonic properties to reduce the leachability of organic, inorganic or metals of concern. Appropriate use of this treatment technology is determined during the approval process. A mix design is developed prior to the treatment of a waste stream. Stabilization may be performed within Mix Bin Tanks, or Containers. Treatment locations may be the Stabilization portion of the Containment Building, the Debris portion of the Containment Building or the Stabilization Facility. Treatment is performed to meet applicable LDR standards. Sampling, analysis verification of the treatment effectiveness and frequency of testing follows the guidelines presented in this WAP.

C.8.3.2 Chemical Oxidation

Chemical oxidation is a treatment process targeted primarily at organic constituents, (e.g., toluene and benzene) but may be used for inorganic constituents as well (e.g., cyanides and heavy metals such as mercury). An organic or inorganic species is oxidized when its respective chemical oxidation number increases (i.e., loses electrons). Consistent with IDAPA 58.01.05.011 {40 CFR 268.42}, the following oxidation reagents (or waste reagents) may be used in part or whole: (1) Hypochlorite (e.g. bleach); (2) chlorine; (3) chlorine dioxide; (4) ozone or UV (ultraviolet light) assisted ozone; (5) peroxides; (6) persulfates; (7) perchlorates; (8) permanganates; and/or (9) other oxidizing reagents of equivalent efficiency. An approved mix design is formulated and tested prior to treatment.

Chemical oxidation may be performed within Mix Bin Tanks or Containers. Treatment is performed to meet EPA LDR standards. Sampling, analysis verification of the treatment effectiveness and frequency of testing follows the guidelines presented in this WAP.

C.8.3.3 Chemical Reduction

Chemical reduction or redox occurs when the targeted component/constituent atoms change as a resultant transfer of electrons from one chemical species to another. The chemical oxidation number for the targeted components decreases (i.e., gains electrons) when the target constituents are reduced. Conversely, the reducing reagents used in this process lose electrons or become oxidized. Derived from IDAPA 58.01.05.011 {40 CFR 268.42}, the following reducing reagents (or waste reagents) may be used in whole or part: (1) Sulfur dioxide; (2) sodium, potassium, (salts), or other alkali salts or sulfites, bisulfites, metabisulfites and polyethylene glycols (e.g., NaPEG and KPEG); (3) sodium hydrosulfide; (4) ferrous salts; and/or (5) other reducing reagents of equivalent efficiency. An approved mix design is formulated and tested prior to treatment.

Chemical reduction may be performed within Mix Bin Tanks or Containers. Treatment is performed to meet EPA LDR standards. Sampling, analysis verification of the treatment effectiveness and frequency of testing follows the guidelines presented in this WAP.

C.8.3.4 Deactivation

Deactivation is the treatment of those wastes that exhibit the characteristics of ignitability, corrosivity, and/or reactivity. Appropriate use of this treatment technology is determined during the pre-acceptance process. A mix design is developed prior to the treatment of the waste stream. Deactivation may be performed within Mix Bin Tanks, or Containers. Treatment is performed to meet applicable LDR standards. Sampling, analysis verification of the treatment effectiveness and frequency of testing follows the guidelines presented in this WAP.

C.8.3.5 Macro Encapsulation

Macro-encapsulation is a confining or immobilization technology used to treat all types of hazardous debris independent of the hazardous constituents involved (with the exception of cyanide-reactive debris). The macro-encapsulation process encases the debris to provide a physical barrier that prevents/minimizes potential leaching of hazardous constituents from the debris. The encapsulating barrier does not need to chemically bond to either the debris or hazardous constituents. Macro-encapsulation is defined in IDAPA 58.01.05.011 {40 CFR §268.42, Table 1} as the application of surface coating materials such as polymeric organics (e.g., resins, plastics) or use of a jacket of inert inorganic materials to substantially reduce surface exposure to potential leaching media. Inert non-waste material, or waste meeting appropriate LDRs, may be used for filler material.

Macro-encapsulation does not require specific testing for LDR constituent standards. This waste is treated at the facility to meet all requirements of the LDR treatment technology standard and is certified by USEI to meet these requirements prior to disposal. Macro-encapsulation may be performed at the Containment Building, CMU's: CSP # 4/5, Truck Unloading Aprons, and the RCRA/PCB Building.

The performance standard for the macro-encapsulation technology is described under IDAPA 58.01.05.011 {40 CFR Part §268.45, Table 1}, entitled "Alternative Treatment Standards for Hazardous Debris". This standard states that "Encapsulating material must completely encapsulate debris and be resistant to degradation by the debris and its contaminants and materials into which it may come into contact after placement (leachate, other wastes, microbes).

C.8.3.6 Micro Encapsulation

Micro-encapsulation is confining or immobilization technology that requires the stabilization of the debris with the following types of reagents (or waste reagents) such that the leachability of the hazardous contaminants is reduced: (1) Portland cement; or (2) lime/pozzolans (e.g., fly ash and cement kiln dust) (3) Additional reagents (e.g., iron salts, silicates, carbon, polymers or clays) as appropriate.

Micro encapsulation does not require specific testing for LDR constituent standards. Following the treatment process, the micro-encapsulated debris is visually inspected. Micro encapsulation may be conducted in tanks or containers. The performance standard for the micro-encapsulation technology is described under IDAPA 58.01.05.011 {40 CFR Part §268.45, Table 1} titled "Alternative Treatment Standards for Hazardous Debris". This standard states that "Leachability if contaminants must be reduced".

C.8.3.7 Neutralization

Neutralization is a treatment process designed to render corrosive matrices non-corrosive. According to IDAPA 58.01.05.011 {40 CFR 268.42}, the following reagents (or waste reagents) in part or whole may be used for neutralization: (1) Acids; (2) Bases; or (3) water (including wastewater's) resulting in a pH greater than 2 but less than 12.5 measured in the aqueous residuals. An approved mix design will be formulated and tested before waste is treated by neutralization.

Neutralization may be performed within Mix Bin Tanks or Containers. Treatment is performed to meet EPA LDR standards. Sampling, analysis verification of the treatment effectiveness and frequency of testing follows the guidelines presented in this WAP.

C.8.3.8 Precipitation.

Precipitation is the process by which regulated metals and/or inorganics are precipitated out as insoluble precipitates of oxides, hydroxides, carbonates, sulfates, chlorides, fluorides, or phosphates. This process entails adjusting the pH of the waste matrix between 9 and 11. This pH range is ideal for hydroxide precipitation. An alternative to this common standard practice is sulfide precipitation. Sulfide precipitates are less soluble and non-amphoteric (less pH dependent than hydroxyl precipitates). However, caution must be employed to ensure hydrogen sulfide is not released at harmful levels by maintaining a pH greater than 8 throughout the treatment process. Based on IDAPA 58.01.05.011 {40 CFR 268.42}, the following reagents (or waste reagents) are typically used alone or in combination: (1) Lime (i.e., containing oxides and/or hydroxides of calcium and/or magnesium; (2) caustic (i.e., sodium and/or potassium hydroxides; (3) soda ash (i.e., sodium carbonate); (4) sodium sulfide; (5) ferric sulfate or ferric chloride; (6) alum; or (7) sodium sulfate. Additional flocculating, coagulation or similar reagents/processes that pertain to precipitation are not precluded from use. An approved mix design will be tested prior to treatment.

Precipitation may be performed within Mix Bin Tanks or Containers. Treatment is performed to meet EPA LDR standards. Sampling, analysis verification of the treatment effectiveness and frequency of testing follows the guidelines presented in this WAP.

C.8.3.9 Adsorption

Adsorption is the use of an appropriate reagent (e.g. activated carbon or treated clay) to remove chemical components from aqueous or compressed gas waste streams. It is most commonly employed for the removal of organic compounds, although some inorganic constituents are effectively removed as well. This process is achieved through physical, chemical, and electrostatic interactions between the waste material and the adsorbent media. Pursuant with IDAPA 58.01.05.011 {40 CFR 268.42}, Total Organic Carbon can be used as an indicator parameter for the adsorption of many organic constituents that cannot be directly analyzed in wastewater residues.

Adsorption primarily occurs in the Tanks 1, 2, 3 and 4, however it may be performed within Mix Bins, Tanks or Containers. Treatment is performed to meet EPA LDR standards. Sampling, analysis verification of the treatment effectiveness and frequency of testing follows the guidelines presented in this WAP and Appendix D.2.5 (for on-site generated waste).

C.8.3.10 Evaporation.

Evaporation of wastes primarily occurs within the Evaporation Pond. Non-hazardous liquids and hazardous liquids meeting applicable LDR's that meet the conditions of this WAP are placed in the Evaporation Pond for evaporation. The USEI facility has a net evaporation rate of approximately 53 inches per year, which allows for evaporation of liquids using solar energy. Waste liquids selected for evaporation must meet Evaporation Pond Parameters set forth in this WAP before being placed in the pond.

C.8.3.11 Bio-remediation.

Bio-remediation is the use of biological mechanisms to destroy, transform, or immobilize environmental contaminants. Bio-remediation is normally conducted in-situ, however, there may be scenarios where it would be conducted at an alternate facility such as a TSDF. Bio-remediation would be performed within tanks or containers.

Certain wastes are treated on-site to meet specified treatment standards. Typically, USEI requires a representative sample of the waste prior to on-site management. The waste sample is then mixed with various types of reagents[2] to determine an acceptable mix design (recipe) by which the waste is treated (separately or along with other wastes) to pass the required standard(s).

C.8.4 Acceptance and Management of Corrective Active Management Unit (CAMU) Wastes

The Permittee is authorized to accept, manage, and dispose of CAMU-eligible wastes, as defined in IDAPA 58.01.05.008 [40 CFR § 264.552(a)(1) & (2).]

For each CAMU remediation waste proposed for acceptance, the Permittee must submit a CAMU-eligible waste stream information package for review by the Director unless exempted as provided below. The information package will document that:

1. The designation of CAMU-eligible waste has been performed by a duly authorized agency,
2. Principal hazardous constituents have been identified and are required to be treated to meet any of the standards referenced in 40 CFR §264.555 (a) (2),
3. The CAMU-eligible waste designating authority provided a public notice and an opportunity for public comment for both the CAMU designation and the placement of the CAMU in an off-site permitted hazardous waste landfill,
4. The approval is specific to a single remediation,
5. All information provided by the person seeking approval (the waste generator) to the duly authorized agency making the CAMU-eligible waste designation has been included in the information package.

For each CAMU-eligible waste proposed for acceptance, the Director and persons on the Permittee's mailing list will be notified of the Permittee's intent to receive CAMU-eligible wastes. This notification shall include the source of the remediation waste, the principal hazardous constituents in the waste, and the treatment requirements. The mailing list notice will be sent within 7 days of the request to the Director and will state that comments or objections to receipt of the waste may be submitted to the Director within 15 days of the notice. Proof of the mailing list notification will be submitted to the Director within seven (7) days of completion.

The Permittee must comply with 40 CFR § 268.7(b)(4) except the certification must state the CAMU wastes meet the referenced treatment requirements at 40 CFR § 264.555(a)(2). The Permittee must dispose of all CAMU-eligible wastes in Permitted landfill cells only. Prior to disposal, all CAMU-eligible wastes must meet one of the standards as discussed in 40 CFR § 264.555(a)(2)(i), (ii), or (iii).

The Permittee may not receive any CAMU-eligible waste until written approval is received from the Director. The Director may take a 30-day review period, with an optional 30-day extension, from the date of receipt of the request from the Permittee.

---

[2] Typical reagents utilized on-site include fly ash, portland cement, cement kiln dust, lime, gypsum, water, clays, and carbon, although many other treatment reagents may be utilized, including other wastes with characteristics appropriate for treatment.

The Director may object to the Permittee's acceptance of any specific CAMU-eligible waste stream. If such written objection is issued, the Permittee may not receive the specific CAMU-eligible waste stream. If at the end of the review period the Director has not notified the Permittee that he or she has chosen not to object, the Permittee may not receive the specific CAMU-eligible waste stream until the objection has been resolved, or the Permittee obtains a permit modification specifically authorizing receipt of the specific CAMU-eligible waste stream.

As part of the permit modification process, the Director may modify, reduce, or eliminate the notification requirements described in this section of the WAP as they apply to specific categories of CAMU-eligible waste, based on minimal risk.

C.8.5 Wastes Meeting the Treatment or Technology Standard upon Arrival

USEI receives waste meeting applicable treatment standards that either has been treated by the generator, a treatment facility, or meets the standard as initially generated. These shipments must be accompanied by a proper notification and certification or, if determined to meet the standard by USEI, USEI may complete the certification. Wastes in this category may be analyzed for conformance with the treatment standards during the pre-acceptance review, during the load acceptance review, or when USEI believes the waste may no longer meet the standard.

Wastes received meeting a technology-based treatment standard will not be tested for LDR constituent standards. The only LDR required analysis for this type of waste is that it is properly certified, in full or in part, to have been treated by the appropriate technology for the waste codes applied.

C.8.6 Treating Wastes Containing Free Liquids

In this process, wastes not otherwise restricted are treated solely to stabilize (solidify) free liquids. Pre-treatment analyses consist of the Fingerprint Analyses performed on incoming shipments unless freestanding liquids are observed (in which case USEI can conclude the waste has free liquids without the analytical test). If free standing liquids are present, they are either removed, stabilized by either placing a stabilization agent in the container or placing the contents into a stabilization unit, or by shredding the container and its contents and, if necessary, stabilizing the shredded material. If freestanding liquids are not observed and process specific criteria are met, (e.g., paint filter test) then the waste may be landfilled directly. If free liquids are decanted, any remaining material containing free liquids will be stabilized using appropriate reagents prior to landfilling, if necessary. Bulk loads, which otherwise do not contain significant quantities of free standing liquids may be "spot stabilized" in order to meet the requirements of IDAPA 58.01.05.008 {40 CFR §264.314(a)(2)} as is sometimes necessary for otherwise dry wastes which have received precipitation during transportation.

In addition, Supplemental Analyses may be requested by USEI to further evaluate the waste. Stabilized wastes will be tested using the Paint Filter Liquids test if the presence of free liquids is still suspected. Figure C.8 provides a flow chart for potential decanting techniques, if necessary.

C.8.7 Treating Wastes to an Approved Delisting Requirement

USEI successfully petitioned the IDEQ to implement its patented treatment technology for the delisting of K061 waste. Wastes treated to an approved delisting requirement shall be sampled and analyzed in accordance with the specific delisting requirements outlined in IDAPA 58.01.05.005.01. This includes specific verification testing and delisting levels.

C.8.8 Landfill Disposal

USEI's sampling & analyses program is an integral part of this phase of operation as the results serve to evaluate compliance with permit constraints, land disposal restrictions, and determine safety constraints. Landfill disposal operations require only pre-disposal analyses. Wastes to be landfilled are subject to the Fingerprint Analyses for pre-acceptance samples and incoming waste shipments, unless otherwise specified.

C.8.9 Solar Evaporation

The Evaporation Pond is used to reduce the volume of waste by solar evaporation of the liquid components of waste. There are three other permitted surface impoundments (Collection Pond Nos. 1, 2, and 3) at the facility which collect surface runoff from active portions of the facility. This water may also be stabilized prior to disposal/evaporation or may be used in the stabilization process as an additive. The end use of the collected runoff depends on its quantity and composition. The runoff is evaluated prior to transfer from the collection ponds to confirm that it is suitable for the intended use.

Pre-acceptance evaluation and waste receipt control requirements are discussed in Section C.6. These control requirements are also used as part of the waste process controls. Wastes designated for placement in the Evaporation Pond are also subjected to the balance of process control parameter analyses as presented in Table C.6 to verify that the waste is amenable to Evaporation Pond treatment. Figure C.9 shows the process control procedures used for the Evaporation Pond.

The wastes to be placed in the Evaporation Pond consist of aqueous wastes. They have relatively low concentrations of total or suspended solids, relatively non-aggressive corrosive characteristics (pH of 2 to 12.5), low concentrations of organic compounds, and no visible oil phase separation, which would impede evaporation.

No hazardous waste subject to IDAPA 58.01.05.008 {40 CFR Part 264} Subpart CC management requirements is accepted for placement into the Evaporation Pond. Waste/liner compatibility and waste/waste compatibility are established in the pre-acceptance evaluation.

USEI's sampling & analyses program is also an integral part of the Evaporation Pond as the results serve to evaluate compliance with permit constraints, land disposal restrictions, and determine safety constraints. Evaporation operations require only pre-disposal analyses. Wastes to be evaporated are typically subject to the Fingerprint Analyses for pre-acceptance samples and incoming waste shipments. Figure C.9 provides a flow chart of process control parameters for evaporation activities.

C.8.10 Wastes Treated On-site

Certain wastes are treated on-site to meet specific treatment standards. Typically, USEI requires a representative sample of the waste prior to on-site management. The waste sample is then mixed with various types of reagents to determine an acceptable mix-design (recipe) by which the waste is treated (separately or along with other wastes) to pass the required LDR standard(s).

A mix design is chosen by USEI, which will meet LDR standard(s). Waste shipments of that particular waste are then treated according to the treatment identified as capable of meeting the applicable treatment standard(s). A treatment certification will be made for each batch treated. In some cases, it may be appropriate to create mix designs after acceptance, but prior to treatment (e.g., batches of mixed wastes streams, etc.), or perhaps during or after treatment (if an approximate recipe is first determined and in-process analysis aids in further mix design development).

Debris, as defined in IDAPA 58.01.05.08 (40 CFR §268.45) may be treated by micro-encapsulation or macro-encapsulation.

C.8.11 LDR and CAMU Verification

The treatment standards are verified prior to ultimate disposal per the requirements of this WAP. LDR or CAMU conformational testing is conducted on waste stabilized at the facility or the CAMU remediation site to verify applicable treatment standards, except alternate treatment standards (e.g.; macro- & micro-encapsulation). Samples are collected from the first two batches of each hazardous waste streams treated at the facility, and at least once a year thereafter. In order to perform verification testing on batches of wastes exceeding 50yds.^{3} treated in MBT-3 or MBT-4 in the Containment Building – Debris Portion, samples will be collected from each truckload of treated waste removed from the tank(s) in accordance with the procedures described in Section C.4. Batches of treated waste less than or equal to 50yds.^{3} will be sampled in the same manner as MBT-1 and MBT-2 in the Containment Building – Stabilization Portion. The sampling frequency may be increased on waste stream that exhibit significant variable characteristics, as determined necessary by the technical reviewers.

Since treated wastes are treated based on an established recipe, they are assumed to meet the applicable treatment standard(s) and may be staged pending verification analyses, if applicable. Additional samples may be collected as necessary while performing verification analyses. Resampling associated with interim Processing Piles is discussed in more detail in Section C.11.5.

Macro-encapsulation does not require specific testing for LDR constituent standards. The performance standard for the macro-encapsulation technology is described under IDAPA 58.01.05.011 {40 CFR Part §268.45, Table 1}, entitled “Alternative Treatment Standards for Hazardous Debris”. This standard states that “Encapsulating material must completely encapsulate debris and be resistant to degradation by the debris and its contaminants and materials into which it may come into contact after placement (leachate, other wastes, microbes).

Additionally, micro-encapsulation does not require specific testing for LDR constituent standards. Following the treatment process, the micro-encapsulated debris is visually inspected. Micro encapsulation may be conducted in tanks or containers. The performance standard for the micro-encapsulation technology is described under IDAPA 58.01.05.011 {40 CFR Part §268.45, Table 1} titled “Alternative Treatment Standards for Hazardous Debris”. This standard states that “Leachability of contaminants must be reduced”.

C.9 WASTE MANAGEMENT UNITS

Section D provides detailed process information associated with all waste management units. The following sections describe the types of treatment conducted in the various waste management units available at the facility.

C.9.1 Containment Building

This Section provides information for the Containment Building. Further detail is provided in Section D.9. The Containment Building (Stabilization and Debris portions) is designed, and operated to meet the criteria for containment buildings described under IDAPA 58.01.05.008 {40 CFR 264 Subpart DD - Containment Buildings}. Operations occur as follows:

- Physical Treatment, including stabilization; and
- Mechanical Processing, including sorting/size reduction/crushing (Misc. Unit – Subpart X).

The Containment Building is used to store and treat non-bulk and bulk containers with or without free liquids anywhere within the unit, including in the oversized debris bin and/or on the sort floors. Also, non-containerized bulk materials with or without free liquids may be stored and treated in limited amounts on the unit floor. Treatment methods for hazardous waste include the following:

- Stabilization[3];
- Chemical Oxidation;
- Chemical Reduction;
- Neutralization;
- Deactivation;
- Macro Encapsulation;
- Micro Encapsulation;
- Adsorption (clay, carbon, etc.);
- Precipitation;

[3] The term “stabilization” is defined by the EPA under 40 CFR 268.42 as “Stabilization with the following reagents (or waste reagents) or combinations of reagents (1) Portland Cement; or (2) lime/pozzolans (e.g., fly ash and cement kiln dust) – this does not preclude the addition of reagents (e.g., iron salts, silicates, and clays) designed to enhance the set/cure time and/or compressive strength, or to overall reduce the leachability of the metal or organic. USEI uses the term Stabilization in a more generic sense to mean the treatment of a waste material to make it physically and chemically stable. In this sense, it consists of those processes, which make the material conform to applicable LDR treatment standards or other applicable standard(s).

- Bio-remediation;
- Mechanical Processing, including sorting/size reduction/crushing; and
- Decanting.

To facilitate treatment, a crushing system is also located inside the Containment Building as described in D.9. The location of the crusher in the Containment Building is shown on Drawing #D2020-A02, -R07 and -R08. The crushing system is physically located within the Containment Building to provide containment for any material spills or release of fugitive dust emissions, for protection from the weather, and to minimize the potential for release of waste constituents.

Additionally, the Containment Building is used to store and treat non-bulk and bulk containers with or without free liquids anywhere within the unit, including the Mixing Bin Tanks. Also, non-containerized bulk materials with or without free liquids may be stored and treated in limited amounts on the unit floor (e.g. frozen material within load).

C.9.1.1 Truck Unloading Apron #1 and #2

Truck Unloading Aprons #1 & #2, contiguous with the Stabilization Facility, are existing, unenclosed storage, processing, and receiving areas for containers with or without free liquids. The aprons consist of individual reinforced concrete slabs with underlying 80 mil HDPE liners for containment.

C.9.1.2 Truck Unloading Apron #3

Truck Unloading Apron #3, contiguous with the Containment Building, is an existing, unenclosed, subdivided storage, processing, and receiving area for containers with or without free liquids. The apron consists of three (3) curbed, reinforced concrete slabs with underlying 80 mil HDPE primary and secondary liners for containment.

C.9.1.3 Mixing Bin Tanks (Stabilization Portion)

The Stabilization Portion's stationary Mixing Bin Tanks are internally lined with steel wear plates that do not act as the primary containment. The wear plates protect the primary containment structures during the mixing of wastes, which is performed with an excavator. Each Mixing Bin Tank is provided with a primary barrier and a secondary system equipped with collection sumps. The concrete slab floor area inside the Containment Building is provided with a primary barrier, also equipped with monitoring and collection sumps, that comply with the requirements of IDAPA 58.01.05.008 {40 CFR §264.193(e)(1)(i)}. Secondary and primary volume calculations are provided in Appendix D.2.7. Further detailed information concerning the Containment Building and the mix bin Tanks is found in Section D.9. This system is designed to manage both solid and liquid type waste streams that require treatment prior to landfill disposal.

C.9.1.4 Mixing Bin Tanks (Debris Portion)

The Debris Portion's stationary Mixing Bin Tanks are constructed of steel and will be placed on top of the existing floor in the containment building. Since the tanks are constructed of steel, wear plates will not be installed in the Mixing Bin Tanks. The Mixing Bin Tanks will provide primary containment. The existing floor of the Debris portion of the Containment Building will provide secondary containment for each Mixing Bin Tank. This is the same surface which provides primary containment for the Containment Building. The Containment Building is provided with a primary barrier and a secondary system equipped with collection sumps. The concrete slab floor area inside the Containment Building is provided with a primary barrier, also equipped with monitoring and collection sumps, that comply with the requirements of IDAPA 58.01.05.008 {40 CFR §264.193(e)(1)(i)}. Primary and secondary volume calculations are provided in Attachment 14a, Tables D-2a, D-2b, and D-2c. Further detailed information concerning the Containment Building and the Mixing Bin Tanks is found in Section D.9. This system is designed to manage both solid and liquid type waste streams that require treatment prior to landfill disposal.

C.9.2 Stabilization Facility

Stabilization in the Stabilization Facility is conducted in Mixing Bins (i.e., containers) (See Section D, Figure D-2 for the Process Flow Diagram). Further information is provided in Section D, Section D.9 and D.10. Empty Mixing Bins are loaded onto one of two parallel tracks located on the South Side of the Stabilization Facility. The Mixing Bins are then pulled towards the Access Ramps where they are loaded with solid, sludge, and liquid wastes via elevated Access Ramps located on both sides of the Stabilization Facility (east and west sides).

After waste has been loaded into the Mixing Bin, the bins continue northward towards the reagent silos where the appropriate amounts of treatment material are added. Reagents are added to the Mixing Bins via a series of bulk material handling systems or a front-end loader, dump truck, or other appropriate equipment. Water is added directly into the mix bin at the mixing areas.
After the required reagents have been introduced to the mix bin(s), the bins are moved to the mixing area on western portion of the facility. Excavators, located on mixing platforms above the mix bins, thoroughly mix the contents of the bins.

After the reagents have been thoroughly mixed, the mix bins are indexed to the sampling area where if appropriate, waste process control samples are collected and analyzed as discussed in Sections C.10, and C.11.4. The Mixing Bins are can then be reprocessed, emptied into another container or pile for additional on and/or off-site treatment or disposal, taken to an appropriate storage area, or taken to the landfill for disposal.

C.9.3 Drum Pads 4 and 5 (CSP #4 & 5)

CSP #4 is an existing, unenclosed, subdivided storage, processing, and receiving area for containers with or without free liquids. It is curbed and constructed of reinforced concrete and sealed with an epoxy coating for containment. Drawing #PRMI-R11 shows the locations, dimensions and designations of the subdivided storage areas used for segregating incompatible wastes; this drawing also shows the locations and design of the containment systems, including slope and drainage information.

CSP #5 is an existing, unenclosed, subdivided storage, processing, and receiving area for containers with or without free liquids. It is curbed and constructed of reinforced concrete and sealed with an epoxy coating for containment. Drawing #PRMI-R11, -C12, and -C13 show the locations, dimensions, and designations of the subdivided storage areas used for segregating incompatible wastes; these drawings also show the locations and design of the containment systems, including slope and drainage information.
Further details for these storage pads are provided in Section D, Section D.1.

C.9.4 Container Storage Area No. 1 (CSA #1)

CSA #1 is an unlined storage pad primarily constructed of native compacted soils. CSA #1 is sloped to the North to Northeast to drainage collection points. Diversion channels are located South and Southwest of the unit to control run-on (Drawing PRMI-R15). Only solid materials are managed in CSA #1.

Solid wastes in non-bulk containers (e.g. bags, boxes and drums, etc.) placed into storage at CSA #1 will be elevated or otherwise protected from contact with potentially accumulated liquid (IDAPA 58.01.05.008 and 40 CFR §264.175(c)). Bulk containers are stored with a minimum of 24 in. between individual containers. Additionally, a minimum of four feet wide aisle is located between every two rows of bulk containers to allow emergency equipment access. A typical storage arrangement for bulk containers in CSA #1 is shown on Drawing # PRMI-R15.

C.9.5 RCRA/PCB Storage Building

The RCRA/PCB Storage Building is an existing, enclosed storage, processing, and receiving area for containers. Part of the building consists of a curbed, welded steel floor for containment within a steel framed building. Drawing #PRMI-R21 and PRMI-R22 show the location, dimensions, and designation of the storage area; these drawings also show the locations and design of the containment systems, including slope and drainage information. The RCRA portion (earthen floor) is for storage of solid wastes that do not contain free liquids. Storage of liquid wastes are permitted within the PCB portion of the building equipped with secondary containment.

C.9.6 Surface Impoundments

A total of four (4) surface impoundments are located at the facility. The Evaporation Pond is utilized to handle onsite or offsite generated liquid wastes, including landfill leachate that may be effectively reduced by evaporation. Three other ponds (Collection Pond Nos. 1, 2, and 3) are utilized to collect surface water runoff and, if necessary, liquids from the Evaporation Pond on a contingency basis. Acceptable wastes are either placed in the appropriate tanks pending transfer to the Evaporation Pond or unloaded directly into the Evaporation Pond.

C.9.7 Waste Water Treatment Tank System

Four (4) above ground tanks are currently used for storage and treatment of RCRA hazardous wastes at the facility designated as Tanks #1, #2, #3 & #4 and are located within secondary containment, adjacent to the southeast corner of CSP #4 as shown on Drawing # PRMI-R11, PRMI-C11, -C12, and -C13. Tank Certifications are provided in Appendix D.2.2.

The four (4) tanks are constructed of 3/8 inch welded carbon steel. Specific components of these tanks are listed in Table D-2.

All (4) tanks are vertical, shell mounted, uniformly structurally supported and anchored on concrete foundations satisfying the requirements of the American Concrete Institute Building Code 318 (ACI 318). Tanks are equipped with either a 16 in. or 24 in. manhole, a conservation breather vent, a liquid level indicator, inlet and outlet valves, and spare valves. Each tank is equipped with a fixed roof and is vented through a closed vent system to a carbon adsorption canister to remove potential volatile organic vapors.

The flow diagram shown on Drawing # 720C-P02, illustrates how the Tanks are integrated into the facility's RCRA operations and provide instrumentation details for each tank. Drawing # 720C-P01 and Appendix D.2.4 provide information on the leachate piping. The tanks are operated under ambient temperature and pressure conditions and are heat traced to prevent freezing in the winter.

Leachate Piping is either placed directly on the ground surface to facilitate regular inspection or consists of double walled pipe. The specification for this piping is included in Appendix D.2.4. The leachate piping system is operated such that it is essentially empty when not in use. The system is designed to drain back towards the leachate risers to prevent the potential for freezing. Pipe culverts have been constructed at all road crossings to protect the pipes from vehicle traffic.

C.10 QUALITY ASSURANCE/QUALITY CONTROL

The following quality assurance/quality control (QA/QC or "quality") information is utilized to ensure adequate quality assurance and quality control during waste management activities. The following documents were utilized during the development of USEI's QA/QC procedures:

1. *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, SW-846*, Third Edition, Final Update I, U.S. EPA, Office of Solid Waste, Washington, DC, July 1992, Section One, as updated

2. Handbook for analytical Quality Control in Water and Wastewater laboratories, EPA 600/4-79-019, March 1979, US Environmental Protection Agency (USEPA), Environmental Monitoring and Support Laboratory (EMSL), Cincinnati, OH.

Quality protocols are applicable to both sampling and analytical techniques. The following sections provide general QA/QC procedures USEI utilizes during the collection, transfer, storage and analysis.

The objective of the Quality Assurance/Quality Control (QA/QC) program is to ensure that operational decisions result in the proper treatment, storage and disposal of the hazardous wastes handled at the facility. An additional aspect of this program is to ensure that hazardous wastes, which are restricted from disposal at the facility, are adequately screened prior to acceptance of waste shipments. The principal components of this program are listed as follows for the routine acceptance, treatment, and disposal of hazardous waste.

- Pre-acceptance review to screen and classify waste;
- Review and cross-check of shipping and manifest documentation for each shipment as it arrives at the facility;
- Second review of pre-acceptance information, classification, and shipping documentation prior to any storage, treatment, or disposal activity;
- Field inspections, item counts, and other physical verification of shipment contents performed independently by technical personnel;
- Sampling performed by trained personnel using accepted procedures;
- Fingerprint analysis performed by qualified technical personnel;
- Comparison of field data, fingerprint data, and pre-acceptance information for consistency prior to QC release of waste for disposal; and
- Treatment determination study of process capabilities for stabilization of hazardous constituents by demonstration and analysis during the pre-acceptance review process.

C.10.1 Sampling QC

Personnel involved in the sampling of waste are given formalized training. This consists of a presentation of the theoretical aspects of random sampling and the practical considerations of sample collection and sampling handling. Documentation is maintained in the employee's personnel file to reflect the nature and content of the training per the requirements of Section H of this Document.

C.10.1.1 Fingerprint Analysis

Fingerprint analysis performed in the routine acceptance of waste shipments provides qualitative confirmation that the waste actually received on-site is consistent with the more rigorous pre-acceptance criteria. For personnel and equipment involved with this analysis, personnel receive training in the types and methods involved in the physical characterization of waste and specific factors of concern. Notations of non-conforming physical characteristics and other fingerprint parameters may be recorded on the ICF and/or other pertinent documentation associated with the processing of the waste for disposal.

C.10.1.2 General Sample Handling

Hazardous waste samples, sample containers, and sampling equipment are handled in a manner that is consistent with the required analytical procedures. Samples are sealed and transported to the laboratory as soon as practical after collection. The seal normally consists of a bottle cap or other closure that prevents spillage. The outside of the sample container is cleaned prior to being removed from the sampling location to limit the potential spread of any contamination. This is accomplished by wiping the sample container with a dry or dampened cloth. In some cases, rinsing with water or other solvents may be appropriate.

C.10.1.3 Sample Identification and Documentation

Hazardous waste samples collected under the requirements of this WAP are currently numbered by one of two systems (or equivalent), depending on whether the samples are from routine waste or non-routine wastes. If the sample is from waste routinely received for disposal, it has an associated Internal Control Form (ICF)/load number assigned. The sample identification number consists of that ICF/load number followed by the ICF item number and a specific container designator.

Non-routine samples (those with no associated ICF number) are consecutively numbered based upon yearly sequential numbers as follows:

03-0001

"03" indicates the calendar year the sample is collected.

"0001" is a consecutive number that progresses upwards until the end of the year.

The following information is placed on all sample labels:

- Essential information;

- Sample Identification Number;
- Date the sample was collected; and
- Initials or name of sample collector.

Additional information (to be provided as requested):

- Generator's name;
- Description of waste, including shipping name, identification numbers, container type, etc.;
- Location of sampling site/grid;
- Waste Stream Identification (WSID) Number; and
- Analysis requested.

Records of all samples collected under the requirements of this WAP are kept by the facility. For all ICF/load related samples, these records include information on physical characteristics (e.g., liquid, solid, etc.), item count, discrepancies/problems, and other related data.

Incoming samples are recorded in the sample logs and/or electronically by the facility. ICF-related samples have a completed WPQ that outlines the required fingerprint parameters and expected results. The specific tracking system is dependent on the current database tracking system, which is periodically updated, as necessary. The above outline provides an example of how a tracking system is organized.

Chain-of-custody procedures are used when deemed necessary to document sample possession from time of collection through transfer to other facilities. Normally, these procedures are used when outside laboratories are utilized and/or there is legal reason to document the chain of possession of the sample. Samples are stored in a secure and controlled location. An example of a chain-of-custody form is shown in Figure C.10.

C.10.1.4 Sample Storage and Preservation

Samples are properly preserved, stored, and analyzed as soon as practical after they are collected. Refrigeration is a part of most sample storage/preservation techniques; however, some sample constituents, such as metal cations, which may precipitate into a salt that will not readily re-dissolve, may be adversely affected by refrigeration.

Chemical preservation is used for specific constituents because of the potential reaction of the preservative with other possible constituents. Where a sample is needed for multiple constituents, several separate sample bottles may be required for proper preservation. For those samples required to be sent to an off-site laboratory, the normal procedure is to contact the off-site laboratory for type of container (e.g. plastic, glass etc.), preservative requirement, required volume, and storage time limitations associated with the analytical method and the requested analysis.

Routine samples for receipt and process control purposes are not usually preserved because analysis is begun shortly after sample collection.

C.10.2 QC for Other Analytical Procedures

The facility maintains a substantial amount of analytical capacity above that required performing routine fingerprint analysis. In order to maintain a high level of confidence in the data generated from the use of the analytical procedures, the QC provisions cited in these procedures are followed as appropriate based on the need for information. For example, if a procedure is run for the purpose of confirmation of analytical information supplied from an outside source, the QC considerations may be relaxed somewhat as opposed to the same procedure run for the precise quantification of a chemical species. The facility may, from time to time, determine the need to incorporate additional analytical procedures for various reasons. As these are adopted for use, appropriate QC provisions are also implemented consistent with the confidence levels associated with the need for additional information.

C.10.3 Additional Laboratory QC Provisions

Additional components of the laboratory QC program are as follows:

- Instrumentation and equipment are maintained in serviceable condition as determined by manufacturers recommendations and by the facility's internally determined need for analytical capability.
- All volumetric glassware is designated as Class "A" as defined by the National Bureau of Standards, if required by the analytical methodology.
- All chemicals and reagents used in any fingerprint test or other analytical procedure are of sufficient purity to be non-interfering with the results desired. In those tests and procedures where minimum purity levels are specified, such as "ACS Reagent Grade", or equivalent are used, as appropriate.

C.10.4 Laboratory and Sampling Quality Assurance Program

The basis for obtaining reliable data consistent with the identified needs of the facility rests with the equipment, procedures, and personnel involved. The methods for maintaining high standards of performance in these areas lie in the detection of deviations from established protocols or the appearance of previously undetected or procedural interference's. In the first case, the assurance of quality is based on observations derived from daily observations and periodic internal compliance audits. In the second case, numerical information is required from the analysis of blanks, spikes, surrogates, and other known quantities. Documentation of the QC activities associated with and required by the sample collection and analyses procedures are maintained.

C.10.4.1 Sampling Program

Sampling procedures are described in Section C.4 of this WAP. The selection of the sample collection device depends on the type of sample, the sample container, the sampling location and the nature and distribution of the waste components. In general, the methodologies used for specific materials correspond to those referenced in IDAPA 58.01.05.005 {40 CFR Part 261, Appendix I}. The selection and use of the sampling device is supervised or performed by a person thoroughly familiar with the sampling requirements. Sampling equipment is constructed of non-reactive materials such as glass, PVC plastic, aluminum, or stainless steel. Care is taken in the selection of the sampling device to prevent contamination of the sample and to ensure compatibility of materials. For example, glass bottles are not used to collect hydrofluoric acid wastes.

Individual container samples that are related may be composited prior to analysis as described in Section C.4.3.

C.10.4.2 Analytical Program

USEI has developed a program of analytical quality practices and procedures to ensure that precision and accuracy are maintained. These programs include the use of control standards, duplicates, spikes, and blanks. Non-company laboratories employed by the company demonstrate quality control practices that are comparable to USEI's practices.

C.11 GENERAL CONSIDERATIONS

In the operation of a hazardous waste management facility a number of issues become apparent, which are not necessarily anticipated in the regulations and may present unique management methods. Below are sections addressing several issues of this nature and other unique situations. It is USEI's intention to address these issues in this forum to provide insight into the technique development.

C.11.1 Disposition of Samples

Samples of waste streams are commonly disposed in the same fashion as the waste stream itself. If, for example, a waste is approved for stabilization and landfilling, the sample may be stabilized (e.g.; in the lab, in containers, or mix bins) and subsequently disposed. Samples received, which are unauthorized for management on-site, are returned to the generator (or representative) or aggregated (under the provisions of IDAPA 58.01.05.006 and 40 CFR §262.34) and sent off-site to an authorized facility for subsequent management. To facilitate sample management, samples approved for the same management processes may be consolidated (e.g.; in tanks or containers) and managed under the provisions of IDAPA 58.01.05.006 {40 CFR §262.34}. Should samples arrive on-site from an identified generator, but without proper waste identification, USEI will attempt to contact the generator to identify the associated waste and appropriate hazardous waste codes, if any. If a sample identity cannot be resolved with a generator, or if the generator of the waste sample cannot be determined, USEI will attempt to identify the generator and send it back or such samples may be managed as on-site generated waste and subject to classification as characteristic wastes (D001 through D043) for the characteristics / contaminants reasonably expected to be in the waste.

C.11.1.1 Frozen Samples

Samples of frozen loads are defrosted prior to analysis (Note: to speed up fingerprinting, samples may be heated under the vent hood). In some cases, it may be necessary to defrost entire loads or, for drum loads, 10% of the load, to facilitate sampling or to inspect for free standing liquids. As an alternative, and if conditions warrant (e.g., anticipated freezing conditions) a sample of waste being delivered may be taken at the point of generation for the purpose of satisfying the requirements of this plan. Such samples will be taken from either the load or place of generation or accumulation. If this procedure is utilized, the load will also be visually inspected on-site for Physical Appearance to check against obvious differences in waste type.

C.11.2 Sampling Safety Precautions

Sampling personnel wear personal protective equipment (PPE) (e.g.; eye, foot, hand, head & respiratory protection & protective clothing), as necessary. Load receipt personnel check the manifest or other shipping or pre-acceptance information to be familiar with the material and ensure necessary precautions are taken. Specific safety precautions are outlined in USEI's Health and Safety Plan.

C.11.3 Remote Project Sampling and/or Analysis

In cases where USEI directs off-site sampling (e.g.; at USEI's Rail Transfer Station) or analysis for the purpose of having that sample or analysis meet the requirements of the USEI provisions (e.g., Fingerprint Testing, etc.), USEI will instruct an on-site representative in the requirements of this WAP or a USEI representative will be at the project site to ensure compliance with the provisions of this WAP including the applicable QA/QC requirements.

C.11.4 Sampling of LDR Waste and CAMU Waste

When waste is treated on-site for the purpose of meeting LDR or CAMU treatment standards or, for LDR or CAMU-eligible waste confirmation testing, samples are taken on a grab sample basis. EPA has promulgated compliance of concentration based treatment standards for all non-wastewaters based on grab samples as stated in IDAPA 58.01.05.011 {40 CFR §268.40(b)}. USEI follows this sampling methodology for waste treated on-site. Any grab sample must pass the treatment standards in order for compliance to be assured. When there is any uncertainty in achievement of treatment standards, the sample should be re-sampled and/or re-analyzed as necessary.

C.11.5 Interim Processing Loads

Following treatment, the treated waste is sent to the landfill for final disposal and “staged” in the landfill while applicable verification testing is performed as described in Section C.6. Up to 50 batches may be staged at any point in time. Staged material will be staged for up to 10 working days.

USEI may submit an extension request to the IDEQ if additional time is needed to verify treatment due to unique verification sampling and analysis requirements (e.g., samples need to be sent offsite for analysis).

C.11.5.1 Re-Sampling of Interim Processing Piles

Wastes treated on or off-site and “staged” at one of the interim processing pile in the landfill that result in a failure of applicable standards (from an initial sample) may need re-sampling for verification analyses. If the re-sampling indicates the waste meets treatment standards the waste may be released for disposal. If re-sampling indicates the material does not meet applicable treatment standards the waste will be redirected for further treatment, as necessary.

C.11.6 Lab Packs

Lab Packs are managed in accordance with IDAPA 58.01.05.008 {40 CFR §264.316}. Lab Packs are not sampled. Lab packs must be packaged in non-leaking inside containers and must be over packed in an open head metal container with less than 110 gallon capacity and surrounded by a sufficient quantity of non-biodegradable sorbent material capable of absorbing the liquid contents of the container. The sorbent material must not be capable of reacting dangerously with, being decomposed by, or being ignited by the contents of the lab pack. Reactive wastes, other than cyanide or sulfide bearing waste (as defined by IDAPA 58.01.05.005 and 40 CFR §261.23(a)(5)) must be treated or rendered non-reactive prior to packaging. Lab pack material is accepted subject to a contents and packaging review. Lab pack materials which are proposed to be treated, stored, or disposed are inventoried, and the inventories are sent to the facility for review. The inventories are reviewed for incompatibility of contained materials, land disposal restrictions, and utilization of appropriate packing materials. Since lab packs contain many small quantities of individual materials, they are not sampled, but are inspected to ensure adequate packing material is present and the drum is at least 90% full (if destined for direct landfilling). If necessary, sorbent material may be added until the lab pack is 90% full.

C.11.7 Management of Residues[4]

Management of waste residues and other miscellaneous equipment or debris originating from on-site management areas or activities may be managed as on-site generated wastes and classified according to their hazardous waste characteristics, if any. However, where an on-site generated waste is derived from one or more wastes, it will be managed in accordance with the approved management conditions for that waste(s) (e.g.; a spill of F002 material may be managed as F002), or if precluded by permit, regulation, or operational conditions, it may be subject to alternative management, as appropriate. Stabilization residues and other treatment residues will carry the waste code(s) and will be managed in the same manner as the last waste stream in the unit. For example, sludge's removed from a stabilization mix bin which last received K061 wastes would carry the K061 code and must meet appropriate treatment standards for K061 before being land disposed on-site, if that were the selected disposal option. Residues from waste treatment units will carry the waste codes and be managed consistent with the waste last managed in the unit. The applicable waste codes and corresponding waste management methods will be based upon the "First In, First Out" principle and the estimated resident time. Residues from truck cleaning, Containment Building, Stabilization Facility, or in other waste management units are managed either with the like materials being managed at those locations or as on-site generated waste. Residues in "RCRA Empty" containers are not subject to this WAP since they are not solid or hazardous wastes per IDAPA 58.01.05.005 {40 CFR §261.7}.

C.11.8 Rejected Load or Rejected Partial-Load, and Re-Manifesting Procedures

Manifest discrepancies are resolved, if possible, by contacting the generator or its representative to obtain the needed information. There are many cases where entire loads or portions of loads may be rejected (e.g., a bulk load contains un-profiled or unacceptable[5] materials). The regulations (IDAPA 58.01.05.008 and 40 CFR Parts 264, Subpart E – *Manifest System, Recordkeeping, and Reporting*) do not give instructions on how materials are rejected or re-manifested. The exact manifesting procedures will be determined considering the variables associated with any particular rejection, but, in general, the following is a summary of the typical considerations associated with rejecting materials.

Two options are available for rejecting some or all of a load. The 1st option includes sending material out on the original manifest noting in Block 19 that the load is being rejected back to the point of origination or the alternate facility designated on the manifest or verbally designated by

[4] Residues is used to mean solids and liquids contained or generated in sumps, truck & equipment washing, tank cleaning, boiler cleaning, evaporator cleaning, distillation unit cleaning, equipment maintenance, repair, or replacement, pipes, valves, filters, filter media, miscellaneous samples, and personal protective equipment.
[5] The material may be "unacceptable" for many reasons, of which only some are due to permit constraints. The term "unacceptable" is not meant to mean unacceptable due to permit constraints, but to also cover those materials for which the facility has not developed the appropriate management procedures or process in managing the waste and for other causes.

the generator. If the manifest has not already been signed, the original manifest may be utilized by either striking through the original TSDF destination and inserting the new (alternate) destination or by simply noting in block 19 the new destination. If the manifest has been signed, an additional line may be struck through USEI's signature on the manifest.

A 2nd option is to generate a new manifest. This procedure is less preferable since USEI must complete the Generator's section of the manifest and, in this case, language may be inserted in blocks J, K, or 15 indicating USEI is the generator for shipping purposes only and referencing the original manifest. This option is often useful for bulk loads for which a portion is being rejected in containers (e.g.; aerosol cans removed from a bulk load may be sent back to the generator packaged in DOT shipping containers) and for rejecting or forwarding on a portion of a container shipment. In either case, USEI will copy the generator notifications and/or certifications for that shipment and attach a copy to the outgoing manifest(s) rather than altering the notifications and/or certifications made by the generator.

Although not required for entire load rejections, USEI will usually keep a copy of the manifest(s), subsequently generated manifest(s), and notifications and/or certifications. In cases where the waste is being manifested back to the generator, USEI does not need to complete the LDR Notifications or Certifications since the waste is not being sent for land disposal.

C.11.9 Restricted Waste

Certain wastes are restricted from on-site disposal at the facility. Table C.8 provides the list of on-site disposal restricted waste.

C.11.10 Brokerage of Non-Hazardous and Hazardous Waste

Wastes accepted for management may be subsequently sent to an alternate facility for disposal and or other management, if necessary. At times, USEI may elect to send waste to an alternate TSDF due to scheduling, economic, and/or operational complications associated with the waste in question. Alternatively, some waste streams may have a specific technology code (IDAPA 58.01.05.011 {40 CFR §268.40} Treatment Standards) that requires a type of treatment not offered by USEI. Other undefined reasons my result in the decision to send waste offsite for disposal. As a result, these wastes will be brokered for further treatment at an appropriate facility, as necessary. Examples of wastes that may require brokering include:

- Wastes greater than 260 mg/kg total mercury;
- Specific customer requests;
- Flammable liquids;
- Wastes with specific technology codes not offered by USEI;
- Certain wastes regulated under Subpart CC.

Brokered wastes will be managed under the same management methods, procedures and restrictions outlined within this WAP. For example, USEI will utilize appropriate waste determination/characterization, sampling, pre-acceptance, receiving, and storage requirements as outlined in this WAP. Wastes my also be consolidated or bulked as necessary for off-site shipment.

Additionally, material that will be brokered for offsite disposal will be designated as such by placing a red dot on the top of the drum or other visible location. Specific markings for brokered waste will facilitate tracking of brokered material as described in Section D.1.b.

C.11.10.1 Storage of Brokered Waste

Waste that will be brokered for offsite shipment will conform to the same management requirements outlined in this WAP including associated compatibility requirements. Section D.1.b provides more detailed storage requirements.

C.11.11 Non-Hazardous Wastes (NHW)

USEI accepts wastes, which are not hazardous as defined under RCRA or are exempt from RCRA regulations (e.g., household hazardous waste, etc.). USEI utilizes this WAP and the procedures contained herein to review non-hazardous wastes, however, depending on the specific waste, specific sections of this WAP may not be applicable (e.g., manifesting provisions, sampling requirements, LDR verification of treated wastes, etc.).

Each load of NHW arriving for on-site treatment or disposal will be visually inspected in order to verify waste conformance and/or acceptability. If applicable, NHW liquids will be solidified prior to disposal and will follow the requirements of IDAPA 58.01.05.008 {40 CFR §264.314}.

C.11.12 Protectively-Characterized Wastes

Generators occasionally "protectively" (overly)-characterize[6] wastes sent to off-site TSDFs for a variety of reasons (including public relations, legal reasons, financial incentives, lack of characterization experience, or lack of specific analytical information). USEI has analytical resources and technical personnel trained and experienced in proper regulatory/waste classification and who are capable of detecting protective-classification. Examples of protective-characterization include remedial projects where soils are classified according to a specific waste characteristic (e.g., D008 – lead), but where any specific load(s) do not fail the TCLP analysis for the specific waste characteristic as a "protective" measure. USEI, where it possesses specific analytical data, process knowledge, or regulatory knowledge may properly characterize waste during the pre-acceptance or load-arrival process. The primary criteria for re-classifying hazardous waste are analytical data (e.g., TCLP test as described above) unless the re-classification is a result of a regulatory exemption and/or other criteria. Prior to disposal, USEI will complete an appropriate Notification and/or an appropriate LDR Certification, as required.

[6] "Over-characterization" means the practice of applying waste codes or UHCs to a waste which do not apply and/or to the practice of not applying appropriate LDT Notifications or Certifications.

C.11.13 Standard Profiles

"Standard profiles" may be used for waste streams which are 1) similar in physical or chemical characteristics or 2) generated by similar industries or processes. This profile designation is consistent with EPA's approach of assigning a listed waste code to similar process wastes. All the wastes within a standard profile are usually managed at USEI using the same treatment process.

USEI may develop standard profiles based on information from waste streams targeted for this process. USEI reviews the generator provided information to evaluate whether an individual waste stream is sufficiently similar in physical and/or chemical characteristics to an established standard profile. A specific waste stream may be identified as conforming to an approved standard profile by evaluating the individual waste stream information against the standard profile. The specific waste stream information must fall within the standard profile representative ranges in order to incorporate that waste stream into the standard profile.

Specific candidate waste streams, which, upon review, are identified as conforming to an existing approved standard profile, will be managed under the existing waste management decision specific for that standard profile.

C.11.14 RCRA/PCB Waste

The USEI facility is a fully permitted RCRA and TSCA facility. Often, material is accepted that is both a characteristic/listed RCRA waste and a PCB contaminated TSCA waste. When this occurs, the material is managed as a RCRA waste since the PCB component is managed as a UHC under the RCRA regulations. In this manner, the material is not a PCB waste but a RCRA waste subject to RCRA regulations. If the material in question is not characteristic/listed under RCRA and does have a PCB component (i.e., regulated under TSCA) then the waste will be managed as a TSCA waste as described by USEI's TSCA permit. This distinction provides important guidance as the two sets of regulations are not always the same and it is necessary that the material be managed under clear and consistent regulations.

C.12 CONCLUSION

The aforementioned sampling and analytical quality practices help ensure the data obtained are precise and accurate for the waste stream being sampled. The analytical results are used by facility management to decide whether or not to accept a particular waste and, upon acceptance, to determine the appropriate method of treatment, storage, and disposal. Results are also important to ensure that wastes are managed properly by the facility and that incompatible wastes are not inadvertently combined. The quality of these results is as important as the results themselves. Thus, the quality of the analytical data, the thoroughness and care with which the sampling and analyses are performed and reported, provides an important basis for day-to-day operational decisions.

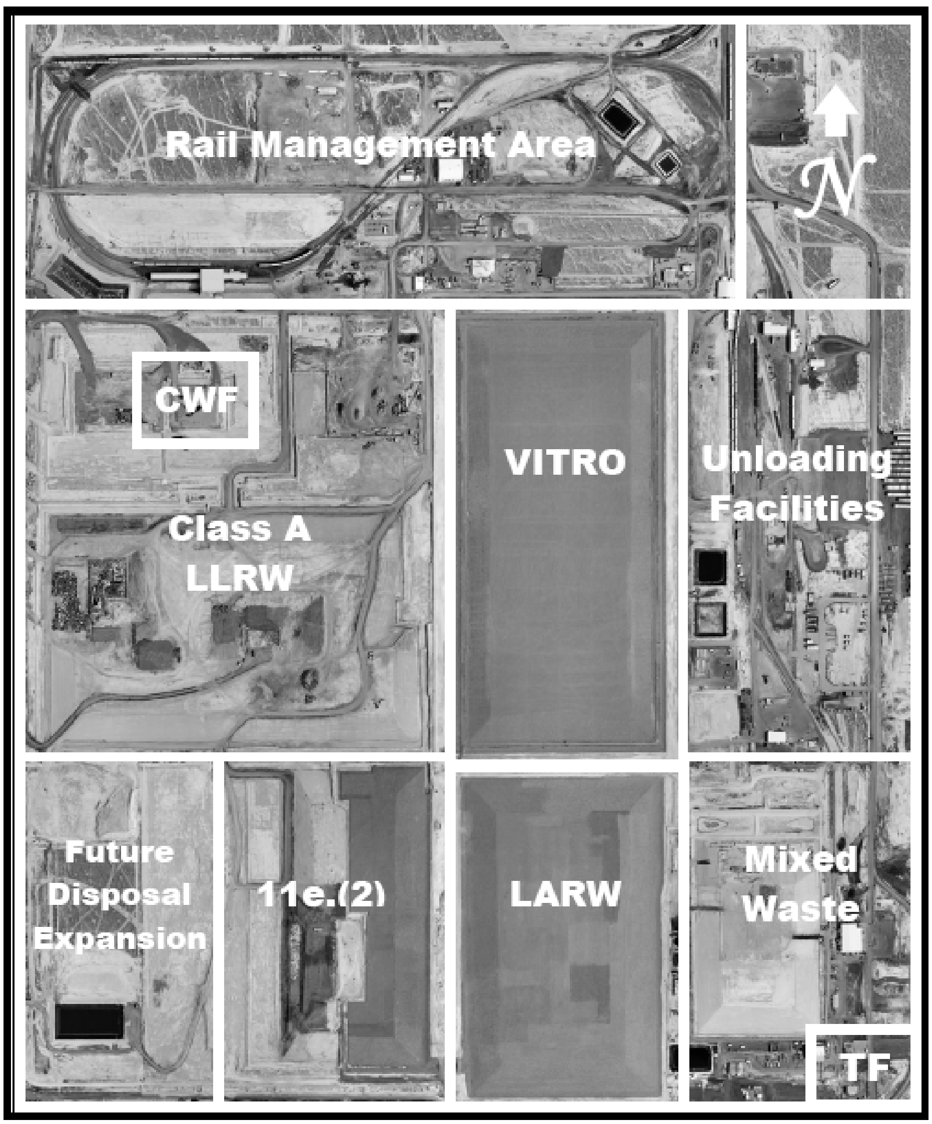
Appendix C-2:

Energy*Solutions* – Clive, Utah

Bulk Waste Disposal and Treatment Facilities Waste Acceptance Criteria

Revision 7

(Includes Class A LLRW, Mixed Waste, and 11e.(2) Disposal Embankments)



Corporate Office
423 West 300 South, Suite 200
Salt Lake City, UT 84101
Phone: (801) 649-2000
Fax: (801) 537-7345

Disposal and Treatment Facility
Interstate 80, Exit 49
Clive, UT 84029
Phone: (435) 884-0155
Fax: (435) 884-3549

TABLE OF CONTENTS

SECTION 1

INTRODUCTION

1.1 PURPOSE

Energy*Solutions* has developed this Bulk Waste Disposal and Treatment Facilities – Waste Acceptance Criteria (BWF WAC) document to assist waste generators and their contractors by providing information about the capabilities and requirements of Energy*Solutions*' disposal and treatment facilities. Energy*Solutions* is authorized to receive:

- Class A Low-Level Radioactive Waste (LLRW)
- NORM/NARM
- Class A Mixed LLRW (i.e., radioactive and hazardous)
- 11e.(2) Byproduct Material
- PCB Radioactive, and
- Other various forms and types of radioactive wastes

The BWF WAC provides information on Energy*Solutions*' waste acceptance processes including:

- Waste characterization and profiling,
- Pre-shipment sampling and analysis,
- Waste packaging, transportation and delivery,
- Waste receipt, verification sampling and acceptance, and
- Waste treatment and disposal

These waste acceptance criteria collectively pertain to the Bulk Waste and Treatment Facilities which are described in detail below. The BWF WAC does not apply to Energy*Solutions*' Containerized Waste Facility (CWF). Please refer to the CWF WAC which can be downloaded from Energy*Solutions*' website at www.energysolutions.com.

1.2 SCOPE

Numerous state and federal agencies regulate the management, transportation, treatment and disposal of radioactive and hazardous materials. This document provides guidance on Energy*Solutions*' waste acceptance process and should be used in conjunction with current copies of Energy*Solutions*' licenses, permits and applicable state and federal regulations. These license, permits, and regulations take precedence over any information contained in this document. Generators may request variances from the BWF WAC on a case-by-case basis. Energy*Solutions* will evaluate such requests and provide written notification to the generator if the variance is approved.

Energy*Solutions*' licenses and permits along with links to applicable parts of the Utah Radiation Rules are included on Energy*Solutions*' website at www.energysolutions.com. In addition, Appendix A of this document contains a list of contact information for both Energy*Solutions* and the State of Utah. For additional information, representatives of Energy*Solutions*' Business Development Department are available to answer any questions and can be contacted at (801) 649-2000.

1.3 RESPONSIBILITIES

The generator is responsible to characterize, classify, schedule, manifest, package and transport waste shipments to Energy*Solutions*' disposal facility in accordance with the BWF WAC, licenses, permits, and applicable state and federal regulations. For waste classification, generators must have in place a quality control program to ensure compliance with the waste classification requirements. The generator or authorized representative must complete and submit a Radioactive Waste Profile Record to Energy*Solutions* for review and approval prior to shipment. Additional forms and certifications may also be required such as the Special Nuclear Material Exemption Certification, the PCB Waste Certification, and the Land Disposal Restriction Notification and/or Certification. Section 4 details the waste profiling process. The generator or authorized representative should be available to resolve issues that arise associated with waste shipments.

Energy*Solutions* is responsible to safely and compliantly receive, treat (if applicable), and dispose of waste shipments in accordance with all applicable permits, licenses, and regulations. Energy*Solutions* will provide disposal and/or treatment certificates upon request from the generator. In addition, Energy*Solutions* will contact the generator to resolve non-conforming waste shipments or discrepancies with the contractual terms and conditions associated in accordance with the receipt and management of waste shipments.

SECTION 2

SITE AND FACILITY DESCRIPTION

2.1 SELECTION OF THE CLIVE DISPOSAL SITE LOCATION

The initial selection of the Energy*Solutions* disposal site location dates back to the late 1970s when the Department of Energy (DOE) and the State of Utah began the cleanup of an abandoned uranium mill site. The Vitro mill site, located in central Salt Lake City, was one of the first sites cleaned up under the DOE Uranium Mill Tailings Remediation Action (UMTRA) Program.

The DOE investigated 29 sites to identify the safest permanent disposal site for these materials. After eight years of characterization and evaluation of several sites, the DOE selected the Clive site located in Utah's West Desert approximately 75 miles west of Salt Lake City. The site's remote location, low precipitation, naturally poor groundwater, and low-permeability clay soils were some of the attractive qualities of the area. From 1984 to 1988, the Vitro tailings were relocated to Clive and placed in an above-ground disposal cell.

Since acquiring land adjacent to the Vitro disposal embankment and obtaining a disposal license, the vision of Energy*Solutions*' Clive facility has been to provide a private disposal option for material from cleanups and generators of radioactive waste in separate disposal embankments similar to those used for DOE's Vitro project. The Clive site has received waste from cleanups carried out across the country including projects by the Environmental Protection Agency (EPA), DOE, Department of Defense, and private companies. The initial disposal license was for Naturally Occurring Radioactive Material (NORM). Since 1988, Energy*Solutions*' Radioactive Material License (RML) has been amended several times, expanding the types of radioactive materials to include low-level radioactive waste (LLRW), in addition to NORM.

2.2 LICENSES, PERMITS, AND AUTHORIZATIONS

Energy*Solutions* is permitted, licensed, and authorized to receive, treat, and dispose Class A LLRW, NORM/NARM, Class A Mixed LLRW, 11e.(2) Byproduct Material, Special Nuclear Material based on concentration limits, as well as Polychlorinated Biphenyl (PCB) Radioactive Waste, and PCB Mixed Waste in accordance with the following documents:

- Radioactive Material License (RML) Number UT 2300249, as amended
  - Class A LLRW as defined in Utah Administrative Code R313-15-1008
  - Class A Mixed LLRW (radioactive and hazardous)
  - NORM/NARM
  - Special Nuclear Material (concentration based limits)

- 11e.(2) Byproduct Material License Number UT 2300478, as amended
  - 11e.(2) Byproduct Material as defined by the Atomic Energy Act, as amended

- State-Issued Part B Permit Number UTD982598898, as amended
  - Storage, treatment, and disposal of Mixed Waste
  - Authorizes disposal of specific types of PCB regulated waste in the Mixed Waste disposal facility

- ➢ Groundwater Quality Discharge Permit Number UGW450005, as amended
  - Authorizes disposal of specific types of PCB regulated waste in the Class A LLRW disposal facility

- ➢ Special Nuclear Material (SNM) Exemption Order issued by the NRC, as amended
  - Authorizes receipt, storage, treatment, and disposal of waste containing SNM based on concentration limits rather than mass limits

- ➢ TSCA Coordinated Approval issued by the EPA Region 8, as amended
  - PCB Radioactive and PCB Mixed Waste (40 CFR Part 761)

Section 3 details the various waste types and waste forms that are acceptable at Energy*Solutions*. Waste streams that are subject to multiple regulations must meet the requirements for each applicable regulation.

2.3 SITE LOCATION AND ACCESS

Energy*Solutions*' operations are conducted on and adjacent to Section 32, Township 1 South, Range 11 West, SLM, Tooele County, Utah. The facility is about 75 miles west of Salt Lake City and about three miles south of Interstate 80, Exit 49. The site is conveniently accessed by both highway and rail transportation. The disposal site mailing address is:

Energy*Solutions* LLC
Clive Disposal Site
Interstate 80, Exit 49
Clive, UT 84029 (84083 if using Fed Ex)
Phone: (435) 884-0155

Energy*Solutions* receives waste shipped via bulk truck, containerized truck, enclosed truck, bulk railcars, rail boxcars, and rail intermodals. The transportation access allows Energy*Solutions* to operate throughout the entire year. The disposal site is accessed by the Union Pacific Railroad at Energy*Solutions*' private siding. Energy*Solutions* uses more than ten miles of track and three locomotives for railcar management. Covered railcar rotary dumper and covered railcar decontamination facilities allow for the efficient unloading, decontamination and return of rail shipments.

2.4 DISPOSAL AND TREATMENT FACILITIES

The design and operation of the Energy*Solutions* disposal site provides a long-term disposal solution with a minimal need for active maintenance after closure. Energy*Solutions* uses an above-ground engineered disposal cell. The design of these cells is patterned after DOE and EPA specifications for the VITRO disposal embankment. Each licensed disposal embankment meets or exceeds the applicable regulatory requirements.

Figure 2-1 shows the locations of Energy*Solutions*' waste treatment, disposal, and operations areas at the Clive facility. Energy*Solutions*' waste operations are managed as three facilities:

- "Bulk Waste Facility" (BWF) – including Mixed Waste, LARW, 11e.(2) and Class A LLRW
- "Containerized Waste Facility" (CWF) – located within the Class A LLRW area
- "Treatment Facility" (TF) – located in the southeast corner of the Mixed Waste area

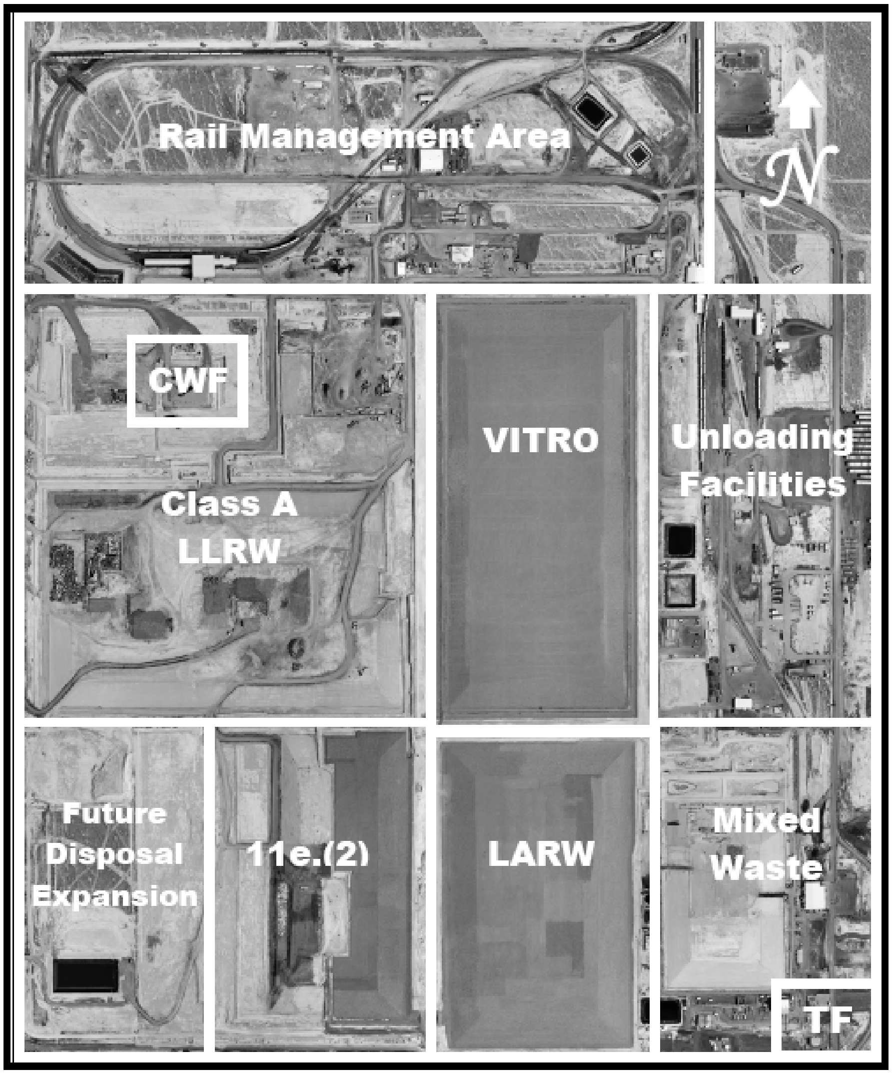


Figure 2-1. Energy*Solutions*' Disposal and Treatment Facilities

<u>Bulk Waste Facility</u>

Waste shipped for direct disposal that is compliant with the ALARA Criteria described below is managed at Energy*Solutions*' Bulk Waste Facility (BWF). Such waste is either removed from the container or filled with a grout-like mixture to minimize void spaces. Waste that is removed from the shipping container is typically compacted into 12-inch soil lifts. Waste that consists of debris items that do not have a dimension small enough to be compacted into the 12-inch soil lifts are disposed of using grout in a different disposal area within the BWF. Waste is directly disposed at the Class A LLRW, Mixed Waste, or 11e.(2) disposal embankments. Bulk containers (e.g., intermodals, gondolas, etc.) and non-bulk containers (e.g., drums, boxes, etc.) are acceptable for receipt at the BWF.

The Bulk Waste Facility (BWF) includes the following disposal embankments and structures:

- Class A LLRW and NORM disposal embankment
- 11e.(2) Byproduct Material disposal embankment
- Mixed Waste disposal embankment for LDR compliant solid waste
- Intermodal unloading facility for unloading and staging bulk waste shipments for disposal
- Railcar Rollover facility for unloading and staging bulk waste shipments for disposal
- Rail Wash Facility for decontamination, surveying, and releasing of railcars
- Container Wash Facility for decontamination, surveying and releasing of bulk containers

<u>Containerized Waste Facility</u>

Waste shipped for direct disposal exceeding Energy*Solutions*' ALARA Criteria is managed at the Containerized Waste Facility (CWF). Waste must be packaged in disposal containers (e.g., drums, boxes, liners, etc.) instead of bulk containers (e.g., intermodals, gondolas, etc.) for shipments to the CWF since Energy*Solutions* will not remove such waste from its container due to the elevated dose rates. Please refer to Energy*Solutions*' CWF WAC for information on shipping waste to the CWF.

Shipments to the CWF typically are shipped in a shielded transportation package such as a cask as illustrated in Figure 2-2.

Figure 2-2. Cask Shipment at the Containerized Waste Facility

<u>Treatment Facility</u>

Waste shipped to Energy*Solutions* for treatment or liquid solidification prior to disposal is managed at Energy*Solutions*' Treatment Facility. The Treatment Facility is shown in Figure 2-1 as "TF". The

Treatment Facility is designed for radioactive waste that requires treatment for RCRA constituents and for liquid radioactive wastes requiring solidification prior to disposal. Energy*Solutions*' Mixed Waste treatment and solidification capabilities include:

- Chemical Stabilization – Including oxidation, reduction, neutralization and deactivation.
- Amalgamation – For the treatment of elemental mercury.
- Macroencapsulation – For the treatment of radioactive lead solids, RCRA metal-containing batteries and hazardous debris.
- Microencapsulation – To reduce the leachability of hazardous constituents in mixed wastes that are generally dry, fine-grained materials such as ash, powders or salts.
- Liquid Solidification – For the solidification of radioactively contaminated liquids such as aqueous solutions, oils, antifreeze, etc. to facilitate land disposal. Mixed waste liquids can also be treated and solidified at the Treatment Facility.
- Vacuum Thermal Desorption of Organic Constituents **-** For the thermal segregation of organic constituents from wastes including wastes with PCBs. Waste containing PCB liquids is also acceptable for VTD treatment. The organic liquid condensate must be treated prior to final disposal. The non-liquid waste residue will be further treated for metal contaminates (if required) and disposed at the Mixed Waste embankment.
- Debris Spray Washing – To remove contaminants from applicable hazardous debris.

Each of these treatment technologies are discussed in further detail in Section 3.1.3.

Currently, all waste processed at the Treatment Facility are disposed in the Mixed Waste disposal embankment. The Treatment Facility includes open and covered waste storage areas for storing, sampling, and staging Mixed Waste shipments, including the following buildings and areas:

- Mixed Waste Operations Building
- Mixed Waste Treatment Building
- Liquids Storage Building
- Mixed Waste storage, staging and sampling areas

2.5 ALARA CRITERIA FOR THE BULK WASTE AND TREATMENT FACILITIES

Energy*Solutions* has implemented an "As Low As Reasonably Achievable" (ALARA) Criteria to minimize worker exposures. The ALARA Criteria is not a license condition but is used as the primary distinction between waste that is acceptable for direct disposal at the BWF and CWF. Wastes with higher dose rates exceeding the ALARA Criteria are disposed at the CWF where waste packages are directly disposed without sampling and actual waste handling. Conversely, wastes with dose rates less than the

ALARA Criteria may be disposed at the BWF since the waste is sampled and, in most cases, removed from the shipping container.

As shown in the table below, these ALARA Criteria define allowable external contact dose rates and loose surface contamination limits for waste managed at the BWF.

External Contact Dose Rate	**Removable Surface Contamination On Exterior Surfaces of Debris**
< 200 mR/hr on manifested container	< 500 dpm α/100 cm^2
< 500 mR/hr on external, accessible surfaces of waste in container	< 50,000 dpm β,γ/100 cm^2
< 80 mR/hr on contact of unshielded bulk containers with resin	

<u>External Contact Dose Rate Limits</u>

The external contact dose rate limit of 200 mR/hr applies to the manifested container (e.g., drums/boxes on a flatbed truck or enclosed van, bulk containers such as intermodals, sealands, cargo containers, etc.). For example, if drums or boxes are shipped in a bulk container, such as an intermodal, and the intermodal is manifested as the strong, tight container, then the external contact dose rate of 200 mR/hr applies to the intermodal and not to the drums or boxes inside the intermodal. The drums and boxes in this case would be considered waste and must not contain any item with dose rates exceeding 500 mR/hr on the external, accessible surfaces of the item.

The dose rate for debris items such as pipes should only be measured on the exterior surfaces and on the plane surface of the opening of the pipe to demonstrate compliance with the ALARA Criteria. For example, the internal pipe surfaces may exceed the 500 mR/hr dose limit only if the surface plane to the opening of the pipe is less than 500 mR/hr. Shield plates used to cover the opening of the pipe should not be used solely to lower the dose rates below the criteria since Energy*Solutions* is required to remove or penetrate into the debris items to fill internal voids with grout material.

Another example is DAW placed into 55 gallon drums and compacted into pucks. The dose rate criteria apply to the external surfaces of the puck itself and not to the DAW inside the puck.

<u>Resin External Contact Dose Rate Limits</u>

Resins shipped in bulk containers must comply with the ALARA Criteria. This is due to the required resin blending process that necessitates worker proximity to the waste. Resins shipped in disposal containers such as drums, boxes, liners, etc. may be acceptable at the BWF for grouting if the container is compliant with the ALARA Criteria for non-bulk packages. Resins shipped to the BWF must be shipped under a Waste Profile specific for resins unless specifically approved in writing by Energy*Solutions*. Resins with dose rates that exceed these limits must be disposed at the CWF.

Removable Surface Contamination Limits

The same ALARA principles apply to the removable surface contamination limits. The main concern is controlling loose contamination on the exterior surfaces of debris items removed from the container. Fixatives may be applied to the debris items to reduce the removable contamination levels below the specified limits.

Requests for Exceptions

Requested exceptions to the ALARA Criteria are evaluated on a case-by-case basis. For example, Mixed Waste exceeding the ALARA Criteria will be evaluated since the CWF cannot accept Mixed Waste for disposal. Generators must provide radiation and contamination surveys of the container and/or waste item when requesting approval to exceed the ALARA Criteria. Dose rate measurements at one foot from the waste should be provided on the radiation survey. The transportation mode and manifested package information should also be included with the request. The generator must receive written approval for exemptions to the ALARA Criteria prior to shipment of the waste.

SECTION 3

WASTE CRITERIA

3.1 ACCEPTABLE RADIOACTIVE WASTES

The type, form, and quantity of LLRW, NORM, 11e.(2) byproduct material, and mixed waste that Energy*Solutions* can receive for treatment and disposal is governed by the various licenses and permits under which Energy*Solutions* operates. Energy*Solutions* has been issued an Agreement State Radioactive Material License (License #UT 2300249, as amended) by the Utah Division of Radiation Control (DRC). This license authorizes Energy*Solutions* to receive Class A LLRW, NORM, and NARM waste. Energy*Solutions* has been issued a separate license to receive and dispose of uranium and thorium mill tailings byproduct material as defined by section 11e.(2) of the Atomic Energy Act of 1954, as amended.

The Utah Division of Solid and Hazardous Waste (DSHW) issued Energy*Solutions* a State-Issued Part B Permit (Permit #UT 982598898, as amended) to treat and dispose of hazardous waste which is also contaminated with LLRW, NORM, or NARM wastes (mixed waste). Early in 1999, Energy*Solutions* received a Permit modification which authorized the receipt and disposal of PCB Radioactive and PCB Mixed wastes. In 2002, Energy*Solutions* received a TSCA Coordinated Approval from the EPA to expand PCB receipt and disposal options. The TSCA Coordinated Approval has been subsequently expanded to include additional types of PCB radioactive and PCB mixed wastes.

3.1.1 Class A Low-Level Radioactive Waste

Energy*Solutions* is authorized to receive Class A Low-Level and Mixed Low-Level Radioactive Waste. These wastes must be classified in accordance with the requirements of the Utah Administrative Code (UAC) R313-15-1008, Classification and Characteristics of Low-Level Radioactive Waste. Utah rule R313-15-1008 is similar to the NRC Waste Classification requirements in 10 CFR 61.55 with the addition of Radium-226. Generators must have in place a quality control program to ensure compliance with the waste classification requirements and prepare and retain with manifest documentation a record documenting the generator's waste classification analysis. Shippers and generators should also review NRC IE Bulletin No. 79-19 to ensure compliance with applicable training requirements in managing LLRW.

The information provided below is a summary of the waste classification regulations and how generators must classify their LLRW prior to shipment to Energy*Solutions*. Further guidance is provided in NRC's "Branch Technical Position on Concentration Averaging and Encapsulation", as amended (BTP). All generators shipping LLRW to Energy*Solutions* must comply with the NRC's BTP as specified in Condition 16 of the Radioactive Material License.

Determination of waste class involves two considerations. First, consideration must be given to specific long-lived radionuclides listed in Table I of UAC R313-15-1008. Second, consideration must be given to specific short-lived radionuclides listed in Table II of UAC R313-15-1008. The waste is Class A if the radionuclides listed in either Table I or Table II are not present in the waste. Both tables are provided below.

The concentration limits for determining waste class are given in curies per cubic meter with the exception of the following Table I radionuclides which are given in nanocuries per gram: alpha-emitting transuranic radionuclides with a half-life greater than five years, Pu-241, Cm-242, and Ra-226. The following bullets outline the steps for determining waste class per R313-15-1008.

Classification Tables from UAC R313-15-1008

Table I

Radionuclide	Ci/m^3	nCi/g
C-14	8	
C-14 (act)	80	
Ni-59 (act)	220	
Nb-94 (act)	0.2	
Tc-99	3	
I-129	0.08	
Alpha-emitting transuranics > 5 year half-life		100
Pu-241		3,500
Cm-242		20,000
Ra-226		100

- When the waste does not contain any radionuclides listed in either Table I or II, it is Class A.
- When the concentration does not exceed 0.1 times the value in Table I, the waste is Class A.
- When the concentration exceeds 0.1 times the value in Table I, but does not exceed the value in Table I, the waste is Class C. Energy*Solutions* is not authorized to receive Class B and Class C waste.
- For wastes containing mixtures of radionuclides listed in Table I, the total concentration shall be determined by the sum of fractions rule as illustrated in the example below.
- When the waste does not contain any of the radionuclides listed in Table I, classification shall be determined based on the concentrations shown in Table II.

Table II

Radionuclide	Column 1 Ci/m^3	Column 2 Ci/m^3	Column 3 Ci/m^3
Total of all radionuclides < 5 year half-life	700	*	*
H-3	40	*	*
Co-60	700	*	*
Ni-63	3.5	70	700
Ni-63 (act)	35	700	7,000
Sr-90	0.04	150	7,000
Cs-137	1	44	4,600

* There are no limits established for these radionuclides in Class B or C wastes. Practical considerations such as the effects of external radiation and internal heat generation on transportation, handling, and disposal will limit the concentrations for these wastes. These wastes shall be Class B unless the concentrations of other radionuclides in Table II determine the waste to be Class C independent of these radionuclides.

- When the concentration does not exceed the value in Column 1 of Table II, the waste is Class A.
- When the concentration exceeds the value in Column 1 but does not exceed the value in Column 2 of Table II, the waste is Class B.
- When the concentration exceeds the value in Column 2 but does not exceed the value in Column 3 of Table II, the waste is Class C.
- For wastes containing mixtures of the radionuclides listed in Table II, the total concentration shall be determined by the sum of fractions rule.

For waste material that contains more than one radionuclide, the waste must be classified by applying the sum of fractions rule described in UAC R313-15-1008(1)(g). This rule states:

> "For determining classification for waste that contains a mixture of radionuclides, it is necessary to determine the sum of fractions by dividing each radionuclide's concentration by the appropriate limit and adding the resulting values. The appropriate limits shall all be taken from the same column of the same table. The sum of fractions for the column shall be less than 1.0 if the waste class is to be determined by that column."

The following examples demonstrate the application of the sum of fractions rule in determining waste class.

EXAMPLE #1: A generator has one 55 gallon container of soil contaminated with plutonium-238, radium-226, uranium-234, uranium-235, uranium-238, cesium-137, and strontium-90. The density of the soil is 1.6 g/cm^3 and is used to convert concentration units from pCi/g to Ci/m^3. The radionuclide concentration in the container is as follows:

Radionuclide	Container Concentration (pCi/g)	Container Concentration (Ci/m^3)*	Table I Class A Concentration Limit (pCi/g)	Table II Class A Concentration Limit (Ci/m^3)
Pu-238	3,000	4.8 E-03	10,000	- -
Ra-226	6,000	9.6 E-03	10,000	- -
U-238	5,000	8.0 E-03	- -	- -
U-235	1,100	1.8 E-03	- -	- -
U-234	5,000	8.0 E-03	- -	- -
Sr-90	5,000	8.0 E-03	- -	0.04
Cs-137	8,000	1.3 E-02	- -	1

* The soil density (1.6 g/cm^3) is used to convert from pCi/g to Ci/m^3.

The sum of fractions rule is applied to the container according to the radionuclides listed in Table I and II as follows:

$$\text{Table I:} \quad \frac{3.0E+03}{1.0E+04} + \frac{6.0E+03}{1.0E+04} = 9.0E-01$$

$$\text{Table II:} \quad \frac{8.0E-03}{4.0E-02} + \frac{1.3E-02}{1.0E+00} = 2.6E-02$$

Based on the sum of fractions rule, the waste in this container is determined to be Class A waste (i.e., 90 percent of the Class A limit for Table I radionuclides). This container is acceptable for disposal at Energy*Solutions* since it meets the sum of fractions rule. The uranium radionuclides are not included in the sum of fractions calculation since these radionuclides are not included in Table I or II of R313-15-1008.

EXAMPLE #2: A generator has one 55 gallon container of Dry Active Waste (DAW) contaminated with americium-241, technetium-99, europium-155, colbalt-58, and cesium-135. The density of the DAW is 0.25 g/cm^3 and is used to convert Table II units from pCi/g to Ci/m^3. The radionuclide concentration in the container is as follows:

Radionuclide	**Container Concentration (pCi/g)**	**Container Concentration (Ci/m^3)***	**Table I Class A Concentration Limit (pCi/g)**	**Table II Class A Concentration Limit (Ci/m^3)**
Am-241	6,000	1.5 E-03	10,000	- -
Tc-99	900,000	2.3 E-01	0.3 Ci/m^3	- -
Eu-155	150,000	3.8 E-02	- -	700
Co-60	100,000	2.5 E-02	- -	700
Cs-135	500,000	1.3 E-01	- -	- -

* The DAW density (0.25 g/cm^3) is used to convert from pCi/g to Ci/m^3.

The sum of fractions rule is applied to the container according to the radionuclides listed in Table I and II as follows:

$$\text{Table I:}\quad \frac{6.0E+03}{1.0E+04}+\frac{2.3E-01}{3.0E-01}=1.4E+00$$

$$\text{Table II:}\quad \frac{3.8E-02}{7.0E+02}+\frac{2.5E-02}{7.0E+02}=9.0E-05$$

Based on the sum of fractions rule, the waste in the DAW container exceeds the Table I Class A concentration limit and would not be acceptable at Energy*Solutions*. Note that Cs-135 is not included in the sum of fractions calculation since this radionuclide is excluded in Table I or II of R313-15-1008.

<u>Waste Classification Labels on Packages</u>

All waste packages containing LLRW, including Mixed LLRW, must be labeled either "Class A Unstable" or "Class AU" and appropriately marked in Block 16 of the Uniform Low-Level Radioactive Waste Manifest Form 541. There are no State or Federal regulations that prescribe the size or color of the classification labels. The Utah DRC, however, requires that each package be labeled with a minimum of 0.5-inch lettering in contrasting color (refer to the "Generator Site Access Permit Enforcement Policy - Utah Division of Radiation Control", as amended). This requirement also applies to bulk packaging (e.g., intermodals, gondolas, etc.).

LLRW Compact Export Approval

Energy*Solutions*' disposal site is not classified as a LLRW compact site under the Federal Low-Level Radioactive Waste Policy Act, as amended. Condition 9A of the Radioactive Material License requires generators to demonstrate that the LLRW has been approved for export to Energy*Solutions* prior to the initial shipment of waste. Approval is required from the LLRW compact of origin, or for states unaffiliated, the state of origin. This license condition only applies to non-DOE generators of LLRW and excludes Mixed LLRW. In addition, Energy*Solutions* is not authorized to receive LLRW from the Northwest Compact. Please contact Energy*Solutions* for assistance in complying with this license condition.

3.1.2 NORM/NARM Waste

Energy*Solutions*' Radioactive Material License allows receipt and disposal of Naturally Occurring or Accelerator-Produced Radioactive Material (NORM/NARM). NORM/NARM does not include Byproduct, Source, or Special Nuclear Material and generally contains radionuclides in the uranium and thorium decay series. Since NORM/NARM waste is not considered LLRW, the waste classification regulations do not apply.

3.1.3 Class A Mixed Low-Level Radioactive Waste

Energy*Solutions* is authorized to receive Class A Mixed Low-Level Radioactive Waste (Mixed Waste) for (1) disposal, or (2) treatment and disposal. Mixed Waste is defined by Energy*Solutions*' State-Issued Part B Permit (# UTD982598898) as:

> Waste defined by the Low Level Radioactive Waste Policy Act, Public Law 96-573; this is radioactive waste not classified as high-level radioactive waste, transuranics waste, spent nuclear fuel, or byproduct material as defined by section 11e.(2) of the Atomic Energy Act, and contains hazardous waste that is either listed as a hazardous waste in Subpart D of 40 CFR 261 and/or exhibits any of the hazardous waste characteristics identified in Subpart C of 40 CFR 261, or hazardous waste which also contains naturally occurring radioactive materials.

In accordance with 40 CFR 268.7, a Land Disposal Restriction Notification and/or Certification must accompany each shipment of Mixed Waste. This includes former hazardous wastes that have been treated to remove the Hazardous Waste Codes.

3.1.3.1 Acceptable Hazardous Waste Codes

The specific EPA Hazardous Waste Codes that may be received by Energy*Solutions* are identified in its Statue-Issued Part B Permit. A copy of this permit is included on Energy*Solutions*' web site at www.energysolutions.com or on the Utah Division of Solid and Hazardous Waste web site at www.hazardouswaste.utah.gov/HWBranch/CFFSection/EnvirocarePermit.htm. The following Utah Hazardous Waste Codes are not acceptable at Energy*Solutions*: F999 and P999.

3.1.3.2 LDR Compliant Mixed Waste

Mixed Waste must be analyzed to determine if treatment is required prior to disposal. Mixed Waste that is determined to be compliant with the Land Disposal Restriction (LDR) treatment standards specified in 40 CFR 268 may be directly disposed in Energy*Solutions*' Mixed Waste disposal embankment. Energy*Solutions* is required to verify LDR compliance for all Mixed Waste streams prior to disposal.

Condition 14.B of the Radioactive Material License prohibits Energy*Solutions* from disposing of characteristic Mixed Waste after treatment in the LLRW disposal embankment. Energy*Solutions* has extended this condition to Mixed Waste treated by generators at their facility. The waste profile must describe the waste as having undergone treatment. As a result, any waste that at the point of generation was considered a hazardous waste per 40 CFR 261 will be disposed of in the Mixed Waste disposal embankment. As noted above, an LDR Certification must be included with the shipping paperwork for treated Mixed Waste (including formerly characteristic or listed hazardous waste).

3.1.3.3 Mixed Waste Requiring Treatment

Energy*Solutions* may also receive Mixed Waste that requires treatment in order to comply with LDR treatment standards. Energy*Solutions* is approved under the State-Issued Part B Permit to operate a mixed waste treatment facility. Mixed Waste that is not LDR compliant may be treated by Energy*Solutions* using one of the following treatment technologies or methods:

- Chemical Stabilization, Oxidation, Reduction, Neutralization, and Deactivation
- Macroencapsulation of hazardous debris or radioactive lead solids
- Debris Spray Washing
- Microencapsulation
- Thermal Treatment of Organics
- Mercury Treatment (Amalgamation)

<u>Chemical Stabilization</u>

Chemical stabilization involves the addition of approved chemical reagents in accordance with a waste-specific treatment formula and is performed in mixers at Energy*Solutions*' Treatment Facility. Formula additions of waste, reagents, and water involve the following chemical processes to chemically bind contaminants to reduce their ability to leach from the waste.

- Stabilization (STABL)
- Deactivation (DEACT)
- Neutralization (NEUTR)
- Oxidation (CHOXD)
- Reduction (CHRED)

Formula development may also be applied to Mixed Waste with very low levels of organic contaminants that require chemical destruction in order to meet total concentration based standards versus a leach standard as determined by the Toxicity Characteristic Leaching Procedure (TCLP) test. Mixed Waste requiring chemical stabilization may be sized and homogenized using various equipment including shredders, vibrating screens, and mixers. In order to evaluate chemical compatibility with the stabilization treatment process, generators shipping waste with Hazardous Waste Codes D001, D002, or D003 must provide a list of specific chemicals in each container with the shipping paperwork.

Macroencapsulation of Hazardous Debris and Radioactive Lead Solids

Mixed Waste consisting of hazardous debris may be macroencapsulated in accordance with the "Alternative Treatment Standards for Hazardous Debris" as specified in 40 CFR 268.45. Figure 3-1 illustrates macroencapsulation of hazardous debris in a container using a polymer or performed in-cell using pozzolanic material. Treatment of hazardous debris via macroencapsulation must meet the following criteria:

> "Macroencapsulation of hazardous debris requires application of surface coating materials such as polymeric organics (e.g., resins and plastics) or use of a jacket of inert inorganic materials to substantially reduce surface exposure to potential leaching media" (40 CFR 268.45).

In order for hazardous debris to qualify for this alternative treatment, the waste must comply with the debris definition in 40 CFR 268.2(g).

> "Debris means solid material exceeding a 60 mm particle size that is intended for disposal and that is: A manufactured object; or plant or animal matter; or natural geologic material. However, the following materials are not debris: Any material for which a specific treatment standard is provided in Subpart D, Part 268, namely lead acid batteries, cadmium batteries, and radioactive lead solids; Process residuals such as smelter slag and residues from the treatment of waste, wastewater, sludges, or air emission residues; and intact containers of hazardous waste that are not ruptured and that retain at least 75% of their original volume. A mixture of debris that has not been treated to the standards provided by § 268.45 and other material is subject to regulation as debris if the mixture is comprised primarily of debris, by volume, based on visual inspection" (emphasis added).

Figure 3-1. Macroencapsulation of Hazardous Debris

Therefore, packaged waste subject to macroencapsulation (MACRO) may contain other material that does not meet the debris definition (e.g., paint chips, scale, etc.) to the extent that the mixture is "comprised primarily of debris". Consistent with the ALARA principle, this definition provides generators with flexibility in managing waste streams requiring treatment without having to sort and segregate non-debris items prior to treatment. However, as noted in 40 CFR 268.2(h), "deliberate mixing of other hazardous material with debris to change its treatment classification (i.e., from waste to hazardous debris) is not allowed under the dilution prohibition in § 268.3."

Radioactive Lead Solids (RLS) are another type of hazardous waste that requires treatment via macroencapsulation. Radioactive Lead Solids include, but are not limited to, all forms of lead shielding and other elemental forms of lead. There are no size criteria for RLS unlike the 60 mm particle size requirement for hazardous debris. As such, smaller forms of RLS such as lead shot or fines require macroencapsulation prior to disposal.

Energy*Solutions*' MACRO treatment capability accommodates any size or weight of hazardous debris, thus enabling the generator to reduce the amount of time and cost associated with preparing waste packages for shipment. Generators with large debris over 20,000 pounds requiring macroencapsulation will provide the following information to Energy*Solutions* for review during the waste acceptance process: drawings, photographs, dimensions, weight, description of access ports to internal voids, radiological dose rate and contamination levels, and loading plans.

Debris Spray Washing

Debris Spray Washing is another alternative treatment option utilized by Energy*Solutions* to treat hazardous debris. High pressure water is sprayed at the debris surface to remove hazardous constituents to a "clean debris surface". This treatment technology is best if used on non-porous debris such as metal. ''Clean debris surface'' criteria are specified in 40 CFR 268.45:

> "Clean debris surface means the surface, when viewed without magnification, shall be free of all visible contaminated soil and hazardous waste except that residual staining from soil and waste consisting of light shadows, slight streaks, or minor discolorations, and soil and waste in cracks, crevices, and pits may be present provided that such staining and waste and soil in cracks, crevices, and pits shall be limited to no more than 5% of each square inch of surface area."

Microencapsulation

Microencapuslation (MICRO) is a technology used on Mixed Waste to reduce the leachability of the hazardous constituent. The types of Mixed Waste most suitable for MICRO include, but are not limited to, ash, powders, and salts. MICRO involves the combining of waste with molten polyethylene to form a material that does not leach hazardous constituents in excess of established TCLP treatment standards. Mixed Waste is placed into the mixer with polyethylene. These are mixed at a high frequency with shear and frictional forces until the polyethylene melts and mixes with the waste to create a microencapsulated waste form. The treatment system includes size separation, size reduction, and a waste dryer for waste preparation prior to treatment.

Thermal Treatment of Organics

Mixed Waste streams contaminated with organic hazardous constituents are among the most difficult waste streams to treat. The LDR treatment standards are expressed in terms of total organic concentrations (i.e., mg/kg) versus TCLP concentration based standards. As such, treatment of organic contaminated waste streams requires either destruction or removal of the organic constituent from the waste.

Energy*Solutions* utilizes Vacuum-Assisted Thermal Desorption technology (VTD) to treat organic contaminated waste streams including waste streams containing PCBs. Waste containing PCB liquids is also acceptable for VTD treatment.

Mixed Waste streams are heated in the VTD system at sufficient temperatures to volatize the organic constituents which are then condensed and collected as a liquid. The thermally treated residue is then sampled to verify LDR compliance. In some cases, the treatment residue will require additional treatment to stabilize hazardous metals prior to disposal. The organic liquid condensate will require further treatment to comply with LDR treatment standards.

Mercury Treatment

Elemental mercury contaminated with radioactive materials must be treated via amalgamation per 40 CFR 268.40. Amalgamation of elemental mercury involves the mixing of reagents with the mercury to produce a non-liquid, semi-solid amalgam that reduces the potential emissions of elemental mercury vapors to the air. The Utah DSHW also requires the amalgamation treatment to reduce the leachability of elemental mercury to below the characteristic concentration limit of 0.2 mg/L TCLP. This requirement applies to amalgamated mercury treated at either Energy*Solutions*' Treatment Facility or treated at another facility and shipped to Energy*Solutions* for disposal. Generators may ship elemental mercury contaminated with radioactive materials to Energy*Solutions* for treatment and disposal.

Energy*Solutions* is also capable of treating both Low (< 260 ppm Hg) and High Mercury Subcategory waste streams (≥ 260 ppm Hg). Waste streams containing Low Subcategory Mercury must be treated to less than 0.025 mg/L TCLP mercury. The EPA requires High Mercury Subcategory waste streams be treated thermally by incinerating (IMERC) or retorting (RMERC). Energy*Solutions* has received a site-specific treatment variance from the Utah Solid and Hazardous Waste Control Board to treat High Mercury Subcategory waste streams via stabilization instead of IMERC or RMERC. Consequently, waste streams containing High Subcategory Mercury are treated via stabilization and analyzed post-treatment to ensure the TCLP mercury results are less than 0.2 mg/L.

Hazardous debris that is contaminated with mercury may be macroencapsulated in accordance with the "Alternative Treatment Standards for Hazardous Debris" as specified in 40 CFR 268.45. Elemental mercury must be removed from hazardous debris to the maximum extent practical including, but not limited to, draining pumps, hoses, pipes, etc. and wiping excessive mercury from external surfaces.

3.1.4 11e.(2) Byproduct Material

Energy*Solutions* is licensed by the Utah DRC to receive and dispose of 11e.(2) byproduct material as defined by the Atomic Energy Act, as amended. 11e.(2) byproduct material is defined as the tailings or waste produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content. Shipments of 11e.(2) waste will be managed and disposed of in a separate disposal embankment specifically licensed and designed for this material.

3.1.4.1 Radionuclide Concentration Limits

Energy*Solutions* may accept 11e.(2) byproduct material with an average concentration in any transport vehicle (truck or railcar) not to exceed 4,000 pCi/g for natural uranium or for any radionuclide in the Radium-226 series, 60,000 pCi/g for Thorium-230, or 6,000 pCi/g for any radionuclide in the thorium decay series. Energy*Solutions*' 11e.(2) Byproduct Material License does not require a sum of fractions calculation. The concentration limits are based on the average concentration of the 11e.(2) byproduct material over the transport vehicle upon receipt and not each individual container on the transport vehicle.

3.1.4.2 Acceptable Forms of 11e.(2) Byproduct Material

In addition to soil and soil-like 11e.(2) byproduct material, Energy*Solutions* may accept 11e.(2) contaminated debris. The generator must certify in the Radioactive Waste Profile Record that the debris was either generated during the cleanup of an 11e.(2) facility or is an integral part of the operations of extraction or concentration of uranium or thorium.

All debris must be less than 10 inches in at least one dimension and no longer than 12 feet in any dimension. Debris that exceeds this size limit (e.g., 11e.(2) oversize debris) is not acceptable for disposal under the 11e.(2) license. Generators with 11e.(2) contaminated debris that are unable to size the debris prior to shipment must contact Energy*Solutions*' Customer Service representative to make necessary arrangements for Energy*Solutions* to size the debris upon receipt.

Shipments of 11e.(2) byproduct material containing free liquid will be considered nonconforming and managed in accordance with Energy*Solutions*' 11e.(2) license.

3.1.4.3 Certification of 11e.(2) Byproduct Material

Energy*Solutions* requires that each generator or owner certify in writing that the waste is 11.e(2) byproduct material as defined by the Atomic Energy Act, as amended. Specifically, the generator or owner must certify that the waste materials are tailings or waste produced by extraction or concentration of uranium or thorium from any ore processed primarily for its source material content. The generator or owner must also certify that the waste material does not contain any other radioactive waste or hazardous waste. The generator or owner must provide the following information as it relates to the 11e.(2) byproduct material:

- License under which the waste was processed
- Licensee that was issued the license
- License issue and/or expiration date
- Issuing agency
- Type of license
- Volume of tailings

The generator or owner must attach to the certification a list of all radiological and non-radiological constituents in the waste and the maximum and average concentrations of such constituents. Energy*Solutions* will perform an independent verification as to the accuracy of the information contained in the certification.

3.1.4.4 Shipping Paperwork for 11e.(2) Byproduct Material

Although 11e.(2) byproduct material is specifically excluded from the definition of Low-Level Radioactive Waste; Energy*Solutions* requires that all shipments be manifested using the Uniform Low-Level Radioactive Waste Manifest (NRC Forms 540 and 541). However, 11e.(2) byproduct material does not have to be classified in accordance with the requirements of URC R313-15-1008. Generators may enter "N/A" in column 16 of the NRC Form 541 for Waste Classification.

3.1.5 Special Nuclear Material

Condition 13 of the Radioactive Material License incorporates the Special Nuclear Material Exemption issued by the NRC. Under specified conditions, the exemption allows Energy*Solutions* to possess waste containing SNM in greater mass quantities than prescribed in 10 CFR Part 150 without obtaining an NRC license pursuant to 10 CFR Part 70. The conditions are based on concentration limits of SNM in the waste and have been established by the NRC to ensure criticality safety. Special Nuclear Material (SNM) is defined in the UAC R313-12-3 as:

> Plutonium, uranium-233, uranium enriched in the isotope 233 or in the isotope 235, and other material that the U.S. Nuclear Regulatory Commission, pursuant to the provisions of Section 51 of the Atomic Energy Act of 1954, as amended, determines to be Special Nuclear Material, but does not include source material; or any material artificially enriched by any of the foregoing but does not include source material.

Each generator shipping waste containing SNM (i.e., uranium enriched in U-235, U-233, Pu-236, Pu-238, Pu-239, Pu-240, Pu-241, Pu-242, Pu-243, or Pu-244) must complete and sign Energy*Solutions*' SNM Exemption Certification form as part of the waste profiling process. A copy of this form must also accompany each radioactive waste manifest for waste streams that contain any of the above isotopes. The SNM Exemption Certification form lists specific requirements that must be met in order for Energy*Solutions* to receive and accept waste containing any amount of SNM.

The NRC developed the SNM Exemption conditions based on criticality studies and independent calculations. A variety of scenarios were analyzed to determine limiting criticality conditions for waste materials containing SNM. The NRC determined that several conditions in addition to concentration limits would be required to assure criticality safety. A discussion of their approach is documented in the *Safety Evaluation Report Regarding the Proposed Exemption from Requirements of 10 CFR Part 70* (SER) (Docket 40-8989). Specific guidance from the SER is included in this section.

The following information provides general guidance on completing the SNM Exemption Certification form. These guidelines are grouped into four sections similar to the sections on the form.

3.1.5.1 Condition 1 - Percent Enrichment of Uranium-235

The first section contains a table that lists U-235 concentration limits and related measurement uncertainty values for four different scenarios. These scenarios allow for different enrichments, waste configurations and commingling with moderating material in different percentages. The measured concentrations and associated uncertainties of U-235 in individual waste containers at time of receipt must not exceed the values listed in the RML, Condition 13. Generators with low SNM concentrations relative to the specified limits may select the most restrictive scenario which allows more flexibility in demonstrating compliance with other conditions in the SNM Exemption. Check "Not Applicable" if the waste does not contain enriched U-235. Other SNM isotopes including U-233, Pu-236, and Pu-238 through Pu-244 and their associated limits are also listed.

The measurement uncertainty values listed in the last column of the table represent a maximum allowable concentration limit rather than a percentage value. The NRC provides the following guidance in the SER:

> Staff considers that a reasonable measurement uncertainty value (one-sigma) would be in the range of 15 percent. Staff used 30 percent (two-sigma) in calculating the operational limit to increase the confidence level that the concentration of the waste based on a measurement

would not exceed the subcritical value. Other radiochemistry techniques may be used to quantify the concentration of these radionuclides. These techniques typically have lower measurement uncertainty levels, but introduce sampling uncertainty. The measurement uncertainty levels are included in condition 1 and represent 15 percent of the maximum concentration value. A concentration value was used for the measurement uncertainty rather than a percentage value to allow greater flexibility for generators with waste having very low SNM concentrations.

3.1.5.2 Condition 2 – Specified Limits for Waste Containing SNM

Each generator must certify to all five conditions listed in this section and provide justification based on process knowledge, physical observations, and/or testing. These conditions are categorized as follows:

- SNM Isotope Concentration Limits
- Spatial Distribution Requirements
- Bulk Chemical Limits
- Unusual Moderator Limits
- Soluble Uranium Limits

These conditions require the generator to adequately characterize the waste in terms of the range and variability of SNM concentrations in the waste.

<u>SNM Isotope Concentration Limits</u>

Condition 2.a requires the generator to certify that concentrations of SNM in individual waste containers do not exceed the applicable U-235 concentration limit and the concentration limits for all isotopes listed in Table 1 of the SNM Exemption Certification form. Generators must certify that measurement uncertainty values from radiological testing are less than the maximum allowable concentration values listed in Table 1. As previously stated, a concentration value was used for the measurement uncertainty rather than a percentage value to allow greater flexibility for generators with waste having very low SNM concentrations.

<u>Spatial Distribution Requirements</u>

Condition 2.b requires the generator to certify that the SNM is homogeneously distributed throughout the waste or that the SNM concentrations in any contiguous mass of 600 kilograms (1,323 lbs) do not exceed on average the specified limits. This certification may be based on process knowledge or testing of the waste. The SER provides the following guidance on verifying spatial distribution of SNM:

> Knowledge of the process by which the waste was generated or laid down may assure that the concentration varies smoothly throughout the volume with a maximum in a known location. It is then only necessary to measure the concentration at this maximum plus other measurements confirming smooth variation. In other cases where a smooth variation in SNM concentration in the waste is not present, additional measurements and characterization will be needed.

If spatial distribution of SNM in the waste is not known through process knowledge, generators may be able to certify to this requirement by using the following example.

EXAMPLE: A generator's waste stream contains less than 10 percent enriched U-235. Based on the limits in Condition 1, the corresponding U-235 concentration limit is 1,900 pCi/g. The mass of U-235 at a concentration of 1,900 pCi/g in 600 kg of waste can be calculated using the specific activity for U-235 ($2.16X10^6$ pCi/g) as follows:

$$\frac{1{,}900\,\frac{\text{pCi}}{\text{g}} \times 600{,}000\,\text{g}}{2.16\text{X}10^{6}\,\frac{\text{pCi}}{\text{g}}} = 527.8\ \text{g U235}$$

If the total mass of U-235 per container does not exceed the mass of U-235 in 600 kg of waste at 1,900 pCi/g, then compliance with the spatial distribution requirement can be achieved. Therefore, for this example, the mass of U-235 in the waste containers must not exceed 527.8 grams. Compliance with DOT regulations must also be met for shipments containing SNM.

Radioactive liquid waste containing SNM may also be accepted for solidification prior to disposal provided the SNM concentration does not exceed the SNM concentration limits specified in Condition 1. For containers of liquid waste with more than 600 kg of waste, the total activity (pCi) in the manifested container must not exceed the SNM concentration in Condition 1 times 600 kg of waste. For example, the maximum activity of Pu-239 in any manifested container of liquid waste is 6.0 mCi as shown below:

$$10{,}000\,\frac{\text{pCi}}{\text{g}} \times 600{,}000\ \text{g} = 6.0\text{x}10^{9}\ \text{pCi} = 6.0\,\text{mCi Pu - 239}$$

The maximum activity of SNM in the liquid waste is limited by the volume of liquid shipped in a container and the concentration of SNM in the waste. Consequently, to comply with this condition, the Pu-239 concentration allowed in the liquid waste decreases as the size of the shipping container increases.

Bulk Chemical Requirements

Condition 2.c excludes wastes containing "pure forms" of chemicals containing carbon, fluorine, magnesium, or bismuth in bulk quantities except as allowed by the conditions in Section 1 (e.g., a pallet of drums, a B-25 box). By "pure forms," it is meant that mixtures of the above elements such as magnesium oxide, magnesium carbonate, magnesium fluoride, bismuth oxide, etc. do not contain other elements. Demonstration of compliance with this condition may be based on process knowledge or testing.

The exclusion of bulk quantities of these chemicals in waste containing SNM is based on the criticality studies conducted by Oak Ridge National Laboratories (ORNL) for the NRC. The ORNL studies used silicon dioxide (SiO_2) to represent the waste matrix in performing criticality calculations. Additional studies were performed replacing the silicon in the SiO_2 matrix with other common elements and determined that the above chemicals produced more reactive systems. Therefore, the NRC implemented this condition to restrict waste forms that contain pure forms of these chemicals.

Unusual Moderator Limits

Condition 2.d limits the total quantities of beryllium, hydrogenous material enriched in deuterium, or graphite to one percent or less of the total weight of the waste (except as allowed by the conditions in

Section 1). Information supporting this requirement may be based on process knowledge, physical observations, or testing. The following explanation from the SER provides the basis for this limit:

> Unusually effective neutron moderating materials, such as beryllium, graphite, or heavy water, could provide a more reactive matrix. Previous evaluations have shown that the presence of large amounts of beryllium can permit criticality to occur at lower concentrations of SNM in soil. Therefore, limiting unusual moderators is required to assure the effectiveness of the SNM concentration limits in maintaining criticality safety. Because prohibiting unusual moderators could result in problems demonstrating compliance, staff decided to set a finite maximum limit on unusual moderators.

Soluble Uranium Limits

Condition 2.e limits highly soluble forms of uranium in waste packages to 350 grams of uranium-235 or 200 grams of uranium-233. If the waste contains mixtures of U-233 and U-235, the waste must meet the sum of the fractions rule on a container basis. Highly soluble forms of uranium include, but are not limited to: uranium sulfate, uranyl acetate, uranyl chloride, uranyl formate, uranyl fluoride, uranyl nitrate, uranyl potassium carbonate, and uranyl sulfate. Compliance with this condition may be based on process knowledge or testing.

This condition is based on an evaluation performed by the NRC to determine mechanisms that could increase the concentration of SNM in the waste. The SER identifies one such mechanism which involves the potential for highly soluble uranium to be readily leached with water and concentrate in the waste. Generators must evaluate each waste stream to determine the chemical composition of uranium in the waste and to ensure that the presence of highly soluble forms of uranium do not exceed the mass limits specified above.

3.1.5.3 Condition 3 – Characterization of Waste Containing SNM

The NRC developed specific pre-shipment requirements that have been implemented into the waste profiling process. Energy*Solutions* reviews this information to determine if the pre-shipment waste characterization and assurance plan is complete and that the supporting information is sufficient to demonstrate compliance with all SNM Exemption requirements. This section describes the information that must be attached to the Waste Profile and includes the following items:

- Waste Description
- Waste Characterization Summary
- Uniformity Description
- Manifest Concentration

Condition 3.a requires the generator to describe how the waste was generated, the physical form of the waste, and the uranium chemical composition. The uranium chemical composition of the waste is required to support condition 2.e which limits highly soluble forms of uranium. If compliance with this requirement cannot be demonstrated by process knowledge, approved laboratory methods are available to determine the uranium leaching characteristics of the waste.

Condition 3.b requires the generator to describe how the waste was characterized, the range of SNM concentrations, and the analytical results with error values used to develop the concentration ranges. This information is required to support Conditions 1, 2.a, and 2.b. Generators must sufficiently sample and characterize the waste to ensure that the SNM concentrations do not exceed the specified limits and that the SNM is homogeneously distributed throughout the waste.

A description of the spatial distribution of SNM in the waste is required by Condition 3.c. This description supports the certification of Condition 2.b. The NRC provides guidance in the SER to assist generators in demonstrating compliance with this requirement. Section 3.3.3.2 contains the related NRC guidance.

Condition 3.d requires a description of the methods that will be used to determine the SNM concentrations on the manifests. If concentrations of SNM are significantly lower than the specified limits or the SNM is uniformly distributed throughout the waste, generators are not necessarily required to perform direct measurements on every container. Appropriate methods such as scaling factors may be used in these instances. As SNM concentrations approach the limits, however, generators must perform more extensive characterization to determine the range and variability of SNM in the waste. The following NRC guidance is provided in the SER:

> Where the concentration is a small fraction of the concentration limit and characterization results indicate relatively small variation in that concentration, using scaling factors would be an appropriate method to determine SNM concentrations in individual waste containers. However, where the concentration of SNM approaches the concentration limit or the characterization results indicate large variations in SNM containers, using direct measurements on each package would be an appropriate method to determine SNM concentrations in individual waste containers.

Waste packages that contain elevated concentrations of SNM must be characterized by direct measurements which should involve sampling and/or radiological testing procedures for individual packages.

3.1.5.4 Condition 4 – Generator's Certification

The generator's certification of compliance is required in the final section. Each generator must certify that the information provided on the SNM Exemption Certification form is complete, true, and accurate. The form and all supporting information must be attached to the Waste Profile upon submission to Energy*Solutions*. In addition, the SNM Exemption Certification form must be included with each waste manifest. The information supporting the form, however, should not be included with the manifest.

3.1.6 Polychlorinated Biphenyl (PCB) Radioactive Waste

Energy*Solutions* is authorized to receive and dispose of most types of PCB/radioactive and PCB/mixed wastes defined by the EPA in 40 CFR 761. The EPA issued Energy*Solutions* a TSCA Coordinated Approval for receipt and disposal of drained PCB Articles and PCB Containers that contained PCBs at concentrations equal to or greater than 500 ppm. Wastes received under the TSCA Coordinated Approval must be disposed in the Mixed Waste disposal embankment. All PCB waste shipped to the Mixed Waste disposal facility must be accompanied with a Uniform Hazardous Waste Manifest. As required by 40 CFR 761, the Uniform Hazardous Waste Manifest must include the date the PCB waste was removed from service. Articles and containers of PCB waste must also be dated with the removed from service date per 40 CFR 761.65(c)(8). Empty PCB containers that contained PCBs at concentrations less than 500 ppm may be disposed in the Class A LLRW Facility; however, this waste will require a Uniform Hazardous Waste Manifest and include the removed from service date on each outer container. A Uniform Hazardous Waste Manifest is not required for any other PCB wastes disposed at the Class A LLRW Facility.

The following sections describe the types of PCB waste categories acceptable for disposal at the Class A LLRW or Mixed Waste disposal embankments. Asterisks indicate PCB waste categories that require disposal in Energy*Solutions*' Mixed Waste disposal embankment.

Energy*Solutions*' Ground Water Quality Discharge Permit (GWQDP) and State-Issued Part B Permit prohibit the receipt of any PCB liquids except for 1) intact, non-leaking PCB Small Capacitors or 2) PCB waste that will be treated via VTD. Shipments of PCB wastes containing unauthorized free liquids will not be accepted by Energy*Solutions* unless re-profiled to a VTD waste stream. Generators shipping PCB wastes in re-usable containers must be lined to prevent PCB contamination on the internal surfaces of the container. Containers contaminated with PCBs will be returned to the shipper as a PCB Container.

3.1.6.1 PCB Remediation Waste

PCB Remediation waste is waste containing PCBs as a result of a spill, release, or other unauthorized disposal, at the following concentrations: (1) Materials disposed of prior to April 18, 1978, that are currently at concentrations ≥ 50 ppm PCBs, regardless of the concentration of the original spill; (2) materials which are currently at any volume or concentration where the original source was ≥ 500 ppm PCBs beginning on April 18, 1978, or ≥ 50 ppm PCBs beginning on July 2, 1979; and (3) materials which are currently at any concentration if the PCBs are spilled or released from a source not authorized for use under this part. PCB remediation waste means soil, rags, and other debris generated as a result of any PCB spill cleanup, including, but limited to soil, gravel, dredged materials, such as sediments, settled sediment fines, and aqueous decantate from sediment, sewage sludge containing < 50 ppm PCBs, buildings and other man-made structures (such as concrete floors, wood floors, or walls) porous surfaces, and non-porous surfaces. Unless sampled and analyzed in accordance with 40 CFR 761.283, .286, or .292, the PCB waste shall be assumed to contain ≥ 50 ppm PCBs (40 CFR 761.61(a)(5)(i)(B)(2)(i)).

PCB Remediation Waste Category	Definition	Acceptable
Non-liquid Cleaning Materials and PPE	Includes non-porous surfaces and other non-liquid materials such as rags, gloves, booties, other disposable PPE, and similar materials resulting from PCB cleanup activities.	Yes
< 50 ppm or < 100 μg/100 cm^2	PCB Remediation waste containing < 50 ppm or < 100 μg/100 cm^2.	
≥ 50 ppm or ≥ 100 μg/100 cm^2	PCB Remediation waste containing ≥ 50 ppm or ≥ 100 μg/100 cm^2.	Yes*

* Requires disposal in Energy*Solutions*' Mixed Waste disposal embankment.

3.1.6.2 PCB Bulk Product Waste

PCB Bulk Product waste is waste derived from manufactured products containing PCBs in a non-liquid state, at any concentration where the concentration at the time of designation for disposal was ≥ 50 ppm PCBs. PCB Bulk Product waste includes bulk wastes or debris from the demolition of buildings and other man-made structures manufactured, coated, or serviced with PCBs.

PCB Bulk Product Waste Category	Definition	Acceptable
Presumed or known to leach < 10 μg/L PCBs	Plastics (such as plastic insulation from wire or cable; radio, television and computer casings; vehicle parts; or furniture laminates); preformed or molded rubber parts and components; applied dried paints, varnishes, waxes or other similar coatings or sealants; caulking; Galbestos; non-liquid building demolition debris; or non-liquid PCB bulk product waste from the shredding of automobiles or household appliances from which PCB small capacitors have been removed (shredder fluff). Other PCB Bulk Product waste that leaches PCBs at < 10 ug/L of water measured using a procedure used to simulate leachate generation.	Yes
Presumed or known to leach ≥ 10 μg/L PCBs	Paper or felt gaskets, fluorescent light ballasts with PCBs in the potting material ≥ 50 ppm	Yes*

* Requires disposal in Energy*Solutions*' Mixed Waste disposal embankment.

3.1.6.3 PCB Articles

A PCB Article is any manufactured article, other than a PCB Container, that contains PCBs and whose surfaces have been in direct contact with PCBs. A "PCB Article" includes capacitors, transformers, electric motors, pumps, pipes and any other manufactured item (1) which is formed to a specific shape or design during manufacture, (2) which has end use functions dependent in whole or in part upon its shape or design during end use, and (3) which has either no change of chemical composition during its end use or only those changes of composition which have no commercial purpose separate from that of the PCB Article.

Energy*Solutions* received a TSCA Coordinated Approval from the EPA to receive and dispose of drained PCB Articles. PCB Articles must be drained of all liquid to the maximum extent practical but in no case shall the liquid exceed one percent of the waste volume (all free liquid must be absorbed). PCB Articles that have been drained must be filled with sufficient absorbent material to absorb <u>all</u> remaining liquid. Some PCB Articles also require flushing with solvents for a specified time period (e.g., PCB Transformers). Energy*Solutions* is also able to process PCB Large Capacitors and leaking PCB Small Capacitors through VTD.

The following table lists the various types of PCB Articles and whether the material is acceptable for disposal in either the mixed waste disposal embankment or LLRW disposal embankment.

PCB Articles Category		Definition	Acceptable
PCB Transformers		Any transformer that contains ≥ 500 ppm PCBs.	Yes*[1]
PCB Capacitors (Intact and non-leaking)		Any capacitor that contains ≥ 500 ppm PCBs. Capacitor is a device for accumulating and holding a charge of electricity and consisting of conducting surfaces separated by a dielectric. Assume PCBs ≥ 500 ppm in a capacitor of unknown concentration made prior to July 2, 1979. Assume PCBs < 50 ppm in a capacitor made after July 2, 1979.	--
	PCB Small Capacitors	A capacitor which contains less than 3 lbs of dielectric fluid. A capacitor whose total volume is less than 100 cubic inches may be considered to contain less than 3 lbs of dielectric fluid. Includes fluorescent light ballasts containing intact and non-leaking PCB small capacitors and PCB potting material (< 50 ppm).	Yes*
	PCB Large High or Low Voltage Capacitors	A large high voltage capacitor contains 3 lbs or more of dielectric fluid and which operates at or above 2,000 volts. A large low voltage capacitor contains 3 lbs or more of dielectric fluid and which operates below 2,000 volts.	Yes*
PCB Hydraulic Machines		Includes die casting machines	Yes*[2]
PCB-Contaminated Electrical Equipment		Any electrical equipment (such as transformers, capacitors, and circuit breakers, including those in railroad locomotives and self-propelled cars) which contain ≥ 50 ppm and < 500 ppm PCBs in the dielectric fluid. In the case of dry electrical equipment, the electrical equipment is PCB-Contaminated if it has PCBs > 10 ug/100 cm^2 and < 100 ug/100 cm^2 as measured by a standard swipe test (40 CFR 761.123).	Yes
Other PCB Articles			--
	PCB Article (≥ 500 ppm PCBs)		Yes*
	PCB-Contaminated Article	Any article which contains ≥ 50 ppm and < 500 ppm PCBs in the dielectric fluid. In the case of dry electrical equipment, the electrical equipment is PCB-Contaminated if it has PCBs > 10 ug/100 cm^2 and < 100 ug/100 cm^2 as measured by a standard swipe test per 40 CFR 761.123.	Yes

* Requires disposal in Energy*Solutions*' Mixed Waste disposal embankment.
[1] Requires solvent flushing.
[2] Requires solvent flushing if PCB concentrations ≥ 1,000 ppm.

3.1.6.4 PCB Containers

A PCB Container is any package, can, bottle, bag, barrel, drum, tank, or other device that contains PCBs or PCB Articles and whose surfaces have been in direct contact with PCBs. PCB Containers must be emptied to the extent practical and not contain any free standing liquid. All PCB Containers received for disposal require a Uniform Hazardous Waste Manifest and removed from service dates. Waste containing PCBs in a liquid or solid phase is acceptable for VTD treatment (refer to Section 3.1.3.3).

PCB Container Category	Definition	Acceptable
≥ 500 ppm PCBs	The PCB concentration of material which was contained in the PCB Containers was ≥ 500 ppm	Yes*
< 500 ppm PCBs	The concentration of material which was contained in the PCB containers was < 500 ppm	Yes

* Requires disposal in Energy*Solutions*' Mixed Waste disposal embankment.

3.1.7 UCNI and Export Controlled Waste

Energy*Solutions* has been granted approval from the DOE to receive Unclassified Controlled Nuclear Information (UCNI) and Export Controlled radioactive waste. This type of waste primarily originates from the DOE gaseous diffusion enrichment facilities. DOE generators must contact Energy*Solutions* prior to shipping UCNI and Export Controlled radioactive waste.

3.1.8 Chelating Agents

Energy*Solutions* is authorized to dispose of waste containing up to 22 percent by weight chelating agents in the Mixed Waste disposal embankment. Waste disposed of in the LLRW disposal embankment must contain less than 0.1 percent by weight chelating agents. Generators may ship waste containing greater than 22 percent chelating agents to Energy*Solutions*' Treatment Facility once approved during the waste profiling process. Energy*Solutions* will treat waste containing greater than 22 percent chelating agents prior to disposal in order to comply with this requirement.

3.1.9 Asbestos and Beryllium

Energy*Solutions* is authorized to dispose of waste containing both friable and non-friable asbestos. The asbestos waste must be described in the Radioactive Waste Profile Record and packaged, marked, and labeled in accordance with applicable federal regulations. Friable asbestos must not be packaged in bulk containers unless approved in writing by Energy*Solutions*.

Asbestos waste that requires wetting to prevent dispersion must be inspected to minimize free liquids. However, unless the waste is to be solidified at the Treatment Facility, the free liquid may not exceed one percent of the waste volume. Absorbent material must be added to containers when free liquids are present. Waste streams containing greater than one percent free liquid by waste volume may be shipped to Energy*Solutions*' Treatment Facility for solidification prior to disposal. Contact Energy*Solutions* prior to shipping waste streams that contain free liquids.

Waste containing other potential inhalation hazards such as beryllium must be described in the Waste Profile and documented on the 5 Working-Day Advanced Shipment Notification form. A quantitative description of potential beryllium surface contamination and air monitoring measurements both before and after any fixatives or wrapping are applied should be included in the Waste Profile for beryllium contaminated waste. The description should also include information about the current management of the beryllium contaminated waste including specific work control procedures in handling and packaging the waste for shipment, details of the beryllium protection program as applicable, and air monitoring measurements, etc. Beryllium contaminated waste must be packaged in 55-gallon or smaller drums unless approved in writing by Energy*Solutions*.

3.1.10 Lab Packs

Lab packs are described as small containers of liquid with varying hazardous waste codes that are placed in a larger shipping or storage container. Energy*Solutions* is authorized to receive lab packs in which all of the contents are known and acceptable for treatment or disposal. Lab packs require a specific Waste Profile that must be approved by Energy*Solutions* prior to shipment. Generators must provide a description of unused chemicals within containers with the shipping paperwork.

3.2 ACCEPTABLE FORMS OF RADIOACTIVE WASTE

Energy*Solutions*' Radioactive Material License authorizes the receipt of radioactive waste in the form of liquids and solids. Solid radioactive waste must contain less than one percent free liquid by waste volume. Generators shipping solid waste must minimize free liquid to the maximum extent practicable. Conversely, liquid radioactive wastes contain greater than one percent free liquid by waste volume (e.g., sludge, wastewater, evaporator bottoms, etc.). Energy*Solutions* will determine if a waste contains free liquids by either visual inspection or by performing the Paint Filter Liquid Test (EPA SW-846 Method 9095). Liquid radioactive waste is solidified at Energy*Solutions*' Treatment Facility prior to disposal.

Solid waste includes, but is not limited to, the following forms of waste: soil, sludge, dry active waste, metal, concrete, wood, glass, resin, etc. For simplicity, these waste forms are categorized into either soil or debris waste streams due to the placement criteria specified in the license.

3.2.1 Soil or Soil-Like Wastes

Energy*Solutions* constructs the disposal embankment by achieving specified compaction criteria and minimizing void spaces in the disposal lift. Construction of the disposal embankment in this manner ensures long-term integrity of the disposal facility. Soil and soil-like waste material are placed in the disposal embankment and compacted in 12-inch soil lifts. The license requires these soil lifts to be compacted to greater than 90 percent of optimum density and at a moisture content not to exceed three percentage points above optimum moisture as determined by the Standard Proctor Method (ASTM D-698). Consequently, soil or soil-like waste must have soil-like properties and conform to the following specifications. Otherwise, the waste material will be considered debris and managed for disposal as described in Section 3.2.2.

Soil/Soil-Like Properties

- Greater than 70 percent by weight compactable material less than 3/4" particle size and 100 percent compactable material less than 4" particle size
- Maximum dry density greater than 70 pounds per cubic foot (dry weight basis)
- Moisture content of the soil or soil-like waste must not exceed three percentage points above optimum moisture upon receipt at Energy*Solutions*
- Maximum dry density and optimum moisture must be determined by Standard Proctor Method ASTM D-698

Energy*Solutions* may request a preshipment sample to perform an independent compaction test using Standard Proctor Method ASTM D-698. Generators must include their compaction test results as part of the waste profile submittal.

Shipments of soil or soil-like waste streams may contain some standard size debris in waste packages. The percentage of allowable debris in the waste stream must be listed in the waste profile. Soil or soil-like waste streams with moisture content exceeding three percentage points above optimum moisture are acceptable by Energy*Solutions* and require additional handling prior to disposal. Contact Energy*Solutions*' Customer Service representatives prior to shipping soil or soil-like waste streams with elevated moisture content.

3.2.2 Debris

Waste material not meeting the specified soil or soil-like properties is considered debris by Energy*Solutions*. Debris includes both decommissioning and routinely generated operational waste including, but not limited to, radiologically contaminated paper, piping, rocks, glass, metal, concrete, wood, bricks, resins, sludge, tailings, slag, residues, and personal protective equipment (PPE) that conforms to the debris size requirements.

3.2.2.1 Standard Size Debris

Debris is defined into two broad categories based on size. The first category is standard debris and includes materials that are less than 10 inches in at least one dimension and no longer than 12 feet in any dimension. Debris that does not meet this size criterion is categorized as oversize debris.

Standard size debris is uniformly distributed throughout the 12-inch soil lifts. Energy*Solutions* adds either native clay or radioactive soil to the debris. Each soil lift is limited to the amount of debris that may be placed with soil to achieve the required compaction criteria. Depending upon the conditions of the disposal agreement, some generators that have both soil and debris may be able to achieve cost savings by delivering these materials together such that the shipping package contains enough soil to mix with the debris to achieve compaction requirements. All debris must be placed in such a way to minimize void space in the soil lift.

3.2.2.2 Oversize Debris and Large Components

Waste material is considered oversize debris if the debris has at one dimension greater than 12 feet or does not have one dimension less than 10 inches. Since oversize debris cannot be compacted directly into the soil lifts, this material is placed in different areas of the disposal embankment where void spaces are minimized to the maximum extent practicable both in and around the debris.

Bulk oversize debris, such as a large component, is also disposed of using this alternative disposal process. Energy*Solutions* has received and disposed of several large components over 250 tons including steam generators, reactor heads, turbine components, and other large equipment as illustrated in Figure 3-2. Generators should identify these types of materials as part of the waste profiling process. This will allow Energy*Solutions* to evaluate the off-loading and placement of the large component prior to shipment.

Generally, single items over 20,000 pounds are considered large components and require special handling and engineering reviews prior to placement. The type of information required for large components includes drawings, photographs, weight, dimensions, description of enclosed voids, packaging configuration, rigging and loading plan, identification of lifting points, transportation mode, and radiological characterization and survey documentation. Void spaces within large components must be made accessible via a minimum of two access ports to allow grout in-fill during disposal operations at the Clive disposal facility. Access ports must be at least four inches in diameter unless approved in writing by Energy*Solutions*. Containers of oversize debris must exclude soil or soil-like waste due to placement criteria.

Energy*Solutions* may also elect to dispose of dispersible waste forms (e.g., filtercake, dusty material, etc.) or waste with elevated dose rates by not emptying the waste from the container. Although ion-exchange media (resin) meets the standard size debris criteria, resins are not emptied from the container but grouted to minimize void spaces. Consequently, resin waste streams must be shipped under a resin specific waste profile unless approved in writing by Energy*Solutions*. Void spaces in and around the containers are minimized to the maximum extent practicable.

Figure 3-2. Large Component Disposal

3.2.3 Gaseous Waste

Energy*Solutions* is authorized to receive gaseous waste in accordance with Utah Administrative Code R313-15-1008(2)(a)(viii). Gaseous waste must be packaged at an absolute pressure that does not exceed 1.5 atmospheres at a temperature of 20 degrees Celsius and the total activity of any container shall not exceed 100 Curies. This information must be identified in the Radioactive Waste Profile Record.

3.2.4 Waste Containing Free Liquids

Wastes containing free liquids greater than one percent by volume are considered liquid waste streams. Generators may use visual inspection of the waste or the Paint Filter Liquids Test to determine if the waste contains free liquids. The Radioactive Waste Profile Record must describe the physical, chemical, and radiological characteristics of the liquid waste. Energy*Solutions* received approval from the Utah DRC to receive radioactive liquid wastes that are aqueous based. Non-aqueous radioactive liquids require case-by-case approval from the Utah DRC.

Energy*Solutions* will perform a solidification study on a sample of the liquid waste prior to authorizing shipments. Liquid waste must be solidified and disposed at the Mixed Waste Facility. Energy*Solutions* has permitted liquid storage tanks to accommodate liquids delivered in tankers and other DOT approved bulk containers.

For generators with waste streams that may contain free liquids, the process by which the liquid will be minimized to less than one percent of the waste volume must be documented in the Radioactive Waste Profile Record. Approval of these waste streams would be considered authorized free liquids.

The presence of unauthorized free liquid within a package or shipment is a significant cause of non-compliance. Each incoming shipment will be tested for free liquids in accordance with Energy*Solutions*' Waste Characterization Plan using visual inspection of the waste or the Paint Filter Liquids Test.

If a solid waste shipment is found to contain unauthorized free liquids greater than one percent of the waste volume in any manifested container, Energy*Solutions* is required to promptly notify the generator and the Utah DRC. Energy*Solutions* may stop shipments of waste material until the cause of the problem is identified and corrected. The Waste Characterization Plan requires that the generator submit a quality control program that identifies the root cause of the problem and outlines corrective actions that will be taken to correct the problem and the quality control measures that will be implemented to prevent recurrence. Until this corrective action plan has been submitted, reviewed, and approved by Energy*Solutions*' Quality Assurance Manager, no further shipments may be permitted from the waste generator's site.

In order to control free liquid within the waste material, the use of absorbent materials is strongly recommended. Sufficient absorbent material to absorb twice the volume of the potential liquid should be used. Experience has shown that some soil matrices actually 'bleed' moisture out during transport due to vibration. If testing indicates that the waste material, as shipped, could exceed the optimum moisture content (as determined by the Standard Proctor Test) and that a risk of waste form separation exists while the shipment is en route, the precautionary addition of absorbents prior to shipment is strongly advised. To ensure that adequate absorbents are added, generators should also consider testing the moisture content of each shipment.

Although uncommon, in some cases it is possible for precipitation to enter the package resulting in free liquids. Detailed inspections should be completed before waste is placed in transit to ensure the package meets strong-tight criteria and that water cannot enter. Energy*Solutions* does not maintain a list of approved absorbents or manufacturers. If absorbents are added to the waste, the specific absorbent must be identified in the Radioactive Waste Profile Record (Section B.5).

3.3 PROHIBITED RADIOACTIVE AND MIXED WASTE

Condition 16 of the Radioactive Material License prohibits receipt of the following wastes:

- Sealed sources defined in UAC R313-12 as "radioactive material that is permanently bonded or fixed in a capsule or matrix designed to prevent release and dispersal of the radioactive material under the most severe conditions which are likely to be encountered in normal use and handling" (e.g., instrument calibration check sources, smoke detectors, nuclear density gauges, etc.).
- Radioactive waste which is classified as Class B, Class C, or Greater Than Class C waste.
- Solid waste containing unauthorized free liquids.
- Waste material that is readily capable of detonation, of explosive decomposition, reactive at normal pressure and temperature, or reactive with water or air.
- Waste materials that contain or are capable of generating quantities of toxic gases, vapors, or fumes harmful to persons transporting, handling, or disposing of the waste.
- Waste materials that are pyrophoric. Pyrophoric materials contained in wastes must be treated, prepared, and packaged to be nonflammable.
- Waste materials containing untreated biological, pathogenic, or infectious material including contaminated laboratory research animals. Generators desiring to ship this type of waste must document in the Radioactive Waste Profile Record the process used to treat the potential non-radiological hazard. Sharps including needles, scalpels, knives, syringes, pipettes, and similar items having a point or sharp edge or that are likely to break during transportation must not be packaged in bulk containers unless written approval is given by Energy*Solutions*. When these items are used in the medical industry or related research, they must be treated to remove the biohazard. Documentation of such treatment must be included in the Waste Profile.

The following Mixed Wastes are <u>not</u> acceptable for treatment or disposal at the Mixed Waste facility:

- Hazardous waste that is not also a radioactive waste
- Wastes that react violently or form explosive reactions with air or water
- Pyrophoric wastes and materials
- DOT Forbidden, Class 1.1, Class 1.2 and Class 1.3 explosives
- Shock sensitive wastes and materials
- Compressed gas cylinders, unless they meet the definition of empty containers
- Utah waste codes F999 and P999

SECTION 4

WASTE ACCEPTANCE PROCESS

4.1 WASTE PROFILING PROCESS

This section details Energy*Solutions*' waste characterization and profiling process. Profiling a waste stream involves collecting samples and obtaining analytical results for the parameters specified on Energy*Solutions*' Radioactive Waste Profile Record (Waste Profile). The Waste Profile serves the following functions: (1) enables Energy*Solutions* to evaluate wastes for acceptance, (2) maintains an operating record for the material during acceptance, storage, treatment, if applicable, and disposal of waste shipments, (3) provides a historical record of the waste project for each waste stream, and (4) ensures compliance with Energy*Solutions*' licenses and permits. The Waste Profile and related instructions can be downloaded from Energy*Solutions*' web site at www.energysolutions.com. An Energy*Solutions* Technical Services Representative is also available to assist in the waste profiling process.

The waste profiling process consists of the following steps as illustrated in Figure 4-1:

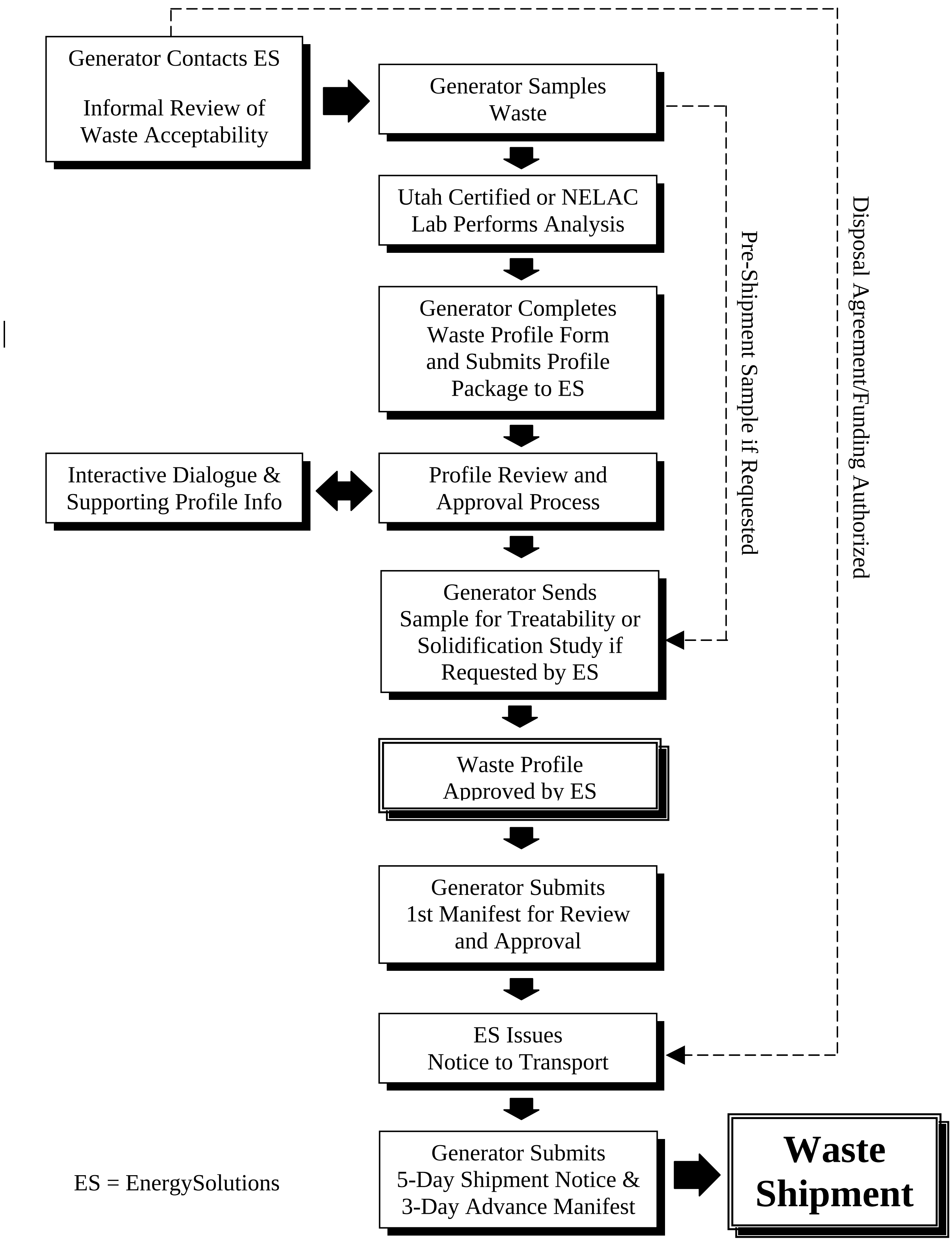
- Initial discussions
- Waste characterization
- Waste Profile Record completion and submittal
- Treatability and/or solidification study sample submitted, if requested
- Profile review and approval
- Notice to Transport

Initial discussions of the waste stream are critical in ensuring that the waste profiling process is accurate and efficient. Technical Services representatives are a resource to the generator in completing this process.

4.2 WASTE CHARACTERIZATION

Early in the process, the generator samples the waste stream where applicable and begins to accumulate the analytical data required in the waste profile record described below. It is critical that chemical analyses are performed by laboratories certified by either the State of Utah or the National Environmental Laboratory Accreditation Conference (NELAC). Generators may contact the Utah Department of Health at (801) 584-8501 or visit their website at http://health.utah.gov to obtain information on the Utah Laboratory certification requirements. Laboratories certified by NELAC are listed on the US EPA's website at www.epa.gov/nerlesd1/land-sci/nelac/accreditlabs.html. Technical Services representatives can also provide current laboratory certification information. Once the analytical support data is available, the generator completes the Waste Profile record as described in the following section.

Figure 4-1. Waste Acceptance Process



4.3 RADIOACTIVE WASTE PROFILE RECORD

The waste profile record is a document required by Energy*Solutions*' licenses and permits. It provides information in the following areas:

- Generator and waste stream information
- Physical properties and packaging
- Radiological information
- Chemical composition and hazard evaluation

Waste generators must complete a Radioactive Waste Profile Record for every waste stream shipped to Energy*Solutions*. To complete this form, the generator should use process knowledge along with analytical laboratory results. The form contains the following sections.

- Generator and Waste Stream Information
  These sections request generator contact information and general overview of the type of waste material, physical characteristics, transportation and package modes, identification of specific radionucildes, and the average and range of radionuclide concentrations.

- Chemical and Hazardous Waste Characteristics (LLRW or MW)
  The generator selects the applicable attachment for describing the chemical properties for either LLRW or Mixed Waste. These attachments request the chemical information to evaluate the waste relative to RCRA regulations. Only one of these attachments is required to be signed and submitted to Energy*Solutions* with the Waste Profile.

- SNM Exemption Certification
  This form requests the radiological information to evaluate waste containing SNM with respect to the SNM Exemption issued by the NRC and incorporated into Energy*Solutions*' license. Condition 3 of the SNM Exemption Certification form requests specific information to be included with the narrative of the Waste Profile.

- PCB Waste Certification
  This form requests information about the type of Polychlorinated Biphenyls (PCBs) waste included with the waste stream. PCB waste streams must be profiled separately from non-PCB waste streams. Energy*Solutions* uses this form and supporting information to evaluate PCB waste streams with respect to Energy*Solutions*' permits and TSCA regulations in 40 CFR 761.

4.3.1 Generator and Waste Stream Information

This section includes contact information for generators, including addresses and responsible parties. The contact information is required for the generator's representative as well as for the individual completing the Waste Profile. The generator must answer a series of questions designed to categorize the waste material that is profiled. The generator identifies the following:

- If the waste is hazardous, and whether it has been treated or requires treatment at Energy*Solutions*
- If the waste is Low-Level Radioactive Waste and subject to LLRW Compact Export approval
- If the waste contains Special Nuclear Materials, PCBs, or asbestos

4.3.2 Waste Physical Properties and Packaging

The physical and geotechnical properties of the waste include gradation of the material, density range, a full description of the physical composition and characteristics of the waste, moisture content, optimum moisture, and maximum dry density determined by the Standard Proctor Method (for soil or soil-like materials).

The purpose of the physical and geotechnical testing requirements is to demonstrate that the material can be managed at Energy*Solutions* under existing license/permit requirements and in accordance with Energy*Solutions*' waste disposal placement methods.

The gradation of the waste may be determined through analysis or waste process knowledge. After an assessment of the entire waste stream, the generator is expected to estimate the amount of material that would pass through the various screens indicated. This information is necessary to determine the method of waste placement.

In this section, the generator addresses questions regarding free liquids. If the waste contains free liquids, the Waste Profile requires a description including the quantity and nature (aqueous or non-aqueous) of the liquid. Solid waste profiled to contain free liquids must be minimized to the maximum extent practical but in no case shall the free liquid exceed one percent of the waste volume upon arrival and inspection at the Energy*Solutions* disposal site. Waste streams containing PCBs must not contain any free liquids unless shipped for VTD treatment.

The waste description is continued by addressing several items in a narrative description and history of the waste provided by the generator as an attachment, referred to as Attachment B.5. The narrative should include the following items as applicable:

- The process that generated the waste
- Waste material physical composition and characteristics
- Radiological and chemical characterization method
- Information requested on the SNM Exemption Certification form, if applicable
- The type and description of PCB waste, if applicable
- Basis for determining manifested radionuclide concentrations
- Description and amounts of absorbents, if applicable
- Basis of non-hazardous or hazardous waste determinations
- Treatment processes, if applicable
- Product information or Material Safety Data Sheets associated with the waste as applicable
- Information requested in other sections of the Waste Profile

4.3.3 Radiological Information

All waste streams must be analyzed to determine the radionuclide concentrations in the waste. The waste must be characterized via gamma spectroscopy, liquid scintillation, or other standard radiochemistry methods to determine the radionuclide concentrations in the waste. Indirect measurements such as dose-to-curie or use of scaling factors may also be used if the process has been validated with direct measurements. Radiological analysis does not need to be performed by a Utah-Certified laboratory. Non-gamma emitting radionuclides such as Fe-55 and Ni-63, may be scaled from the gamma spectral analysis obtained from testing the material if the waste generator has specific process knowledge of the material being profiled (10 CFR Part 61 analyses).

Please note that discrepancies between radiological information, particularly concentration ranges, and waste manifest documents could delay or prevent acceptance of a shipment. The Waste Profile must always be reviewed with the waste manifest documents prior to shipping waste to Energy*Solutions*. In the event that radiological, physical, or chemical properties of a profiled waste stream have changed, an update to the Waste Profile must be submitted and approved before such waste can be shipped to Energy*Solutions*.

Energy*Solutions* requires that generators evaluate the maximum dose rates and contamination levels anticipated in each waste stream. In the radiological section of Waste Profile, the generator indicates whether or not the maximum dose rate on accessible surfaces exceeds the ALARA Criteria as described in Section 2.3.1.

While Energy*Solutions* is permitted to receive Class A LLRW, certain radionuclides are subject to additional controls established by the Utah DRC. For example, Radium-226 is limited to 10,000 pCi/g. In addition, the Utah DRC regulates the following radionuclides under Condition 29E of Energy*Solutions*' Radioactive Materials License:

- Aluminum-26
- Berkelium-247
- Calcium-41
- Californium-250
- Chlorine-36
- Rhenium-187
- Terbium-157
- Terbium-158

Energy*Solutions* is required to provide a one-time notice for each generator shipping one of these radionuclides to the Class A disposal embankment. For waste shipped for disposal at the Mixed Waste disposal embankment, Energy*Solutions* must provide a one-time notification for each generator shipping waste containing Chlorine-36 and Berkelium-247. The generator includes the anticipated presence of these nuclides in the radiological information provided in the Waste Profile.

Finally, the generator lists the radionuclides present in the waste stream in conjunction with the expected maximum manifested concentration and the weighted average concentrations expected for each radionuclide. The generator is expected to manifest values for each shipment that are within the maximum values stated in this section of the Waste Profile. In the event that a generator needs to ship waste to Energy*Solutions* that exceeds the limits in the radiological information section of the Waste Profile, the generator may submit a revised Waste Profile to Energy*Solutions* for review and approval.

Any additional information including laboratory results for gamma spectroscopy or radiochemistry analysis must be attached to the Waste Profile. Radiological characterization methods and the basis for determining manifested radionuclide concentrations should be included in Attachment B.5 as described above.

4.3.4 Chemical Composition and Hazardous Waste Evaluation

In accordance with the response to the hazardous waste question posed in the generator and waste stream information section, the generator provides one of two attachments with the Waste Profile addressing the chemical composition of the waste.

For hazardous wastes, the generator provides a completed and signed copy of the Hazardous Waste Analysis Certification Attachment. The chemical and hazardous characteristics of the waste stream must be provided in extensive detail. The purposes of chemical testing are to (1) demonstrate that the waste meets specific waste acceptance chemical requirements; and (2) demonstrate that the waste is either non-hazardous, compliant with RCRA treatment standards, or will require treatment prior to disposal. In addition, analysis is required to qualify wastes that may contain other specific regulated constituents.

Energy*Solutions*' licenses and permits require the results of the following minimum analyses be provided with the Waste Profile:

Analysis	EPA SW-846 Method(s)
pH (liquids only)	Method 9045
PFLT (solid waste only)	Method 9095
Organics (Totals)	Method 8260 & 8270
Results from applicable concentration based treatment standards	

The results of these analyses are documented on the Hazardous Waste Analysis Certification Attachment and attached to the Waste Profile.

The Hazardous Waste Analysis Certification Attachment also includes waste codes applicable to the waste stream with corresponding treatment standards or technology codes and worst case concentrations. This information is critical in evaluating wastes for treatment at Energy*Solutions*.

Applicable Underlying Hazardous Constituents (as defined in 40 CFR 268.48) and other chemicals present are identified at the end of the attachment.

For non-hazardous waste streams, the generator provides a signed copy of the Low-Level Radioactive Waste Certification Attachment. Energy*Solutions*' licenses and permits require the results of the following analyses be provided with the Waste Profile:

Analysis	EPA SW-846 Method
pH (liquids only)	Method 9045
TCLP Metals	Method 6010/7470
TCLP Herbicides	Method 8151
TCLP Pesticides	Method 8081
TCLP Semi-volatiles	Method 8270
TCLP Volatiles	Method 8260

The individual chemical compounds required for these analyses are listed on the Low-Level Radioactive Waste Certification Attachment and correspond to the characteristic D-list constituents (D004 through D043) identified in 40 CFR 261.24 Table 1 as shown below.

40 CFR 261.24 Table 1

TABLE 1—MAXIMUM CONCENTRATION OF CONTAMINANTS FOR THE TOXICITY CHARACTERISTIC

EPA HW No.[1]	Contaminant	CAS No.[2]	Regulatory Level (mg/L)
D004	Arsenic	7440–38–2	5.0
D005	Barium	7440–39–3	100.0
D018	Benzene	71–43–2	0.5
D006	Cadmium	7440–43–9	1.0
D019	Carbon tetrachloride	56–23–5	0.5
D020	Chlordane	57–74–9	0.03
D021	Chlorobenzene	108–90–7	100.0
D022	Chloroform	67–66–3	6.0
D007	Chromium	7440–47–3	5.0
D023	o-Cresol	95–48–7	[4] 200.0
D024	m-Cresol	108–39–4	[4] 200.0
D025	p-Cresol	106–44–5	[4] 200.0
D026	Cresol	....	[4] 200.0
D016	2,4-D	94–75–7	10.0
D027	1,4-Dichlorobenzene	106–46–7	7.5
D028	1,2-Dichloroethane	107–06–2	0.5
D029	1,1-Dichloroethylene	75–35–4	0.7
D030	2,4-Dinitrotoluene	121–14–2	[3] 0.13
D012	Endrin	72–20–8	0.02
D031	Heptachlor (and its epoxide).	76–44–8	0.008
D032	Hexachlorobenzene	118–74–1	[3] 0.13
D033	Hexachlorobutadiene	87–68–3	0.5
D034	Hexachloroethane	67–72–1	3.0
D008	Lead	7439–92–1	5.0
D013	Lindane	58–89–9	0.4
D009	Mercury	7439–97–6	0.2
D014	Methoxychlor	72–43–5	10.0
D035	Methyl ethyl ketone	78–93–3	200.0
D036	Nitrobenzene	98–95–3	2.0
D037	Pentrachlorophenol	87–86–5	100.0
D038	Pyridine	110–86–1	[3] 5.0
D010	Selenium	7782–49–2	1.0
D011	Silver	7440–22–4	5.0
D039	Tetrachloroethylene	127–18–4	0.7
D015	Toxaphene	8001–35–2	0.5
D040	Trichloroethylene	79–01–6	0.5
D041	2,4,5-Trichlorophenol	95–95–4	400.0
D042	2,4,6-Trichlorophenol	88–06–2	2.0
D017	2,4,5-TP (Silvex)	93–72–1	1.0
D043	Vinyl chloride	75–01–4	0.2

[1] Hazardous waste number.
[2] Chemical abstracts service number.
[3] Quantitation limit is greater than the calculated regulatory level. The quantitation limit therefore becomes the regulatory level.
[4] If o-, m-, and p-Cresol concentrations cannot be differentiated, the total cresol (D026) concentration is used. The regulatory level of total cresol is 200 mg/l.

The attachment also includes a question as to whether or not the waste was at the point of generation of a hazardous waste, and a section to address former hazardous waste codes and additional chemical constituents.

As stated previously, the chemical analysis must be performed by a laboratory holding a NELAC or State of Utah certification. Data provided to the generator prior to any discussions of waste characterization with Energy*Solutions* may be acceptable for waste profiling purposes upon investigation of associated quality control sample data.

Energy*Solutions* may waive the chemical laboratory analyses if the material is not amenable to chemical sampling and analysis (e.g., debris items including metal pieces, concrete, plastic, etc.). Justification for waiving the chemical analyses must be provided in the narrative in Attachment B.5. Technical Service representatives can provide direction in cases where the waste meets such a description.

4.3.5 Special Nuclear Material Exemption Certification Form

Waste containing Special Nuclear Material (SNM) must comply with the SNM requirements for concentration, spatial distribution, chemical mixture, solubility and chemical composition of SNM isotopes as described in Section 3.1.5 of the BWF WAC. The SNM Exemption Certification form guides the generator through the supporting information that must accompany the Waste Profile and each shipment of waste containing SNM. In addition to answering the questions on the form, the generator includes descriptions in Attachment B.5 for the requirements listed in items 3(a) through 3(d) of the SNM form. A completed and signed copy of the SNM Exemption Certification form must accompany the shipping paperwork for waste shipments containing Special Nuclear Material.

4.3.6 PCB Waste Certification Form

Energy*Solutions*' Statue-Issued Part B Permit and Groundwater Quality Discharge Permit include the authorizations and requirements for Energy*Solutions* to receive PCB waste regulated for disposal under 40 CFR 761. The PCB waste types acceptable at Energy*Solutions* are listed in Section 3.1.6 of the BWF WAC. The generator must include a description of the type of PCB waste in the narrative of Attachment B.5. The PCB Waste Certification form does not need to accompany the waste shipment unless requested by Energy*Solutions* during the Waste Profile approval process.

4.4 TREATABILITY AND SOLIDIFICATION STUDY SAMPLES

For waste streams requiring treatment or solidification, Energy*Solutions* will request a preshipment sample to perform a treatability and/or solidification study during the waste profiling approval process. This allows Energy*Solutions* to develop the necessary treatment and solidification formula prior to receipt of the waste. Preshipment samples are not required for waste streams requiring treatment via macroencapsulation. Energy*Solutions* may request additional preshipment samples during the waste profiling process to evaluate the waste material prior to receipt.

Preshipment samples should represent the waste material destined for shipment to Energy*Solutions*. Representative sampling techniques appropriate to radiological and hazardous wastes should be employed in obtaining these samples. Treatability study samples should represent the "worst case" for a waste stream destined for treatment at Energy*Solutions*. The samples should contain the highest anticipated levels of chemical contaminants in the waste steam to ensure that Energy*Solutions* can develop a treatment formula that is adequate for the entire waste stream. Energy*Solutions* may be required to perform additional treatability studies if the waste shipments contain chemical constituents of concern at concentrations that are higher than the treatability study sample.

Preshipment samples may not be shipped to Energy*Solutions* without prior authorization. At a minimum, a preliminary Waste Profile will need to be created that describes the waste and its generation. This preliminary Waste Profile must include both chemical and radiological assessments and must be approved by Energy*Solutions* prior to shipment of the sample. When approved for shipment, Energy*Solutions* will provide a Preshipment Sample Authorization Record to the generator.

Samples should be packaged into one or more sealed containers in such a manner that the sample container will not break during normal shipping conditions. Generally, the volume of sample requested will be less than 5 gallons. Sample containers should be labeled with the waste stream number, date, and a sample ID number. Sample closure devices should also be sealed with a custody or anti-tamper seal to ensure sample integrity.

Preshipment samples sent to Energy*Solutions* must be properly classed, described, packaged, marked, labeled, and in condition for transport as required by the DOT Hazardous Materials Regulations (HMR) contained in 49 CFR Parts 171 through 180. The Preshipment Sample Authorization forms must be completed and attached to the outside of the shipping package. A Uniform LLRW Manifest (Forms 540/541) must also accompany the shipping paperwork. The manifest number for the shipping paperwork is the Waste Stream ID number (e.g., XXXX-YY). The samples must be sent to the following address:

Energy*Solutions*
Attention: Sample Control
US I-80, Exit 49
Tooele County
Clive, UT 84029 (84083 if using Fed Ex)
Phone: (435) 884-0155

Treatability studies normally require 30 to 45 days to complete. Please keep this in mind when planning the first shipment of waste. Rush treatability studies are possible; however, there are higher costs for this service. Please contact Energy*Solutions* if a rush treatability study is required to meet a disposal schedule.

4.5 WASTE PROFILE REVIEW AND APPROVAL

Energy*Solutions* will assist waste generators throughout the waste profiling process to ensure shipping and acceptance of the waste can be accomplished within the desired timeframe. In order to facilitate timely shipment and receipt of waste materials, Energy*Solutions* requests that the Waste Profile forms and analytical reports be provided as far in advance of the anticipated shipping date as possible. Upon receipt, Energy*Solutions* will complete a preliminary review of the waste profile information provided. Comments concerning the Waste Profile will usually be provided within two weeks of Energy*Solutions*' receipt of the profile information. If additional information is required for pre-acceptance, Energy*Solutions* will specify the information needed and communicate this to the generator. A comprehensive internal review is completed once all information has been submitted.

In order to assist each generator and accomplish the profile review and approval process as quickly as possible, Energy*Solutions* has developed a two-phase review process. During the first phase, an Energy*Solutions* Technical Services Representative will review and assess the Waste Profile, accompanying documentation, and analytical data for acceptability. If necessary, Energy*Solutions* will provide comments that delineate additional information needed for approval. This process typically takes one to two weeks. Once the additional information or revisions have been received by Energy*Solutions* and found to be satisfactory, phase 2 of the process begins.

The second phase involves and independent evaluation of the Waste Profile by Energy*Solutions*' Compliance and Operations representatives. Energy*Solutions* will notify the generator as soon as the review and approval process is completed.

At this point, the waste stream has been "pre-approved" for management at Energy*Solutions*, since the waste has been shown to be in compliance with all waste acceptance criteria. Energy*Solutions* will issue a Notice to Transport once the Waste Profile has been approved and a contractual disposal agreement or necessary funding is authorized for the waste stream.

4.6 NOTICE TO TRANSPORT

Energy*Solutions* will issue a Notice to Transport to the generator that authorizes subsequent waste shipments. The Notice to Transport is completed and issued once the Waste Profile is completed and approved by Energy*Solutions*. A Notice to Transport is also issued in the following situations:

- The Waste Profile is revised in such a way that additional evaluations are required (radiological, chemical, or physical properties change significantly)
- An annual update letter is received for Mixed Waste streams
- The approval to ship is restored after the Notice to Transport is revoked

In the event that the Notice to Transport is revoked, customers will not be able to schedule shipments until the approval to ship is restored and a new Notice to Transport is issued.

SECTION 5

SHIPMENT SCHEDULING AND MANIFESTING

5.1 GENERATOR SITE ACCESS PERMIT

Prior to the first shipment of waste material to Energy*Solutions*' disposal site, generators must receive a Generator Site Access Permit (GSAP) issued by the Utah DRC. Utah Administrative Code R313-26 establishes the terms for a Generator Site Access Permit Program that authorizes waste generators, waste processors, and waste collectors to deliver radioactive wastes to a disposal facility within Utah. Generators may apply for the GSAP on-line at the Utah DRC's website at www.radiationcontrol.utah.gov/DRC_prmt.htm.

The GSAP number must be listed in Block 5 of the Uniform LLRW Manifest Form 540 and correspond to the shipper's name and facility. Shippers must ensure the GSAP is renewed annually with the Utah DRC.

Shippers are subject to the provisions contained in the "Generator Site Access Permit Enforcement Policy" as amended, UAC R313-14, and UAC R313-19-100 for violations of state rules or requirements in the current land disposal facility operating license regarding radioactive waste packaging, transportation, labeling, notification, classification, marking, or manifesting requirements.

5.2 SHIPPING CHECKLIST

To assist generators with shipments to Energy*Solutions*, the "Shipping Checklist" shown below in Figure 5-1 provides general contact, scheduling, and manifesting information. Generators and shippers should use this checklist in conjunction with their shipping procedures to ensure compliance with Energy*Solutions*' waste acceptance process. Energy*Solutions*' Technical Service Representatives are available to assist generators and shippers during the shipment scheduling and transportation process.

5.3 5 WORKING-DAY ADVANCED SHIPMENT NOTIFICATION

Generators must schedule the shipment to arrive at the facility a minimum of five working days prior to the requested shipment arrival date. Energy*Solutions* strongly encourages generators to submit the 5 Working-Day Advanced Shipment Notification form prior to the shipment departing from the generator's site. A completed copy of the 5 Working-Day Advanced Shipment Notification form must be sent to the attention of Energy*Solutions* Scheduling Department to establish an arrival date for each shipment. This form may be downloaded from Energy*Solutions*' website at www.energysolutions.com. This form must be completed and either emailed to scheduling@energysolutions.com or faxed to the site at (435) 884-3549. Once this form has been received, the Scheduling Department will confirm the shipment's arrival date with the shipper. If all required information is not available at the time of submission, updates may be provided as the information becomes available. The Scheduling Department must be informed in the event that there are delays in the shipment scheduled arrival date.

Scheduling: Must be established at least 5 working days in advance of requested arrival date

- ☐ A "Notice to Transport" has been issued by Energy*Solutions* for the Waste Profile.
- ☐ **Submitted "5 Working Day Advanced Shipment Notification" form to request shipping schedule. Email form to scheduling@energysolutions.com or fax to (435) 884-3549.**
- ☐ Shipping schedule has been confirmed by Energy*Solutions*.
  Energy*Solutions*' Shipping & Receiving Scheduler: (435) 884-0155.

Advanced Manifesting: Must be submitted prior to releasing each shipment/conveyance

- ☐ Manifested information is consistent with the approved Waste Profile.
  Verify that all manifested radionuclides are listed in the approved Waste Profile and that manifested concentrations do not exceed the approved ranges.
- ☐ Verified consignee information on manifests (see below).

Consignee:	Energy*Solutions*, LLC	Contact:	Shipping and Receiving
	Clive Disposal Site	Phone:	(435) 884-0155
	Interstate 80, Exit 49		
	Clive, UT 84029		

- ☐ Verified Shipment ID/Manifest Number (XXXX-YY-ZZZZ)
  XXXX is the generator number, YY is the waste stream number, and ZZZZ is the shipment number (starting with 0001 for the first shipment/conveyance and incrementing by one for each additional shipment/conveyance). If a Hazardous Waste Manifest is submitted, include the Shipment ID Number in Block 15.
- ☐ Verified valid Utah Site Access Permit number in Block 5 on Form 540. Generators must apply for the permit with the Utah Division of Radiation Control (DRC). The Shipper Name and Facility must be consistent with the Utah Site Access Permit number.
- ☐ Verified that Block 9 of Form 540 specifies Energy*Solutions*' "Treatment Facility" or "Bulk Waste Facility". Enter "Bulk Waste Facility" for LLRW, 11e.(2) Byproduct Material, and Mixed Waste shipped for direct disposal or enter "Treatment Facility" for waste streams requiring treatment by Energy*Solutions* prior to disposal.
- ☐ Submitted manifests to Energy*Solutions* **at least three working days** prior to the shipment arrival date. If possible, please export the manifests and send electronically via email to manifest@energysolutions.com. Otherwise, fax manifests to "Shipping and Receiving – Manifest" at (801) 413-5643. If applicable, include the LDR Notification/Certification forms, Hazardous Waste Manifest, and SNM Exemption Certification form.

Shipment Paperwork and Inspection

- ☐ The original shipping paperwork/manifests accompany each shipment (conveyance). If applicable, include the LDR Notification/Certification forms and Hazardous Waste Manifest for each shipment.
- ☐ If applicable, **a completed and signed copy of the SNM Exemption Certification form and DOE/NRC form 741** has been included with the shipping papers.
- ☐ If applicable, the Uniform Hazardous Waste Manifest lists all hazardous waste codes associated with the shipment.
- ☐ Containers have been inspected and comply with DOT packaging requirements. Waste must be packaged in a strong, tight container at a minimum.
- ☐ **Containers do not contain unauthorized free standing liquids.**
- ☐ If applicable, containers are labeled **"Class A Unstable" or "Class AU"**. Refer to Block 16 of NRC Form 541.

Figure 5-1. Shipping Checklist

Shipments containing radionuclides with total activities exceeding the limits listed below must be specified on the 5 Working-Day Shipment Notification form and approved prior to waste shipment.

- Californium-252 (in excess of 5.4 Ci)
- Co-60 (in excess of 8.1 Ci)
- Cs-137 (in excess of 27 Ci)
- Gd-153 (in excess of 270 Ci)
- Ir-192 (in excess of 22 Ci)
- Pm-147 (in excess of 11,000 Ci)
- Se-75 (in excess of 54 Ci)
- Tm-170 (in excess of 5,400 Ci)
- Yb-169 (in excess of 81 Ci)

5.4 SHIPPING PAPERWORK

Advance copies of the Uniform Low-Level Radioactive Waste Manifest (Forms 540/541, and 542 if applicable) are required to be sent to Energy*Solutions* **at least three working days** prior to the shipment arrival date. Shippers must submit the shipping paperwork electronically via email to **manifest@energysolutions.com** or fax to "Shipping and Receiving – Manifest" at (801) 413-5643. Energy*Solutions* encourages submittal of the Uniform LLRW Manifest electronically by exporting the manifest information to a specified file format as discussed below. The advance manifest must include the Uniform LLRW Manifest, and if applicable, LDR Notification/Certification forms, Uniform Hazardous Waste Manifest, and SNM Exemption Certification form.

Additional shipping paperwork may be required depending on the type of waste being shipped to Energy*Solutions*. Multiple waste streams on a single conveyance must include a unique set of shipping paperwork for each manifested shipment. The following paperwork may also need to accompany the shipping paperwork as applicable:

- SNM Exemption Certification form. This form must be completed, signed, and included with the shipping paperwork for shipments containing Special Nuclear Material.

- LDR Certification and/or Notification form must contain the information required in 40 CFR 268.7. Energy*Solutions* requires that this information be provided with each shipment of Mixed Waste or waste that has been treated to meet 40 CFR 268 treatment standards.

- Uniform Hazardous Waste Manifest must be included with the shipping paperwork for waste shipments of Mixed Waste. As applicable, Energy*Solutions* requests that shippers list the gross weight on the manifest.

5.4.1 Instructions for the Uniform LLRW Manifest Forms 540, 541, and 542

The NRC's guidance document "Instructions for Completing the NRC's Uniform Low-Level Radioactive Waste Manifest" (NUREG/BR-0204, Rev. 2, July 1998) should be used by shippers when preparing the shipping paperwork. Energy*Solutions* requires shippers to include information in both metric units and English units following the International Standard of Units (SI). Additionally, Energy*Solutions* has specific information that should also be included on the Uniform LLRW Manifest.

Form 540

- Block 5, "Shipper" must list the shipper's company name and facility that corresponds to the Utah Generator Site Access Permit (GSAP) number. Shippers shipping on behalf of the generator and using their GSAP number should list "(shipper's company name) on behalf of (generator's name)".

- Block 5, "Shipment Number" and "Shipment ID Number" may be used by the shipper for their own tracking purposes. In most cases, shippers use the "Manifest Number" in Block 8 as the "Shipment ID Number".

- Block 8, "Manifest Number" must list the Energy*Solutions* shipment number in the following format: (XXXX-YY-ZZZZ) where XXXX is the generator number, YY is the waste stream number, and ZZZZ is the shipment number (starting with 0001 for the first shipment and incrementing by one for each additional shipment).

- Block 9, "Consignee" must list Energy*Solutions*' disposal site address as shown below, contact name and telephone number. The address must specify Energy*Solutions*' "Treatment Facility" or "Bulk Waste Facility". List "Bulk Waste Facility" for LLRW, 11e.(2) Byproduct Material, and Mixed Waste shipped for direct disposal or list "Treatment Facility" for waste streams requiring treatment by Energy*Solutions* prior to disposal.

  Energy*Solutions*, LLC
  Clive Disposal Site – Bulk Waste Facility
  Interstate 80, Exit 49
  Clive, UT 84029

Form 541

- Block 6, "Container Description" specifically applies to the disposal container. For bulk shipments (e.g., gondola railcars, intermodals, etc.), list "11" for "Bulk, Unpackaged Waste" along with the bulk packaging descriptor if the bulk package does not contain other manifested packages inside. For example, a gondola railcar with a super-load wrapper would be listed as "11A" in Block 6.

- Blocks 7 and 8, "Volume" and "Waste and Container Weight" must list the gross volume and weight of the disposal container and contents. For bulk, unpackaged waste where the waste package will not be disposed (e.g., gondola railcar, intermodal, etc.), list the weight and volume of the waste.

- Block 15, "Radiological Description" must also include a column for the radionuclide concentration expressed in units of pCi/g.

- Block 16, "Waste Classification" must list "AU" for Class A Unstable LLRW. Waste packages must also be labeled either "Class A Unstable" or "Class AU". For NORM or 11e.(2) waste material, enter "N/A" since the waste classification requirements are not applicable.

Form 542

Form 542, "Manifest Index and Regional Compact Tabulation) is required for processors and collectors of LLRW who are shipping LLRW attributed to others for ultimate disposal at Energy*Solutions*. Energy*Solutions* requires that processors or collectors submitting the Form 542 do so electronically using the file transfer protocol described in Section 5.4.2 due to the size of the manifest.

5.4.2 Electronic Submittal of the Uniform LLRW Manifest

Energy*Solutions* developed a document titled "Electronic Submittal of the Uniform Low-Level Radioactive Waste Manifest" to assist generators with the electronic submittal of the Uniform Low-Level Radioactive Waste Manifest (Forms 540, 541 and 542). Generators are able to submit their manifests electronically in a comma-delimited file format to the Energy*Solutions* disposal facility for review and distribution. Upon arrival, manifests are imported directly into Energy*Solutions*' waste tracking system. Manifest information is checked against the information contained in the generators Waste Profile. Any discrepancy will be automatically flagged, allowing potential problems to be fixed well in advance of shipment arrival.

Electronic manifest submittal has numerous benefits for both the generator and Energy*Solutions* which include:

- Generators are able to e-mail their shipping manifests directly to the site, reducing the time and expense of express mailing or faxing copies to the disposal facility.
- The generator can use the electronic signature feature, eliminating the need for any advance hard copies to be sent to Energy*Solutions*.
- Energy*Solutions* personnel can print the required copies of the manifest, including electronic signature, and distribute for proper review.
- The import of manifest information directly to Energy*Solutions*' waste tracking system will eliminate manual data entry.
- Electronic submittal will significantly reduce the time it takes Energy*Solutions* personnel to process the advanced paperwork.

5.5 90-DAY SHIPPING FORECAST

The 90-Day Shipping Forecast is used by Energy*Solutions* to properly staff and ensure adequate resources are available to ensure efficient and timely management of waste shipments. Generators are strongly encouraged to provide Energy*Solutions* with a 90-Day Shipping Forecast for all upcoming shipments. Current shippers will receive a fax or email from Energy*Solutions* every month and are requested to return the shipping forecast to Energy*Solutions* within three working days of receipt. The forecast can also be emailed to the appropriate Client Service Manager.

SECTION 6

PACKAGING AND TRANSPORTATION

6.1 COMPLIANCE WITH TRANSPORTATION REGULATIONS

Each shipment of waste material sent to Energy*Solutions* for disposal must be properly classed, described, packaged, marked, labeled, and in condition for transport as required by the Department of Transportation (DOT) Hazardous Materials Regulations (HMR) contained in 49 CFR Parts 171 through 180. Shipments of radioactive waste that are exempt from DOT regulations must be shipped to Energy*Solutions*' disposal site in packages that prevent release of the waste during transit. Specifically, all waste packages must be secure to 1) prevent rain or snow from entering the manifested waste package and 2) prevent waste from being exposed to the environment at any time during transit. Shippers should review NRC IE Bulletin No. 79-19 for training requirements applicable to radioactive waste management.

Energy*Solutions* will inspect each shipment arriving at its disposal facility for compliance with the applicable licenses and/or permits including compliance with DOT HMR requirements. Energy*Solutions* will notify the generator of a non-compliant shipment and determine the best course of action to resolve the discrepancy in a safe, compliant, and timely manner.

6.2 WASTE PACKAGING GUIDELINES

Energy*Solutions* receives waste for disposal either in bulk or in non-bulk packages. The packaging used must be authorized for the specific material being shipped by the HMR. Each generator is responsible for ensuring that the packaging used meets the appropriate regulations. The shipper of waste material is responsible for the certification of the packaging as meeting the DOT requirements. The DOT and NRC have published a joint guidance document to assist shippers of LSA and SOC material. The title of this document is "Categorizing and Transporting Low Specific Activity Materials and Surface Contaminated Objects" (NUREG-1608 or RSPA Advisory Guidance 97-005). The document is available from either agency. The following minimum packaging requirements must be met for all packages received at Energy*Solutions*.

6.2.1 Bulk Packaging

Generators are able to minimize packaging and transportation costs by utilizing bulk packages that are intended for re-use. Energy*Solutions* receives various bulk packages illustrated in Figure 6-1 which include gondola railcars with either hard-top lids or super-load wrappers, intermodals, sealands, cargo containers, roll-offs, etc. Bulk packages are unloaded at Energy*Solutions* and then decontaminated, surveyed, and returned in accordance with the requested radiological release criteria specified in Section 6.5. Bulk packaging must conform to the following requirements:

- Bulk packaging must, at a minimum, meet the applicable requirements contained in 49 CFR 173.24, General Requirements for Packagings and Packages and in 49 CFR 173.410, General Design Requirements.
- Bulk packaging must be covered. The top must be completely enclosed with no opening along the sides or openings in the top.

- Bulk packaging (e.g., railcars, trucks, trailers, etc.) must also be tightly sealed to prevent waste from leaking out or water from leaking in to the package. Packages containing unauthorized free liquids will be considered non-compliant.
- Bulk packaging must be clean. It must not have any waste material, or other material that could be mistaken for waste material, on the outer surface. Energy*Solutions* will perform contamination surveys on suspect areas of the package to ensure compliance with DOT regulations.
- Bottom dump railcars and end-dump trucks are not permitted unless approved in writing by Energy*Solutions*.
- Bulk packaging in intermodals, sealands, cargo containers, roll-offs, etc. must have ISO connectors on the top corners as illustrated in Figure 6-1 to allow the containers to be lifted from the top unless approved in writing by Energy*Solutions*.
- Friable asbestos is prohibited in bulk packages unless approved in writing by Energy*Solutions*.
- Each bulk container, which requires marking, will be properly marked in accordance with 49 CFR 172 Subpart D.
- Bulk packaging may not contain a mixture of bulk, unpackaged waste and manifested packaged waste (e.g., an intermodal containing loose unpackaged soil with manifested disposal containers within the same intermodal).

6.2.2 Non-Bulk Packaging (Disposal Containers)

Energy*Solutions* receives non-bulk packages (disposal containers) including boxes, drums, super sacks, etc. The disposal container is generally disposed of with the waste contents and will not be returned to the generator. Energy*Solutions* recommends drums be palletized to reduce the amount of time required to offload drum shipments. Palletized drums are also safer to manage at the disposal site. Generators may be charged extra for shipments containing non-palletized drums. Drums on one pallet must be from the same waste stream unless approved in writing by Energy*Solutions*. Contact Energy*Solutions* to request approval to ship non-palletized drums prior to shipment. Non-Bulk packaging must conform to the following requirements:

- Non-Bulk packaging must, at a minimum, meet the applicable requirements contained in 49 CFR 173.24, General Requirements for Packagings and Packages and in 49 CFR 173.410, General Design Requirements.
- Containers must be properly sealed to prevent load movement from "pumping" dust-laden air out of the container.
- Containers must be clean. They must not have any waste material, or other material, which could be mistake for waste material, on the outer surface. Energy*Solutions* will perform contamination surveys on suspect areas of the package to ensure compliance with DOT regulations.
- Containers in a shipment must be properly loaded and blocked and braced securely to prevent shifting and damage during transport. The specific transport loading requirements contained in 49 CFR 174 for rail and 49 CFR 177 for highway should be examined as well as 49 CFR 393 Subpart I, Protection Against Shifting and Falling Cargo.
- Although preferred, containerized rail shipments are not required to be enclosed or covered.
- Do not have unnecessary container closures; e.g., welding of drum rings or box lids.
- Non-bulk packages will not be returned to the generator.
- Overpack containers only when necessary (e.g., to meet DOT requirements) for shipment.
- Energy*Solutions* prefers drums to be palletized to reduce the amount of time required to offload drum shipments. Palletized drums are also safer to manage at the disposal site. The pallets must

be strong enough to withstand collapse during transit. The drums should be securely banded to the pallet.

- Truck or railcar beds used to transport containers must be free of all loose material, waste or otherwise.
- Each container that is required to be labeled will be properly labeled in accordance with the requirements of 49 CFR 172 Subpart E and UAC R313-15-1008.

Each container that is required to be marked will be properly marked in accordance with the requirements of 49 CFR 172 Subpart D and/or 49 CFR 173.421 and Subpart 425.

Figure 6-1. Bulk Shipping Containers

6.3 HIGHWAY TRANSPORTATION

For highway shipments (Figure 6-2), Energy*Solutions* is located just three miles south of Interstate 80 at the Clive Exit (Exit 49). Highway shipments should arrive for receipt and acceptance between 7:00 AM to 12:00 PM MST, Monday through Friday only. Shipments that arrive after 12:00 PM may not be accepted until the next day unless special handling arrangements have been previously approved.

Figure 6-2. Truck Highway Shipments

Shipments are generally unloaded on a first-come, first-served basis. Non-compliant shipments may result in unexpected delays. Shipments may take up to four hours to be checked in, inspected, surveyed, evaluated, and unloaded. Consequently, drivers should be informed that there are no eating facilities within the vicinity of the site.

6.4 RAIL TRANSPORTATION

Rail shipments will be delivered to the Energy*Solutions*' rail siding by the Union Pacific railroad on a predetermined schedule (Figure 6-3). Once at Energy*Solutions*' siding, they will be moved into the disposal site by Energy*Solutions*' equipment.

Figure 6-3. Rail Shipments

Since the signed copies of the Uniformed Low-Level Radioactive Waste Manifest or Uniform Hazardous Waste Manifest forms do not travel with the railcars during transport, the original signed manifest must be mailed or electronically transferred to the Clive Disposal Facility. The documents must arrive at the Clive Disposal Facility a minimum of 3 working days prior to the receipt of the rail shipment.

6.5 RELEASE OF SHIPPING CONVEYANCES

The timeframe for the release of shipping conveyances (e.g., trucks, intermodal containers, railcars, etc.) is based on the specific contractual arrangements that have been established between each generator and Energy*Solutions*. Generators must request the type of radiological release prior to the shipment's arrival and must be allowed under the Terms and Conditions of the disposal agreement. The requested release types must be authorized by Energy*Solutions*' Business Development Department. Containers released to the Unrestricted Use criteria require significantly more time and expense due to the resources needed to meet these release criteria. Energy*Solutions* performs the following types of radiological releases as listed in the following table.

Energy*Solutions* Radiological Release Criteria

Release Type	Criteria	Reference
Unrestricted Use	Removable and fixed surface contamination levels are isotope specific. The most restrictive isotopic removable surface contamination levels are less than 20 dpm α/100 cm^2 and 200 dpm β-γ/100 cm^2. The most restrictive isotopic total surface contamination levels are less than 100 dpm α/100 cm^2 and 1,000 dpm β-γ/100 cm^2. The contamination levels apply to all internal and external surfaces. Contact Energy*Solutions*' Business Development Department to make contractual arrangements for this type of release.	US NRC Regulatory Guide 1.86, June 1974 (Consistent with Energy*Solutions*' RML Condition 27)
Return to Service	Removable surface contamination levels must be less than 220 dpm α/100 cm^2 and 2,200 dpm β-γ/100 cm^2. The radiation dose rate at each accessible surface must be less than 0.5 mrem/hr. The contamination levels apply to all internal and external surfaces of the transport vehicle.	49 CFR 173.443(c)
DOT Empty	Removable surface contamination levels on the outside of the package must be less than 220 dpm α/100 cm^2 and 2,200 dpm β-γ/100 cm^2. Removable surface contamination levels on the inside of the package must be less than 22,000 dpm α/100 cm^2 and 220,000 dpm β-γ/100 cm^2. The package must be emptied of contents to the extent practical.	49 CFR 173.428
Sole Use	Removable surface contamination levels on the outside of the transport vehicle must be less than 220 dpm α/100 cm^2 and 2,200 dpm β-γ/100 cm^2. The radiation dose rate on the internal surfaces must be less than 10 mrem/hr or 2 mrem/hr at one meter from the surface.	49 CFR 173.443(d)

APPENDIX A

CONTACT INFORMATION

<u>Energy*Solutions*</u>

Corporate Office Phone:	(801) 649-2000	Fax: (801) 537-7345
Technical Service Fax:	(801) 413-5664	
Shipment Scheduling Phone:	(435) 884-0155	Fax: (435) 884-3549 Email: scheduling@energysolutions.com
Shipping & Receiving Phone:	(435) 884-0155	Fax: (801) 413-5643 Email: manifest@energysolutions.com

Energy*Solutions* Website: www.energysolutions.com

<u>State of Utah</u>

Utah Dept of Environmental Quality:	www.deq.state.ut.us
Utah Division of Radiation Control (DRC) Email:	drcadmin@utah.gov
Utah Division of Radiation Control Website:	www.radiationcontrol.utah.gov
Utah DRC – Generator Site Access Permit:	(801) 536-0077
Utah DRC – Generator Site Access Permit:	www.radiationcontrol.utah.gov/DRC_prmt.htm
Utah DRC Rules:	www.radiationcontrol.utah.gov/rules.htm
Utah Division of Solid and Hazardous Waste:	www.hazardouswaste.utah.gov
Utah DSHW Rules:	www.hazardouswaste.utah.gov/rpc.htm
Utah Dept of Health – Lab Certification:	health.utah.gov/els/labimp/envlabcert.html
State-Issued Part B Permit:	www.hazardouswaste.utah.gov/HWBranch/CFFSection/EnvirocarePermit.htm

Appendix C-3:

Clean Harbors, Inc. – Deer Trail, Colorado

Clean Harbors Deer Trail NORM Waste Acceptance

Facility Permitting

Clean Harbors Deer Trail (CHDT) operates a treatment, storage and land disposal facility near Last Chance, Colorado. The Deer Trail facility operates under Colorado RCRA Permit CO-05-12-21-01, and Colorado Radioactive Materials License CO-1102. The permit and license allows for treatment, storage and landfill disposal of liquid and solid NORM wastes less than 2000 pCi/g total radionuclide activity. Additionally, our permits allow us to accept landfillable mixtures of RCRA and NORM wastes.

Waste Pre-Acceptance Process

To evaluate a NORM waste stream for facility acceptance, each Generator must submit a **Material Profile Sheet, Supplemental Radioactive Questionnaire and Laboratory Analysis.** Required lab analysis are listed below. CHDT evaluates the information to determine if the waste meets the acceptance criteria for land disposal at CHDT. After the waste is approved to come to CHDT, an **Application for Waste Impor**t must be made to the Rocky Mountain Low-Level Radioactive Waste Board (Compact) and an application fee must be sent with the application. (An import application is not required for wastes from the States of CO, NM and NV.) A sample Import Application is included. Import Application Requests are normally approved and processed within two weeks. If waste is generated from a one-time site or process, a new profile and analysis must be completed each time. If the waste is produced by an ongoing process from one site, the profile and import application can be approved such that only periodic analysis is needed for repeat waste shipments.

On-Site Waste Acceptance

Bulk waste shipments of radioactive material must be scheduled in advance. All shipments must be documented using a manifest. Once a shipment arrives at CHDT, it is weighed and the external dose rate of the vehicle is measured. The waste is analyzed using a portable gamma spectrum analyzer and the truck is surveyed for removable radioactive contamination. After testing is complete, the vehicle/container will either be dumped in the landfill or, if it requires solidification/treatment, will be dumped in the treatment area. After dumping, the inside and outside of the container will be surveyed for radioactive contamination. If necessary, the container will be decontaminated. CHDT’s permit requires us not to release any container or vehicle above the allowed permit limits. Shippers of solid radioactive material are encouraged to line the beds of roll-off containers or dump trucks with plastic in order to prevent incurring the costs of vehicle washouts and decontamination fees.

Deer Trail Minimum Analytical Requirements

1. Total Uranium (mg/kg) by ICP; alternate Isotopic Uranium by Alpha Spec.
2. Total Thorium (mg/kg) by ICP; Alternate Isotopic Thorium by Alpha Spec.
3. Gamma spectrum analysis with Peak identification and Ra-226 quantitation pCi/g
4. Gross alpha (pCi/g)
5. Gross beta (pCi/g)
6. Pb-210 if applicable (pCi/g) (Natural Gas Processing Waste Only)

Deer Trail NORM Acceptance Limits

1. Must be Classified NORM or TENORM by CO Regulations
2. Must be less than 2000 pCi/g total activity
3. Must be less than 500mg/kg total Uranium and Thorium
4. Ra-226 must be less than 222pCi/g if only primary radionuclide present
5. Pb-210 must be less than 666pCi/g if only primary radionuclide present
6. Gamma dose rate must be less than 116 μRoentgens/hr at the surface of the container.

Other Requirements

1. Wastes containing free liquids must contain less than 500ppm VOC's (Volatile Organic Compounds)
2. Waste containing free liquids must have a flash point greater than 140F
3. Wastes containing greater than 500ppm reactive sulfides require special treatment.
4. RCRA/NORM wastes are acceptable but may require additional testing.

Transportation & Disposal

Deer Trail, Colorado Facility Facts

Colorado Radioactive Materials License Issued on December 21, 2005

The Deer Trail facility is a fully permitted Subtitle C landfill authorized to treat, store and dispose of a wide variety of hazardous and industrial wastes, including RCRA, TSCA (megarule) and debris for encapsulation.

As of December 21, 2005, Deer Trail is now licensed to dispose of Naturally Occurring Radioactive Material (**NORM**) and Technologically Enhanced Radioactive Material (**TENORM**) wastes. This license was issued by the State of Colorado, Department of Public Health and Environment. Deer Trail can accept NORM and TENORM wastes containing radionuclides (in the decay series of U-238, U-235 and Th-232) up to 2000 pCi/gram. The Rocky Mountain Low Level Radioactive Waste Compact has designated Deer Trail as the Low Level Waste Facility for Colorado, New Mexico and Nevada.

Deer Trail is located 75 miles east of Denver, CO. The facility can store, treat and dispose of wastes in bulk and containerized quantities. Deer Trail receives waste by truck and also by rail from a trans-loading point located in Sterling, Colorado.

Permits

- Colorado Radioactive Materials License Number Colo. 1101-01, CDPHE
- RCRA Part B Permit renewed 2005, No. CO-05-12-21-01, CDPHE
- EPA ID No COD991300484, USEPA
- Certificate of Designation, No. 147-82-C-CD, Adams County
- Colorado Wastewater Discharge Permit, No. CO-0042064, CDPHE
- Colorado Air Emissions No. 01AD0713

Facility Description & General Information

- Permit issued - 1987, first waste received - 1991
- 325 acres of permitted facility surrounded by 5760 acres of Clean Harbors owned buffer zone
- Rural location
- 2.5 million cubic yards of permitted cell space
- Sited on the impermeable Pierre Shale formation

Services Provided:

- Storage, final treatment and landfill disposal
- Stabilization treatment of toxic metal wastes
- Custom treatment of organic wastes
- Chemical reduction
- Solidification of liquid wastes
- Deactivation and neutralization
- Micro encapsulation
- Macro encapsulation
- Direct landfill

Typical Customers: Customers include, but are not limited to, remediation sites, chemical facilities, manufacturers, refineries, mines, plating facilities, and brokers.

Typical Waste Streams: Typical waste streams accepted include, but are not limited to, NORM and TENORM wastes, industrial metal bearing wastes, contaminated process wastewaters, refinery wastes, inorganic cleaning solutions, plating wastes, paint residues, debris from toxic or reactive chemical cleanups, off-spec commercial products.

Treatment, Storage and Disposal Capabilities

- Totally enclosed waste treatment building with dual emission control systems
- Drum Storage Building with capacity for 600 x 55-gallon drums or 33,000 gallons
- Bulk Container Storage Area A: 2000 cubic yards of bulk solids
- Bulk Container Storage Area B: 1000 cubic yards of bulk solids
- Wide range of permitted waste codes

CleanHarbors
ENVIRONMENTAL SERVICES®

Waste Disposal Services

NORM and TENORM Waste Management Fact Sheet

NORM and TENORM Waste Management

Clean Harbors provides disposal for Naturally Occurring Radioactive Material (NORM) and Technologically Enhanced Naturally Occurring Radioactive Material (TENORM) wastes at our Deer Trail, Colorado and Buttonwillow, California facilities.

Deer Trail and Buttonwillow are fully permitted Subtitle C landfills authorized to accept NORM and TENORM wastes containing radionuclides (in the decay series of U-238, U-235 and Th-232) up to 2000 pCi/gram for Deer Trail and up to 1800 pCi/gram for Buttonwillow.

Typical sources of NORM and TENORM wastes include

- Oil and gas industry
- Geothermal energy production
- Coal combustion
- Mining of uranium and metals
- Phosphate production
- Municipal water treatment
- Abandoned mines and processing facilities
- General manufacturing

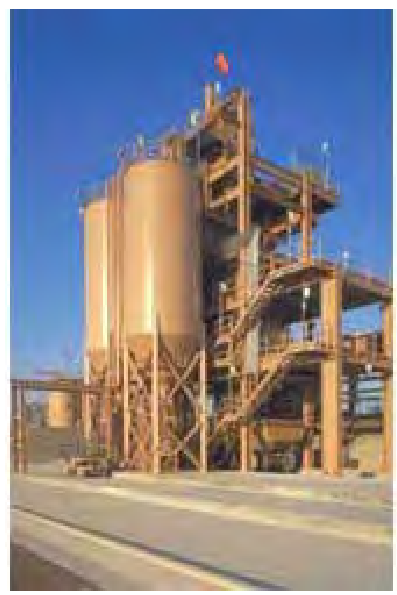
Deer Trail, Colorado Facility

The Rocky Mountain Low Level Radioactive Waste Compact has designated the Deer Trail facility as the low level waste facility for Colorado, New Mexico, and Nevada. The facility is located 75 miles east of Denver, Colorado, and can store, treat and dispose of wastes in bulk and containerized quantities. Deer Trail receives waste by truck and also by rail from a trans-loading point located in Sterling, Colorado.

The Deer Trail facility is also authorized to treat, store, and dispose of a wide variety of hazardous and industrial wastes including RCRA, TSCA (megarule), and debris for encapsulation.

Buttonwillow, California Facility

Located in central California, the Buttonwillow facility is also fully permitted to manage a large number of RCRA hazardous wastes, California hazardous waste, and non-hazardous waste for stabilization treatment, solidification, and landfill. It can handle waste in bulk (solids and liquids) and in containers.



This facility operates a permitted drum handling and storage area, which can store and/or transfer up to 1,500 drums. Permitted landfill capacity is in excess of 10 million cubic yards.

CleanHarbors ENVIRONMENTAL SERVICES®

Clean Harbors Deer Trail, LLC • 108555 East Highway 36 • Deer Trail, CO 80105 • 970.386.2293 • www.cleanharbors.com
Clean Harbors Buttonwillow, LLC • 2500 West Lokern Road • Buttonwillow, CA 93206 • 661.762.6200 • www.cleanharbors.com

STATE OF COLORADO

Bill Owens, Governor
Dennis E. Ellis, Executive Director

Dedicated to protecting and improving the health and environment of the people of Colorado

4300 Cherry Creek Dr. S.
Denver, Colorado 80246-1530
Phone (303) 692-2000
TDD Line (303) 691-7700
Located in Glendale, Colorado

Laboratory Services Division
8100 Lowry Blvd.
Denver, Colorado 80230-6928
(303) 692-3090

http://www.cdphe.state.co.us

Colorado Department of Public Health and Environment

Fax

To:	Scott Zoller	**From:**	Jennifer Opila
Fax:	970-386-2262	**Pages:**	11 (includes cover sheet)
Phone:	970-386-2293	**Date:**	3/30/2009
Re:	License Amendment	**CC:**	

• **Comments:**

Scott,

Attached is the license amendment.

Please feel free to call me if you have any questions.

Thank you,

Jennifer T. Opila

Jennifer T. Opila
Radiation Management Unit
Hazardous Materials and Waste Management Division
Colorado Department of Public Health and Environment
(303) 692-3403

STATE OF COLORADO

Bill Ritter, Jr., Governor
James B. Martin, Executive Director

Dedicated to protecting and improving the health and environment of the people of Colorado

4300 Cherry Creek Dr. S.
Denver, Colorado 80246-1530
Phone (303) 692-2000
TDD Line (303) 691-7700
Located in Glendale, Colorado

Laboratory Services Division
8100 Lowry Blvd.
Denver, Colorado 80230-6928
(303) 692-3090

http://www.cdphe.state.co.us

Colorado Department of Public Health and Environment

Clean Harbors Deer Trail, LLC
108555 East Hwy 36
Deer Trail, CO 80105

Attention: Scott Zoller, Radiation Safety Officer

Re: License Amendment
Colorado Radioactive Materials License Number Colo. 1102-01

Enclosed is Radioactive Materials License Number Colo. 1102-01, Amendment No. 6, which has been amended as requested in your letter dated March 18, 2009. Please review this document thoroughly.

This amendment was necessary because of a change to the definitions in the Colorado Rules and Regulations that caused radium contaminated debris to no longer fall under the definition of TENORM. It is now defined as a "new" type of byproduct material. Because the license restricted Clean Harbors to only NORM and TENORM, the amendment is necessary to retain Clean Harbors' ability to take radium contaminated debris and soil. This amendment does not expand the scope of the material that Clean Harbors is allowed to accept for disposal.

Please note that the mailing address, use location(s), maximum quantities of radioactive materials, and the radiation safety officer are specific conditions of your license. If you have questions about making changes to your licensed activities, please contact the Radiation Management Unit to discuss the requirements for an amendment of your license.

If you have any questions regarding this letter or your license please contact Jennifer Opila at 303-692-3403 or jennifer.opila@state.co.us. Additional questions or comments can be directed to me at 303-692-3423 or steve.tarlton@state.co.us.

Steve Tarlton, Unit Leader
Radiation Management Unit
Hazardous Materials and Waste Management Division

Enclosure: Colo. 1102-01, Amendment No. 6

State of Colorado
Department of Public Health and Environment

RADIOACTIVE MATERIALS LICENSE

Pursuant to the *Radiation Control Act* Title 25, Article 11, *Colorado Revised Statutes*, and the State of Colorado *Rules and Regulations Pertaining to Radiation Control* and in reliance on statements and representations heretofore made by the licensee designated below; a license is hereby issued authorizing such licensee to receive, possess, analyze, store, process and dispose the radioactive material(s) designated below; and to use such radioactive material(s) for the purpose(s) and at the place(s) designated below. This license is subject to all applicable rules, regulations, and orders now or hereafter in effect of the Colorado Department of Public Health and Environment (CDPHE) and to any conditions specified below.

---

1. Licensee: Clean Harbors Deer Trail, LLC
2. Address: 108555 East US Highway 36, Deer Trail, CO 80105-9611
3. License Number Colo. 1102-01, Amendment Number 06
4. Expiration date: December 31, 2010
5. Reference Number: Fee Category: 4.A

---

6. **Authorized Radioactive Material and Uses**

   A. The licensee is authorized to receive, possess, analyze, store, process, and dispose of waste materials containing naturally occurring radioactive material (NORM), technologically enhanced naturally occurring radioactive material (TENORM), and radium contamination resulting from activities involving purposefully concentrated radium-226. The specific radionuclides are limited to K-40 and all of the radionuclides in the decay series for U-238, U-235 and Th-232. The summed activity of all radionuclides per gram contained in such waste materials shall not exceed 2000 pCi (74 Bq). Additionally, the Ra-226 activity per gram shall not exceed 400 pCi (14.8 Bq). The physical form of the material includes but is not limited to soils, sludges, process residues, resins, and filters that are compatible with the design and operational criteria required by the CHWA permit.

   B. In addition to the limits established in items 6.A the total uranium and thorium content shall be less than 0.05% by weight (500 µg per gram) of the materials received for disposal.

   C. In addition to the limits established in items 6.A and 6.B the licensee shall limit the total of all waste materials containing radioactive material to a total volume not to exceed 510,440 cubic yards. Of this amount, at least 16,000 cubic yards shall be set aside for radium processing wastes.

State of Colorado
Department of Public Health and Environment

RADIOACTIVE MATERIALS LICENSE

Conditions

7. The licensee shall comply with the provisions of the State of Colorado *Rules and Regulations Pertaining to Radiation Control*: Part 3, "Licensing of Radioactive Material"; Part 4, "Standards for Protection Against Radiation"; Part 10, "Notices, Instructions and Reports to Workers: Inspections"; Part 11, "Special Land Ownership Requirements"; Part 14, "Licensing Requirements for Land Disposal of Low Level Radioactive Wastes"; Part 15, "Colorado Low-Level Radioactive Waste Rate Regulations"; and Part 17, "Transportation of Radioactive Material."

8. Radioactive materials may be received, stored, handled, processed and disposed only at the Clean Harbors Deer Trail facility, 108555 East US Highway 36, Deer Trail, CO 80105-9611.

9. The licensee is prohibited from receiving low-level wastes, as defined by the Rocky Mountain Low Level Waste Compact Board, from outside the Compact Region without written authorization from the Rocky Mountain Low Level Waste Compact Board.

10. For the purposes of this license and as used in the application, regulated waste refers to any waste received, handled, processed or disposed of at the site containing radioactive material including: a) NORM/TENORM radionuclides in solid waste; b) NORM/TENORM radionuclides in material licensed by CDPHE; c) NORM/TENORM radionuclides mixed with Colorado Hazardous Waste Act (CHWA) hazardous wastes; d) radium processing wastes; and e) radium contamination resulting from activities involving purposely concentrated radium-226.

11. Pursuant to its authority over all radioactive materials at the facility, the Department may at any time impose additional requirements and/or license conditions regarding the receipt, processing, analysis, storage or disposal of these materials as may be necessary to ensure health and safety of workers, protection of the environment and compliance with any applicable rules, regulations and statutes.

12. Should the licensee become aware of radioactive materials that were not identified in any waste characterization or manifest that are present in waste materials received or buried at the site, the licensee shall maintain a record of these and shall provide immediate notification to the Department for any materials that are not specifically authorized on the license.

13. The designated Radiation Safety Officer (RSO) is Scott Zoller, CHP.

14. The designated Alternate Radiation Safety Officer (RSO) is Tracy A. Ikenberry, CHP.

15. The Radiation Safety Officer shall be on-site sufficient to ensure protection of workers and compliance with this license and the Rules and Regulations.

16. Radioactive material authorized in License Conditions 6.A. through 6.C. shall only be received, stored, handled, analyzed, processed or disposed by or under the supervision of John Kehoe, Michael Webb, Ismael Hernandez, Randall Musgrave, Daniel O'Brien, Leresa Wilson, Joseph Sanchez, or Terry Musgrave.

State of Colorado
Department of Public Health and Environment

RADIOACTIVE MATERIALS LICENSE

17. One or more authorized users identified in Condition 16 of this license shall be physically present at the facility at all times when radioactive materials are being received, stored, handled, analyzed, processed or disposed. The number of authorized users present on site at any one time shall be sufficient to ensure adequate supervision of all persons within the restricted area.

18. Temporary contract laborers and members of the public shall be escorted throughout the restricted area under the direct supervision and in the physical presence of an authorized user listed in License Condition 16. Temporary contract laborers shall sign in and out of the facility each day. The sign-in, sign-out logs for the facility shall be maintained in the Operating Record.

19. Contract laborers and consultants who have successfully completed the radiation safety training as described in the Radiation Protection Program may work throughout the restricted area without continuous direct supervision by Clean Harbors personnel.

20. The Radiation Safety Officer, Alternate Radiation Safety Officer, or persons specifically listed in License Condition 16 shall physically observe the day-to-day activities of contract laborers and consultants who work without constant supervision. The extent of these observations shall be sufficient to ensure that contract laborers and consultants are complying with established procedures and the requirements of this license.

21. Each person receiving an occupational dose at the facility is deemed to require monitoring pursuant to Section 4.18 of the Regulations.

22. The Radiation Safety Officer shall maintain training and dose monitoring records for each worker at the site who receives an occupational dose. These records shall show the initial hire date, the specific training received, the date training was successfully completed, the date when dose monitoring was initiated, the date when employment terminated, and a copy of the annual total dose assessment for each year the individual works at the site.

23. The licensee shall determine occupational doses on a quarterly basis, with the final determination being completed within 60 days from the end of each quarter.

24. The licensee shall determine occupational doses (total effective dose equivalent (TEDE), committed effective dose equivalent (CEDE), and deep dose equivalent (DDE)) within 90 days from the end of each calendar year.

State of Colorado
Department of Public Health and Environment

RADIOACTIVE MATERIALS LICENSE

25. The licensee shall not make any substantial modification to the facility, equipment, process, or procedures used in the receipt, storage, handling, processing or disposal of waste containing radioactive materials without first evaluating and documenting the impact of such changes to workers, the environment, and members of the public. The licensee shall obtain written authorization from the Department, including a license amendment, if deemed necessary by the Department prior implementing the proposed changes. The Radiation Safety Officer shall maintain documentation of all such evaluations for review by the Department.

26. Characterization and approval of regulated waste streams shall be performed in accordance with the Waste Acceptance SOP 15.W.01 dated April 19, 2006. All records of characterization and approval of regulated waste streams shall be maintained by the licensee for review by the department.

27. The licensee shall collect a random sample from 1 shipment out of every 20 shipments from each waste stream from each generator as described in the Waste Acceptance SOP 15.W.01 dated April 19, 2006. The random sample shall be sent to an off-site laboratory for analysis including: Gamma Spectrum, Gross Alpha Activity/g, Gross Beta Activity/g, Total Uranium Mass/g, Total Thorium Mass/g and Total Radium Activity/g. The results of this analysis shall be compared to the initial characterization data for the waste stream. If the results differ significantly from the profile, the RSO, general manager, compliance manager, or their designee shall contact the waste generator and attempt to resolve the discrepancy. If the results cannot be reconciled, the waste stream shall be deactivated until it can be resolved. All records from the random sampling program shall be maintained for review by the Department.

28. The licensee shall implement and maintain Department-approved controls for limiting the release of radon and radioactive particulates from all waste repositories and processing facilities.

29. The licensee shall conduct an air sampling program sufficient to demonstrate compliance with the public and occupational dose limits specified in Part 4 of the Regulations.

30. The licensee shall continue collecting monthly samples of groundwater, leachate and air for the purposes of establishing baseline environmental data for radionuclides until the Department approves an alternate sampling frequency.

31. Samples collected for the assessment of doses to members of the public, occupational doses, and samples collected for verification of characterization of wastes or environmental contamination levels shall be analyzed by radiochemistry laboratory that is appropriately licensed for the type of analysis being performed.

32. The licensee shall conduct sufficient radiation surveys on materials and equipment to ensure that contamination levels do not exceed Department-approved criteria prior to release to unrestricted areas or for unrestricted use. The results of each survey shall be recorded and maintained on file for review by the Department for three (3) years after the record is made in accordance with RH 4.42.

State of Colorado
Department of Public Health and Environment

RADIOACTIVE MATERIALS LICENSE

33. The licensee shall maintain all equipment and facilities, essential to operations governed by this license, in good working condition. This includes but is not limited to process equipment, process tanks, dust suppression equipment, air sampling equipment, water monitoring wells, radiation detection equipment, survey instruments, gates, fences, waste impoundments, security systems, safety equipment, and emergency systems and equipment.

34. The licensee's management and radiation safety officer shall take prompt and appropriate action to correct known deficiencies in the facility's procedures, processes, equipment, and site conditions. These deficiencies and the corrective actions shall be documented and records maintained for review by the Department for three (3) years.

35. The licensee shall document and implement a system of routine preventive maintenance so that safety equipment is checked for proper working order according to a regular schedule.

36. The license shall post individual areas of the facility and the entrances to each building or room that contains radioactive materials, with a conspicuous sign bearing the radiation symbol and the words, "Caution – Radioactive Materials".

37. The licensee shall maintain security measures to prevent unauthorized access to the site's facilities and radioactive materials.

38. Prior to closure of each landfill cell, the licensee shall submit an analysis of the adequacy of the cap design to the Department for approval. The cap design must provide reasonable assurance of control of radiological hazards to be effective for 1,000 years, to the extent reasonably achievable, and, in any case, for at least 200 years. Additionally, the cap design must be sufficient such that the release of Radon-222 does not exceed 20 pCi per square meter per second averaged over the surface area of the cell. This analysis shall include radon flux measurements and an analysis of the amount and concentration of radon producing materials disposed in the cell.

39. Upon closure of each landfill cell containing radioactive material, the licensee shall record with the Adams County clerk and recorder a deed annotation as required in Section 11.3.5.

40. Following the construction of a new landfill liner system or a landfill final cover system, the licensee shall provide the Department with "as-built" drawings of the landfill liner system or final cover system.

State of Colorado
Department of Public Health and Environment

RADIOACTIVE MATERIALS LICENSE

41. The licensee shall provide the Department with an annual report by April 1 of each calendar year. That report shall contain the following items:

    A. specification of each quantity of radioactive contaminants released to unrestricted areas in liquid and in airborne effluents;

    B. the results of the environmental monitoring program;

    C. a summary of licensee disposal unit radiation survey and maintenance activities;

    D. a summary of activities and quantities of radionuclides disposed of;

    E. any instances in which the observed site characteristics were significantly different from those described in the application for a license;

    F. estimated doses to members of the public from the licensee's activities. This includes TEDE (total effective dose equivalent) and TODE (total organ dose equivalent) for both the nearest resident and the maximally exposed member of the public (if they are not the same person). The calculation of public doses shall be in accordance with Department approved methods, sampling frequencies, and dose modeling assumptions. Dose estimates shall be accompanied by appropriate supporting data including an electronic copy of the lab results, spreadsheets, computer model inputs, and modeling results/outputs;

    G. a summary of Occupational Doses (total effective dose equivalent (TEDE), committed effective dose equivalent (CEDE), and deep dose equivalent (DDE));

    H. a copy of the annual ALARA program audit;

    I. a summary of anticipated activities for coming year;

    J. an evaluation of the existing decommissioning warranty to ensure that the available funds are sufficient to account for inflation, current site conditions, and projected activities for the coming year; and

    K. an evaluation of the existing decommissioning funding plan to ensure that the licensee will have sufficient funds for the licensee to complete site decommissioning activities.

State of Colorado
Department of Public Health and Environment

RADIOACTIVE MATERIALS LICENSE

License conditions 42 and 43 only apply to wastes under the jurisdiction of the Rocky Mountain Low-Level Radioactive Waste Board

42. Two (2) years after the facility has been licensed, the licensee shall petition the Board of Health of the State of Colorado to determine the rates using a historic test period of no less than twelve (12) continuous months, adjusted for known and certain future expenditures that will be incurred by the licensee which are reasonable and necessary for the operation of the facility.

43. The licensee shall provide rate review documentation to the Department pursuant to Sections 15.16, 15.17, 15.18 and 15.19.

    A. Semiannual reports shall be submitted by July 31st and January 31st of each year.

    B. Annual reports shall be submitted by April 1st of each year.

44. Records of waste disposal shall be maintained in accordance with Section 4.48.

45. The licensee's facility management and the radiation safety officer shall thoroughly review the content and requirements of this license. The licensee shall promptly notify the Department whenever it identifies an error in license authorizations or it has identified a specific license condition or technical requirement established in this license that is not achievable given the current state of technology or site conditions.

46. If statements in referenced documents conflict, the most recent document listed below shall prevail unless otherwise specified in this license.

47. The State of Colorado Rules and Regulations Pertaining to Radiation Control and the *Radiation Control Act* Title 25, Article 11, *Colorado Revised Statutes*, shall govern the licensee, unless the conditions of this license or the licensee's statements, representations, or procedures contained in applications or other documents submitted to the Department are more restrictive than the Regulations. Except as specifically provided otherwise by this license, the licensee shall possess and use radioactive material described in Item 6 of this license in accordance with statements, representations, and procedures contained in:

    A. the application and attachments received January 31, 2005; and

    B. the CHWA Subtitle C Permit dated December 2005; and

    C. financial assurance arrangements for decommissioning and long term care (Steadfast Insurance Policy Number ENC 5254333-02); and

    D. the decommissioning funding plan dated December 20, 2005; and

State of Colorado
Department of Public Health and Environment

RADIOACTIVE MATERIALS LICENSE

E. the Rocky Mountain Low-Level Radioactive Waste Board Designation as a Limited Regional Disposal Facility, as amended; and

F. the Radiation Protection Plan dated October 4, 2005; and

G. the Standard Operating Procedures as follows:

i. Standard Operating Procedure on Airborne Monitoring for Regulated Waste dated October 14, 2005;
ii. Standard Operating Procedure on Individual and Area Dosimetry dated October 4, 2005;
iii. Standard Operating Procedure 15.SUR.01 Routine Radiation Surveys Revision 1 dated April 16, 2007;
iv. Standard Operating Procedure on Personnel Surveys dated October 7, 2005;
v. Standard Operating Procedure on Equipment Surveys dated October 4, 2005;
vi. Standard Operating Procedure on Surveys Following Spills dated October 4, 2005;
vii. Standard Operating Procedure on Worker Radiation Protection Records dated October 4, 2005;
viii. Standard Operating Procedure on Use of the Gate Monitoring System dated October 4, 2005;
ix. Standard Operating Procedure on Gamma Spectra Analysis dated October 7, 2005;
x. Standard Operating Procedure on Treatment Operations dated October 14, 2005;
xi. Standard Operating Procedure on Regulated Waste Landfill Operations dated October 14, 2005;
xii. Standard Operating Procedure on Estimating Inhalation Doses dated June 23, 2005;
xiii. Standard Operating Procedure on Radiation Protection Training dated June 23, 2005;
xiv. Standard Operating Procedure 15.LAB.01 Use of the Alpha Beta Counter Revision 1 dated April 16, 2007;
xv. Standard Operating Procedure on Waste Tracking dated June 24, 2005;
xvi. Waste Acceptance SOP 15.WAC.01 Revision 2 dated April 19, 2006;
xvii. Groundwater Sampling Standard Operating Procedure 15.Env.2 dated September 1, 2006;
xviii. Standard Operating Procedure 15.OPS.03 Liquid Regulated Wastes Revision 1 dated April 16, 2007; and

H. the Decommissioning Plan dated December 21, 2005; and

I. the Environmental Covenant granted by the licensee to the Colorado Department of Public Health and Environment on January 5, 2006 and as may be amended from time to time; and

State of Colorado
Department of Public Health and Environment

RADIOACTIVE MATERIALS LICENSE

J. the correspondence and attachments dated April 7, 2005; May 2, 2005; May 24, 2005; July 7, 2005; July 26, 2005; July 28, 2005; August 10, 2005 (email); October 25, 2005; October 26, 2005; April 4, 2006; April 19, 2006; and October 10, 2006 (received by the Department on January 30, 2007); April 16, 2007, June 28, 2007; September 1, 2008; and March 18, 2009.

FOR THE COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT

By: 3/30/09 Date: [signature]

Waste Disposal Services

Truck-to-Rail Transloading Fact Sheet

Truck-to-Rail Transloading

Clean Harbors portable truck-to-rail transloading solution provides the most economical and safest method of overland transportation of bulk waste material. Our truck-to-rail transloading ramps offer you a significant advantage when managing the shipment of material from your project site to one of Clean Harbors rail served treatment and disposal facilities, including our incinerators and landfills. Even if your project location does not have rail on-site or the rail is at the opposite side of a property, you can still benefit from the economies of rail shipping by utilizing our truck-to-rail transloading solution.

- We provide a total solution
- Railroad approved & specifically designed
- Gain high throughput rates
- Minimal site requirements

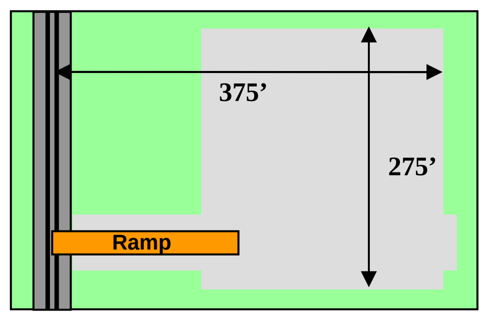
We Provide a Total Solution - Clean Harbors will set up and operate portable truck-to-rail ramps on your project site. We can also provide the trucks to move materials to the rail cars as well as manage the rail shipments to the end disposal facility.

Railroad Approved & Specifically Designed - These ramps are railroad approved and specifically designed for transloading activity involving transferring bulk loads of soils and small debris from dump trailers and roll-offs into 90-100 ton gondola rail cars.

Auto-leveling hoppers distribute the bulk wastes evenly throughout the length of the railcar. The ramps are configured for “back-on” use and can handle most any conventional dump trailer or the higher model roll-off frames. To maximize railcar payload, our ramp system is compatible for use with 53-foot, 90-100-ton gondola railcars.

Gain High Throughput Rates - When transloading operating conditions are optimal, approximately 92 tons (four trailer loads) can be transloaded per 1½ hours.

Minimal Site Requirements - We require a non-shared dedicated rail spur or siding. The transload ramp will be set-up at approximately the mid-point of the siding. The siding must have sufficient length to accommodate a full days/shifts production of railcars on both sides of the transload ramp. A minimum of 375 feet of perpendicular approach to the inside rail and approximately 275 feet of truck/trailer maneuvering area is necessary. Since our equipment is a back-on ramp, we do not require any additional area or accommodations on the opposite side of the rail.



Typical Site Layout – perpendicular approach to the rail supported by a load bearing improved surface, without overhead obstacles, shallow buried conveyances and/or highly irregular angles of approach.

Summary - Understanding and appreciating the complexities of remedial and project site activities and knowing the nuts and bolts of railroad service, Clean Harbors is able to provide a unique value-added service that makes transportation and disposal economical and as seamless and uncomplicated as ever.

CleanHarbors
ENVIRONMENTAL SERVICES®

42 Longwater Drive • PO Box 9149 • Norwell, Massachusetts 02061-9149 • 800.282.0058 • www.cleanharbors.com

APPENDIX D:

Evaluation of Excavation Shoring Technology

Appendix D: Evaluation of Shoring Option to Reduce Overburden Excavation

The feasibility and economics of stabilizing excavations within the Areas 1 and 2 were considered using vertical sheet piling to stabilize the RIM excavation area versus laying back the excavation sideslopes at a 3:1 slope for the two "complete rad removal" alternatives. This evaluation began by identifying the following shoring alternatives: (i) sheet piling; (ii) soldier piles with timber lagging; (iii) grout curtains; and (iv) temporary freeze-walls. Sheet piling, soldier walls, and grout curtains are proven, commonly-used technologies for stabilizing excavation sidewalls and are reasonably cost effective. Freeze-walls have limited application to sites where groundwater intrusion needs to be controlled by freezing water; their applications are also very expensive.

Sheet piling was selected as the representative technology because it has a reasonable probability of being installed through the solid waste and RIM at this site, the pile sections can be locked in place when installed without excavation, and they can be removed without excavation. Soldier walls require excavation inside and outside of the wall alignment to install them, and are difficult to remove without first alleviating soil pressures against the walls. Grout curtains are permanent installations and cannot reasonably be constructed in highly-permeable solid waste. In addition, they are not typically removed once installed.

For estimating purposes, the alignments of sheet pile walls were established as the Extrapolated RIM Limit of the basal layer of the RIM (RIM 2) as illustrated on Drawings in Appendix A. The walls would be constructed from the ground surface down to the RIM 2 elevation (overburden plus RIM thickness = depth), then penetrate twice that depth into underlying material for wall stability. Wall segments would be driven prior to overburden removal and remain in place until RIM is removed, then would be removed as the remaining landfills are refilled and recontoured.

For Area 1, the volume of overburden material that could be saved by shoring the sideslopes would be approximately 30,000 bank cubic yards, based on a 2005 aerial photograph. This equates to a 38% reduction in overburden excavation. The surface area of the sheet pile wall, including the buried penetration, would be approximately 67,000 square feet. The cost savings from reduced excavation and reclamation would be approximately $530,000. The additional cost to install the wall, assuming the sheet piles can be removed and reclaimed, would be approximately $2,190,000. Thus, the net cost for this option for Area 1 would be an increase of approximately $1,660,000 above the cost of the program proposed in the SFS. In addition, the Area 1 shoring program would add approximately 123 days to the construction schedule. See attached cost and schedule calculations.

For Area 2, the volume of overburden that could be saved by shoring would be approximately 93,000 bank cubic yards assuming a conservative 30% reduction in overburden excavation. The surface area of the sheet pile wall, including the buried penetration, would be approximately 291,000 square feet. The cost savings from reduced excavation and reclamation would be approximately $1,636,000. The additional cost to install the wall would be approximately $9,461,000. Thus, the net cost for Area 2 would be an increase of approximately $7,825,000 above the cost of the program proposed in the SFS. This shoring program would add approximately 1 year to the construction schedule, assuming two rig-crews can be assigned to the project. See attached cost and schedule calculations.

Primary benefits of sheet-pile wall construction would be a reduction in overburden excavation of approximately 38% and 30% for Areas 1 and 2, respectively; no exposure to debris buried beneath that overburden; and a reduction in associated reclamation. The technology to construct the wall is available and demonstrated. Installation would be performed using conventional equipment and materials. However, the main risk to installing the walls is the variable and uncertain subsurface conditions and the probability of encountering buried construction debris, such as steel or concrete, that may not be penetrated by a driven pile. This would require frequent field changes to re-position and re-attempt sheet-pile driving. Also, the sheet-pile walls would be installed through waste, which has variable engineering properties. Portions of the wall may be founded in or adjacent to waste with insufficient shear strength to support the excavation, unless design changes during construction are made (e.g., revise the sheet-pile embedment depth, structural steel cross section of the sheet piles, add tie-back anchors, bracing, etc.). Finally, there are also health and safety risks associated with driving sheet piles through a landfill that is actively generating methane gas. Wall installation would add at least one year or more to the construction schedule. And all of these uncertainties and risks have the potential to add substantial time and cost to the remedial action.

Overall, the option to reduce excavation of overburden volume by stabilizing sidewalls with sheet piling may reduce overburden volume by about 35%, but implementation may be compromised by obstructions in the subsurface and unknown geotechnical properties of the foundation material underlying the RIM. This option will add approximately $9.5 million to the cost and extend the construction schedule by at least a year for either of the two “complete rad removal” alternatives. Consequently, the benefit does not appear to be commensurate with the additional construction risks, cost, and schedule extension.

Area 1 Shoring Cost Differential

Description	Number	Quantity	Units	Unit Rate	Estimated Cost
Sheet Piling Along Required Areas					
Assumptions:					
Sheet Piling requred for 4 feet of overburden along entire length, plus segments of RIM where needed (up to 8 feet thick), plus subsoil penetration at 2x open face. Total area = 3x open face - see manual calcs					
Surveying required to stake Extrapolated RIM limits and pile depths					
Steel sheet piles based on 22 psf (up to 15 ft excavation)					
Sheet pile mobed to and demobed from site using flatbed trucks from within 10 miles of site					
Pile Driver installs and extracts piling (2 mobilizations)					
Surveying		3	days	1,500	4,500
Equipment mobilization/demobilization		2	lump sum	12,000	24,000
Steel Sheet Piles (22 psf). Assume drive, extract, and salvage		67,000	SF	21.50	1,440,500
Subtotal - Sheet Piling					**1,469,000**
Estimated Construction Costs - Subtotal					1,469,000
Project Management			*%*	*5*	*73,500*
Engineering Design			*%*	*8*	*117,500*
Construction Management			*%*	*6*	*88,100*
Estimated Project Capital Costs - Subtotal					1,748,100
Contingency (10% scope + 15% bid)			*%*	*25*	*437,000*
Estimated Project Capital Costs - Total					**2,185,000**
Sheet Pile Production rates					
Installation and leave in place (983 sf/day)	67,000	983	days	68	
Install, extract, and salvage (545 sf/day)	67,000	545	days	123	
Savings from Reduced Overburden Excavation					
Assumptions:					
Overburden beyond extrapolated limits of RIM will not need removal. Feezor estimates 29,908 bcy savings.					
Excavation performed with Self-propelled 14 cy scraper w/ 1/4 dozer push					
Temporaty stockpile within 3,000 ft haul distance					
Savings will be realized from less surveying, excavation, stockpiling, replacement, compaction, revegegation, and air monitoring.					
Soil swell factor of 30%					
Surveying (pre- and post-excavation)		2	days	1,500	3,000
Equipment mobilization/demobilization (no savings)		0	lump sum	10,000	0
Establish staging area for non-contaminated soil (no savings)		0	lump sum	3,000	0
Excavation of non-contaminated soil overburden. Consider 29,908 bcy x 1.3 = 38,880 lcy					
Excavation and onsite stockpiling (assume sandy clay and loam)	1	29,908	bcy	4.52	135,200
Replacement	1	38,880	lcy	4.52	175,700
Compaction (sheepsfoot, 12" lifts, 3 passes)	1	29,908	bcy	0.60	17,900
Water truck	1	20	days	560	11,200
Revegation (utility mix, air seeding with mulch and fertilizer) (approx 30,000 sf)	1	30	msf	78	2,300
Air monitoring (assume 15 days with PID and rad monitors)	1	20	days	500	10,000
Subtotal - Reduction in Overburden Excavation					**355,300**
Estimated Construction Costs - Subtotal					355,300
Project Management			*%*	*5*	*17,800*
Engineering Design			*%*	*8*	*28,400*
Construction Management			*%*	*6*	*21,300*
Estimated Project Capital Costs - Subtotal					422,800
Contingency (10% scope + 15% bid)			*%*	*25*	*105,700*
Estimated Project Capital Costs - Total					**529,000**

Area 2 Shoring Cost Differential

Description	Number	Quantity	Units	Unit Rate	Estimated Cost
Sheet Piling Along Required Areas					
Assumptions:					
Length of sheet piling requred to surround upper RIM area = 4720 LF. Average overburden depth assumed to be 4 feet. Open face calculated to be 41,720 ft2. Total area - 3x open cace = 125,160 ft2. see manual calcs.					
Length of sheet piling requred to surround lower RIM areas = 2,,870 LF. Overburden depths range from 8 to 20 feet. Open face calculated to be 55,200 ft2. Total area - 3x open cace = 165,600 ft2. see manual calcs.					
Total sheet pile area required = 290,760 ft2					
Surveying required to stake Extrapolated RIM limits and pile depths					
Steel sheet piles based on 22 psf (up to 15 ft excavation average)					
Sheet pile mobed to and demobed from site using flatbed trucks from within 10 miles of site. Two mob/demobs required: one for Upper and one for Lower RIM					
Pile Driver installs and extracts piling (2 mobilizations)					
Surveying will require 2 mobilizations at 3 days each.		6	days	1,500	9,000
Equipment mobilization/demobilization		2	lump sum	50,000	100,000
Steel Sheet Piles (22 psf). Assume drive, extract, and salvage		290,760	SF	21.50	6,251,300
Subtotal - Sheet Piling					**6,360,300**
Estimated Construction Costs - Subtotal					6,360,300
Project Management			*%*	*5*	*318,000*
Engineering Design			*%*	*8*	*508,800*
Construction Management			*%*	*6*	*381,600*
Estimated Project Capital Costs - Subtotal					7,568,700
Contingency (10% scope + 15% bid)			*%*	*25*	*1,892,200*
Estimated Project Capital Costs - Total					**9,461,000**
Sheet Pile Production rates					
Installation and leave in place (983 sf/day)	290,760	983	days	296	
Install, extract, and salvage (545 sf/day)	290,760	545	days	534	
Savings from Reduced Overburden Excavation					
Assumptions:					
Overburden beyond extrapolated limits of RIM will not need removal. Assume savings is 20-40% of total overburden volume - use 30%. So 309,703 bcy of overburden x 0.3 = 92,911 bcy					
Excavation performed with Self-propelled 14 cy scraper w/ 1/4 dozer push					
Temporaty stockpile within 3,000 ft haul distance					
Savings will be realized from less surveying, excavation, stockpiling, replacement, compaction, revegegation, and air monitoring.					
Soil swell factor of 30%					
Surveying (pre- and post-excavation)		5	days	1,500	7,500
Equipment mobilization/demobilization (no savings)		0	lump sum	10,000	0
Establish staging area for non-contaminated soil (no savings)		0	lump sum	3,000	0
Excavation of non-contaminated soil overburden. Consider 92,911 bcy x 1.3 = 120,784 lcy					
Excavation and onsite stockpiling (assume sandy clay and loam)	1	92,911	bcy	4.52	420,000
Replacement	1	120,784	lcy	4.52	545,900
Compaction (sheepsfoot, 12" lifts, 3 passes)	1	92,911	bcy	0.60	55,700
Water truck	1	60	days	560	33,600
Revegation (utility mix, air seeding with mulch and fertilizer) (approx 30,000 sf)	1	90	msf	78	7,000
Air monitoring (assume 15 days with PID and rad monitors)	1	60	days	500	30,000
Subtotal - Reduction in Overburden Excavation					**1,099,700**
Estimated Construction Costs - Subtotal					1,099,700
Project Management			*%*	*5*	*55,000*
Engineering Design			*%*	*8*	*88,000*
Construction Management			*%*	*6*	*66,000*
Estimated Project Capital Costs - Subtotal					1,308,700
Contingency (10% scope + 15% bid)			*%*	*25*	*327,200*
Estimated Project Capital Costs - Total					**1,636,000**

APPENDIX E:

Evaluation of Area 1 and 2 Regrading Options

M:\clients\EMSI\westlake\2011\CAD-2011-Jan\Area-25pct-Slopes.dwg plotted: 09/28/2011

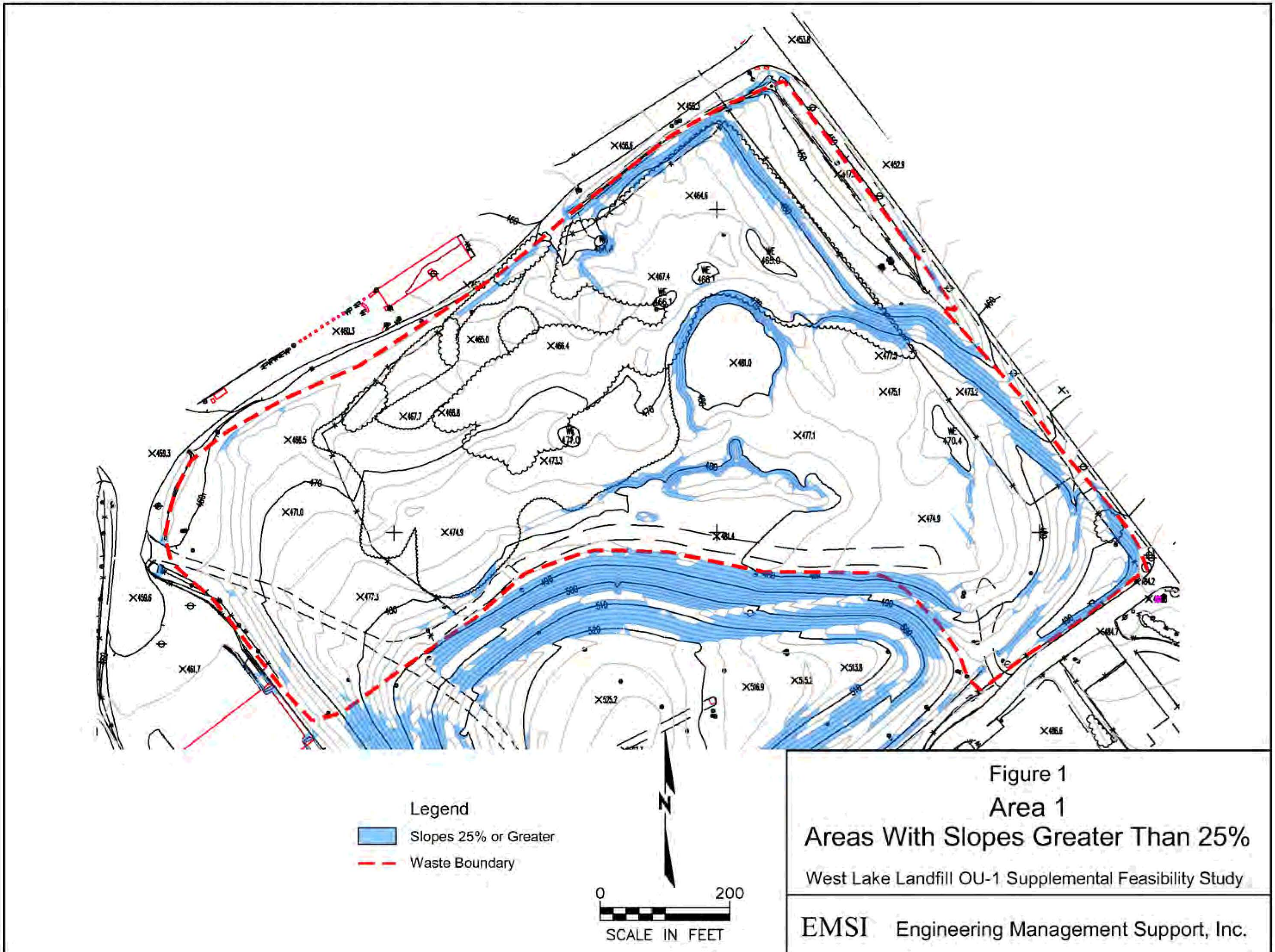


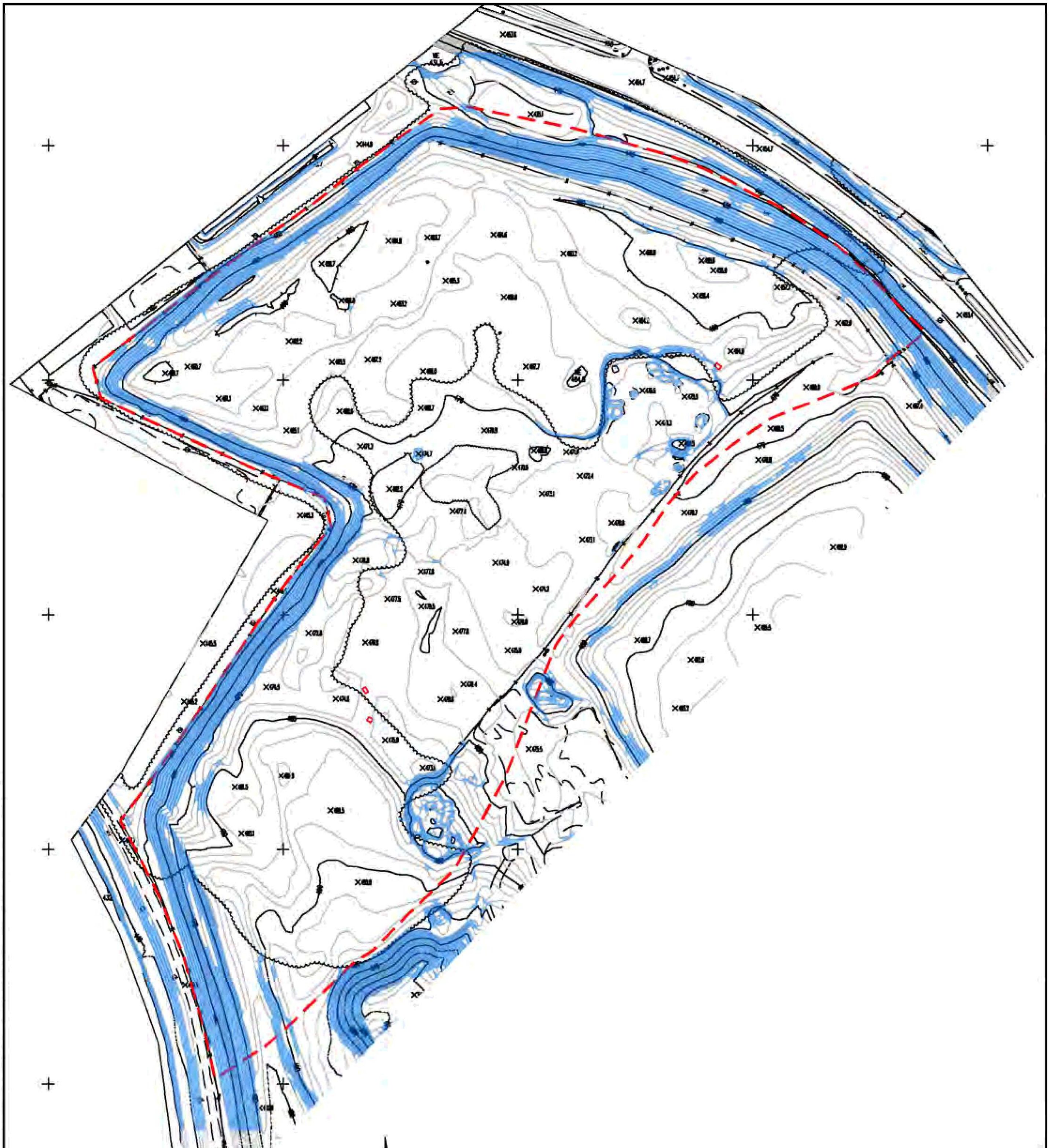
Figure 1

Area 1

Areas With Slopes Greater Than 25%

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.



Legend

Slopes 25% or Greater

Waste Boundary

0 300

SCALE IN FEET

Figure 2

Area 2

Areas With Slopes Greater Than 25%

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

M:\clients\EMSI\westlake\2011\CAD-2011-Jan\Area-25pct-Slopes.dwg plotted: 09/28/2011

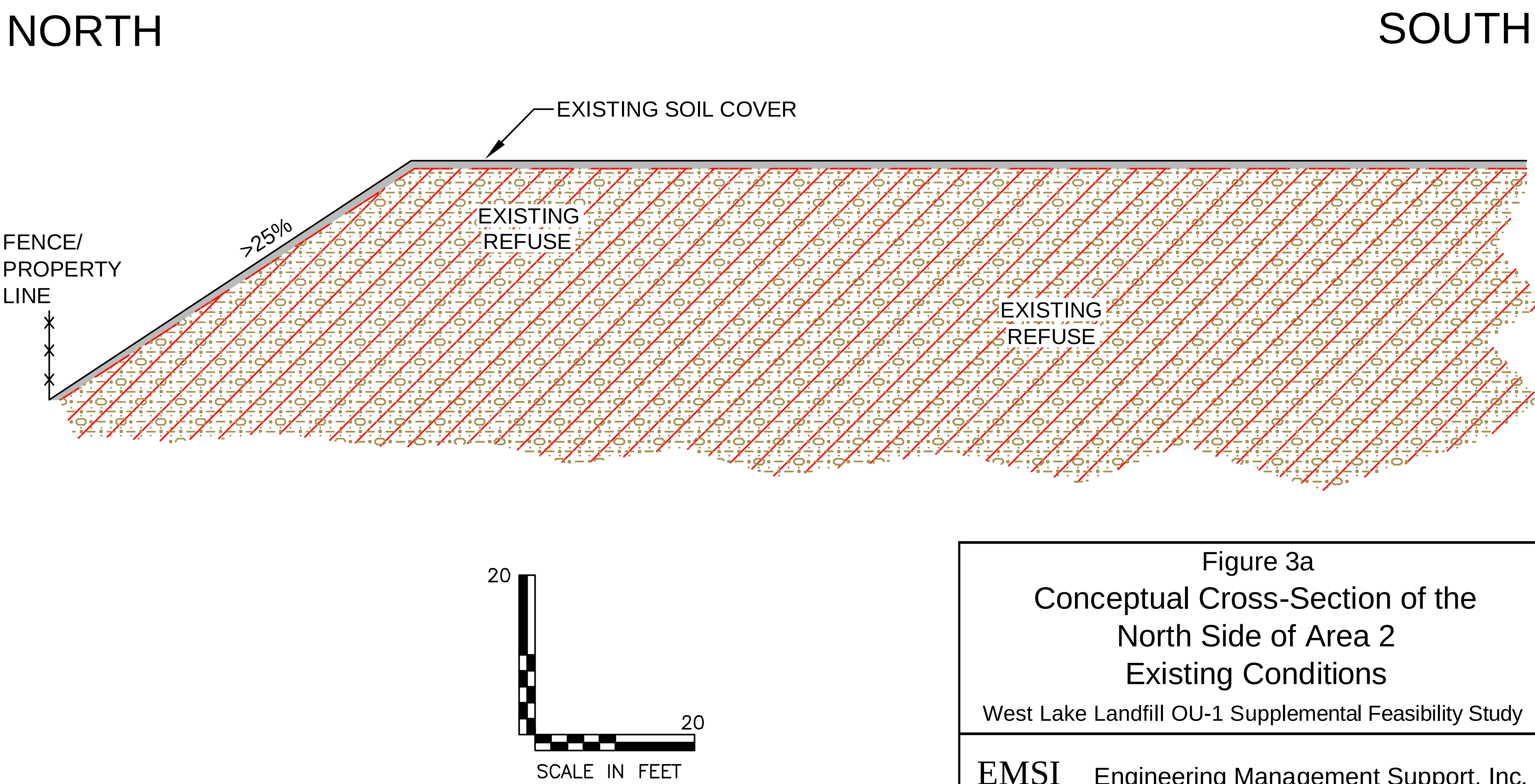


Figure 3a

Conceptual Cross-Section of the North Side of Area 2 Existing Conditions

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

M:\clients\EMSI\westlake\2011\NS-Section\NS-Section-Cartoon-fig3b.dwg plotted: 09/28/2011

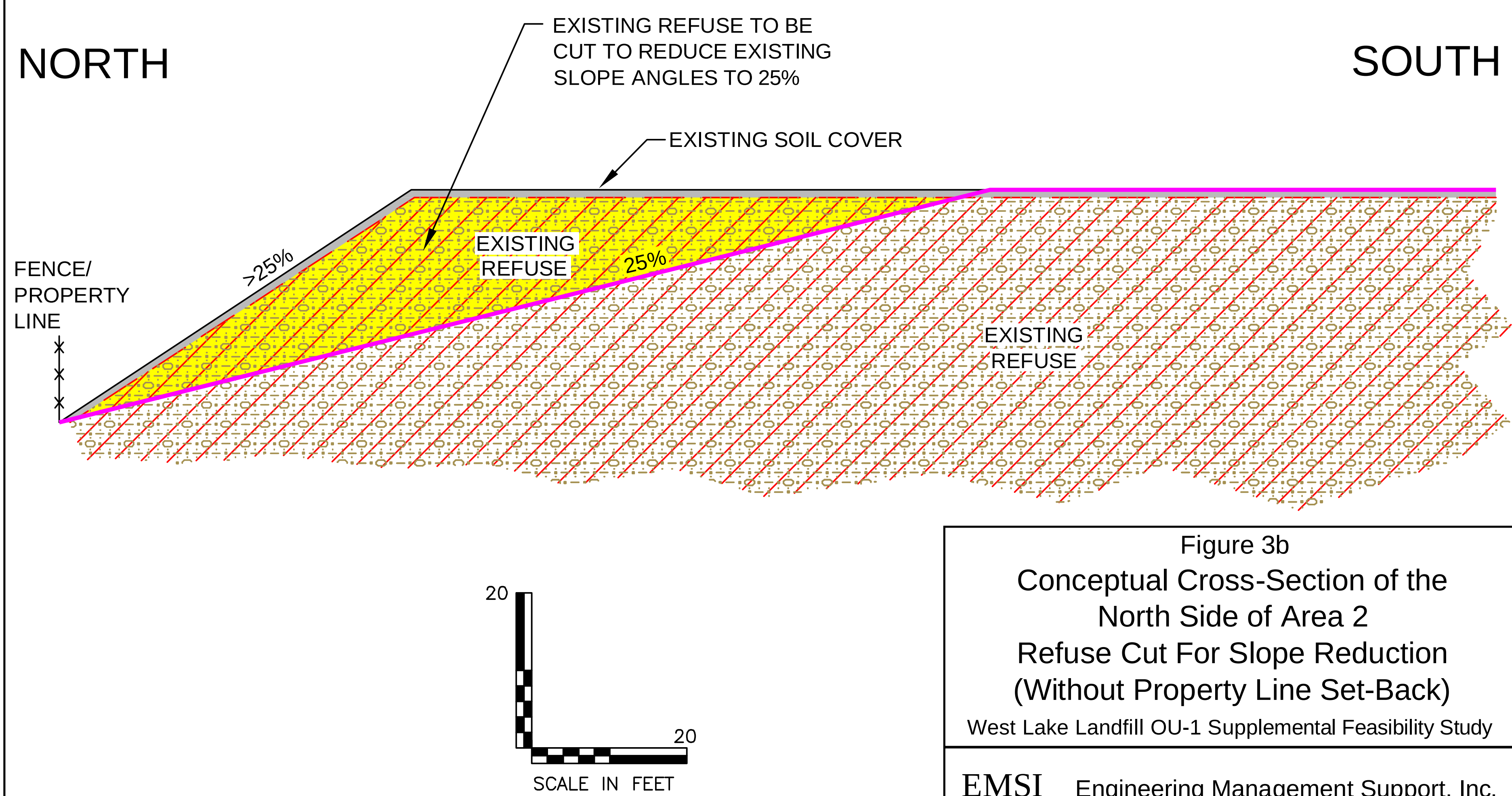


Figure 3b

Conceptual Cross-Section of the North Side of Area 2 Refuse Cut For Slope Reduction (Without Property Line Set-Back)

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

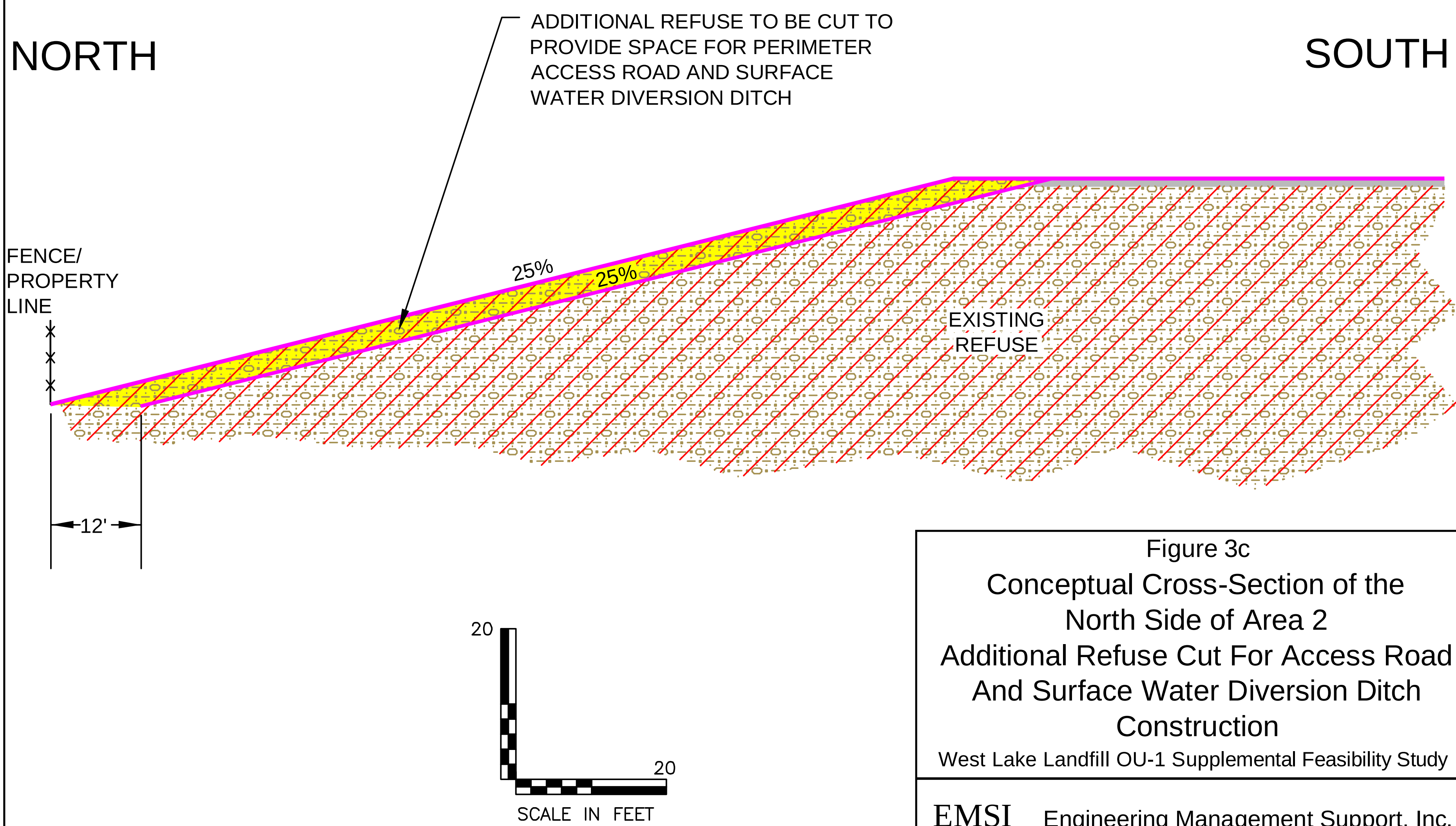


Figure 3c

Conceptual Cross-Section of the North Side of Area 2
Additional Refuse Cut For Access Road And Surface Water Diversion Ditch Construction

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

M:\clients\EMSI\westlake\2011\NS-Section\NS-Section-Cartoon-fig3d.dwg plotted: 09/28/2011

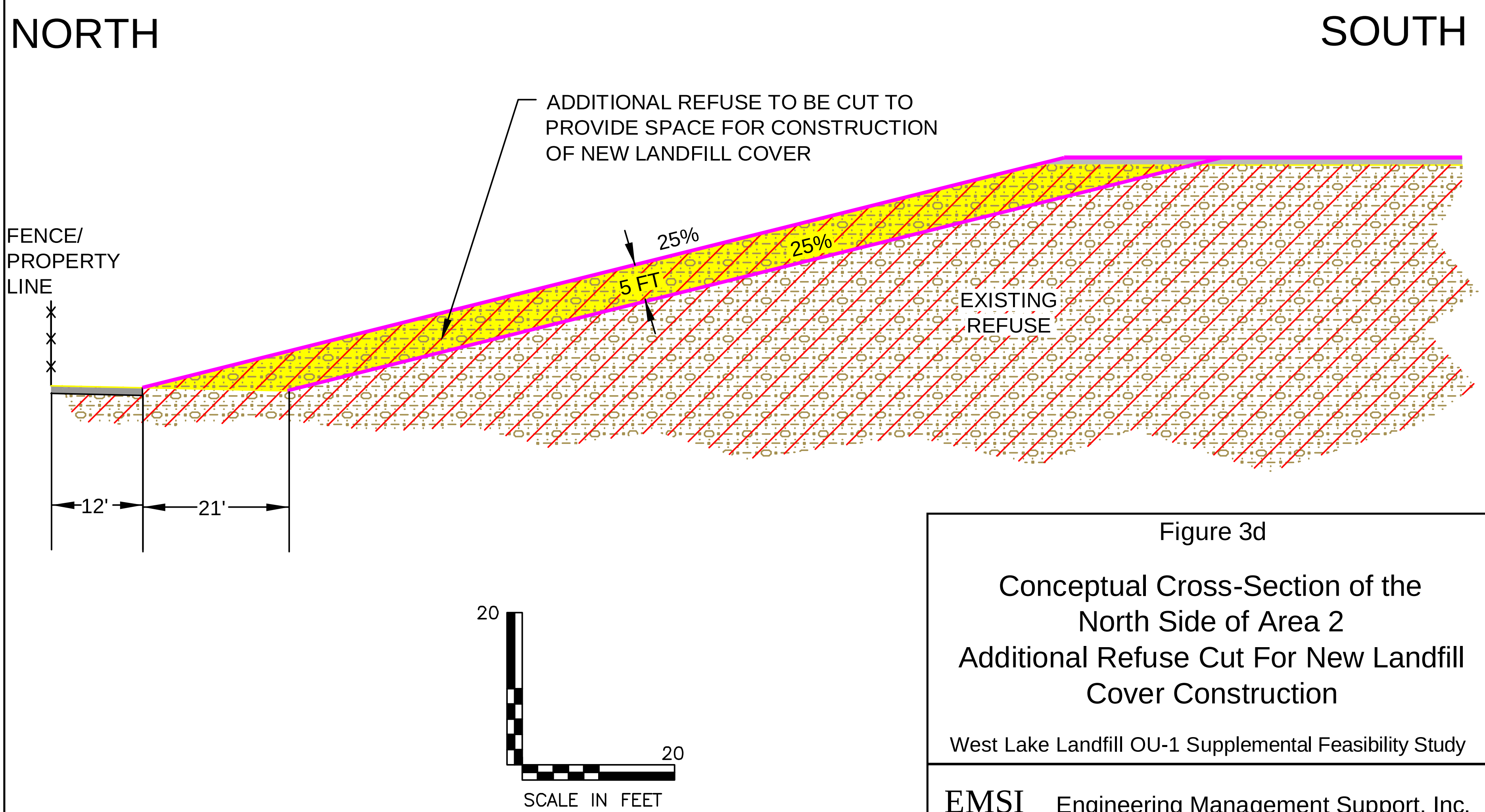


Figure 3d

Conceptual Cross-Section of the
North Side of Area 2
Additional Refuse Cut For New Landfill
Cover Construction

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

M:\clients\EMSI\westlake\2011\NS-Section\NS-Section-Cartoon-fig3e.dwg plotted: 09/28/2011

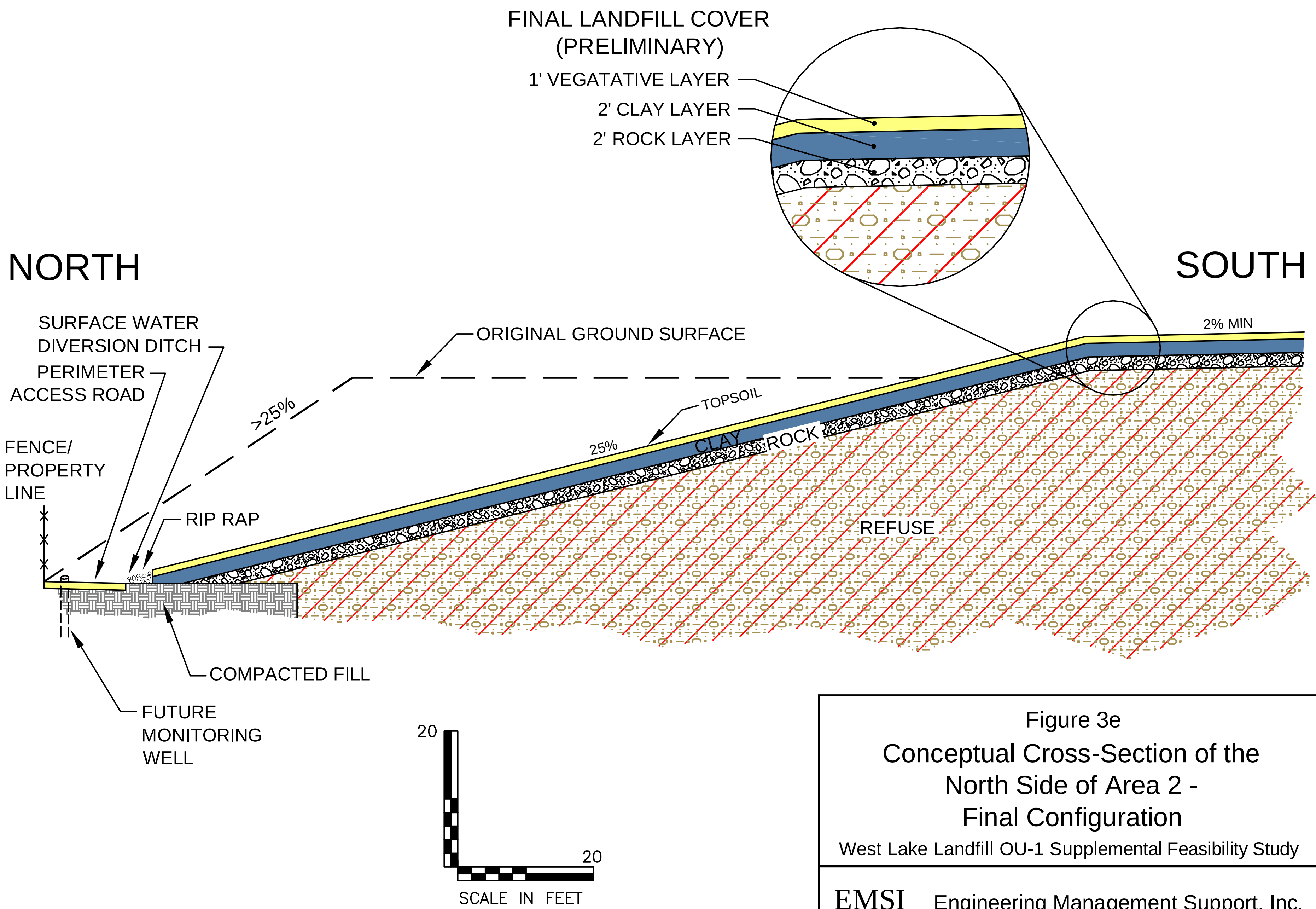


Figure 3e

Conceptual Cross-Section of the North Side of Area 2 - Final Configuration

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

DESIGN OPTION DRAWINGS FOR THE

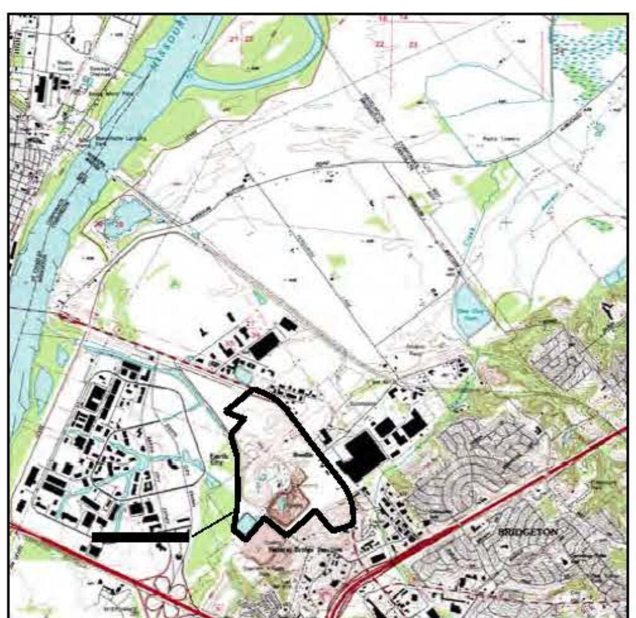
OPERABLE UNIT 1 WASTE GRADING

WEST LAKE LANDFILL

BRIDGETON, ST. LOUIS COUNTY, MISSOURI

NOVEMBER 2010

PREPARED FOR:
WEST LAKE OU-1 RESPONDENTS



LOCATION MAP

SOURCE: KAMPVILLE, MO & ST.CHARLES, MO 7.5 MINUTE QUADRANGLES

Engineering for a Better World
FEEZOR
ENGINEERING, INC.

406 EAST WALNUT STREET
CHATHAM, IL 62629
TEL. (217) 483-3118
FAX. (217) 483-2356

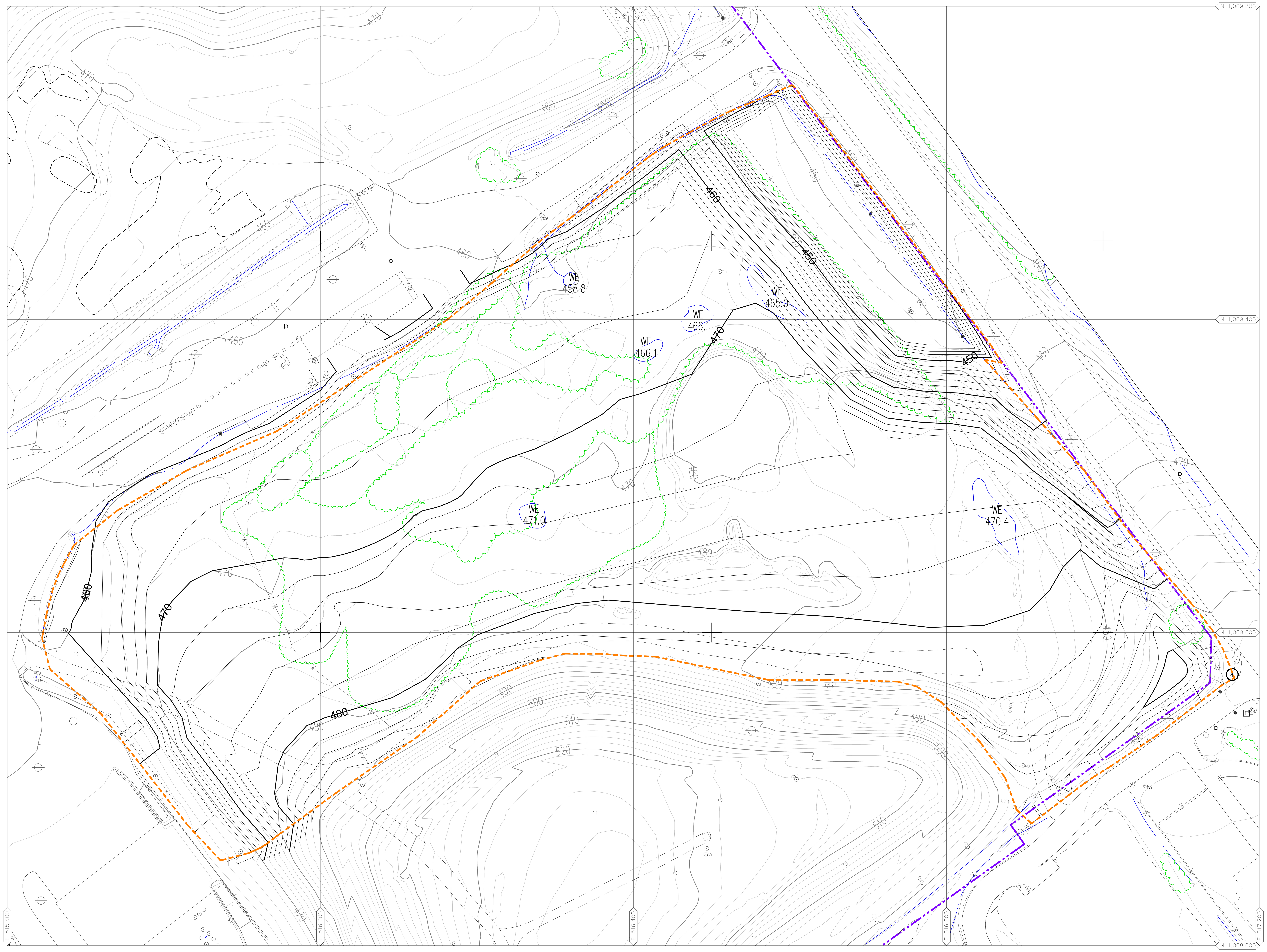
INDEX OF DRAWINGS

Daniel R. Feezor, P.E. Expires 11/30/2011

IL P.E. No: 062-049889 Date

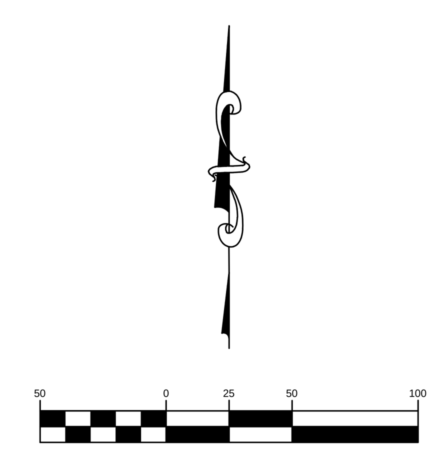
CHANGES TO THIS PLAN/DRAWING SET REQUIRE WRITTEN APPROVAL BY FEI.

S:\Work Files\Projects\Bridgeton Landfill\BT-006 (OU-1 Final Cover Design)\Step 6 - Cut Minimization\Drawings\BT-006-001 (Title Sheet) ACTUAL.dwg



LEGEND

(light line)	EXISTING GRADE (2' CONTOUR)
500 (grey line)	EXISTING GRADE (10' CONTOUR)
(thin black line)	TOP OF WASTE (2' CONTOUR)
500 (heavy black line)	TOP OF WASTE (10' CONTOUR)
(purple dash-dot line)	PROPERTY BOUNDARY
(orange dashed line)	WASTE BOUNDARY



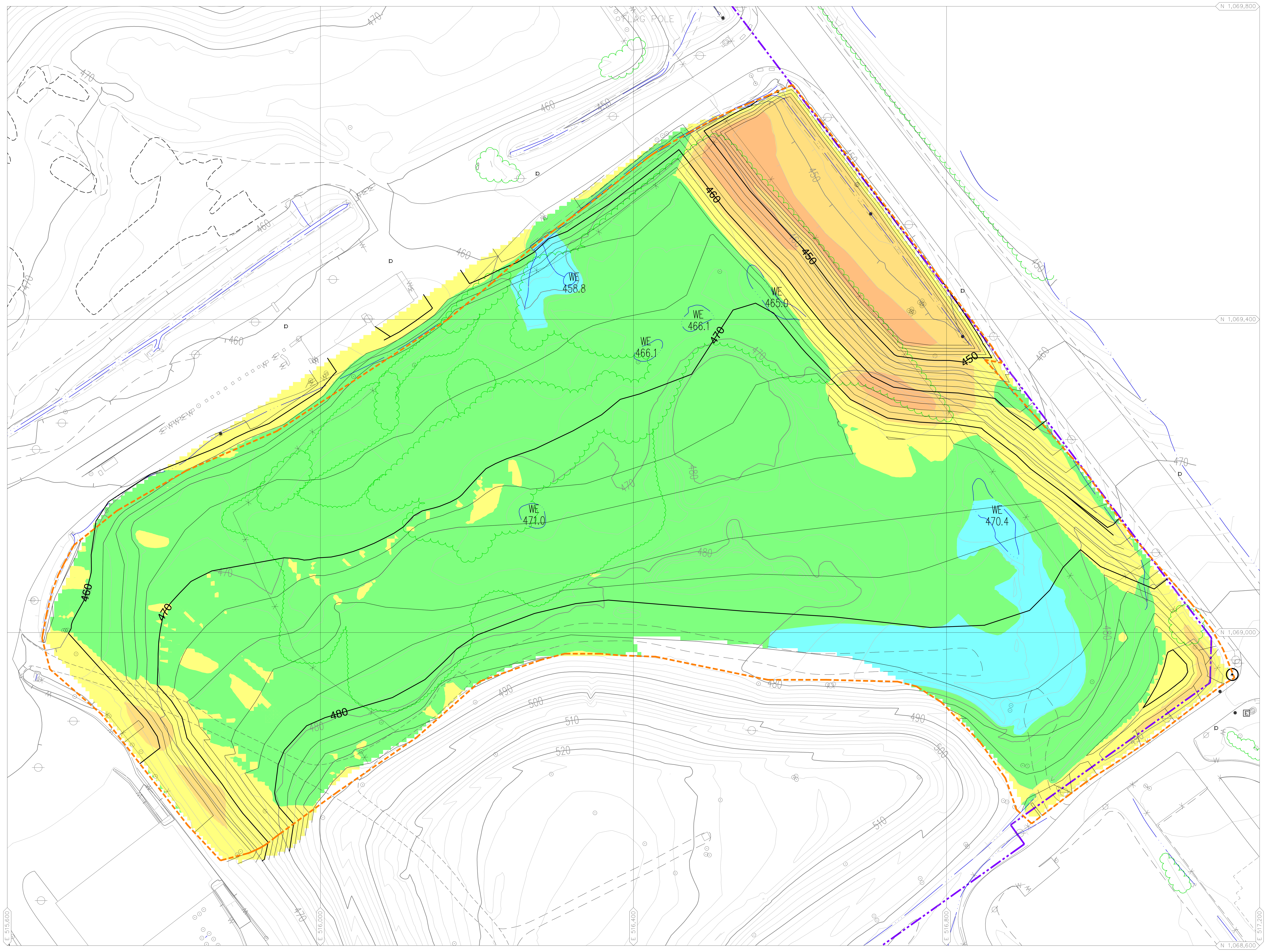
SCALE: 1" = 50'

NOTE:
1.) AERIAL TOPOGRAPHY WAS PROVIDED BY SANBORN AND IS DATED FEBRUARY 19, 2009.

WEST LAKE LANDFILL OU-1 REMEDIAL DESIGN	WEST LAKE LANDFILL OU-1 RESPONDENTS	Engineering for a Better World FEEZOR ENGINEERING, INC.	DATE: NOVEMBER 2010 DESIGNED BY: NAC APPROVED BY: DRF REV. 2 — 1/27/2011 REVISION — DATE	DRAWING NO.: **002**

AREA I TOP OF WASTE GRADING - OPTION 1

PROJECT NUMBER: BT-005 FILE PATH: S:\Work Files\Projects\Bridgeton Landfill\BT-005 (OU-1 Final Cover Design)\Step 6 - Cut Minimization\Revised With Thicker Area 2 Cap\Drawings\BT-005 Waste Grading Option 1 - REV 1-19-11.dwg

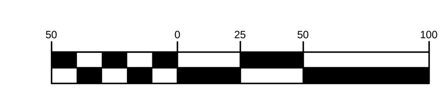


Cut/Fill Table			
Number	Minimum Cut/Fill	Maximum Cut/Fill	Color
1	-15	-10	
2	-10	-5	
3	-5	0	
4	0	5	
5	5	9	

CUT: 31,464 cubic yards
FILL: 40,290 cubic yards

LEGEND

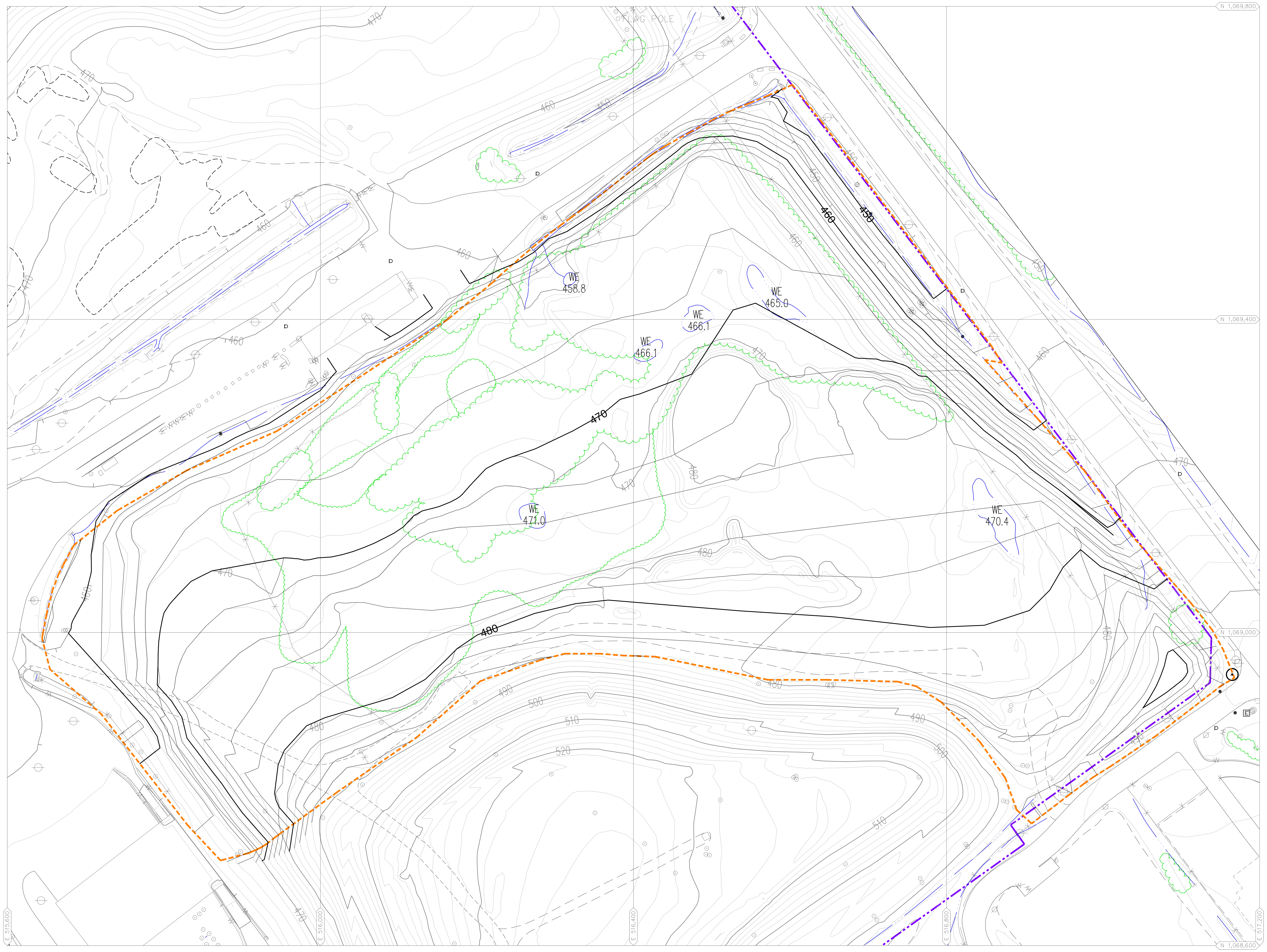
- EXISTING GRADE (2' CONTOUR)
- 500 EXISTING GRADE (10' CONTOUR)
- TOP OF WASTE (2' CONTOUR)
- 500 TOP OF WASTE (10' CONTOUR)
- PROPERTY BOUNDARY
- WASTE BOUNDARY



SCALE: 1" = 50'

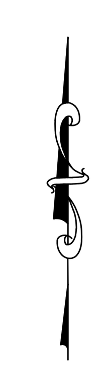
NOTE:
1.) AERIAL TOPOGRAPHY WAS PROVIDED BY SANBORN AND IS DATED FEBRUARY 19, 2009.
2.) THE 2009 AERIAL TOPOGRAPHY HAS BEEN MODIFIED TO REMOVE 19,729 CUBIC YARDS OF STOCKPILES FROM AREA I.

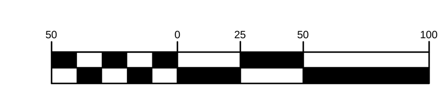
WEST LAKE LANDFILL OU-1 REMEDIAL DESIGN	WEST LAKE LANDFILL OU-1 RESPONDENTS	FEEZOR ENGINEERING, INC. Engineering for a Better World	DATE: NOVEMBER 2010 DESIGNED BY: NAC APPROVED BY: DRF	DRAWING NO.:
AREA I GRADING VOLUME - OPTION 1			REV. 2 — 1/27/2011	003
PROJECT NUMBER: BT-005	FILE PATH: S:\Work Files\Projects\Bridgeton Landfill\BT-005 (OU-1 Final Cover Design)\Step 6 - Cut Minimization\Revised With Thicker Area 2 Cap\Drawings\BT-005 Waste Grading Option 1 - REV 1-19-11.dwg		REVISION — DATE	



LEGEND

	EXISTING GRADE (2' CONTOUR)
500	EXISTING GRADE (10' CONTOUR)
	TOP OF WASTE (2' CONTOUR)
500	TOP OF WASTE (10' CONTOUR)
	PROPERTY BOUNDARY
	WASTE BOUNDARY

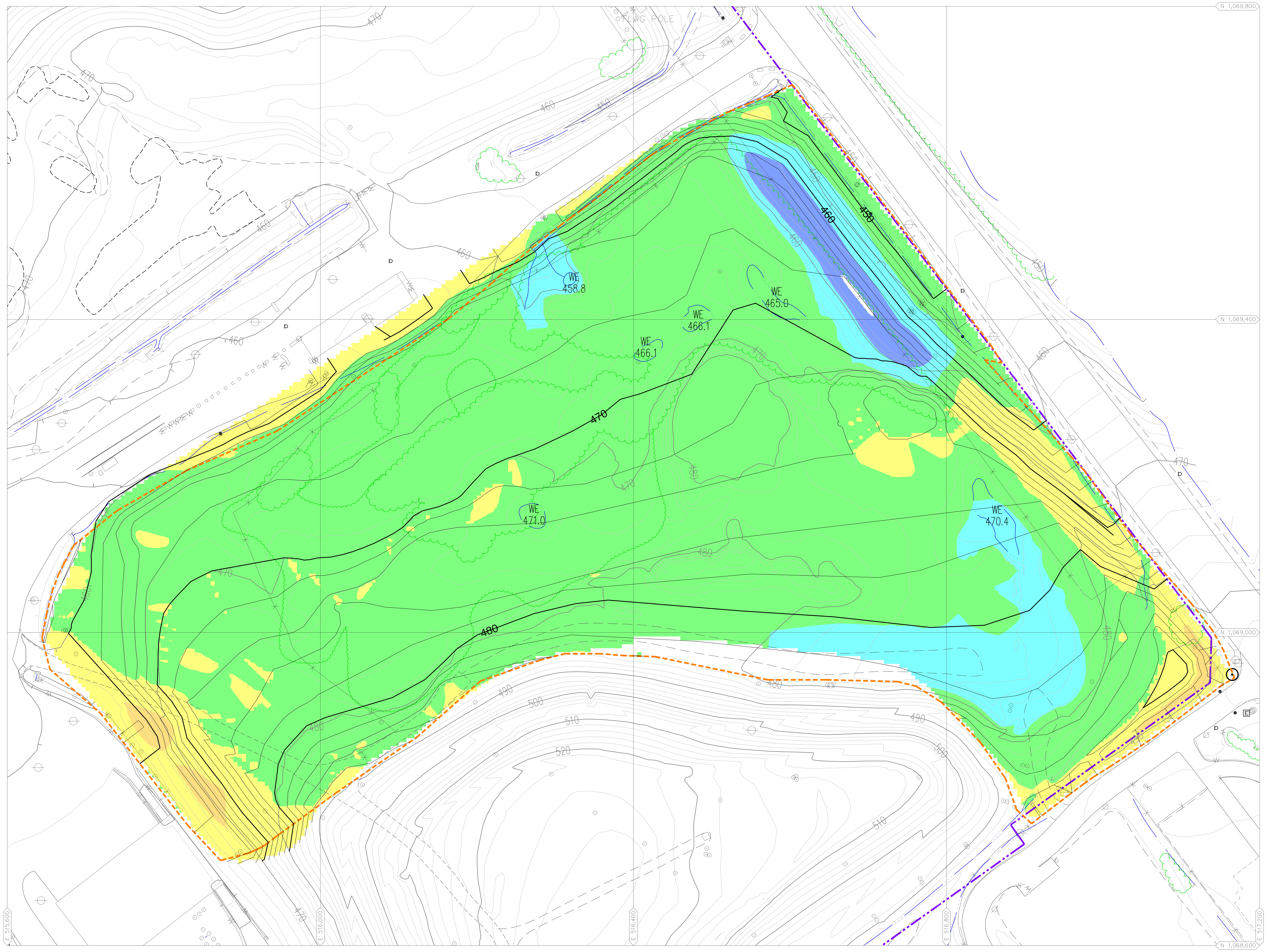




SCALE: 1" = 50'

NOTE:
1.) AERIAL TOPOGRAPHY WAS PROVIDED BY SANBORN AND IS DATED FEBRUARY 19, 2009.

WEST LAKE LANDFILL OU-1 REMEDIAL DESIGN	WEST LAKE LANDFILL OU-1 RESPONDENTS	Engineering for a Better World FEEZOR ENGINEERING, INC.	DATE: NOVEMBER 2010	DRAWING NO.: 004
			DESIGNED BY: NAC	
			APPROVED BY: DRF	
			REV. 2 / 1/27/2011	
AREA I TOP OF WASTE GRADING - OPTION 2			REVISION / DATE	
PROJECT NUMBER: BT-005	FILE PATH: S:\Work Files\Projects\Bridgeton Landfill\BT-005 (OU-1 Final Cover Design)\Step 6 - Cut Minimization\Revised With Thicker Area 2 Cap\Drawings\BT-005 Waste Grading Option 2 - REV 1-19-11.dwg			

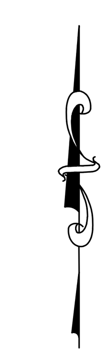


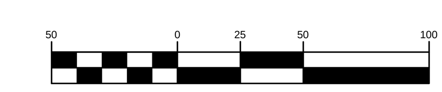
Cut/Fill Table			
Number	Minimum Cut/Fill	Maximum Cut/Fill	Color
1	-8	-5	
2	-5	0	
3	0	5	
4	5	10	
5	10	14	

CUT: 7,361 cubic yards
FILL: 55,918 cubic yards

LEGEND

- EXISTING GRADE (2' CONTOUR)
- 500 EXISTING GRADE (10' CONTOUR)
- TOP OF WASTE (2' CONTOUR)
- 500 TOP OF WASTE (10' CONTOUR)
- PROPERTY BOUNDARY
- WASTE BOUNDARY

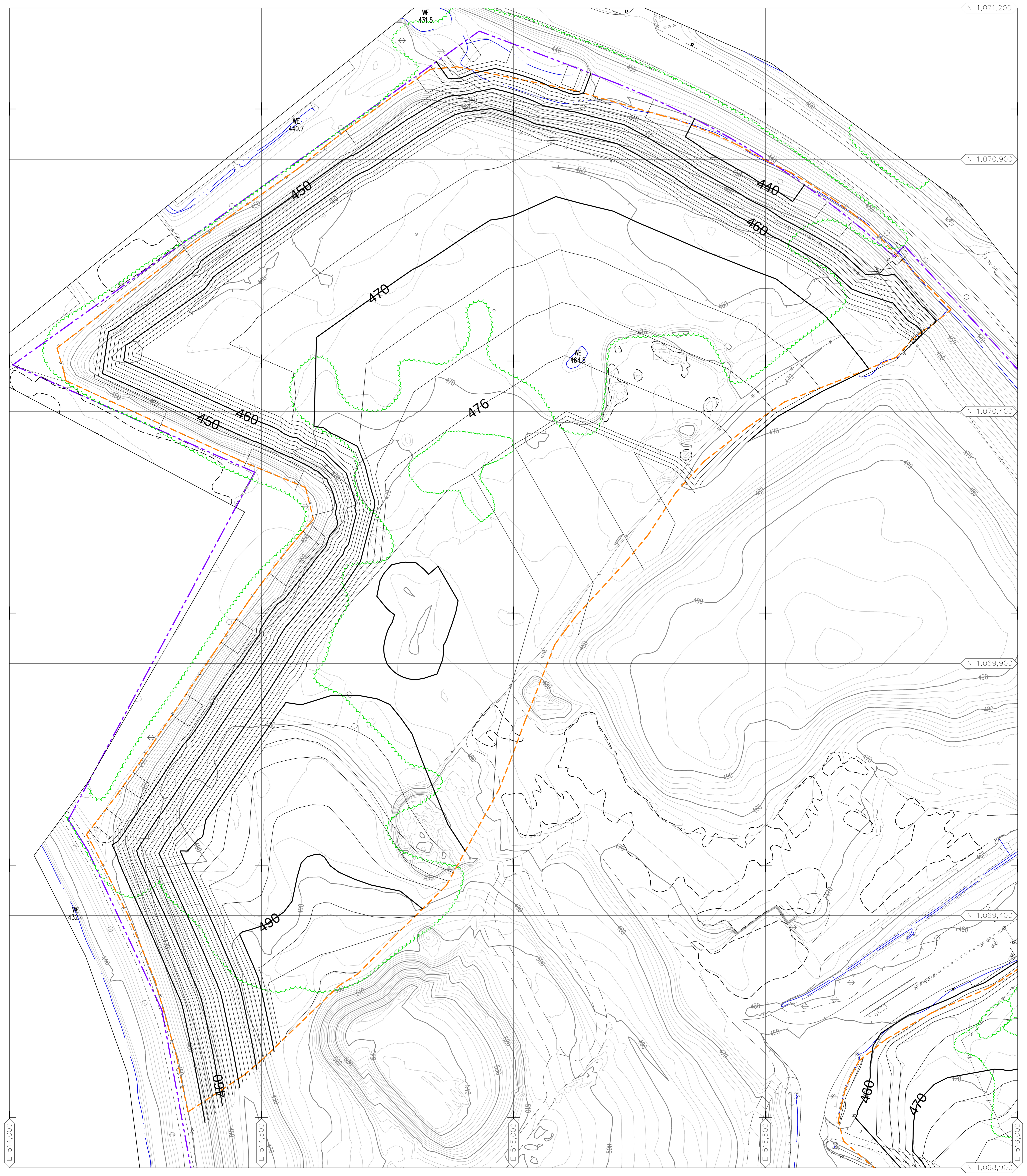




SCALE: 1" = 50'

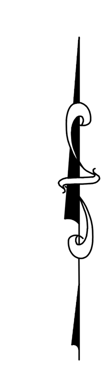
NOTE:
1.) AERIAL TOPOGRAPHY WAS PROVIDED BY SANBORN AND IS DATED FEBRUARY 19, 2009.
2.) THE 2009 AERIAL TOPOGRAPHY HAS BEEN MODIFIED TO REMOVE 19,729 CUBIC YARDS OF STOCKPILES FROM AREA I.

WEST LAKE LANDFILL OU-1 REMEDIAL DESIGN	WEST LAKE LANDFILL OU-1 RESPONDENTS	Engineering for a Better World FEEZOR ENGINEERING, INC.	DATE: NOVEMBER 2010 / DESIGNED BY: NAC / APPROVED BY: DRF	DRAWING NO.: 005
AREA I GRADING VOLUME - OPTION 2			REV. 2 — 1/27/2011	
PROJECT NUMBER: BT-005	FILE PATH: S:\Work Files\Projects\Bridgeton Landfill\BT-005 (OU-1 Final Cover Design)\Step 6 - Cut Minimization\Revised With Thicker Area 2 Cap\Drawings\BT-005 Waste Grading Option 2 - REV 1-19-11.dwg		REVISION — DATE	



LEGEND

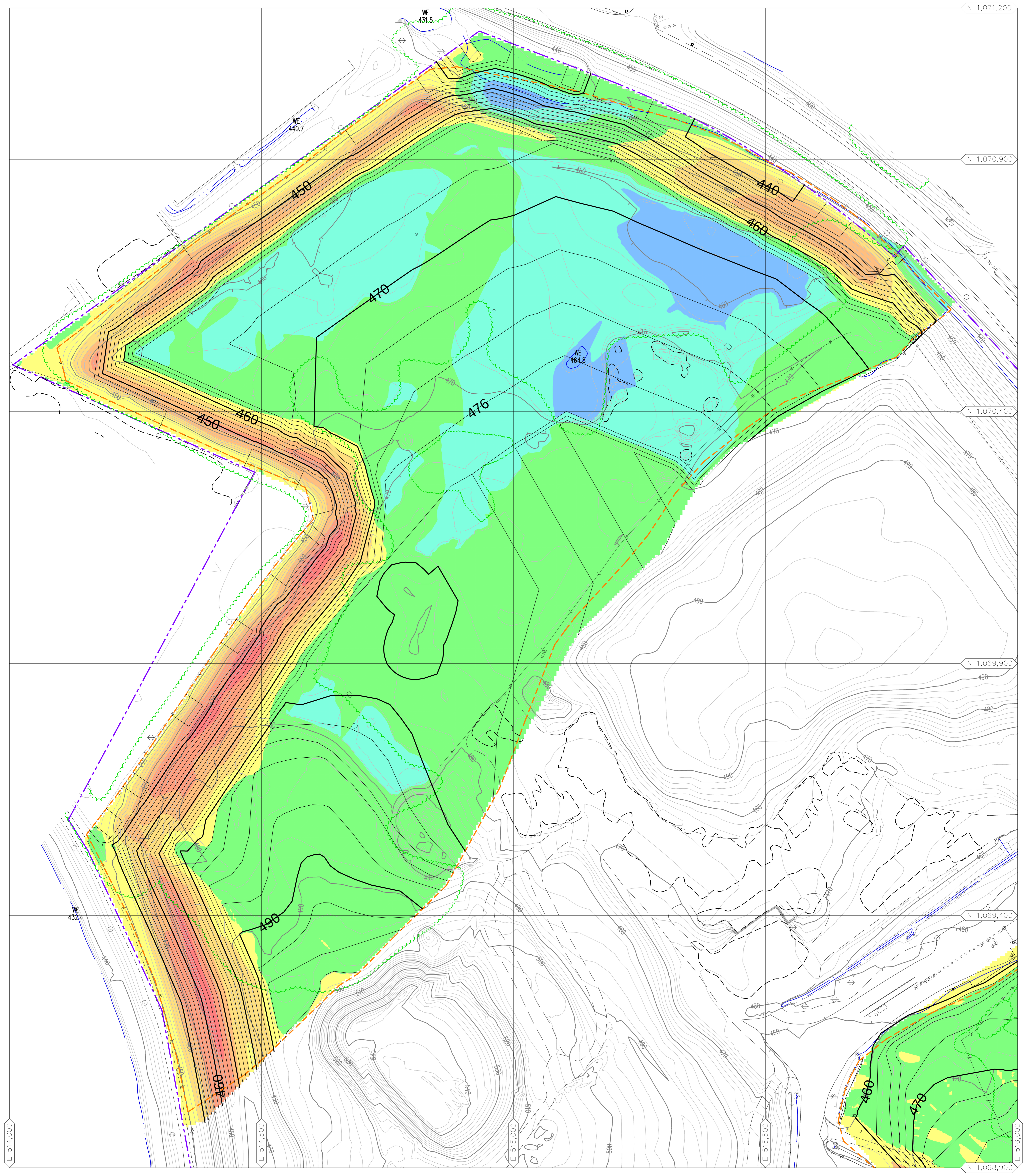
	EXISTING GRADE (2' CONTOUR)
500	EXISTING GRADE (10' CONTOUR)
	TOP OF WASTE (2' CONTOUR)
500	TOP OF WASTE (10' CONTOUR)
	PROPERTY BOUNDARY
	WASTE BOUNDARY



SCALE: 1" = 100'

NOTE:
1.) AERIAL TOPOGRAPHY WAS PROVIDED BY SANBORN AND IS DATED FEBRUARY 19, 2009.

WEST LAKE LANDFILL OU-1 REMEDIAL DESIGN	WEST LAKE LANDFILL OU-1 RESPONDENTS	FEEZOR ENGINEERING, INC. Engineering for a Better World	DATE: NOVEMBER 2010	DRAWING NO.:
			DESIGNED BY: NAC	006
			APPROVED BY: DRF	
			REV. 2 1/27/2011	
AREA II TOP OF WASTE GRADING - OPTION 1			REVISION / DATE	
PROJECT NUMBER: BT-005	FILE PATH: S:\Work Files\Projects\Bridgeton Landfill\BT-005 (OU-1 Final Cover Design)\Step 6 - Cut Minimization\Revised With Thicker Area 2 Cap\Drawings\BT-005 Waste Grading Option 1 - REV 1-19-11.dwg			



Cut/Fill Table			
Number	Minimum Cut/Fill	Maximum Cut/Fill	Color
1	-25	-20	
2	-20	-15	
3	-15	-10	
4	-10	-5	
5	-5	0	
6	0	5	
7	5	10	
8	10	14	

CUT: 147,916 cubic yards
FILL: 207,092 cubic yards

LEGEND

- EXISTING GRADE (2' CONTOUR)
- 500 EXISTING GRADE (10' CONTOUR)
- TOP OF WASTE (2' CONTOUR)
- 500 TOP OF WASTE (10' CONTOUR)
- PROPERTY BOUNDARY
- WASTE BOUNDARY

100 0 50 100 200

SCALE: 1" = 100'

NOTE:

1.) AERIAL TOPOGRAPHY WAS PROVIDED BY SANBORN AND IS DATED FEBRUARY 19, 2009.
2.) THE 2009 AERIAL TOPOGRAPHY HAS BEEN MODIFIED TO REMOVE 30,389 CUBIC YARDS OF STOCKPILES FROM AREA II.

WEST LAKE LANDFILL OU-1
REMEDIAL DESIGN

WEST LAKE LANDFILL OU-1
RESPONDENTS

AREA II GRADING VOLUME - OPTION 1

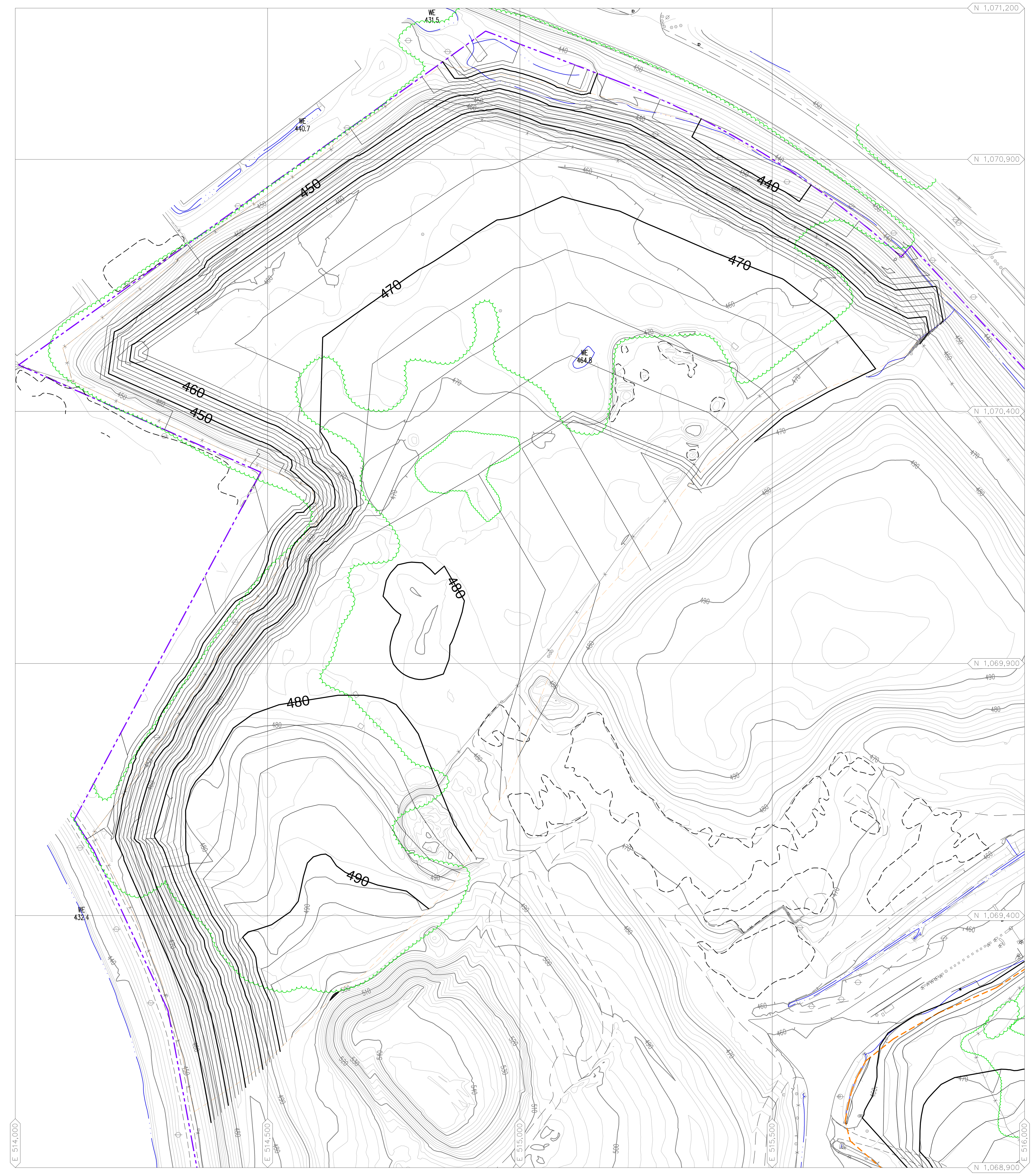
Engineering for a Better World
FEEZOR ENGINEERING, INC.

DATE: NOVEMBER 2010
DESIGNED BY: NAC
APPROVED BY: DRF

REVISION	DATE
REV. 2	1/27/2011

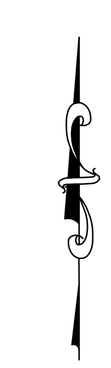
DRAWING NO.: 007

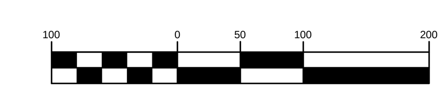
PROJECT NUMBER: BT-005 FILE PATH: S:\Work Files\Projects\Bridgeton Landfill\BT-005 (OU-1 Final Cover Design)\Step 6 - Cut Minimization\Revised With Thicker Area 2 Cap\Drawings\BT-005 Waste Grading Option 1 - REV 1-19-11.dwg



LEGEND

	EXISTING GRADE (2' CONTOUR)
500	EXISTING GRADE (10' CONTOUR)
	TOP OF WASTE (2' CONTOUR)
500	TOP OF WASTE (10' CONTOUR)
	PROPERTY BOUNDARY
	WASTE BOUNDARY

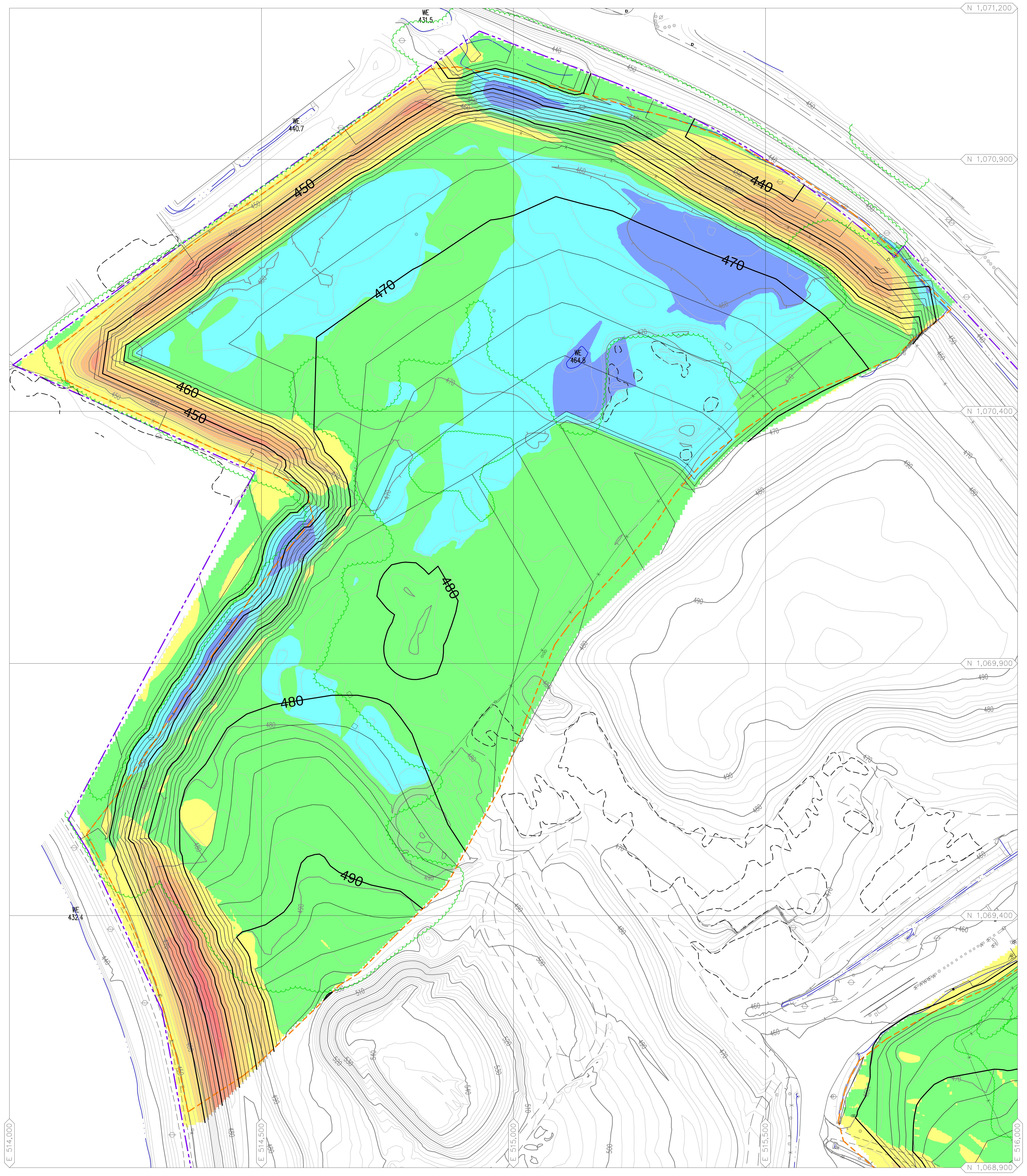




SCALE: 1" = 100'

NOTE:
1.) AERIAL TOPOGRAPHY WAS PROVIDED BY SANBORN AND IS DATED FEBRUARY 19, 2009.

WEST LAKE LANDFILL OU-1 REMEDIAL DESIGN	WEST LAKE LANDFILL OU-1 RESPONDENTS	Engineering for a Better World FEEZOR ENGINEERING, INC.	DATE: NOVEMBER 2010	DRAWING NO.:
			DESIGNED BY: NAC	008
			APPROVED BY: DRF	
AREA II TOP OF WASTE GRADING - OPTION 2			REV. 2 / 1/27/2011	
PROJECT NUMBER: BT-005	FILE PATH: S:\Work Files\Projects\Bridgeton Landfill\BT-005 (OU-1 Final Cover Design)\Step 6 - Cut Minimization\Revised With Thicker Area 2 Cap\Drawings\BT-005 Waste Grading Option 2 - REV 1-19-11.dwg		REVISION / DATE	



Cut/Fill Table			
Number	Minimum Cut/Fill	Maximum Cut/Fill	Color
1	-24	-20	
2	-20	-15	
3	-15	-10	
4	-10	-5	
5	-5	0	
6	0	5	
7	5	10	
8	10	17	

CUT: 91,853 cubic yards
FILL: 231,702 cubic yards

LEGEND

- EXISTING GRADE (2' CONTOUR)
- 500 EXISTING GRADE (10' CONTOUR)
- TOP OF WASTE (2' CONTOUR)
- 500 TOP OF WASTE (10' CONTOUR)
- PROPERTY BOUNDARY
- WASTE BOUNDARY

100 0 50 100 200

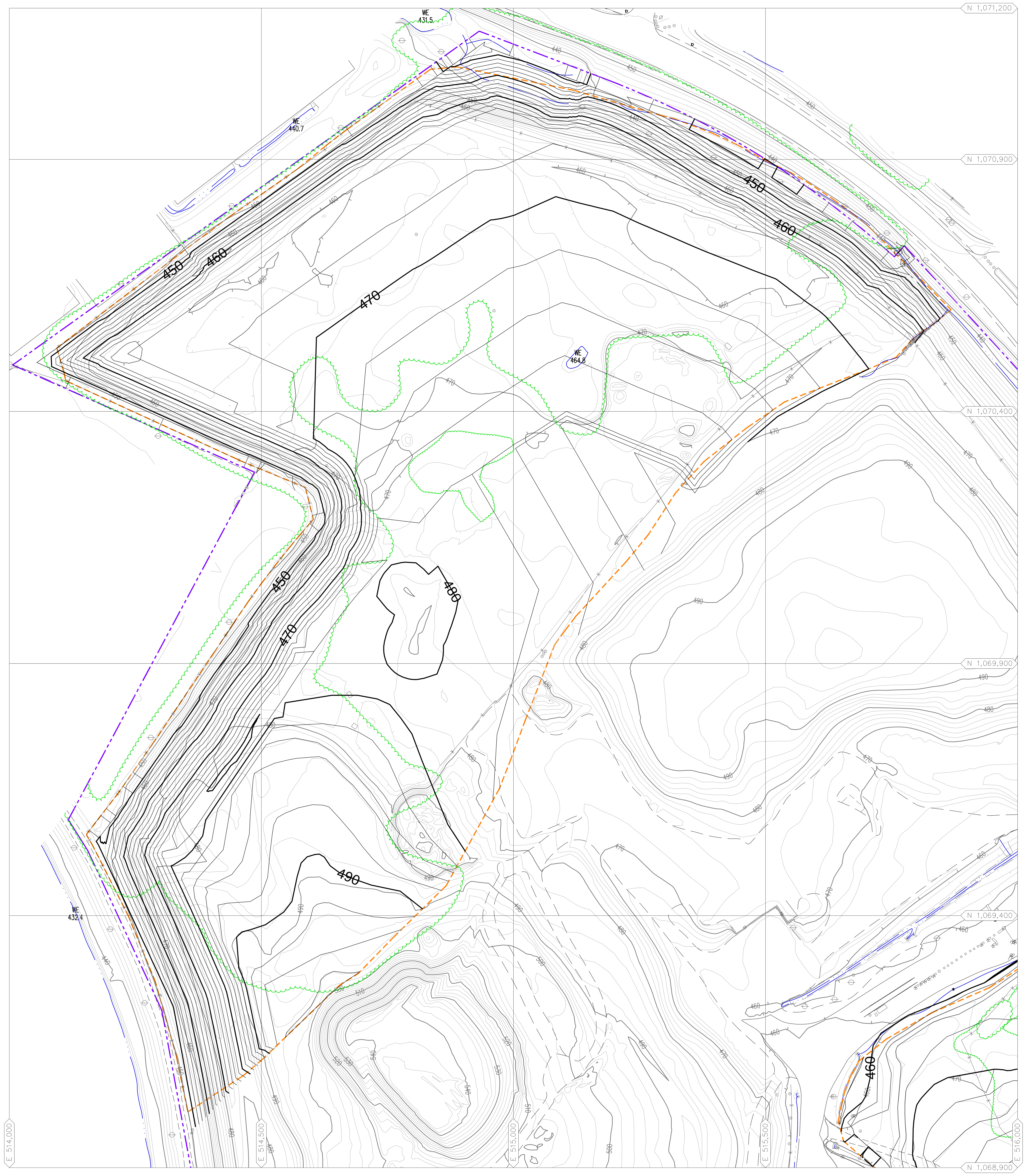
SCALE: 1" = 100'

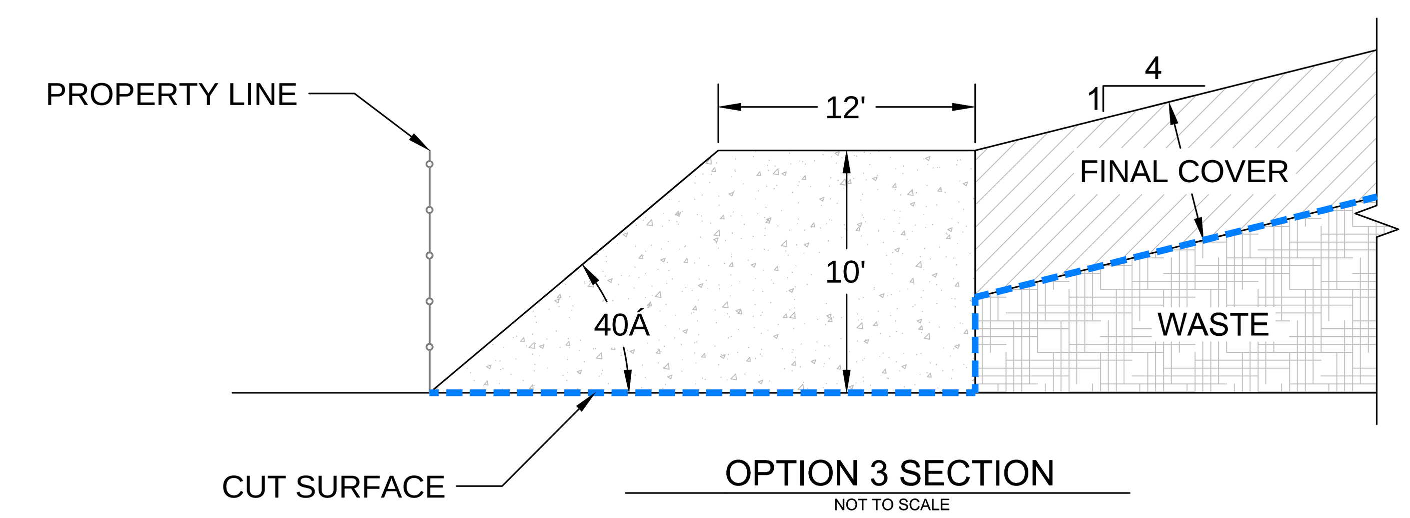
NOTE:

1.) AERIAL TOPOGRAPHY WAS PROVIDED BY SANBORN AND IS DATED FEBRUARY 19, 2009.

2.) THE 2009 AERIAL TOPOGRAPHY HAS BEEN MODIFIED TO REMOVE 30,389 CUBIC YARDS OF STOCKPILES FROM AREA II.

WEST LAKE LANDFILL OU-1 REMEDIAL DESIGN	WEST LAKE LANDFILL OU-1 RESPONDENTS	Engineering for a Better World FEEZOR ENGINEERING, INC.	DATE: NOVEMBER 2010	DRAWING NO.:
			DESIGNED BY: NAC	
			APPROVED BY: DRF	
AREA II GRADING VOLUME - OPTION 2			REV. 2 / 1/27/2011	**009**
PROJECT NUMBER: BT-005	FILE PATH: S:\Work Files\Projects\Bridgeton Landfill\BT-005 (OU-1 Final Cover Design)\Step 6 - Cut Minimization\Revised With Thicker Area 2 Cap\Drawings\BT-005 Waste Grading Option 2 - REV 1-19-11.dwg		REVISION / DATE	

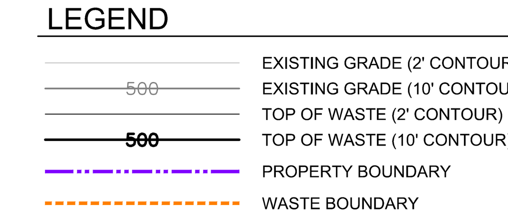


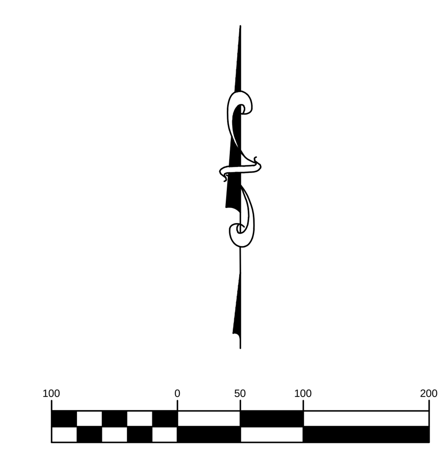


OPTION 3 SECTION

NOT TO SCALE

LEGEND

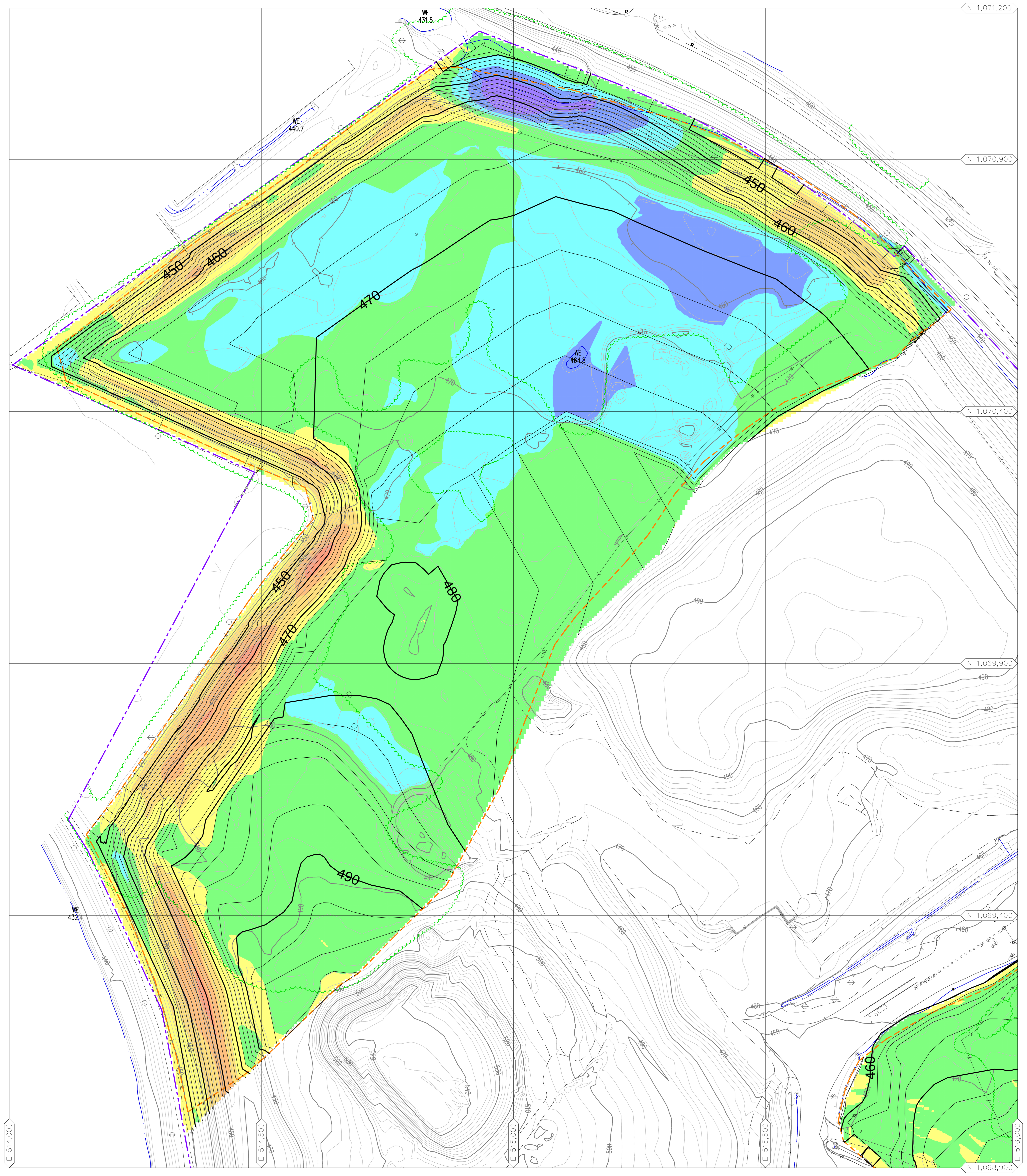


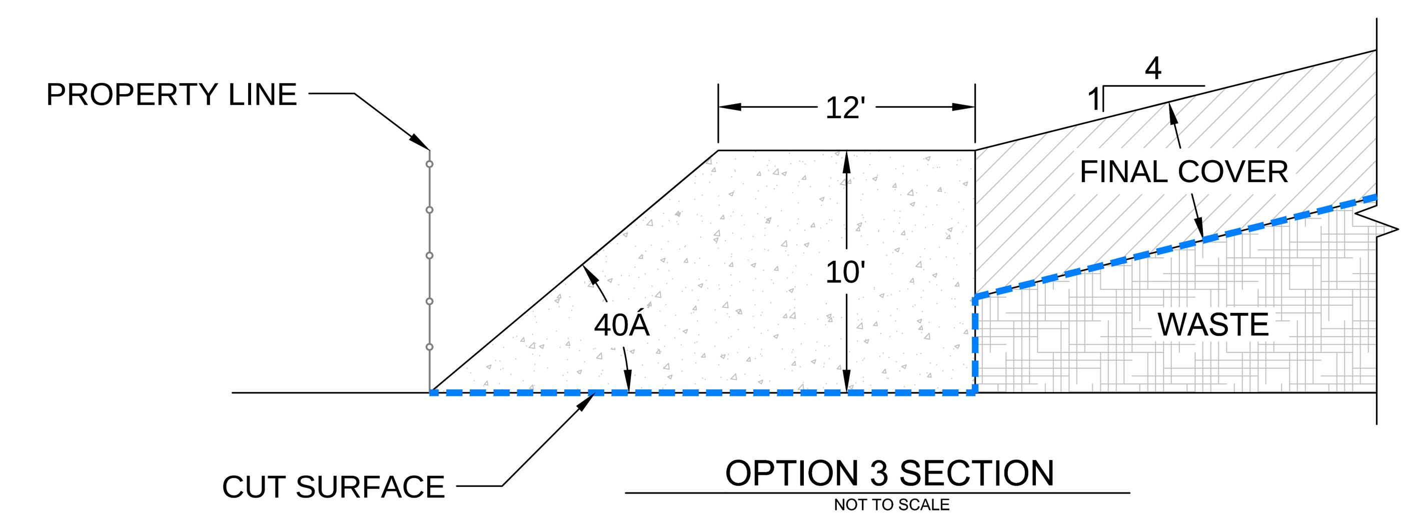


SCALE: 1" = 100'

NOTE:
1.) AERIAL TOPOGRAPHY WAS PROVIDED BY SANBORN AND IS DATED FEBRUARY 19, 2009.

WEST LAKE LANDFILL OU-1 REMEDIAL DESIGN	WEST LAKE LANDFILL OU-1 RESPONDENTS	DATE: FEBRUARY 2011 DESIGNED BY: DMK APPROVED BY: DRF REV. 3 2/5/2011	DRAWING NO.: **010**
AREA II TOP OF WASTE GRADING - OPTION 3	FEEZOR ENGINEERING, INC. Engineering for a Better World	REVISION / DATE	
PROJECT NUMBER: BT-005	FILE PATH: S:\Work Files\Projects\Bridgeton Landfill\BT-005 (OU-1 Final Cover Design)\Step 6 - Cut Minimization\Revised With Thicker Area 2 Cap\Drawings\BT-005 Waste Grading Option 3 - REV 2-05-11.dwg		





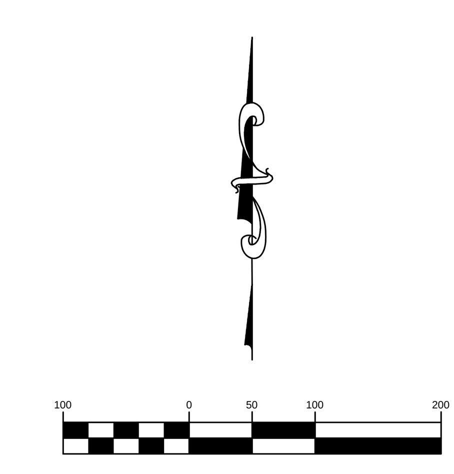
OPTION 3 SECTION
NOT TO SCALE

Cut/Fill Table			
Number	Minimum Cut/Fill	Maximum Cut/Fill	Color
1	-19	-15	
2	-15	-10	
3	-10	-5	
4	-5	0	
5	0	5	
6	5	10	
7	10	15	
8	15	21	

CUT: 66,493 cubic yards
FILL: 230,251 cubic yards

LEGEND

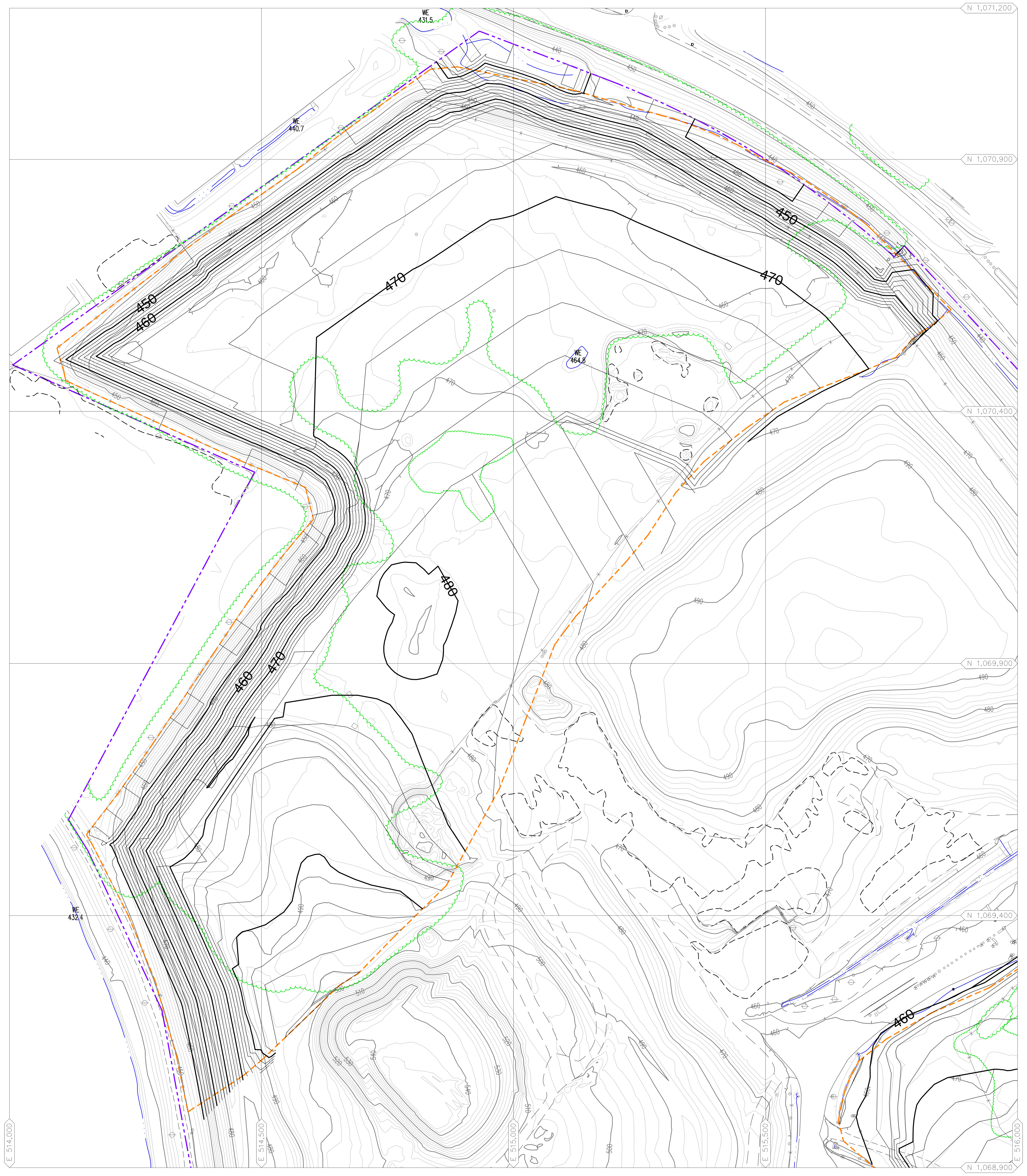
EXISTING GRADE (2' CONTOUR)
500 EXISTING GRADE (10' CONTOUR)
TOP OF WASTE (2' CONTOUR)
500 TOP OF WASTE (10' CONTOUR)
PROPERTY BOUNDARY
WASTE BOUNDARY

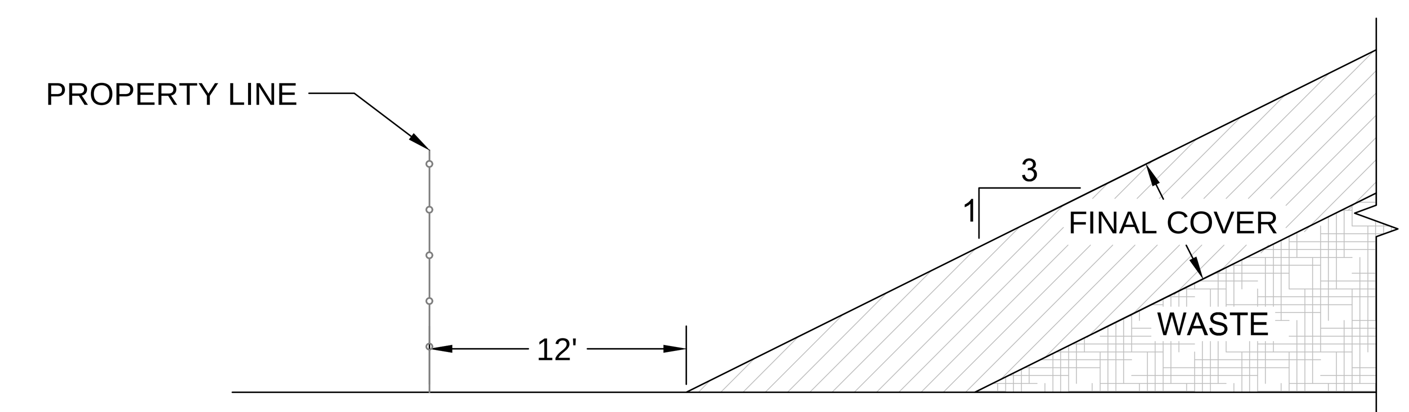


NOTE:
1.) AERIAL TOPOGRAPHY WAS PROVIDED BY SANBORN AND IS DATED FEBRUARY 19, 2009.

WEST LAKE LANDFILL OU-1 REMEDIAL DESIGN	WEST LAKE LANDFILL OU-1 RESPONDENTS	Engineering for a Better World FEEZOR ENGINEERING, INC.	DATE: FEBRUARY 2011	DRAWING NO.: 011
			DESIGNED BY: DMK	
			APPROVED BY: DRF	
			REV. 3 — 2/5/2011	
AREA II GRADING VOLUME - OPTION 3			REVISION — DATE	

PROJECT NUMBER: BT-005 FILE PATH: S:\Work Files\Projects\Bridgeton Landfill\BT-005 (OU-1 Final Cover Design)\Step 6 - Cut Minimization\Revised With Thicker Area 2 Cap\Drawings\BT-005 Waste Grading Option 3 - REV 2-05-11.dwg





OPTION 4 SECTION

NOT TO SCALE

LEGEND

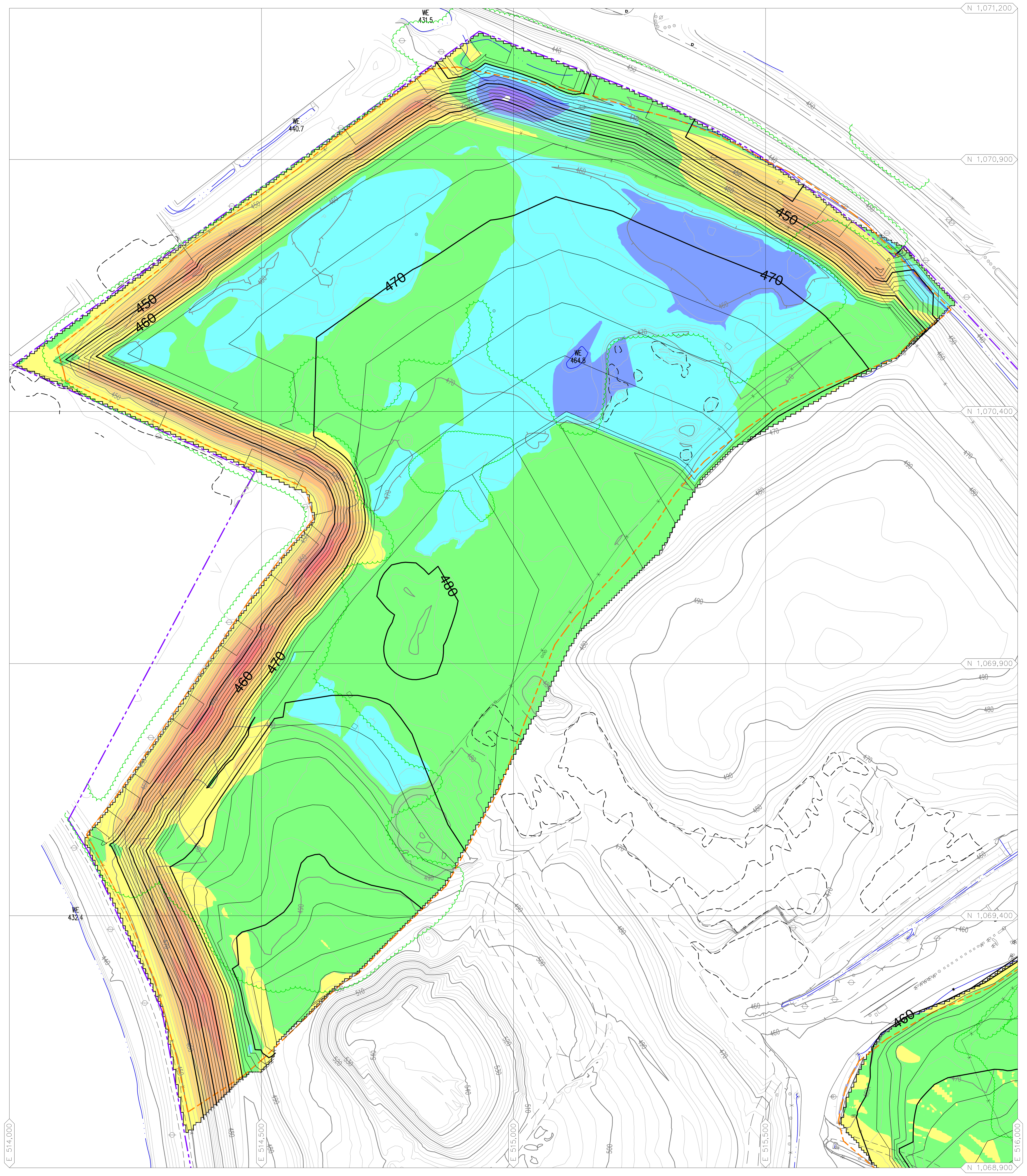
- EXISTING GRADE (2' CONTOUR)
- 500 EXISTING GRADE (10' CONTOUR)
- TOP OF WASTE (2' CONTOUR)
- 500 TOP OF WASTE (10' CONTOUR)
- PROPERTY BOUNDARY
- WASTE BOUNDARY

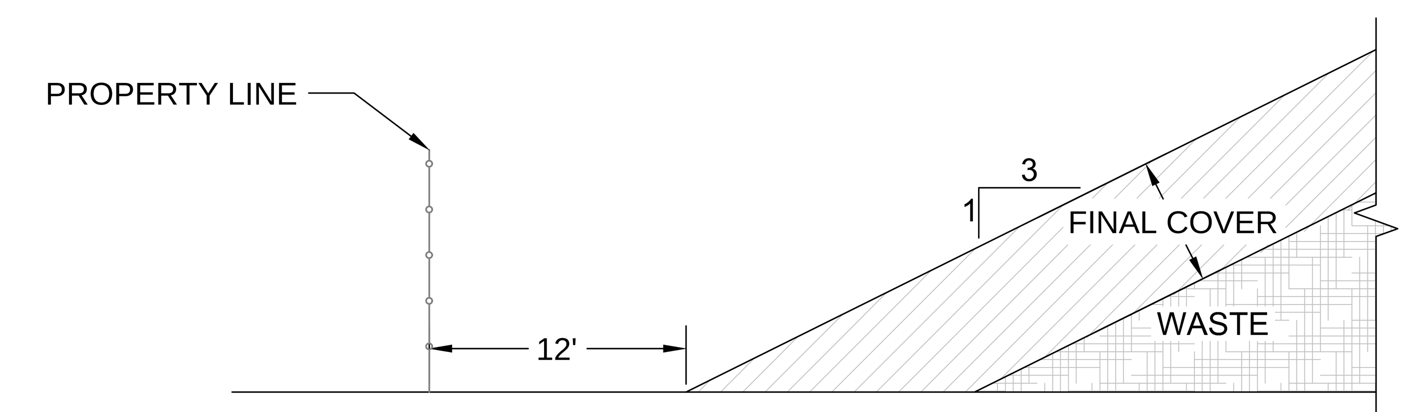
SCALE: 1" = 100'

NOTE:

1.) AERIAL TOPOGRAPHY WAS PROVIDED BY SANBORN AND IS DATED FEBRUARY 19, 2009.

WEST LAKE LANDFILL OU-1 REMEDIAL DESIGN	WEST LAKE LANDFILL OU-1 RESPONDENTS	FEEZOR ENGINEERING, INC. Engineering for a Better World	DATE: NOVEMBER 2010	DRAWING NO.: 012
			DESIGNED BY: DMK	
			APPROVED BY: DRF	
			REV. 2 — 1/27/2011	
AREA II TOP OF WASTE GRADING - OPTION 4			REVISION — DATE	
PROJECT NUMBER: BT-005	FILE PATH: S:\Work Files\Projects\Bridgeton Landfill\BT-005 (OU-1 Final Cover Design)\Step 6 - Cut Minimization\Revised With Thicker Area 2 Cap\Drawings\BT-005 Waste Grading Option 4 - REV 1-22-11.dwg			





OPTION 4 SECTION

NOT TO SCALE

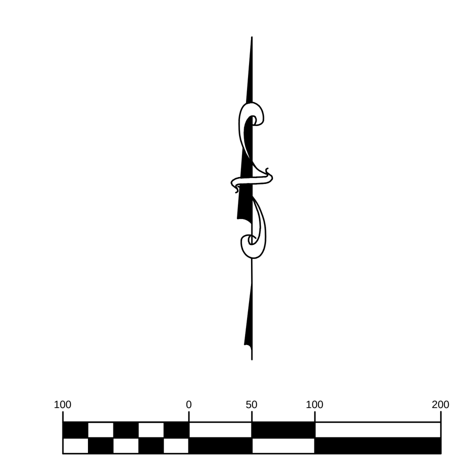
Cut/Fill Table

Number	Minimum Cut/Fill	Maximum Cut/Fill	Color
1	-24	-20	
2	-20	-15	
3	-15	-10	
4	-10	-5	
5	-5	0	
6	0	5	
7	5	10	
8	10	15	
9	15	18	

CUT: 107,446 cubic yards
FILL: 220,109 cubic yards

LEGEND

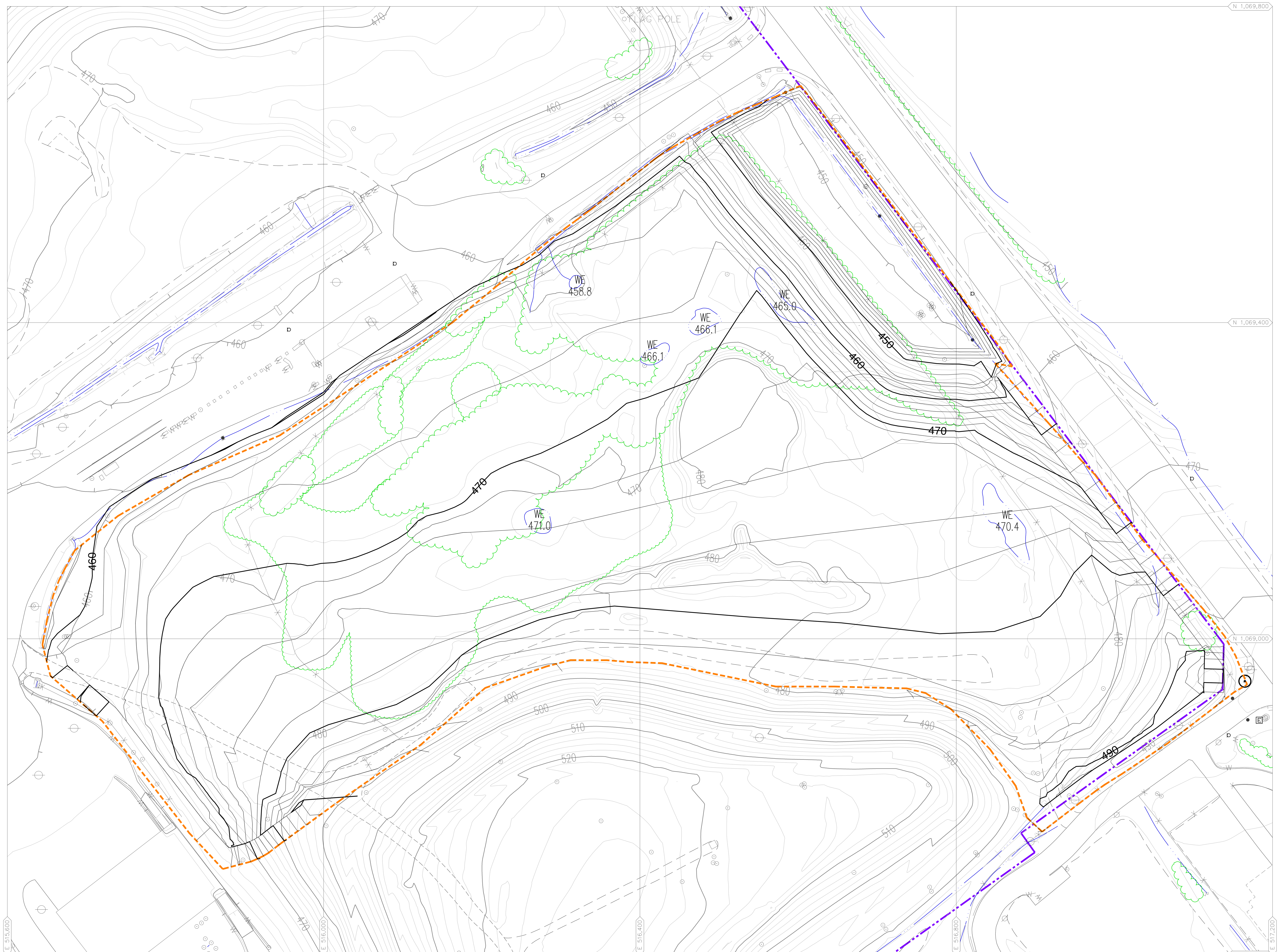
- EXISTING GRADE (2' CONTOUR)
- 500 EXISTING GRADE (10' CONTOUR)
- TOP OF WASTE (2' CONTOUR)
- 500 TOP OF WASTE (10' CONTOUR)
- PROPERTY BOUNDARY
- WASTE BOUNDARY

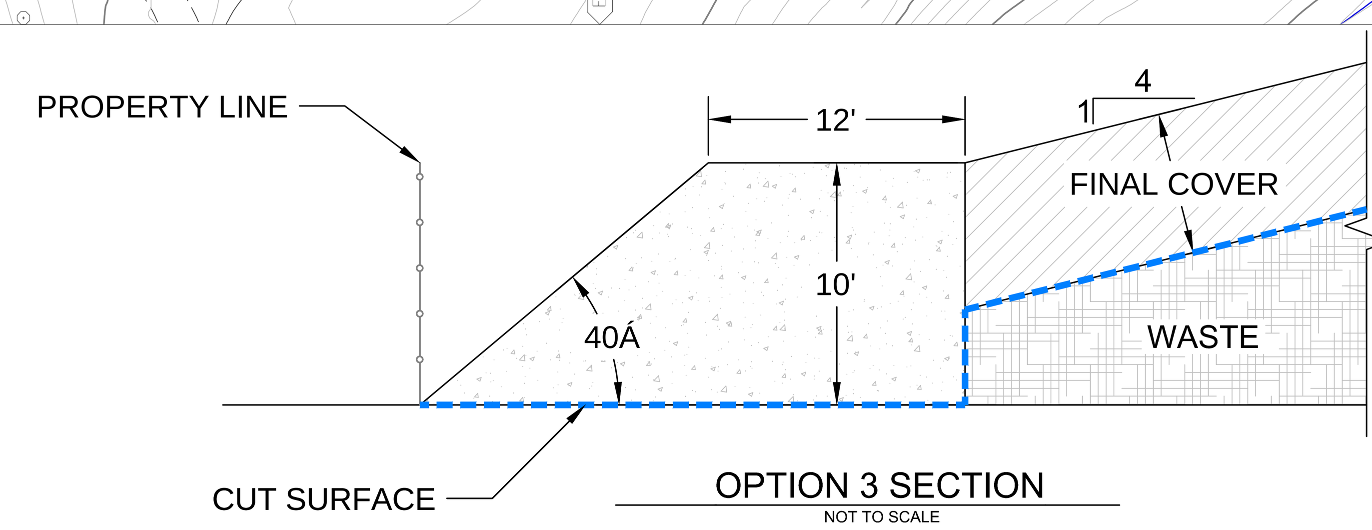


SCALE: 1" = 100'

NOTE:
1.) AERIAL TOPOGRAPHY WAS PROVIDED BY SANBORN AND IS DATED FEBRUARY 19, 2009.

WEST LAKE LANDFILL OU-1 REMEDIAL DESIGN	WEST LAKE LANDFILL OU-1 RESPONDENTS	Engineering for a Better World FEEZOR ENGINEERING, INC.	DATE: NOVEMBER 2010 DESIGNED BY: DMK APPROVED BY: DRF REV. 2 1/27/2011 REVISION DATE
AREA II GRADING VOLUME - OPTION 4			DRAWING NO.: 013
PROJECT NUMBER: BT-005	FILE PATH: S:\Work Files\Projects\Bridgeton Landfill\BT-005 (OU-1 Final Cover Design)\Step 6 - Cut Minimization\Revised With Thicker Area 2 Cap\Drawings\BT-005 Waste Grading Option 4 - REV 1-22-11.dwg		





OPTION 3 SECTION

NOT TO SCALE

LEGEND

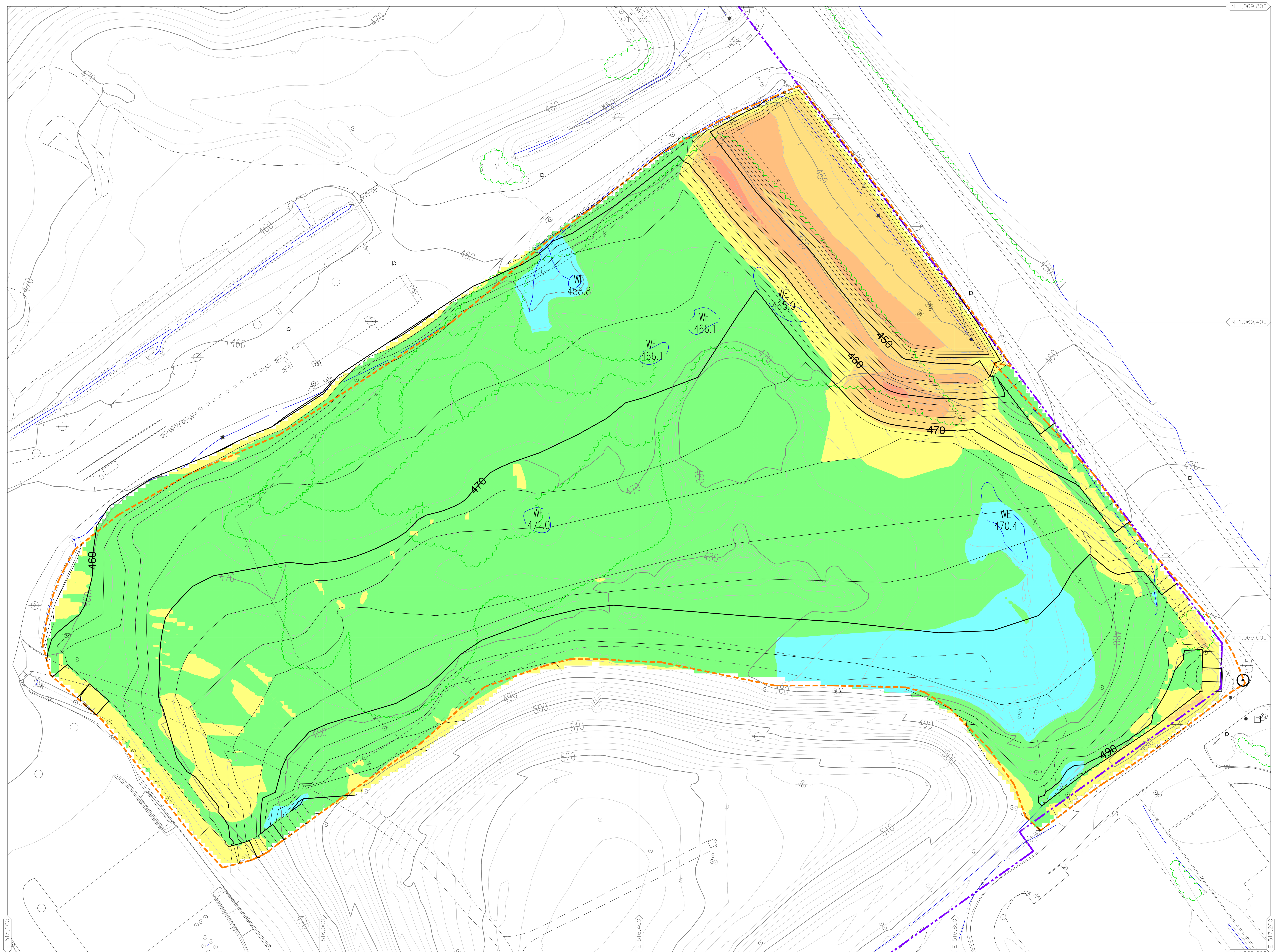
- EXISTING GRADE (2' CONTOUR)
- EXISTING GRADE (10' CONTOUR)
- TOP OF WASTE (2' CONTOUR)
- TOP OF WASTE (10' CONTOUR)
- PROPERTY BOUNDARY
- WASTE BOUNDARY

SCALE: 1" = 50'

NOTE:

1.) AERIAL TOPOGRAPHY WAS PROVIDED BY SANBORN AND IS DATED FEBRUARY 19, 2009.

WEST LAKE LANDFILL OU-1 REMEDIAL DESIGN	WEST LAKE LANDFILL OU-1 RESPONDENTS	DATE: FEBRUARY 2011	DRAWING NO.: 014
		DESIGNED BY: DMK	
		APPROVED BY: DRF	
AREA I TOP OF WASTE GRADING - OPTION 3	FEEZOR ENGINEERING, INC. Engineering for a Better World	REV. 3 / 2/5/2011	
PROJECT NUMBER: BT-005	FILE PATH: S:\Work Files\Projects\Bridgeton Landfill\BT-005 (OU-1 Final Cover Design)\Step 6 - Cut Minimization\Revised With Thicker Area 2 Cap\Drawings\BT-005 Waste Grading Option 3 - REV 2-05-11.dwg	REVISION / DATE	

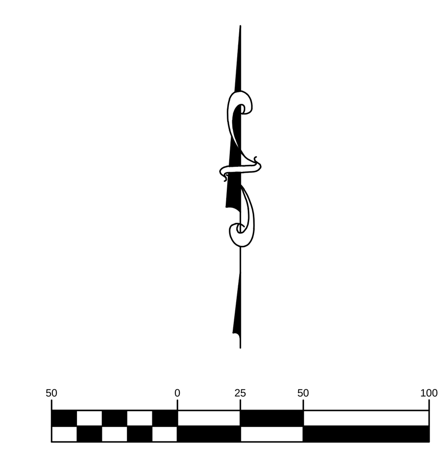


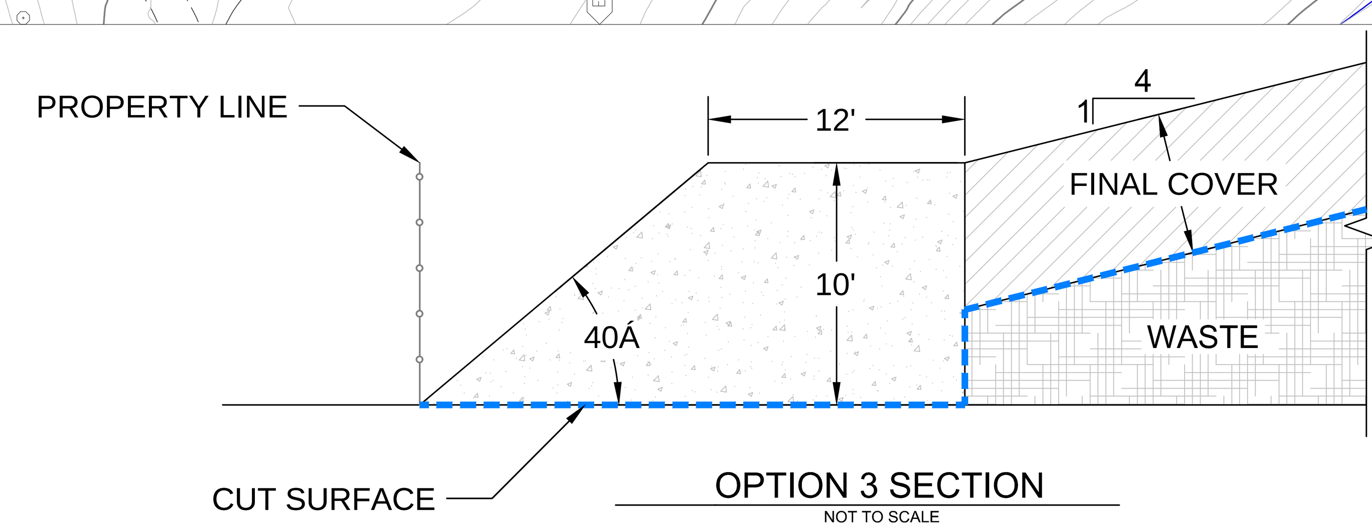
Cut/Fill Table			
Number	Minimum Cut/Fill	Maximum Cut/Fill	Color
1	-17	-15	
2	-15	-10	
3	-10	-5	
4	-5	0	
5	0	5	
6	5	9	

CUT: 29,744 cubic yards
FILL: 44,269 cubic yards

LEGEND

- EXISTING GRADE (2' CONTOUR)
- 500 EXISTING GRADE (10' CONTOUR)
- TOP OF WASTE (2' CONTOUR)
- 500 TOP OF WASTE (10' CONTOUR)
- PROPERTY BOUNDARY
- WASTE BOUNDARY





OPTION 3 SECTION
NOT TO SCALE

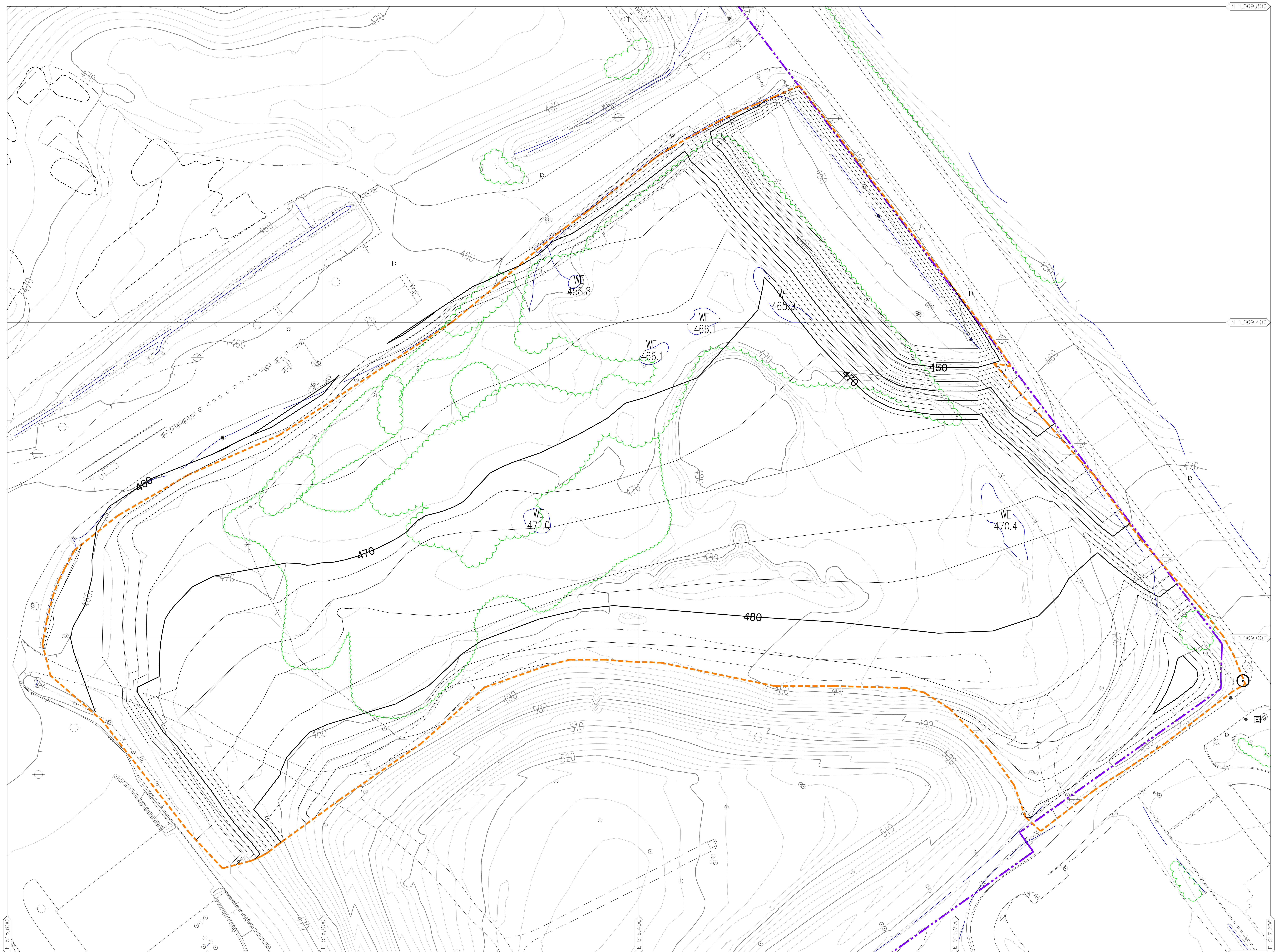
NOTE:
1.) AERIAL TOPOGRAPHY WAS PROVIDED BY SANBORN AND IS DATED FEBRUARY 19, 2009.

WEST LAKE LANDFILL OU-1 REMEDIAL DESIGN	WEST LAKE LANDFILL OU-1 RESPONDENTS	FEEZOR ENGINEERING, INC. Engineering for a Better World	DATE: FEBRUARY 2011 DESIGNED BY: DMK APPROVED BY: DRF
AREA I GRADING VOLUME - OPTION 3			

REVISION	DATE
REV. 3	2/5/2011

DRAWING NO.: **015**

PROJECT NUMBER: BT-005 FILE PATH: S:\Work Files\Projects\Bridgeton Landfill\BT-005 (OU-1 Final Cover Design)\Step 6 - Cut Minimization\Revised With Thicker Area 2 Cap\Drawings\BT-005 Waste Grading Option 3 - REV 2-05-11.dwg

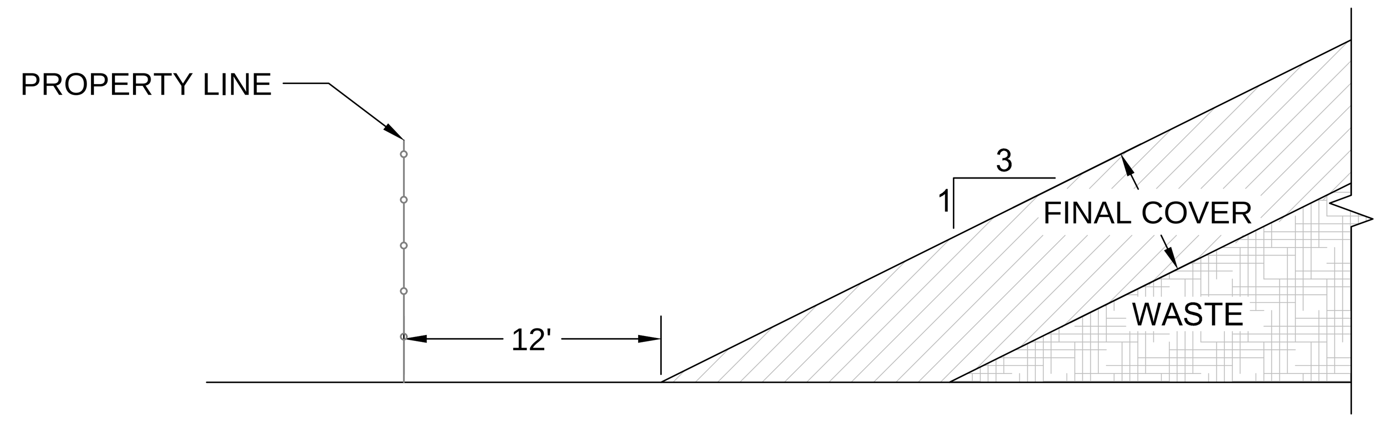


LEGEND

	EXISTING GRADE (2' CONTOUR)
500	EXISTING GRADE (10' CONTOUR)
	TOP OF WASTE (2' CONTOUR)
500	TOP OF WASTE (10' CONTOUR)
	PROPERTY BOUNDARY
	WASTE BOUNDARY

100 0 50 100 200

SCALE: 1" = 100'



OPTION 4 SECTION

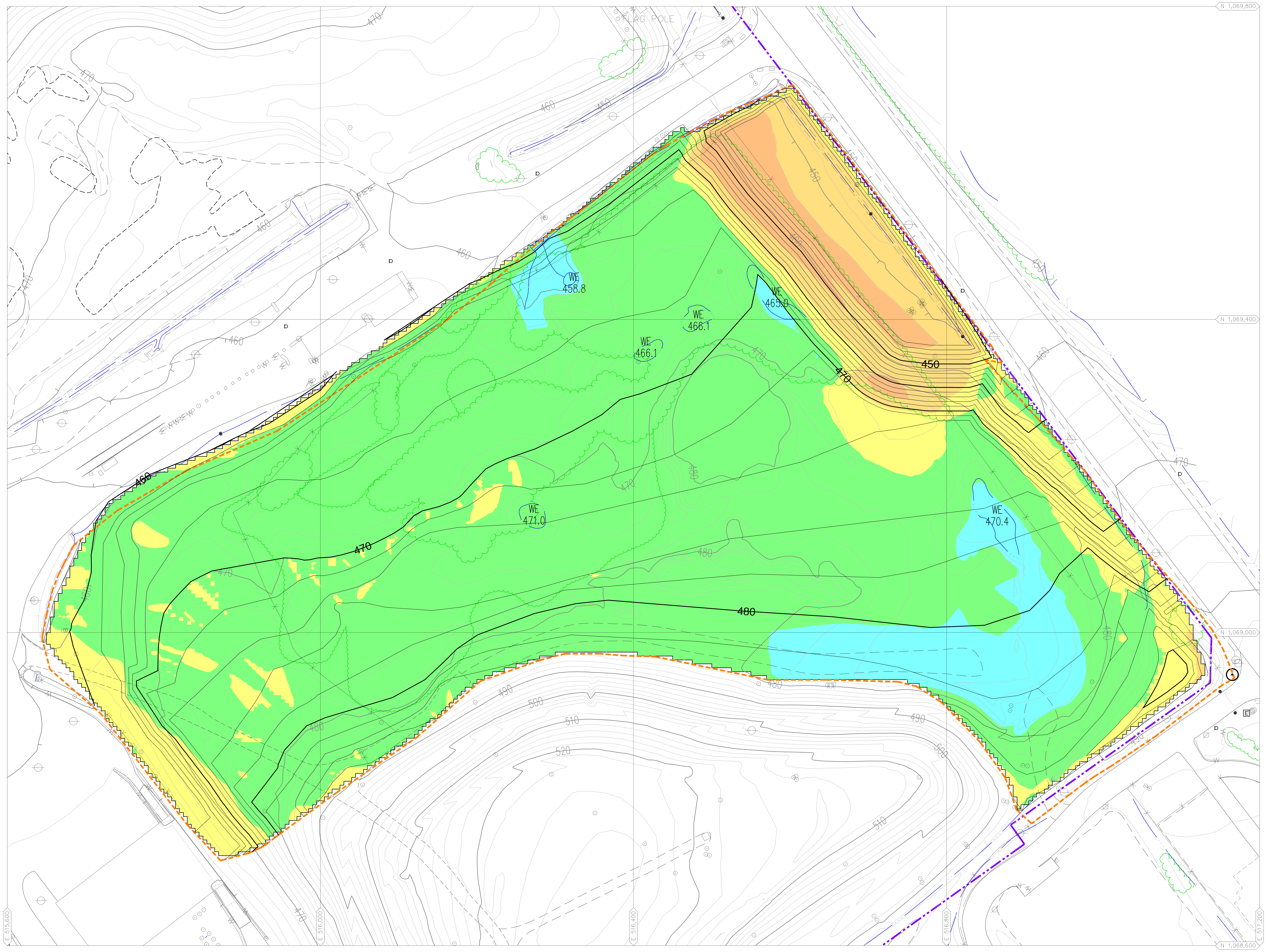
NOT TO SCALE

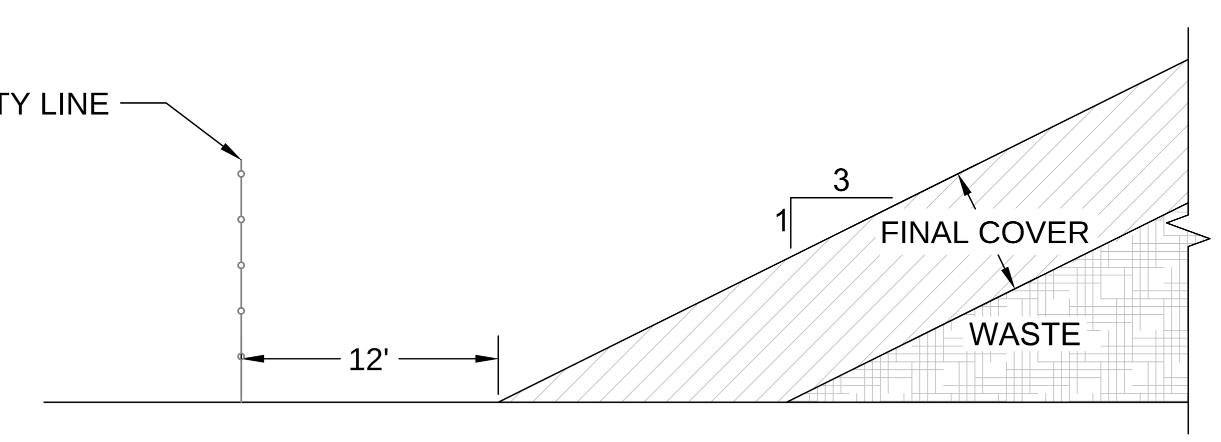
NOTE:
1.) AERIAL TOPOGRAPHY WAS PROVIDED BY SANBORN AND IS DATED FEBRUARY 19, 2009.

WEST LAKE LANDFILL OU-1 REMEDIAL DESIGN	WEST LAKE LANDFILL OU-1 RESPONDENTS	FEEZOR ENGINEERING, INC. Engineering for a Better World	DATE: JANUARY 2011	DRAWING NO.: 016
			DESIGNED BY: DMK	
			APPROVED BY: DRF	
			REV. 2 / 1/27/2011	

AREA I TOP OF WASTE GRADING - OPTION 4

PROJECT NUMBER: BT-005 | FILE PATH: S:\Work Files\Projects\Bridgeton Landfill\BT-005 (OU-1 Final Cover Design)\Step 6 - Cut Minimization\Revised With Thicker Area 2 Cap\Drawings\BT-005 Waste Grading Option 4 - REV 1-22-11.dwg | REVISION | DATE





OPTION 4 SECTION

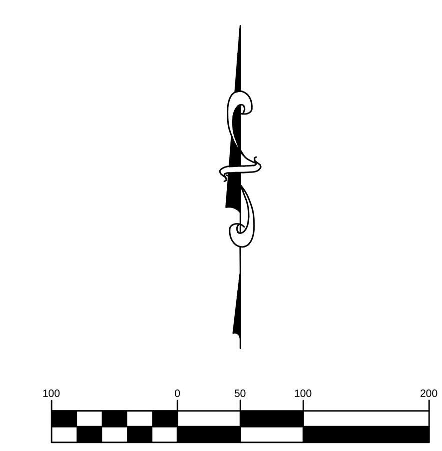
NOT TO SCALE

Cut/Fill Table			
Number	Minimum Cut/Fill	Maximum Cut/Fill	Color
1	-14	-10	
2	-10	-5	
3	-5	0	
4	0	5	
5	5	9	

CUT: 26,102 cubic yards
FILL: 43,218 cubic yards

LEGEND

- EXISTING GRADE (2' CONTOUR)
- 500 EXISTING GRADE (10' CONTOUR)
- TOP OF WASTE (2' CONTOUR)
- 500 TOP OF WASTE (10' CONTOUR)
- PROPERTY BOUNDARY
- WASTE BOUNDARY



SCALE: 1" = 100'

NOTE:
1.) AERIAL TOPOGRAPHY WAS PROVIDED BY SANBORN AND IS DATED FEBRUARY 19, 2009.

WEST LAKE LANDFILL OU-1 REMEDIAL DESIGN	WEST LAKE LANDFILL OU-1 RESPONDENTS	DATE: JANUARY 2011	DRAWING NO.:
		DESIGNED BY: DMK	
		APPROVED BY: DRF	
		REV. 2 — 1/27/2011	017
AREA I GRADING VOLUME - OPTION 4	Engineering for a Better World FEEZOR ENGINEERING, INC.	REVISION — DATE	
PROJECT NUMBER: BT-005	FILE PATH: S:\Work Files\Projects\Bridgeton Landfill\BT-005 (OU-1 Final Cover Design)\Step 6 - Cut Minimization\Revised With Thicker Area 2 Cap\Drawings\BT-005 Waste Grading Option 4 - REV 1-22-11.dwg		

APPENDIX F

Cover Thickness Calculations

COVER THICKNESS CALCULATIONS

For the

Supplemental Feasibility Study

Radiological-Impacted Material Excavation Alternatives Analysis West Lake Landfill Operable Unit-1

Prepared for
The United States Environmental Protection Agency Region VII

Prepared on behalf of
The West Lake Landfill OU-1 Respondents

Prepared by:
Auxier & Associates, Inc.
9821 Cogdill Road, Suite 1
Knoxville, Tennessee 37932
(865) 675-3669
www.auxier.com

December 13, 2011

TABLE OF CONTENTS

SECTION **PAGE**

LIST OF TABLES

SECTION **PAGE**

LIST OF FIGURES

SECTION **PAGE**

1 DETERMINATION OF COVER THICKNESS

Two of the alternatives evaluated in this SFS involve containing RIM beneath enhanced cover designs. The thickness of these covers would be constrained, in part, by two regulations. The final cover system designs should:

1. consider the requirements of the Missouri Department of Natural Resources (MDNR) Solid Waste Regulations (10 CSR 80-3.010) to the extent that such additional requirements do not compromise or diminish the performance of appropriate components of the Uranium Mill Tailings Radiation Control Act (UMTRCA) regulations, and
2. provide assurance that the design will limit radon emissions consistent with the standards set forth in 40 CFR 192 - "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings," as required by the UMTRCA.
3. provide assurance that level of gamma radiation shall not exceed the background level by more than 20 microroentgens per hour as set forth in 40 CFR 192 - "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings,"

The analysis described in this Appendix first identified the minimum thickness required to satisfy the MDNR Solid Waste regulations. Computer simulations were then performed to determine if these prescriptive designs met the UMTRCA design requirements. The thickness of the component layers that would make up the proposed final cover system configurations over Radiological Areas 1 and 2 for the ROD remedy and the final cover configuration for the cover of the new cell for the "Complete RAD Removal" with on-site disposal alternative are summarized in Table 1-1. The bases for these values are presented in the remainder of this Appendix.

1.1 MDNR DESIGN REQUIREMENTS FOR LANDFILL COVERS

The MDNR Solid Waste regulations published in 10 CSR 80-3.010(17)(C)(4) are ARARs:

10 CSR 80-3.010(17)(C)(4)(A) requires the final cover of existing sanitary landfills without composite liners include two feet (2') of compacted clay with a coefficient of permeability of 1×10^{-5} cm/sec or less and overlaid by at least one foot (1') of soil capable of sustaining vegetative growth.

10 CSR 80-3.010(17)(C)(4)(B) requires existing sanitary landfills with a composite liner to include a geomembrane liner, one foot (1') of compacted clay with a coefficient of permeability of 1×10^{-5} cm/sec or less, a drainage layer, and two feet (2') of soil capable of sustaining vegetative growth in their final cover.

Areas 1 and 2 are preexisting landfills that do not have composite liners, and are therefore subject to 10 CSR 80-3.010(17)(C)(4)(A). The engineered on-site disposal cell associated with the "Complete RAD Removal" with on-site disposal alternative would include a composite liner and would therefore be subject to 10 CSR 80-3.010(17)(C)(4)(B). Table 1-2 summarizes the cover dimensions that would be required for these three units according to the 10 CSR 80 regulations listed above.

1.2 UMTRCA REQUIREMENTS

Standards for UMTRCA remedial cell performance have been established by the U.S. Environmental Protection Agency (EPA) in 40 CFR 192, Subpart A - Standards for the Control of Residual Radioactive Materials from Inactive Uranium Processing. These standards require that final cover designs limit exposures to radiation and radioactive materials, provide long-term stability; and require minimal maintenance to assure performance standards are met in the future. Control measures would be designed to be effective for up to one thousand years (to the extent reasonably achievable) and, in any case, for at least 200 years. The control measures must provide reasonable assurance that releases of radon-222 from residual radioactive material to the atmosphere would not exceed an average release rate of 20 picocuries per square meter per second (20 $pCi/m^2/s$) and radiation exposure rates should be limited to 20 microroentgens per hour above background.

1.3 CHANGE IN RADIOACTIVE SOURCE OVER TIME

The minimum cover thicknesses required to meet the UMTRCA design objectives as stated above would be directly related to the concentrations of the radionuclides present in the RIM. Radioactive decay of some radionuclides and the subsequent in-growth of others would change the concentrations of the radionuclides in the RIM during the evaluation period. This change must be quantitatively estimated to determine the cover thickness required during the period of maximum radioactivity. In particular, the concentration of radium-226 must be estimated before radon emanation or gamma shielding calculations can be made. The maximum radium-226 concentration during the 1,000 year study period occurs in year 1,000. Table 1-3 presents the calculated current concentrations and calculated 1,000-year concentrations of radium-226 and its parent thorium-232 in Areas 1 and 2 (for the ROD remedy) and the engineered on-site cell (for the "Complete RAD Removal" with on-site disposal alternative).

1.4 RADON-222 FLUX CONSTRAINTS

If uncontained, radon-222 produced by radioactive decay of radium-226 in soil or waste can be released to the atmosphere. The amount of radon released can be greatly reduced by placing a cover over the radium-bearing materials. Such a cover would slow the escape of free radon, allowing its rapid decay rate[1] to deplete the amount of activity that reaches the surface. By adjusting the thickness of the cover it is possible to change potential radon emissions to meet regulatory requirements.

The cover thickness required to reduce radon emissions to 20 pCi/m^2/s was calculated using the approach described in the NUREG/CR-3533[2]. NUREG/CR-3533 offers a set of one-dimensional, steady-state radon diffusion calculations to determine radon concentrations and fluxes in a multi-layer system. These equations form the basis of the computer program RAECOM (Radiation Attenuation Effectiveness and Cover Optimization with Moisture Effects). A copy of this program has been modified to run as a web-based calculator.[3] This web-based radon flux calculator was used to calculate the radon attenuation potentials of several potential final cover system options, as discussed below.

The RAECOM calculator requires user input that describes the physical and radiological characteristics of the source and overlying cover layers. Specific types of information required include:

- the porosity and moisture content of materials in the source and each layer of the cover (see Table 1-4),
- the radon emanation coefficient (0.2 is cited in NUREG/CR-3533 as a typical value for tailings), and
- the thicknesses of the source layer and the overlying cover layers.

1.4.1 Thickness of Cover over RIM in Areas 1 and 2 (ROD Remedy)

The radon attenuation characteristics of the 10 CSR 80 design for landfills without liners were evaluated for the RIM in Areas 1 and 2. The outputs from these two simulations are presented in Figure 1-1 and Figure 1-2, respectively. In these figures, the case name and case-specific input values are listed at the top of each output file and the results of the calculations for the different layers follow the input values. The radon flux at the top of the cover is the last value in the column headed “Exit Flux”.

---

[1] Only half the produced radon-222 remains after 3.8 days. After 7.6 days a quarter of the original radon-222 remains. Delaying its emergence by 30 days reduces the radon to just 0.4% of its original concentration.

[2] “Radon Attenuation Handbook for Uranium-Mill Tailings Cover Design, NUREG/CR-3533.” Battelle Pacific Northwest Labs., Richland, WA. April 1984.

[3] The REACOM web calculator used in this evaluation is hosted at http://www.wise-uranium.org/ctc.html (March 21, 2011.

The results of the RAECOM simulations indicate that the 2 foot (0.6 m) clay and 1 foot (0.3 m) final cover system described in 10 CSR 80-3.010(17)(C)(4)(A), along with the underlying rubble layer is sufficient to meet the 20 pCi/m^2/s radon flux standard for the RIM in Areas 1 and 2. These cover configurations and the final calculated radon fluxes for each are summarized in Table 1-5.

1.4.2 Thickness of Cover over RIM in On-site Disposal Cell

Figure 1-3 presents the output file generated by the RAECOM calculator for the on-site cell cover configuration proposed under the "Complete RAD Removal and on-site disposal" alternative. The cover configuration and the final calculated radon flux for the on-site disposal cell in year 1,000 are presented as the final row in Table 1-5. The calculated radon flux for this cover configuration[4] in year 1,000 does not exceed 20 pCi/m^2/s.

1.5 EXPOSURE RATE CONSTRAINTS

The exposure rates for the three cover designs evaluated were calculated as part of the human health risk assessment presented in Appendix H. These exposure rates are also listed below in Table 1-5 for quick reference.

1.6 SUMMARY

The cap thickness evaluations described in the previous sub-sections were used to determine the minimum thickness that would simultaneously satisfy the requirements of each design constraint. The thickness of the component layers that make up the proposed final cover configurations for the ROD Remedy and the complete RAD removal with on-site disposal alternative are summarized in Table 1-5, along with the calculated radon flux and gamma exposure rates for each cover design.

[4] Any additional attenuation of radon by the geomembrane is specifically excluded from these calculations as it is uncertain if the man-made material will remain intact over the 1,000 year evaluation period.

Table 1-1 Design Cover Thickness

Location	Rock Layer (m)	Clay Cap (m)	Sand (m)	Top Soil (m)	Total Thickness (m)
ROD Remedy					
Area 1	0.6	0.6	0	0.3	1.5
Area 2	0.6	0.6	0	0.3	1.5
"Complete RAD Removal" with On-site Disposal Alternative					
On-site Cell	0.6	0.3	0.3	0.6	1.8

Table 1-2 10 CSR 80-3.010(17)(C)(4) Cover Design Requirements for Area 1, Area 2, and the On-Site Cell

Location	Rock Layer (m)	Clay Cap (m)	Sand (m)	Top Soil (m)	Total Thickness (m)
ROD Remedy					
Area 1	0	0.6	0	0.3	0.9
Area 2	0	0.6	0	0.3	0.9
"Complete RAD Removal" with On-site Disposal Alternative					
On-site Cell	0	0.3	0.3 [a]	0.6	1.2

[a] Drainage layer.

Table 1-3 Current and 1,000 Year Inventories for Thorium-230 and Radium-226

Location	Th-230 Conc. in First Year (pCi/g) [a]	Ra-226 Conc. in First Year (pCi/g) [a]	Th-230 Conc. at 1,000 yr (pCi/g) [b]	Ra-226 Conc. at 1,000 yr pCi/g [c]
ROD Remedy				
Area 1	1,060	72	1,051	417
Area 2	3,730	338	3,697	1,523
"Complete RAD Removal" with On-site Disposal Alternative				
On-site Cell	1,384	113	1,372	557

[a] First year concentrations in Areas 1 and 2 are the 95% CL on the arithmetic mean values listed in Table A.3-2 and A.3-4 in the BRA (Auxier 2000). Concentrations in the on-site cell were calculated by dividing the total activity in the original 39,000 tons of material sent to the landfill by the estimated mass of the waste to be placed in the on-site disposal cell.

[b] Th230 at 1,000y = Initial_Th230(pCi/g) xEXP[-Lambda_Th(0.000009002/y) xTime(1000y)]

[c] Ra230 at 1,000y = {Initial_Ra226(pCi/g) x EXP[-Lambda_Ra(0.0004327/y) x Time(1000y)]} + {[Lambda_Ra(0.0004327/y) x Initial_Th230(pCi/g)] / [Lambda_Ra(0.0004327/y) - Lambda_Th(0.000009002/y)]} x {EXP[-Lambda_Th(0.000009002/y) x Time(1000 y)] - EXP[-Lambda_Ra(0.0004327/y) x Time(1000y)])}

Table 1-4 Moisture and Porosity of Cover Materials Used in Cover Optimization Calculations

Parameter	Value	Units	Reference
Municipal solid waste porosity	0.671	none	EPA/600/R-94/168a,[1] Table 4, HELP soil texture class 18
Municipal solid waste moisture content	25	%	EPA-456/R-03-007, pg 6
Rock layer porosity	0.397	none	EPA/600/R-94/168a, Table 4, HELP soil texture class 21
Rock layer moisture content	0.8	%	EPA/600/R-94/168a, Table 4, HELP soil texture class 21, Bulk Soil Density = 2.7
Clay layer porosity	0.427	none	EPA/600/R-94/168a, Table 4, HELP soil texture class 16
Clay layer moisture content	23.7	%	EPA/600/R-94/168a, Table 4, HELP soil texture class 16, Bulk Soil Density = 2.7
Sand layer porosity	0.457	none	EPA/600/R-94/168a, Table 4, HELP soil texture class 3
Sand layer moisture content	2.25	%	EPA/600/R-94/168a, Table 4, HELP soil texture class 3, Bulk Soil Density = 2.7
Top soil porosity	0.419	none	EPA/600/R-94/168a, Table 4, HELP soil texture class 22
Top soil moisture content	11.5	%	EPA/600/R-94/168a, Table 4, HELP soil texture class 22, Bulk Soil Density = 2.7

1 EPA/600/R-94/168a. Schroeder, P. R., Dozier, T.S., Zappi, P. A., McEnroe, B. M., Sjostrom, J. W., and Peyton, R. L. "The Hydrologic Evaluation of Landfill Performance (HELP) Model: Engineering Documentation for Version 3," September 1994, U.S. EPA Office of Research and Development, Washington, DC.

2 EPA-456/R-03-007. Alexander, Amy, "Example Moisture Mas Balance Calculations for Bioreactor Landfills" December 2003, U.S. EPA Office of Air Quality Planning and Standards, Research Triangle Park, NC.

Table 1-5 Summary of Cover Component Dimensions and Resulting Radon Fluxes and Exposure Rates

Location	RIM (m)	Rock/ Rubble (m)	Clay (m)	Sand Layer (m)	Top Soil (m)	Radon Flux ($pCi/m^2/s$)	Exposure Rate (microR/h)
Area 1	1.4	0.6	0.6[a]	0	0.3[a]	< 1	< 1[b]
Area 2	2.6	0.6	0.6[a]	0	0.3[a]	< 1	3[c]
On-site Cell	6	0.6	0.3[d]	0.3	0.6[d]	1.3	2[e]

[a] Minimum thickness that complies with 10 CSR 80-3.010(17)(C)(4)(A).
[b] Dose from Risk Assessment's Exhibit 5-1, Appendix H. 12.7 microrem for 40 hour exposure or ~ 0.3 microR/h.
[c] Dose from Risk Assessment's Exhibit 5-2, Appendix H. 117 microrem for 40 hour exposure or ~ 3 microR/h.
[d] Minimum thickness that complies with 10 CSR 80-3.010(17)(C)(4)(B).
[e] Dose from Risk Assessment's Exhibit 7-1, Appendix H. 90 microrem for 40 hour exposure or ~ 2 microR/h.

Figure 1-1 RAECOM Calculator Output File: Area 1, 10 CSR 80-3.010(17)(C)(4)(A) Cover

```
Area 1 ROD Remedy Cover
----------------  Input Parameters  ----------------
 Number of Layers:  4
 Radon Flux into Layer 1:  0 pCi/m2s
 Surface Radon Concentration:  0 pCi/L
 Bare Source Flux (Jo) from Layer 1:  134.3 pCi/m2s
 Specific Bare Source Flux from Layer 1:  0.322 pCi/m2s per pCi_Ra-226/g

   Layer      Thickness      Ra-226     Emanat    Porosity   Moisture  Diff Coeff
    No.          [m]         [pCi/g]     Fract               [dry wt_%]   [m2/s]
     1           1.4           417        0.2       0.671        25      1.947E-06
     2           0.6            1         0.2       0.397        0.8     4.038E-06
     3           0.6            1         0.2       0.427       23.7     46.58E-09
     4           0.3            1         0.2       0.419       11.5     1.496E-06

--------  Results of Radon Diffusion Calculation  --------
   Layer      Thickness     Exit Flux  Exit Conc.    MIC
    No.          [m]       [pCi/m2s]   [pCi/L]
     1           1.4         47.02     71.75E3      0.755
     2           0.6         4.066     83.31E3      0.976
     3           0.6         0.231     80.73E2      0.365
     4           0.3         0.407      0E+0        0.681

Total cover radon retention: 99.70%
```

Note: Box around cover exit flux added for clarity.

Figure 1-2 RAECOM Calculator Output File: Area 2, 10 CSR 80-3.010(17)(C)(4)(A) Cover

```
Area 2 ROD Remedy Cover
----------------  Input Parameters  ----------------
 Number of Layers:  4
 Radon Flux into Layer 1:  0 pCi/m2s
 Surface Radon Concentration:  0 pCi/L
 Bare Source Flux (Jo) from Layer 1:  542.2 pCi/m2s
 Specific Bare Source Flux from Layer 1:  0.356 pCi/m2s per pCi_Ra-226/g

   Layer    Thickness   Ra-226     Emanat    Porosity   Moisture  Diff Coeff
    No.        [m]      [pCi/g]     Fract              [dry wt_%]   [m2/s]
     1         2.6       1523        0.2       0.671       25      1.947E-6
     2         0.6        1          0.2       0.397       0.8     4.038E-6
     3         0.6        1          0.2       0.427       23.7    46.58E-9
     4         0.3        1          0.2       0.419       11.5    1.496E-6

    --------  Results of Radon Diffusion Calculation  --------
   Layer    Thickness  Exit Flux  Exit Conc.    MIC
    No.        [m]     [pCi/m2s]   [pCi/L]
     1         2.6       178.5     270.4E3     0.755
     2         0.6       15.57     313.7E3     0.976
     3         0.6       0.627     178.1E0     0.365
     4         0.3       0.779    0.000E+00    0.681


Total cover radon retention: 99.86%
```

Note: Box around cover exit flux added for clarity.

Figure 1-3 RAECOM Calculator Output File:
Cover for On-site Cell

```
On-site Cell Alternative
----------------  Input Parameters  ----------------
 Number of Layers:  5
 Radon Flux into Layer 1:  0 pCi/m2s
 Surface Radon Concentration:  0 pCi/L
 Bare Source Flux (Jo) from Layer 1:  200.1 pCi/m2s
 Specific Bare Source Flux from Layer 1:  0.359 pCi/m2s per pCi_Ra-226/g

   Layer    Thickness   Ra-226     Emanat    Porosity   Moisture  Diff Coeff
    No.        [m]      [pCi/g]     Fract               [dry wt_%]   [m2/s]
     1          6         557        0.2       0.671       25      1.947E-06
     2         0.6         1         0.2       0.397       0.8     4.038E-06
     3         0.3         1         0.2       0.427      23.7     46.58E-09
     4         0.3         1         0.2       0.457      2.25     4.124E-06
     5         0.6         1         0.2       0.419      11.5     1.496E-06

   --------  Results of Radon Diffusion Calculation  --------
   Layer    Thickness  Exit Flux  Exit Conc.    MIC
    No.        [m]     [pCi/m2s]   [pCi/L]
     1         19        65.40     99.27E3     0.755
     2         0.6       5.854     115.1E3     0.976
     3         0.3       1.537     707.5E0     0.365
     4         0.3       1.226     1.618E3     0.947
     5         0.6       1.310       0E0       0.681

Total cover radon retention: 99.35%
```

Note: Box around cover exit flux added for clarity.

APPENDIX G:

Conceptual Environmental Monitoring Plan

APPENDIX G

Conceptual Bases for Costs of Occupational and Environmental Monitoring Associated with each Remedial Alternative

West Lake Landfill OU-1
Supplemental Feasibility Study

Prepared by

Auxier & Associates
9821 Cogdill Drive, Suite 1
Knoxville, TN 37932

and

Engineering Management Support, Inc.
7220 W. Jefferson Ave, Suite 406
Lakewood, CO 80235

September 28, 2011 with December 13, 2001 changes

Table of Contents

List of Tables

List of Figures

List of Acronyms

DOT	U.S. Department of Transportation
dpm	atomic disintegrations per minute
EMSI	Engineering Management Support, Inc.
FS	feasibility study
ft	feet
LAACC	Large Area Activated Charcoal Canisters
LEL	lower explosive limit
MCL	Maximum Contaminant Level
MDNR	Missouri Department of Natural Resources
m^2	square meter
µCi/mL	microCuries per milliliter
NCP	National Contingency Plan
NESHAPs	National Emission Standards for Hazardous Air Pollutants
OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response
OU	Operable Unit
PPE	Personal Protective Equipment
QA	quality assurance
QC	quality control
RIM	radiologically-impacted materials
ROD	Record of Decision
SWMP	Solid Waste Management Program
SVOC	semi-volatile organic compound
TOC	total organic carbon
µg	microgram
UMTRCA	Uranium Mill Tailings Radiation Control Act
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound

1 INTRODUCTION

The West Lake Landfill OU-1 Superfund Site (the Site) is a former solid waste landfill that consists of various contiguous and discrete areas historically used for disposal of municipal solid wastes and construction and demolition debris. During past operations at the landfill, some radiologically-impacted materials (RIM) were placed in two areas (now known as Area 1 and Area 2). The Site also includes the Buffer Zone/Crossroads property. No occupied structures are currently located over Areas 1 and 2.

Land use surrounding the site is primarily commercial and industrial. A small population of workers inhabits the area primarily during the daytime. A few occupied buildings are currently located on the landfill, and the Spanish Village residential subdivision is located less than a mile to the south of Area 1 (Figure 1-1).

As discussed in Section 1 of the Supplemental Feasibility Study (SFS), Region 7 has requested that an additional evaluation of three select remedial alternatives be prepared for the site. The three alternatives are:

> **The remedy prescribed in the Record of Decision (ROD) -** Under this alternative, the RIM would remain in place and improvements would be made to the site as specified in the ROD. This design protects human health and the environment by using an engineered cap to cover the RIM and isolate the radioactive material from human receptors and the environment.
>
> **"Complete rad-removal" followed by off-site disposal -** This alternative provides for the RIM to be excavated from Areas 1 and 2 and transported to an off-site disposal facility that is permitted to receive radioactive materials. The non-RIM overburden excavated to access the RIM would be returned to the excavated areas in Areas 1 and 2 after all RIM had been excavated and Areas 1 and 2 would be covered with a Subtitle D cap.
>
> **"Complete rad-removal" followed by on-site disposal -** This alternative would require construction of a new disposal cell on the landfill property, followed by excavation of the RIM from Areas 1 and 2 and placement of the RIM in the new cell. The new cell would be capped after all RIM was placed in the cell. The non-RIM overburden excavated to access the RIM would be returned to the excavated areas in Areas 1 and 2 after all RIM had been excavated and Areas 1 and 2 would be covered with a Subtitle D cap.

Each of these alternatives would include monitoring activities that would be performed during and after construction of the remedy. The exact scope of this monitoring would be developed as part of the remedy design effort, but a preliminary description of the scope of potential monitoring activities is necessary to assess the anticipated effectiveness of a monitoring system as well as to provide the bases for estimated monitoring costs.

Monitoring activities associated with the three alternatives were divided into three groups for this evaluation: monitoring activities with a limited duration that would be performed during construction (short-term monitoring), post-construction baseline monitoring, and longer duration monitoring activities performed after remedy construction would be complete (long-term monitoring). These three groups of monitoring activities are discussed separately in this evaluation.

The remainder of this Appendix provides a description of the monitoring systems proposed for each alternative. Section 2 contains a description of short-term monitoring during construction. Section 3 provides a description of post-construction baseline monitoring for the alternatives. Section 4 presents a description of the long-term monitoring systems and a summary of monitoring activities and systems for each alternative is provided in Section 5.

As indicated previously, this Appendix E (Conceptual Bases for Costs of Occupational and Environmental Monitoring Associated with each Remedial Alternative) was prepared only for purposes of developing cost estimates for the SFS. Actual monitoring networks, locations, analytical parameters, and sampling frequencies would be determined during remedial design (RD) of the EPA-selected remedial alternative.

2 SHORT-TERM MONITORING

Short-term monitoring activities that would be performed during construction of the remedial alternatives were divided into two categories for this evaluation: (1) health-based monitoring, and (2) remediation control monitoring. Data quality objectives would be different for each category of short-term monitoring activity. Health-based monitoring activities would be designed to evaluate potential emissions and human exposures that may be produced during construction of a given alternative. The remediation control monitoring program would be designed to guide the construction contractor during excavation of the RIM and to characterize excavated material prior to transport and disposal. Both of these categories of monitoring and survey activities would be limited to the period of construction and are therefore termed “short-term monitoring” in this evaluation.

In addition to the short-term monitoring program descriptions, this section also includes a discussion regarding the utility of providing an on-site radiological analytical laboratory for the “Complete Rad Removal” alternatives.

2.1 Short-Term Health-Based Monitoring

Potential emissions that might affect the health of workers or the public would be monitored using a combination of fixed and mobile monitors. After potential emissions, exposures, and receptors associated with construction of each alternative were identified, the type and number of fixed and mobile monitors were estimated for each alternative.

RIM would be encountered in the same locations in Areas 1 and 2 and similar general construction techniques would be shared among all three remedial alternatives. It would be reasonable to assume that similar emissions and types of exposure pathways would potentially be produced during construction of all three remedial alternatives. Therefore, the same types of emissions and exposures would be measured by the short-term monitoring programs for all three remedial alternatives. The major differences among the proposed health-based short-term monitoring programs would be due to the relative differences of the duration and magnitude of emissions and exposures that might be generated during implementation of the different alternatives. For example, workers would be required to be in close proximity to the RIM at some point during excavation and/or grading operations for each alternative. While the potential exposure pathways would be the same, the amount of time spent near the RIM and the degree to which the RIM would be disturbed would vary among the alternatives. For the ROD remedy, the amount of time spent near the RIM and the degree to which the RIM would be disturbed would be minimal. The amount of time spent near the RIM and the degree to which the RIM would be disturbed would be significant for the two “Complete Rad Removal” alternatives. Because of the added activity of filling the new cell with RIM, the amount of time spent near the RIM would be the highest for the “Complete Rad Removal” with on-site cell alternative.

An evaluation of populations in the area concluded that during construction, each of the three remedial alternatives had the potential to impact similar groups and types of receptors. One group of potential receptors common to all alternatives would be remediation workers. Remediation workers could potentially encounter RIM directly or indirectly as part of their duties and would be subject to the project medical monitoring and health and safety programs. A second group of potential receptors common to all alternatives would include members of the public (i.e., workers in near-by businesses, visitors/transients, and off-property residents).

Table 2-1 contains a list of potential exposure pathways and receptors considered for the remedial alternatives. These short-term exposures and associated monitoring efforts are grouped by the program under which they would likely be monitored - either the Occupational Health and Safety Program or the Environmental Monitoring Program. The list of receptors and the types and nature of potential exposures proposed in this Appendix is based on current knowledge of the site and may change in response to additional information collected during remedial design or remedy construction.

2.1.1 Health-Based Monitoring During Construction of ROD Remedy

During construction of the ROD remedy, it is anticipated that most of the RIM would remain covered throughout the construction phase. A small volume of RIM is anticipated to be relocated from the Buffer Zone/Crossroad Property to Area 2 and some RIM located near the surface of Areas 1 and 2 might be disturbed during cut and fill activities associated with regrading of Areas 1 and 2 to achieve final surface slopes. Direct contact with exposed RIM would be expected to be limited to remediation workers in a few areas.

Remediation workers might walk over or operate equipment on the RIM during construction of the ROD remedy, but most of the RIM would remain covered so repeated contact during construction would be limited. Some remediation workers performing activities close to the RIM may encounter elevated radiation levels. Radiation survey technicians and other health and safety personnel would be expected to spend the most time near the RIM and have the greatest risk for exposure. Because only a minimal volume of RIM is anticipated to be disturbed, it was assumed that minimal, if any, measureable airborne exposure levels would be experienced during construction of the ROD remedy.

It would be possible that nonremediation workers would be present in buildings near the site. The nearest residential community is located about 1,000 meters to the south of where RIM in Areas 1 and 2 might be exposed. These two groups of potential receptors would not be exposed to radiation directly from the RIM but might be subject to airborne exposure. Airborne radiological and chemical constituent exposures to receptors, if any, would be expected to be transient and small. Use of dust control measures at the site and the distance between the potential receptors and the site reduces the potential for dust generation and exposure to dust thereby lessening risk of ingestion or inhalation by on-site or off-site receptors.

Due to operational procedures and engineering controls, any ponding of surface water from precipitation would be expected to be localized and limited in size during construction of this alternative. Any surface water contacting exposed RIM during construction would be collected, sampled, and treated or discharged. Workers handling collected surface water would be required to wear personal protective equipment (PPE) and use appropriate tools and techniques to minimize exposures and risks.

2.1.1.1 Occupational Health and Safety Monitoring

Because exposures to remediation workers would be expected to be much larger than exposures to other individuals, these workers would be subject to more intense monitoring than other potential receptors. If monitoring can demonstrate that risks to remediation workers from radiological and other hazardous constituents would be within acceptable levels, then risks to less exposed receptors would also be within safe levels.

Airborne emissions from construction activities would be monitored on a daily basis as part of the Occupational Health and Safety Program. Portable air samplers would be set up in the area of construction and moved as necessary to provide representative samples of air in the breathing zone of workers. These samples would be collected at the end of each day of work and checked for asbestos, arsenic, and total alpha and total beta radiation. In some cases continuous radon monitors may be included to monitor occupational radon exposures.

Radiation exposure rates in work areas would be periodically monitored with hand-held instrumentation. Any cumulative radiation exposures would be tracked using personal dosimetry badges or electronic dosimeters.

The anticipated types of health and safety monitors proposed and projected quantities of monitors are presented in Table 2-2. This table also lists the current constituents of concern with the understanding that the list may change if new information becomes available during remedy design.

2.1.1.2 Environmental Monitoring

An integrated system of 15 short-term environmental monitoring stations would be established around the perimeters of Areas 1 and 2, near the closest occupied building on-site, and at off-site background and community locations (Figure 2-1). Air samples collected in the stations would be analyzed for particulates and gases that may be emitted during cut and fill operations, grading for the final cover, and movement of any RIM from the Buffer Zone/Crossroad Property onto Area 2.

The sampling and sensor equipment in each typical weatherproof monitoring station enclosure would consist of a low volume air sampler for airborne particulates and toxic chemical vapors, a continuous radon monitor and an environmental radiation dosimeter. A short-term static radon collector would also be included in the station until confidence was established in the accuracy of the continuous radon monitor. The on-site station near the closest building and the off-site background and community stations would include equipment to monitor for radon daughters until the fraction of radon daughter/radon equilibrium can be established. The anticipated types of environmental monitoring equipment proposed and projected quantities of equipment are summarized in Table 2-3. The table also lists the current constituents of concern with the understanding that this list may change if new information becomes available during remedy design.

Air samplers would operate continuously during construction operations. Radon monitors would operate continuously and record the average radon concentration every three or four hours. Radiation dosimeters would be exchanged and sent for analysis every calendar quarter. The short-term radon monitors would be collected, packaged, sent to an outside laboratory and analyzed in accordance with the vendor specifications.

These environmental monitoring stations would be maintained by the on-site radiological protection group (health physics personnel). Buried or overhead electrical power service would be provided to all planned environmental monitoring station locations.

2.1.2 Health-Based Monitoring During "Complete Rad Removal" and Off-site Disposal

This alternative would involve complete removal of the RIM in Areas 1 and 2. Overburden would be excavated and stockpiled on-site and RIM in Areas 1 and 2 would be excavated and transported to a permitted off-site disposal facility. A small volume of RIM would also be excavated from the Buffer Zone/Crossroad Property (Figure 2-2) and along with the RIM from Areas 1 and 2, transported and disposed in the off-site facility. It is anticipated that only a portion of the RIM would be uncovered at any one time, and the remaining RIM would remain covered until it was scheduled to be excavated.

In the analysis of this alternative, it was assumed that individuals working near the RIM for a protracted period of time would encounter elevated radiation levels. During construction, remediation workers could walk over RIM or operate equipment on RIM. Other remediation workers would be close to the RIM while surveying. If RIM would be transported via truck to a truck-to-rail transloading facility, remediation workers sealing the RIM-filled Department of Transportation (DOT) bags in the semi-trailers would be close to the RIM during the sealing activity. Also, because of the large volumes of RIM that would be disturbed, it was assumed that measureable airborne exposures would be experienced during excavation and loading of the DOT bags lining the semi-trailers.

Of all the potential receptors evaluated, radiation survey technicians and other health and safety personnel would be expected to encounter the highest risk from radioactive and chemical exposures because they would spend the most time near the RIM and would receive the highest doses. Highway semi-truck drivers who would routinely haul RIM could potentially accrue a small but measureable dose as they would spend a part of their workday near the RIM when loaded semi-trailers are hauled to the truck-to-rail transloading facility. Exposures to the public from covered trucks hauling RIM would be transitory.

Due to operational procedures and engineering controls, any ponding of surface water from precipitation is expected to be localized and limited in size during construction of this alternative. Any surface water contacting exposed RIM during construction would be collected, sampled, and treated or discharged. Workers handling collected surface water would be required to wear PPE and use appropriate tools and techniques to minimize exposures and risks.

2.1.2.1 Occupational Health and Safety Monitoring

Because exposures to remediation workers would be expected to be much larger than exposures to other individuals, these workers would be subject to more intense monitoring than other potential receptors. If monitoring can demonstrate that risks to remediation workers from radiological and other hazardous constituents would be within acceptable levels, then risks to less exposed receptors would also be within safe levels.

Airborne emissions from construction activities would be monitored on a daily basis as part of the Occupational Health and Safety Program. Portable air samplers would be set up in the area of construction and moved as necessary to provide representative samples of air in the breathing zone of workers. These samples would be collected at the end of each day of work and checked for asbestos, arsenic, and total alpha and total beta radiation. In some cases continuous radon monitors may be included to monitor occupational radon exposures.

Ambient radiation levels would be monitored in real-time with hand-held instrumentation. Any cumulative radiation exposures would be tracked using personal dosimetry badges or electronic dosimeters.

It would be likely that some surface water from precipitation would be collected, sampled, and treated or discharged during remediation. Workers handling this water would be required to wear PPE and use appropriate tools and techniques to minimize exposures and risks.

The anticipated types of health and safety monitors proposed and projected quantities of monitors are presented in Table 2-2. This table also lists the current constituents of concern with the understanding that the list may change if new information becomes available during remedy design.

2.1.2.2 Environmental Monitoring

Similar to the ROD remedy, for the "Complete Rad Removal" with Off-Site Disposal alternative, an integrated system of 15 short-term environmental monitoring stations would be established around the perimeters of Areas 1 and 2, near the closest occupied building on-site, and at off-site background and community locations (Figure 2-2). Air samples collected in the stations would be analyzed for particulates and gases that may be emitted during excavation and stockpiling of overburden, RIM excavation and placement in semi-trailers, movement of any RIM from the Buffer Zone/Crossroad Property, backfilling of overburden in Areas 1 and 2, and final grading of Areas 1 and 2 after the RIM has been removed.

The sampling and sensor equipment in each typical weatherproof monitoring station enclosure would consist of a low volume air sampler for airborne particulates and toxic chemical vapors, a continuous radon monitor and an environmental radiation dosimeter. A short-term static radon collector would also be included in the station until confidence was established in the accuracy of the continuous radon monitor. The on-site station near the closest building and the off-site background and community stations would include equipment to monitor for radon daughters until the fraction of radon daughter/radon equilibrium can be established. The anticipated types of environmental monitoring equipment proposed and projected quantities of equipment are summarized in Table 2-3. The table also lists the current constituents of concern with the understanding that this list may change if new information becomes available during remedy design.

Air samplers would operate continuously during excavation and subsequent construction operations. Radon monitors would operate continuously and record the average radon concentration every three or four hours. Radiation dosimeters would be exchanged and sent for analysis every calendar quarter. The short-term radon monitors would be collected, packaged, sent to an outside laboratory and analyzed in accordance with the vendor specifications.

These environmental monitoring stations would be maintained by the on-site radiological protection group (health physics personnel). Buried or overhead electrical power service would be provided to all planned environmental monitoring station locations.

2.1.3 Health-Based Monitoring During "Complete Rad Removal" and On-site Disposal

Similar to the "Complete Rad Removal" alternative discussed in Section 2.1.2, this alternative would also involve complete removal of RIM in Areas 1 and 2. Excavated overburden would be stockpiled. RIM would be relocated from Areas 1 and 2 to a newly constructed engineered cell. The location of Areas 1 and 2 relative to the potential location of the on-site cell is shown on Figure 2-3. Excavated RIM would be placed in articulated off-road construction trucks and hauled to the new on-site cell via a temporary gravel road that would be constructed over the Former Active Sanitary Landfill. A small volume of RIM would also be relocated from the Buffer Zone/Crossroad Property to the on-site cell. It is anticipated that only a portion of the RIM would be uncovered at any one time, and the remaining RIM would remain covered until it was scheduled to be excavated.

In the analysis of this alternative, it was assumed that individuals working near the RIM for a protracted period of time would encounter elevated radiation levels. Also, because of the large volumes of RIM that would be disturbed, it was assumed that measureable airborne exposures would be experienced during excavation, loading of off-road trucks, transport of the RIM to the on-site cell, and placement of the RIM in the cell.

Of all the potential receptors evaluated, radiation survey technicians and other health and safety personnel would be expected to encounter the highest risk from radioactive and chemical exposures during construction of this remedy as they would spend the most time near the RIM and would receive the highest doses. Remediation workers could walk over or operate equipment on the RIM during excavation of the RIM as well as during placement of the RIM in the new on-site engineered cell. Other workers would be close to the RIM while surveying. Truck drivers who would routinely haul RIM from Areas 1 and 2 to the on-site cell may also accrue a small but measureable dose while hauling the RIM.

Due to operational procedures and engineering controls, ponding of surface water would be expected to be localized and limited in size, but some temporary surface ponding may occur after large run-off events. This water would be collected by remediation personnel, analyzed, and treated or discharged as appropriate.

2.1.3.1 Occupational Health and Safety Monitoring

Because exposures to remediation workers would be expected to be much larger than exposures to other individuals, these workers would be subject to more intense monitoring than other potential receptors. If monitoring can demonstrate that risks to remediation workers from radiological and other hazardous constituents would be within acceptable levels, then risks to less exposed receptors would also be within safe levels.

Airborne emissions from construction activities would be monitored on a daily basis as part of the Occupational Health and Safety Program. Portable air samplers would be set up in the area of construction and moved as necessary to provide representative samples of air in the breathing zone of workers. These samples would be collected at the end of each day of work and checked for asbestos, arsenic, and total alpha and total beta radiation. In some cases continuous radon monitors may be included to monitor occupational radon exposures.

Ambient radiation levels would be monitored in real-time with hand-held instrumentation. Any cumulative radiation exposures would be tracked using personal dosimetry badges or electronic dosimeters.

It would be likely that some surface water from precipitation would be collected, sampled, and treated or discharged during remediation. Workers handling this water would be required to wear PPE and use appropriate tools and techniques to minimize exposures and risks.

The anticipated types of health and safety monitors proposed and projected quantities of monitors are presented in Table 2-2. This table also lists the current constituents of concern with the understanding that the list may change if new information becomes available during remedy design. Specific monitoring activities, safe levels, etc. would be identified and discussed in the Remedial Action Health and Safety Plan that would be developed during RD.

2.1.3.2 Environmental Monitoring

The types of monitoring proposed for the "Complete Rad Removal" with disposal in an on-site cell alternative would be similar to the requirements of the "Complete Rad Removal" with Off-Site Disposal alternative, but additional areas of exposed working face would be expected within the footprint of the on-site cell. An integrated system of 19 short-term monitoring stations would be established around the perimeters of Areas 1 and 2, around the on-site disposal cell, near the closest occupied building, and at off-site background and community locations (Figure 2-3). The stations would sample air for particulates and gases that may be emitted during excavation and stockpiling of overburden, RIM excavation and placement in off-road construction trucks, transport of RIM from Areas 1 and 2 to the on-site cell, placement of RIM in the on-site cell, movement of any RIM from the Buffer Zone/Crossroad Property, backfilling of overburden in Areas 1 and 2, and final grading of Areas 1 and 2 after the RIM has been removed.

The sampling and sensor equipment in each typical weatherproof monitoring station enclosure would consist of a low volume air sampler for airborne particulates and toxic chemical vapors, a continuous radon monitor and an environmental radiation dosimeter. A short-term static radon collector would also be included in the station until confidence was established in the accuracy of the continuous radon monitor. The on-site station near the closest building and the off-site background and community stations would include equipment to monitor for radon daughters until the fraction of radon daughter/radon equilibrium can be established. The anticipated types of environmental monitoring equipment proposed and projected quantities of equipment are summarized in Table 2-3. The table also lists the current constituents of concern with the understanding that this list may change if new information becomes available during remedy design. Specifics with respect to environmental monitoring would be presented in the Environmental Monitoring Plan that would be developed during RD.

Air samplers would operate continuously during excavation and subsequent construction operations. Radon monitors would operate continuously and record the average radon concentration every three or four hours. Radiation dosimeters would be exchanged and sent for analysis every calendar quarter. The short-term radon monitors would be collected, packaged, sent to an outside laboratory and analyzed in accordance with the vendor specifications.

These environmental monitoring stations would be maintained by the on-site radiological protection group (health physics personnel). Buried or overhead electrical power service would be provided to all planned environmental monitoring station locations.

2.2 Short-Term Remediation Monitoring

Short-term remediation control monitoring would include remediation control surveys to guide cut and fill operations, guide overburden and RIM excavation activities, verify that cover thickness would be sufficient under the ROD remedy, and verify that RIM from the Buffer Zone/Crossroad Property and from Areas 1 and 2 had been removed both during and after RIM excavation. Remediation control monitoring would also include waste characterization surveys and sampling.

2.2.1 Remediation Control Monitoring During Construction of the ROD Remedy

Disturbance of RIM during construction of the ROD remedy would be minimal. Some RIM might be moved during cut and fill operations that would be necessary for regrading of the surfaces of Areas 1 and 2. Other deposits of RIM may be inadvertently uncovered during grading in preparation for placement of the cover over Areas 1 and 2. Other than the RIM that would be relocated from the Buffer Zone/Crossroad Property onto Area 2, no RIM would be excavated and relocated or disposed off-site.

2.2.1.1 Remediation Control Surveys

Four types of radiological surveys would be conducted to guide the minor cut and fill operations in Areas 1 and 2, to guide the excavation and relocation of RIM from the Buffer Zone/Crossroad Property onto Area 2, and to obtain regulatory approval that final cover placement over Areas 1 and 2 would meet design criteria, including:

- Surveys conducted to identify and delineate any exposed RIM at the Buffer Zone/Crossroad Property;

- Quality Control (QC) walkover surveys of areas after final cover grading operations have ceased but before the cover would be released for final status survey;

- Final Status Surveys for each covered (capped) area; and

- Final Status Surveys for areas on the West Lake Landfill site adjacent to the final-covered Areas 1 and 2.

Following is a description of each of the remediation control survey types:

Surveys conducted to locate and delineate any exposed RIM at the Buffer Zone/Crossroad Property. These surveys would be conducted to locate areas where RIM is exposed or close to the surface in the Buffer Zone/Crossroad Property area. Due to the complexity of surveying in unconsolidated material, the care that survey technicians would need to exhibit during the survey, and the need to communicate potentially complex instructions to the excavator operator, this process would reduce the excavator efficiency. A 50 percent reduction in excavation production was assumed to calculate estimated survey costs.

Samples of RIM and surrounding materials would be collected during any activity where RIM would be exposed or moved. These samples would require rapid analysis by field or on-site or off-site laboratory equipment to support decisions by the survey technicians to continue or cease handling materials on the current working face.

QC walkover surveys conducted after final cover grading and capping in an area has ceased. This type of survey would involve a systematic walkover survey of the final cover areas of Areas 1 and 2 after construction has ended. The intent of this type of survey would be to provide reasonable assurance that recently disturbed or capped areas have a high likelihood of passing a final survey.[1] This survey would be conducted with hand-held gamma survey equipment. Soil samples would likely be collected if areas of higher gamma activity were identified during the scan. For any areas where soil concentrations above the remediation goals would be identified, these areas would be marked and referred to engineering construction management personnel for potential RIM relocation or covering. These areas would then be resurveyed. This process would repeat until the entire covered area of Areas 1 and 2 meets the surface soil concentration criteria and cover design requirements set for the site. This level-of-effort would likely require two or three survey technicians equipped with hand held survey meters and soil sampling equipment. The survey team should be able to complete a survey of 1,000 square meters (m^2) in 4 to 8 man-hours. Some of these survey and sampling activities could potentially be conducted as areas of the final cover are being completed and prior to the entire cover surface being completed.

2.2.1.2 Final Status Surveys

Final Status Surveys for each covered area. These surveys would be the regulatory-required surveys needed to declare that the covered areas in Areas 1 and 2 meet the

---

[1] While the proposed clean-up goals would include area and depth averaging criteria, the intent of this post-excavation QC survey would be to clean to a “not-to-exceed” number. The averaging criteria would be used during the subsequent final status survey, but they would not be considered during this phase of the remediation.

release criteria. The exact method used to perform the Final Status Survey will be submitted will be submitted for approval prior to remedy construction. For example, on other sites impacted with similar radionuclides, walkover surveys have been conducted using a 2” x 2” sodium iodide detector coupled to a meter and a GeoPositioning System (GPS). The surveys were conducted by walking across the site in a systematic pattern at a rate of one meter per second with the detector held as close to the ground as practical. The results of these surveys were plotted on site maps or aerial photos and examined for anomalies. If no anomalies were identified, a reference grid was staked out on the remediated area and samples were taken at regular intervals as specified in the Final Status Survey Plan. Note that if the preceding QC walkover survey did not identify locations of elevated radioactivity in an area during the first pass over the area, that QC walkover survey was used to satisfy the walkover requirement of the Final Status Survey. The same successful approach would be proposed in the Final Status Survey Plan for this remedy.

For planning purposes the level-of-effort for this Final Status Survey would likely require three or four survey technicians as well as a health physics supervisor. For purposes of estimating costs in this SFS, it is assumed that the survey team would complete a survey of 1,000 m^2 in 4 to 8 man-hours and 10 samples every 1,000 m^2 would be collected for laboratory analysis. Samples would be subject to gamma spectroscopy analysis and alpha spectroscopy analysis for isotopic thorium and isotopic uranium. A final survey report for both Areas 1 and 2 would be prepared and submitted for approval to the Regulatory Agencies. When accepted, these surveys will serve as the baseline gamma surveys for these areas.

<u>Final Status Surveys for areas on the West Lake Landfill site adjacent to the final-covered Areas 1 and 2.</u> A final survey of the surface of the property would also be required for areas traversed by vehicles containing RIM and where overburden was stored. These surveys would be identical to the final status surveys conducted for covered/capped areas. For purposes of estimating costs in this SFS, it is assumed that the survey team would complete a survey of 1,000 m^2 in 4 to 8 man-hours and 10 samples every 1,000 m^2 would be collected for laboratory analysis. When accepted, these surveys will serve as the baseline gamma survey for these areas.

2.2.1.3 Waste Characterization Surveys and Sampling

Since disturbance of RIM in Areas 1 and 2 during construction of the ROD remedy would be minimal and no areas of RIM in Areas 1 and 2 would be targeted for excavation and disposal, no formal waste characterization sampling would be proposed for Areas 1 and 2. A small volume of soil containing RIM would be relocated from the Buffer Zone/Crossroad Property onto Area 2. Waste characterization of this soil would involve collection and analysis of samples for radiological parameters at a frequency to be determined during remedial design.

2.2.2 Remediation Control Monitoring During "Complete Rad Removal" and Off-site Disposal

2.2.2.1 Remediation Control Surveys

Disturbance of RIM during the "Complete Rad Removal" alternatives would be significant. Remediation control monitoring would be crucial in assuring (1) that excavated overburden debris from Areas 1 and 2 would not contain any RIM, and (2) that all RIM would have been removed from Areas 1 and 2 as well as from the Buffer Zone/Crossroad Property. Remediation control monitoring would be used to selectively excavate RIM while leaving non-impacted materials behind. Remediation Control Surveys

Eight types of radiological surveys would be conducted to guide excavation of all RIM in Areas 1 and 2 and from the Buffer Zone/Crossroad Property and to assure that all RIM would have been removed. These surveys would include:

- Surveys of overburden known or suspected to be above an area of RIM;
- Surveys conducted to identify and delineate any exposed RIM;
- Surveys conducted to guide selective excavation of RIM;
- Surveys conducted for waste acceptance criteria:
- Surveys conducted on trucks leaving the Site;
- QC walkover surveys of an excavated area after excavation has ceased but before the area would be released for Final Status Survey;
- Final Status Surveys for each completed excavation of a RIM area; and
- Final Status Surveys for the unexcavated areas involved with the movement and handling the RIM, overburden storage locations, and Subtitle D capped areas over Areas 1 and 2.

Following is a description of each of the remediation control survey types:

<u>Surveys conducted to support removal of overburden from above the RIM</u>. This type of survey would be designed to assure that RIM would not be intermingled with the uncontaminated debris overburden being excavated. The survey would be conducted on the uncontaminated waste as it would be moved by the excavator. The level-of-effort would likely require one full time survey technician with each excavator.

Surveys conducted to locate and delineate any exposed RIM. These surveys would be conducted to locate areas where RIM is exposed or close to the surface. Except in the Buffer Zone/Crossroad Property area, these surveys would likely require two or three full-time survey technicians with survey instruments to accompany each excavator. Due to the complexity of surveying in unconsolidated material, the care that survey technicians would need to exhibit during the survey, and the need to communicate potentially complex instructions to the excavator operator, this process would reduce the excavator efficiency. A 50 percent reduction in excavation production was assumed to calculate estimated survey costs.

Samples of RIM and surrounding materials would be collected during any activity where RIM would be exposed or moved. These samples would require rapid analysis by field or on-site or off-site laboratory equipment to support decisions by the survey technicians to continue or cease handling materials on the current working face.

Surveys conducted to guide selective excavation of RIM. The purpose of these real-time surveys would be to guide the excavator operators to deposits of RIM while avoiding the surrounding overburden. These surveys would likely require two or three full-time survey technicians with survey instruments to accompany each excavator. Due to the complexity of surveying in unconsolidated material, the care that survey technicians would need to exhibit during the survey, and the need to communicate potentially complex instructions to the excavator operator, this process would reduce the efficiency of excavation. A 50 percent reduction in excavation production was assumed to calculate estimated survey costs.

Samples of RIM and surrounding materials would be collected during any excavation involving RIM or overburden. These samples would require rapid analysis by laboratory equipment to support decisions by the survey technicians to continue or cease excavation on the current working face.

Surveys conducted for waste acceptance criteria. These surveys would be conducted by a representative of the off-site disposal facility where the RIM would be transported and disposed on excavated RIM placed in DOT bags as well as on the trailers of the highway trucks to assure that material leaving the Site would meet the acceptance criteria of the disposal facility permit(s).

Surveys conducted on trucks leaving the Site. These surveys would be conducted on the tires of the highway trucks prior to the trucks leaving the site. If radiological material were to be identified as a result of the survey, the truck would be directed to a decontamination pad where the radiological material would be removed and the truck resurveyed.

QC walkover surveys of an excavated area after excavation has ceased but before the area would be released for Final Status Survey. This type of survey would involve a systematic walkover survey of the entire excavated area after excavation would have ceased but before the excavator would be released from the area. The intent of this type of post-excavation survey would be to provide reasonable assurance that the recently excavated area would have a high likelihood of passing a Final Status Survey.[2] QC walkover surveys would be conducted with hand-held gamma survey equipment. Soil samples would likely be collected if areas of higher gamma activity were identified during the scan. If any areas where soil concentrations above the published remediation goals would be identified, these areas would be "spot cleaned" and resurveyed until the entire area meets the soil concentration criteria established for "Complete Rad Removal". Extensive QC surveying and sampling would be anticipated, supplemented by some boring or excavation to provide reasonable assurance that another layer of RIM would not exist below the newly exposed uncontaminated surface. A small excavator or backhoe with operator might be necessary to assist the survey technicians. The level-of-effort would likely require two or three survey technicians equipped with hand held survey meters and soil sampling equipment. After RIM excavation would be completed in an area, it is estimated that the survey team would be able to complete a QC walkover survey of a 1,000 m^2 area in 4 to 8 man-hours. Some of the survey and sampling work would be on-going as excavation was being completed.

2.2.2.2 Final Status Surveys

Final Status Surveys for completed RIM excavation areas. These surveys would consist of the regulatory-required surveys conducted to confirm that the excavated area would have met the release criteria. The exact method used to perform the Final Status Survey will be submitted will be submitted for approval prior to remedy construction. For example, on other sites impacted with similar radionuclides, walkover surveys have been conducted using a 2" x 2" sodium iodide detector coupled to a meter and a GeoPositioning System (GPS). The surveys were conducted by walking across the site in a systematic pattern at a rate of one meter per second with the detector held as close to the ground as practical. The results of these surveys were plotted on site maps or aerial photos and examined for anomalies. If no anomalies were identified, a reference grid was staked out on the remediated area and samples were taken at regular intervals as specified in the Final Status Survey Plan. Note that if areas of elevated radioactivity were not identified during the first pass of the preceding QC survey, that QC walkover survey was used to satisfy the area survey component of the Final Status Survey. The same successful approach would be proposed in the Final Status Survey Plan for this remedy.

The level-of-effort for this Final Status Survey would likely require three or four survey technicians as well as a health physics supervisor. For purposes of estimating costs in this SFS, it is assumed that the survey team would complete a survey of 1,000 m^2 in 4 to

---

[2] While the proposed clean-up goals would include area and depth averaging criteria, the intent of this post-excavation survey would be to clean to a "not-to-exceed" number. The averaging criteria would be used during the subsequent final status survey, but they would not be considered during this phase of the remediation.

8 man-hours and 10 samples every 1,000 m^2 would be collected for laboratory analysis. A final survey report for each RIM excavation area would be prepared and submitted for approval to the Regulatory Agencies. The respective areas would not be backfilled until Regulatory Agency approval would be secured. When accepted, these surveys will serve as the baseline gamma surveys for the excavated areas.

<u>Final Status Surveys for the unexcavated areas involved with the movement and handling the RIM and overburden storage locations.</u> Final Status Surveys would be conducted of the surface of the property traversed by vehicles containing RIM (i.e., the area between where semi-trucks would be loaded by excavators and where the DOT bags in the semi-trailers would be sealed and the trucks scanned before leaving the site and the area between the RIM excavations in Areas 1 and 2 and where the overburden would be stored) and the surface of the property where overburden would be stored. These surveys would be identical to the Final Status Surveys conducted for excavated areas.

For purposes of estimating costs in this SFS, it is assumed that the survey team would complete a survey of 1,000 m^2 in 4 to 8 man-hours and 10 samples every 1,000 m^2 would be collected for laboratory analysis. When accepted, these surveys will serve as the baseline gamma survey for the completed remedy in these locations.

2.2.2.3 Waste Characterization Surveys and Sampling

Off-site disposal facilities would require that incoming waste meet certain acceptance criteria. Prior to being transported off-site, waste would be sampled and analyzed to determine that the material meets the waste acceptance criteria of the receiving facility. The offsite disposal facility representatives have indicated that an employee of the waste disposal facility would be dedicated to be present at the site at all times when RIM would be loaded into DOT bags in semi-trailers and that this employee would conduct all waste acceptance sampling and/or scanning to assure that each load would meet the acceptance criteria prior to leaving the site.

2.2.3 Remediation Control Monitoring During "Complete Rad Removal" and On-site Disposal

This alternative would involve excavation of all RIM in Areas 1 and 2 and from the Buffer Zone/Crossroad Property, hauling of RIM in off-road construction trucks to a newly-constructed on-site engineered cell, and placement of the excavated RIM in the new cell. Remediation control monitoring would be used to selectively excavate RIM while leaving nonimpacted materials behind.

2.2.3.1 Remediation Control Surveys

For purposes of preparing cost estimates for this SFS, it is assumed that six types of radiological surveys would be conducted to guide the excavation and verify that the RIM had been removed during and after the RIM excavation process:

- Surveys of overburden known or suspected to be above an area of RIM;
- Surveys conducted to identify and delineate any exposed RIM;
- Surveys conducted to guide selective excavation of RIM;
- QC walkover surveys of an excavated area after excavation has ceased but before the area would be released for Final Status Survey;
- Final Status Surveys for each completed excavation of a RIM area;
- Final Status Surveys for the unexcavated areas involved with the movement and handling the RIM and overburden storage locations; and
- Final Status Surveys for the covered area over the on-site cell.

Following is a description of each of the remediation control survey types:

Surveys conducted to support removal of overburden from above the RIM. This type of survey would be the same as previously described in Section 2.2.2 for the "Complete Rad Removal" and Off-site Disposal alternative.

Surveys conducted to locate and delineate any exposed RIM. This type of survey would be the same as previously described in Section 2.2.2 for the "Complete Rad Removal" and Off-site Disposal alternative.

Surveys conducted to guide selective excavation of RIM. This type of survey would be the same as previously described in Section 2.2.2 for the "Complete Rad Removal" and Off-site Disposal alternative. Due to the complexity of surveying in unconsolidated material, the care that survey technicians would need to exhibit during the survey, and the need to communicate potentially complex instructions to the excavator operator, this process would reduce the efficiency of excavation. A 50 percent reduction in excavation production was assumed to calculate estimated survey costs.

Samples of RIM and surrounding materials would be collected during any excavation involving RIM or overburden. These samples would require rapid analysis by laboratory equipment to support decisions by the survey technicians to continue or cease excavation on the current working face.

QC walkover surveys of an excavated area after excavation has ceased but before the area would be released for final status survey. This type of survey would be the same as previously described in Section 2.2.2 for the "Complete Rad Removal" and Off-site Disposal alternative.

2.2.3.2 Final Status Surveys

Final Status Surveys for completed RIM excavation areas. A Final Status Survey Plan that includes a detailed description of the cleanup criteria, instrumentation, survey method, and sampling and analysis procedures will be submitted for approval prior to the start of remedy construction. Section 2.2.2 for the "Complete Rad Removal" and Off-site Disposal alternative presents an example of a survey and sampling method used on other sites. When accepted, these surveys will serve as the baseline gamma survey for the completed remedy in these areas.

Final Status Surveys for the unexcavated areas involved with the movement and handling the RIM and overburden storage locations. Final Status Surveys would be conducted of the surface of the property traversed by vehicles containing RIM (i.e., the area between Areas 1 and 2 and the on-site cell where off-road construction trucks would travel to transport RIM to the on-site cell and the area between the RIM excavations in Areas 1 and 2 and where the overburden would be stored) and the surface of the property where overburden would be stored. These surveys would be identical to the Final Status Surveys conducted for excavated areas. For purposes of estimating costs in this SFS, it is assumed that the survey team would complete a survey of 1,000 m^2 in 4 to 8 man-hours and 10 samples every 1,000 m^2 would be collected for laboratory analysis. When accepted, these surveys will serve as the baseline gamma survey for the completed remedy in these locations.

Final Status Surveys for the covered area over the on-site cell. The Final Status Surveys for the completed RIM excavation areas and the unexcavated areas would need to be completed before the on-site cell would be closed. Once regulatory approval of these Final Status Surveys would be attained, the on-site cell would be closed and capped. The cover of the on-site cell would then be surveyed and the results submitted for regulatory approval. When accepted, these surveys will serve as the baseline gamma survey for the completed cell.

2.2.3.3 Waste Characterization Surveys and Sampling

Some level of sampling and analysis would probably be required to characterize RIM excavated from the Buffer Zone/Crossroad Property and Areas 1 and 2. The results would be used to calculate the activity of the material placed in each lift in the on-site cell. The frequency of sampling and parameters that would be analyzed would be specified in the Construction SAP prepared during remedial design. The level-of-effort would likely require one full-time survey technician while the cell would be filled.

2.3 Utility of an On-site Laboratory during Construction of "Complete Rad Removal" Alternatives

A large number of air and soil samples would be generated by the Occupational Health and Safety and Environmental monitoring programs discussed previously in this section for the "Complete Rad Removal" alternatives. The estimated cost for analysis in an off-site commercial analytical laboratory of the large number of samples estimated to be generated during implementation of one of the "Complete Rad Removal" would be substantial. To significantly decrease the turnaround time on key samples as well as to reduce project costs, estimated costs associated with siting and operating/maintaining an on-site laboratory containing a low-background alpha-beta counter and a gamma spectroscopy system are included in the cost estimates presented in Appendix I of the SFS for the two "Complete Rad Removal" alternatives.

Significantly fewer samples for radiological parameter analysis would be generated during implementation of the ROD remedy because only a minor amount of RIM, if any, would be disturbed during cut/fill activities associated with regrading the surfaces of Areas 1 and 2 prior to cap placement. Therefore, use of an on-site laboratory was not considered in the cost estimates for the ROD remedy. (The cost estimates provided in Appendix I for the ROD remedy do assume the on-site use of a low-background counter during the cut/fill and surface regrading activities.)

2.3.1 Radiological Analysis of Air Samples

As discussed above, the proposed monitoring systems would be designed to capture information regarding potential emissions during remedy implementation activities. A large number of air samples requiring radiological analysis would be generated over the duration of construction. Due to the volume of samples expected, an on-site laboratory would be proposed to reduce response times and overall analytical costs.

Any radioanalytical equipment used on-site would be required to have the capability to reliably measure radionuclide concentrations in air that were at or below health-based standards. A very conservative detection goal for air samples was set in this analysis to evaluate the feasibility of an on-site laboratory and to estimate the total counter time required to perform the analyses.

The required radionuclide detection limit for on-site radioanalytical equipment was calculated by assuming that Thorium-230 would be the only alpha emitter in the sampled air. Thorium-230 was chosen because it would be the most radiotoxic radionuclide at the Site. Assuming that Thorium-230 would be the only alpha emitter is a very health-protective assumption because some of the alpha emissions in air would actually be produced by less-radiotoxic radionuclides.

In 19 CSR 20-10.004, the State of Missouri limits the acceptable airborne concentration of Thorium-230 in areas accessible to the public to 2×10^{-14} microCuries per milliliter (µCi/mL). Assuming all alpha emissions in air were from Thorium-230 (a gross overestimation), the detection limit for this equipment would be set at the State of Missouri limit of 2×10^{-14} µCi/mL, after correcting for interferences from radon daughters.

Because daily measurements would be proposed for the initial stages of construction, air filter samples would be retrieved every 24 hours. Operating for 24 hours at 60 liters per minute, 86,400 liters (86,400,000 milliliters) of air would be pulled through an air filter. Typically, approximately 99.98 percent of the mass of 0.3 micron particles in air passing through filter would be captured. Using this efficiency, approximately 1.7×10^{-6} µCi would be captured on a filter after a full day of operation. This 1.7×10^{-6} µCi is equivalent to approximately four (4) atomic disintegrations per minute (dpm), which means the on-site laboratory radioanalytical equipment must be capable of measuring four (4) dpm or lower on a filter to meet the detection criteria.

This evaluation of the feasibility of employing an on-site laboratory assumed a gas proportional counter would be used to count air samples. A counter with a background of about 0.05 counts per minute and an efficiency of 0.4 counts per atomic disintegration should be capable of measuring 3 dpm with a 15 minute count time. This capability would be approximately 75% of the calculated detection limit used in the above analysis, which demonstrates that a gas proportional counter would be adequate.

For the purpose of estimating operation costs for an on-site laboratory, it assumed that each air sample would require two separate 15 minute analyses on a state-of-the-art low-background counter.[3] Approximately 30 samples per day could be counted (including sample loading, unloading and counter maintenance) with one gas proportional counter. Based on this evaluation, one gas proportional counter was assumed to be included in an on-site laboratory in the cost estimates for the "Complete Rad Removal" alternatives in Appendix I of the SFS. This assumption may be revised after preparation of the Construction SAP during remedial design to include two counters to provide redundancy and excess capacity for smear and occupational health and safety samples.

2.3.2 Nonradiological Analysis of Particulate Air Samples

For the purpose of estimating costs, it was assumed that two air sample filters per week (the background sample and one other) would be routinely submitted for chemical analysis. The number of samples per week may increase for non-routine events.

Chemical analyses of air samples would not be considered for an on-site laboratory because of the significant cost of analytical equipment and QA/QC requirements for a

---

[3] This would allow interferences from radon daughter build-up on the filters to be estimated and removed from the final gross alpha measurement used to determine compliance with the 2×10^{-14} µCi/mL Thorium-230 limit in air.

laboratory conducting chemical analyses. After the nondestructive radiological analysis of the particulates captured on the air sampling filters would be complete, a subset of the environmental monitoring samples would be sent to an off-site laboratory for asbestos and metals analyses. The contract required detection limits for the analytical methods used would allow direct comparison to the air quality objectives established for the project during remedy design.

2.3.3 Radiological Analysis of Soil and Waste Samples

Because of the anticipated significant number of soil and RIM waste samples that would require analysis for either of the "complete Rad Removal" alternatives, it is anticipated that an on-site gamma spectroscopy system would be provided. As compared to shipping samples to an off-site commercial laboratory for gamma spectroscopy analysis, use of an on-site system would afford a rapid turnaround time between sample collection and analytical reporting allowing excavation decisions to be made quickly and thus reducing both standby time for construction equipment and the overall remedy implementation schedule . A secondary consideration would be the reduction in the analytical cost per sample that would be provided by an on-site gamma spectroscopy system.

2.3.4 Nonradiological Analysis of Soil and Waste Samples

After the nondestructive radiological analysis of an individual soil or waste sample would be completed and depending on the characteristics of the sample, it may be sent to an off-site commercial analytical laboratory for analysis of organic and/or inorganic parameters.

3 POST-CONSTRUCTION BASELINE MONITORING

Post-construction baseline radiological monitoring would be conducted to confirm that the remedial action would have been completed as designed and to provide initial post-construction values that could be compared to long-term monitoring results.

3.1 Baseline Monitoring Following Construction of the ROD Remedy

Baseline monitoring proposed to be performed following completion of construction of the ROD remedy would be used to assess whether any radon gas would be emanating from or around the cover over Areas 1 and 2. Monitoring activities would include:

- Measurement of radon flux emanating from the cover over Areas 1 and 2; and
- Measurement of radon in subsurface landfill gas.

3.1.1 Radon Flux Measurement

A one-time radon flux monitoring campaign would be performed after the final cover would be completed over Areas 1 and 2. The purpose of this monitoring would be to assess surface emissions of radon from the final cover over Areas 1 and 2 to demonstrate compliance with the standard established under 40 CFR 192.02(b).

Radon flux would be measured using the Large Area Activated Charcoal Canisters (LAACC) method presented in Method 115, Appendix B, 40 CFR, Part 61. The protocols used for the LAACC radon flux measurement program and calculations are contained in the USEPA report Radon Flux Measurements on Gardinier and Royster Phosphogypsum Piles near Tampa and Mulberry, Florida (USEPA, 1986).

For purposes of costing, it was assumed that approximately 50 LAACC samplers would be placed on the surface of Areas 1 and 2. The LAACC samplers would be distributed to provide coverage at a rate of approximately one per acre in Areas 1 and 2. This proposed measurement campaign may change as more information becomes available during remedy design.

3.1.2 Sub-surface Landfill Gas Monitoring

A landfill gas monitoring program would be developed and implemented as part of the long-term monitoring program. The need for and scope of the landfill gas monitoring program including the exact number and locations of gas monitoring points and measurement frequency would be determined in the remedial design documents for the selected remedy for OU-1. Final landfill gas monitoring well locations and spacing would be based on geologic conditions and proximity to property boundaries and adjacent features. Gas monitoring wells would be designed and constructed in accordance with the MDNR Solid Waste Management Program (SWMP) fact sheet *Design and Construction of Landfill Gas Monitoring Wells* (MDNR, 2007). This guidance indicates that monitoring locations be spaced 100 to 500 feet apart depending on the ground permeability and the number of nearby features that could be potentially damaged from landfill gas.

For purposes of this SFS report, it is assumed that 2-inch diameter "Code Wells" (see MDNR, 2007) would be installed to a depth of approximately 10 feet for the subsurface gas monitoring program. The inner casing of each well would be sealed with a bushing and a sampling port consisting of a shutoff valve and hose barb fitting would be installed in each well. For purposes of preparing cost estimates for this ROD remedy alternative, it is assumed that approximately 18 monitoring wells would be installed along the boundary of Area 2 and approximately 13 wells along the boundary of Area 1 (Figure 3-1). A spacing of approximately 100 feet was assumed for the wells around Area 1 because of the proximity of Area 1 to the landfill entrance road and St. Charles Rock Road. Because of the lack of significant features near the boundaries of Area 2, a greater spacing was assumed for the Area 2 gas monitoring wells.

For the post-construction baseline radiological monitoring program, only radon gas would be monitored in the gas wells. Landfill gas (i.e., lower explosive limit [LEL] for methane) would be monitored as part of the Long-Term Monitoring Program (see discussion in Section 4). Gas samples would be collected from each well and the radon content of the gas would be measured using a radon gas monitor and detector (e.g., Pylon Instrument Manufacturing Model AB-5R monitor and Pylon Model 300A detector).

3.2 Baseline Monitoring After "Complete Rad Removal" and Off-site Disposal

Since all RIM would have been removed under this alternative as confirmed by the Final Status Surveys discussed in Section 2.2.2.1, the only baseline monitoring that would be conducted would be measurement of radon gas in landfill gas wells installed along the boundaries of Areas 1 and 2. For purposes of preparing cost estimates for this "Complete Rad Removal" alternative, it is assumed that the same type and number of gas monitoring wells as well as locations around Areas 1 and 2 as those assumed for the ROD remedy (Figure 3-1) would be monitored. Gas samples would be collected from each well and the radon content of the gas would be measured using a radon gas monitor and detector.

3.3 Baseline Monitoring After "Complete Rad Removal" and On-site Cell Disposal

Like the other "Complete Rad Removal" alternative, baseline monitoring for the "Complete Rad Removal" and On-site Cell Disposal alternative would include measurement of radon gas in landfill gas wells installed along the boundaries of Areas 1 and 2. The covered area of the on-site cell would also be of concern with respect to monitoring for sub-surface gases for this "Complete Rad Removal" with On-Site Cell alternative. In addition to the gas monitoring wells around Areas 1 and 2, it is assumed that approximately 29 gas monitoring wells spaced approximately 100 feet apart around the perimeter of the on-site cell (Figure 3-2) would be sampled and analyzed for radon gas.

A one-time radon flux monitoring campaign would be performed upon completion of the final cover surface of the on-site engineered cell. Radon flux would be measured using the LAACCs, as described previously in Section 3.1.1. It was assumed that approximately 10 LAACCs would be placed on the cover of the on-site disposal cell. The LAACC samplers would be distributed to provide coverage at a rate of approximately one per acre. This proposed measurement campaign may change as more information becomes available during remedy design.

3.4 Gamma Radiation

As discussed in Sections 2.2.1.2, 2.2.2.2, and 2.2.3.2, the Final Status Surveys for each area will serve as the baseline survey of gamma radiation after remedy construction is complete.

4 LONG-TERM MONITORING

Long-term monitoring landfill gas, groundwater, and surface water as well as annual post-construction site inspections would be conducted after the remedy would be constructed to verify that the constructed remedy would be performing as designed. Long-term air monitoring would not be performed because after construction completion the windborne transport mechanism for gases and dust would no longer exist.

This section provides a conceptual overview of the types of systems and equipment that would be used to monitor potential exposure and emissions after construction would be complete. For purposes of preparing a monitoring plan for the SFS it is assumed that the level of potential exposure would be low for the three alternatives under consideration and that the constructed remedy would have reduced potential exposures to the point that they would be indistinguishable from normal background using current technology. A detailed long-term monitoring plan would be developed as part of the remedial design for the selected remedy.

4.1 Long-term Monitoring Following Construction of the ROD Remedy

4.1.1 Long-term Landfill Gas Monitoring

Landfill gas would be monitored following construction of the cover over Areas 1 and 2 as part of the Long-Term Monitoring Program for the ROD remedy using the approximately 31 subsurface gas monitoring wells discussed in Section 3.1.2. Gas samples would be analyzed for methane (as a percentage of total air volume or as a percentage of LEL) and percent volume of oxygen using a multi-gas detector (e.g., Industrial Scientific iBrid™ MX6). The radon content of each gas sample would also be measured using a radon gas monitor and detector. In addition, the barometric pressure at the time of gas sample collection would be recorded.

In accordance with the MDNR Solid Waste Management Program technical bulletin *Sampling of Landfill Gas Monitoring Wells* (MDNR, 2006); gas monitoring would be conducted quarterly during the months of February, May, August, and November. Depending on weather conditions, consideration would also be given to sampling at those times when landfill gas would be most likely to migrate (i.e., when barometric pressure is low and soils are saturated, when snow cover is just beginning to melt, and/or when the ground is frozen or ice covered).

4.1.2 Long-term Groundwater Monitoring

One of the primary objectives of the ROD remedy would be to protect groundwater from any ongoing or future impacts from Areas 1 and 2. The landfill cover over Areas 1 and 2 would be designed and constructed to shed water and minimize the potential for precipitation to infiltrate waste materials. Therefore, the cover would be expected to further reduce the potential for migration of contaminants from Areas 1 and 2 to the shallow groundwater underlying the site.

A long-term groundwater monitoring program would be established to demonstrate that the ROD remedy performs as required over the post-closure period. Also, as requested in the EPA Office of Superfund Remediation and Technology Innovation (OSRTI) memorandum of May 21, 2009 to EPA Region 7, the groundwater monitoring program would be designed so that it can be determined whether contaminants from the landfill have migrated across the waste management unit boundary in concentrations that exceed drinking water Maximum Contaminant Levels (MCLs). The plan would have a groundwater monitoring component and a detection monitoring component. Statistical evaluation of groundwater data would be used to assess groundwater quality and identify long-term trends.

The exact scope and requirements for the long-term groundwater monitoring component of the selected remedy would be set forth in the remedial design documents. Any design and implementation of a long-term groundwater monitoring program would be expected to meet the substantive requirements of the UMTRCA groundwater protection and monitoring requirements and the MDNR post-closure regulations for closed solid waste landfills.

A conceptual groundwater monitoring plan for the ROD remedy was developed as part of the FS (EMSI, 2006). For purposes of estimating monitoring costs for this SFS, the point of compliance for groundwater monitoring is assumed to consist of those portions of the boundaries of Areas 1 and 2 that would be coincident with the boundary of the West Lake Landfill. Specifically, this would include the northeastern boundary of Area 1 and the northeastern, northern, northwestern and western boundaries of Area 2. The point of compliance used for this evaluation does not include the other boundaries of Areas 1 and 2 as these boundaries would be located internal to and within the overall boundary of the site and therefore would be adjacent to areas containing other landfill wastes making compliance monitoring along these boundaries impractical.

In this SFS evaluation it was assumed that 16 existing groundwater monitoring wells shown on Figure 4-2 would be reconditioned and monitored before use. These wells would be sampled quarterly for three years to characterize baseline conditions. After the first three years of baseline monitoring, it is assumed that the groundwater monitoring would be conducted twice a year for the next two years. After five years, the rate of sampling would be reduced to once every two years to identify any changes that may occur in the future.

Groundwater samples would be analyzed for gross alpha and beta, uranium and radium isotopes, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), trace metals, mercury, total organic carbon (TOC), major anions and cations, phosphorus, and ammonia as required by the UMTRCA groundwater protection standards and the MDNR regulations (see Table 4-1 in FS). During the sample collection process, water level elevations and field parameters (e.g., pH, specific conductance, turbidity, temperature, and redox potential) would be recorded. Also, as requested in the EPA OSRTI memorandum of May 21, 2009 to EPA Region 7, in addition to those contaminants that have historically been detected in concentrations above MCLs (e.g., benzene, chlorobenzene, dissolved lead, total lead, dissolved arsenic, dissolved radium, and total radium), broader indicators of contamination (e.g., alkalinity, carbonates, and sulfates/sulfides) would analyzed in the collected samples. Both filtered and unfiltered samples would be collected in the field and analyzed in the laboratory.

As with any alternative, the exact number and locations of the wells to be monitored, the parameters for which they would be monitored, and the frequency at which they would be monitored would be determined as part of the remedial design activities. The description of the wells to be monitored, analyte list, and monitoring frequency presented above is intended solely to provide a basis for developing an estimated cost for long-term groundwater monitoring following construction of the ROD remedy.

4.1.3 Long-term Surface Water Monitoring

Two surface water samples would be collected on the same sample schedule and analyzed for the same parameters as the groundwater monitoring samples. As shown on Figure 4-3, it is assumed that one surface water sample would be collected from the Missouri River at a location upstream and a second sample would be collected at a location downstream from where storm water from the West Lake Landfill surface would discharge into the Missouri River.

4.1.4 Annual Post Construction Site Inspections

Every year the surface of the cover constructed over Areas 1 and 2 would be inspected to assess whether any significant changes have occurred.

Annual long-term monitoring results would be validated and compiled along with environmental monitoring results from previous years in a database and archived in a secure, accessible location. Monitoring results would be made available to the regulatory agency team conducting the Comprehensive Five-Year Reviews of the remedy (OSWER Directive 9355.7-03B-P). The frequency and extent of post-construction site inspections would be subject to reassessment as a result of each Five-Year Review. Estimated costs for compiling, reporting, and maintaining monitoring results are included in the long-term monitoring costs provided in Appendix I of the SFS for the ROD remedy.

4.2 Long-term Monitoring - "Complete Rad Removal" with Off-site Disposal Alternative

4.2.1 Long-term Landfill Gas Monitoring

Under the "Complete Rad Removal" with Off-Site Disposal Alternative, all RIM would have been removed from Areas 1 and 2. Therefore, samples from subsurface gas wells installed around Areas 1 and 2 would only be analyzed for methane and percent volume of oxygen. It is assumed for purposes of this SFS that the same number of subsurface gas monitoring wells would be installed and monitored as those for the ROD remedy (Figure 3-1).

4.2.2 Long-term Groundwater Monitoring

Although under the "Complete Rad Removal" with Off-Site Disposal Alternative, RIM would have been removed from the Site, it is assumed for purposes of this SFS that the same groundwater monitoring wells shown on Figure 4-2 for the ROD remedy would be monitored. Further, it is assumed that the frequency of monitoring and parameters analyzed would also be the same as those described previously for the ROD remedy in Section 4.1.2.

4.2.3 Long-term Surface Water Monitoring

It is assumed that the same long-term surface water monitoring program described for the ROD remedy in Section 4.1.3 would be implemented for this "Complete Rad Removal" with Off-Site Disposal alternative.

4.2.4 Annual Post Construction Site Inspections

Every year the surface of the Subtitle D cover constructed over Areas 1 and 2 after the RIM would have been removed would be inspected to assess whether any significant changes have occurred.

Annual long-term monitoring results would be compiled along with environmental monitoring results from previous years and archived in a secure, accessible location. Long-term monitoring results would be made available to the regulatory agency team conducting the Five-Year Reviews of the remedy. The estimated costs for compiling, reporting, and maintaining monitoring results are included in the long-term monitoring costs provided in Appendix I of the SFS for the "Complete Rad Removal" with Off-Site Disposal Alternative.

4.3 Long-term Monitoring Following "Complete Rad Removal" with On-Site Disposal Cell Alternative

4.3.1 Long-term Landfill Gas Monitoring

Since all RIM would have been removed from Areas 1 and 2, samples from the approximately 31 subsurface gas wells installed around Areas 1 and 2 (Figure 3-2) would only be analyzed for methane and percent volume of oxygen. The number (approximately 29) and location (Figure 3-2) of gas monitoring wells for the covered area of the on-site cell were discussed previously in Section 3.3.2. Because RIM would be contained in the on-site cell, these wells would be monitored for both radon gas and methane.

4.3.2 Long-term Groundwater Monitoring

For this "Complete Rad Removal" with On-Site Disposal Cell alternative, it is assumed that the same 16 existing groundwater monitoring wells described for the other two alternatives plus 10 additional new groundwater monitoring wells constructed around the on-site cell shown on Figure 4-3 would be sampled for the long-term groundwater monitoring program. The frequency of monitoring and parameters analyzed would also be the same as those described previously for the ROD remedy in Section 4.1.2. For purposes of costing, it is assumed that construction of new monitoring wells would be to a depth of approximately 20 feet below the bottom liner of the on-site disposal cell. The number, locations, and depths of the new groundwater monitoring wells around the on-site cell as well as the frequency of monitoring and parameters analyzed would be determined during remedial design.

4.3.3 Long-term Surface Water Monitoring

It is assumed that the same long-term surface water monitoring program described for the ROD remedy in Section 4.1.3 would be implemented for this "Complete Rad Removal" with On-Site Disposal Cell alternative.

4.3.4 Annual Post Construction Site Inspections

Every year the surface of the Subtitle D cover constructed over Areas 1 and 2 after the RIM would have been removed and the covered area of the on-site cell would be inspected to assess whether any significant changes have occurred.

Annual long-term monitoring results would be compiled along with environmental monitoring results from previous years and archived in a secure, accessible location. Long-term monitoring results would be made available to the regulatory agency team conducting the Five-Year Reviews of the remedy. The estimated costs for compiling, reporting, and maintaining monitoring results are included in the long-term monitoring costs provided in Appendix I of the SFS for the "Complete Rad Removal" with On-Site Disposal Cell Alternative.

5 SUMMARY OF MONITORING FOR EACH ALTERNATIVE

A summary table listing the types of monitoring assumed for the purpose of generating estimated costs is provided in Table 5-1. Specific types of monitors and the number of monitor types would likely change to some degree during remedy design and construction.

6 REFERENCES

Engineering Management Support, Inc. (EMSI), 2006, Feasibility Study, West Lake Landfill Operable Unit 1, May 8.

Missouri Department of Natural Resources (MDNR), 2006, Solid Waste Management Program (SWMP) Technical Bulletin *Sampling of Landfill Gas Monitoring Wells,* June.

MDNR, 2007, SWMP Fact Sheet *Design and Construction of Landfill Gas Monitoring Wells*, January.

United States Environmental Protection Agency (USEPA), 1986, “Radon Flux Measurements on Gardinier and Royster Phosphogypsum Piles Near Tampa and Mulberry, Florida”, EPA 520/5-85-029, January.

Tables

Table 2-1: Short-term Health-Based Monitoring Responsibilities

Potential Exposure Source	Postulated Transport Mechanism	Receptors Evaluated	Constituents of Potential Concern	Controlling Short-term Monitoring Program
Exposed RIM	Suspension of particulates and transport as windborne dust	Remediation workers (e.g., survey techs, operators, waste handlers, and truck drivers)	Friable asbestos, metals, radioactive particles	Occupational Health & Safety Program
		Workers in adjacent businesses, off-property residents	Friable asbestos, metals, radioactive particles	Environmental Monitoring Program
	Emission of gas followed by windborne transport	Remediation workers (e.g., survey techs, operators, waste handlers, and truck drivers)	Methane, radon, hydrogen sulfide, mercaptans, etc.	Occupational Health & Safety Program
		Workers in adjacent businesses, off-property residents	Methane, radon, hydrogen sulfide, mercaptans, etc.	Environmental Monitoring Program
	Irradiation due to proximal exposure	Remediation workers (e.g., survey techs, operators, waste handlers, and truck drivers)	Predominately radium-226	Occupational Health & Safety Program
		Workers in adjacent businesses, off-property residents	Receptors not located next to RIM, pathway not considered further	None
	Direct contact with exposed RIM	Remediation workers (e.g., survey techs, operators, waste handlers, and truck drivers)	None. Workers required to wear appropriate PPE	Occupational Health & Safety Program (workers would be monitored during operations)
		Workers in adjacent businesses, off-property residents	Receptors not located next to RIM, pathway not considered further	None

Table 2-1: Short-term Health-Based Monitoring Responsibilities

Potential Exposure Source	Postulated Transport Mechanism	Receptors Evaluated	Constituents of Potential Concern	Controlling Short-term Monitoring Program
Excavated RIM (Only for "Complete Rad Removal" Alternatives)	Loose RIM on trucks leaving restricted areas	Remediation workers (e.g., survey techs, operators, waste handlers, and truck drivers)	Predominately isotopes of uranium, thorium, and radium.	Occupational Health & Safety Program (equipment release and safe work practices would be monitored)
		Workers in adjacent businesses, off-property residents	Trucks would be surveyed and decontaminated if necessary before leaving contaminated areas, pathway not considered further	None
	Radiation from RIM in trucks	Remediation workers (e.g., survey techs, operators, waste handlers, and truck drivers)	Predominately radium-226	Occupational Health & Safety Program (PPE would be monitored during operations)
		Receptors near roads	Exposure durations very limited, partial shielding by truck, dosimeters on drivers would provide upper-bound exposure.	Occupational Health & Safety Program (worker dosimetry would be monitored)

Table 2-1: Short-term Health-Based Monitoring Responsibilities

Potential Exposure Source	Postulated Transport Mechanism	Receptors Evaluated	Constituents of Potential Concern	Controlling Short-term Monitoring Program
Excavated RIM (Only for "Complete Rad Removal" Alternatives)	Loose RIM on trucks leaving restricted areas	Remediation workers (e.g., survey techs, operators, waste handlers, and truck drivers)	Predominately isotopes of uranium, thorium, and radium.	Occupational Health & Safety Program (equipment release and safe work practices would be monitored)
		Workers in adjacent businesses, off-property residents	Trucks would be surveyed and decontaminated if necessary before leaving contaminated areas, pathway not considered further	None
	Radiation from RIM in trucks	Remediation workers (e.g., survey techs, operators, waste handlers, and truck drivers)	Predominately radium-226	Occupational Health & Safety Program (PPE would be monitored during operations)
		Receptors near roads	Exposure durations very limited, partial shielding by truck, dosimeters on drivers would provide upper-bound exposure.	Occupational Health & Safety Program (worker dosimetry would be monitored)

Table 2-2: Projected Elements of Occupational Health and Safety Monitoring During Construction

Monitoring Location	Sampler Type	Number of Monitors	Parameters of Concern
On-site in areas of exposed RIM	Air pumps with air filters	1 per work area	Total alpha and total beta, asbestos, total mass of particulates and arsenic if mass exceeds threshold level
	Portable monitors for volatile and explosive gases	1 per work area	Methane, misc. volatile organics
	Portable monitors for radon-222 gases	1 per work area	Radon-222
	Radiation dosimeters	1 per worker	Personal gamma radiation doses accrued over time
	Hand held radiation detection instruments	2 per work area	Exposure rates
	Hand held radiation detection instruments, smears	1 per work area	Total and removable surface contamination (rad)

Table 2-3: Projected Elements of Environmental Monitoring During Construction

Monitoring Location	Sampler Type at Location	Parameters of Concern
ALL ALTERNATIVES 3 at targeted locations: 1-Closest occupied building 1-Community and 1-Background locations	Metered air pump with dual chamber sampler for particulate fiber filter and PUF (Polyurethane Foam) plug	Total alpha and total beta, asbestos, total mass of particulates, arsenic if mass exceeds threshold level
	Radon gas monitor	Radon
	Radon daughter monitor	Radon daughters
	Radiation dosimeters	Cumulative radiation dose at that location
ROD REMEDY 12 additional perimeter + 3 targeted locations	Metered air pump with particulate filter.	Total alpha and total beta, asbestos, total mass of particulates, arsenic if mass exceeds threshold level
	Radon gas monitor	Radon
	Radiation dosimeters	Cumulative radiation dose at that location
"COMPLETE RAD REMOVAL" & OFF-SITE DISPOSAL 12 additional perimeter + 3 targeted locations	Metered air pump with particulate filter.	Total alpha and total beta, asbestos, total mass of particulates, arsenic if mass exceeds threshold level
	Radon gas monitor	Radon
	Radiation dosimeters	Gamma radiation doses accrued over time
"COMPLETE RAD REMOVAL" & ON-SITE DISPOSAL 16 additional perimeter + 3 targeted locations	Metered air pump with particulate filter	Total alpha and total beta, asbestos, total mass of particulates, arsenic if mass exceeds threshold level
	Radon gas monitor	Radon
	Radiation dosimeters	Cumulative radiation dose at that location

Table 5-1: Types of Monitoring Included in Cost Estimates for Each Alternative

Site Status and Monitoring Program		Monitor Type	ROD Remedy	"Complete Rad Removal" & Off-site Disposal	"Complete Rad Removal" & On-site Disposal
During Construction	Short-term Environmental Monitoring	Static perimeter monitoring stations	12	12	16
		Static community monitoring stations	1	1	1
		Static monitor at nearest occupied building	1	1	1
		Static background monitoring stations	1	1	1
	Short-Term Occupational Health and Safety Monitoring	Area air samplers	1 per exposed area		
		Portable gas monitor	1 per exposed area		
		Portable radon gas monitor	1 per exposed area		
		Personal air samplers	1 per exposed area		
		Hand-held radiation detection instruments	2 per area		
		Smears	As needed		
		Radiation dosimeter	1 per remediation worker		
Baseline	Radon Attenuation	One-time radon flux measurement	50	0	10
		Sub-surface gas monitoring	31	31	60
Long-term Post-Construction	Long-term Environmental Monitoring	Groundwater monitoring wells	16	16	26
		Surface water sampling locations	2	2	2
		Sub-surface gas monitoring	31	31	60

Figures

Source: MyTopo.com Date of Photograph 8/9/2007

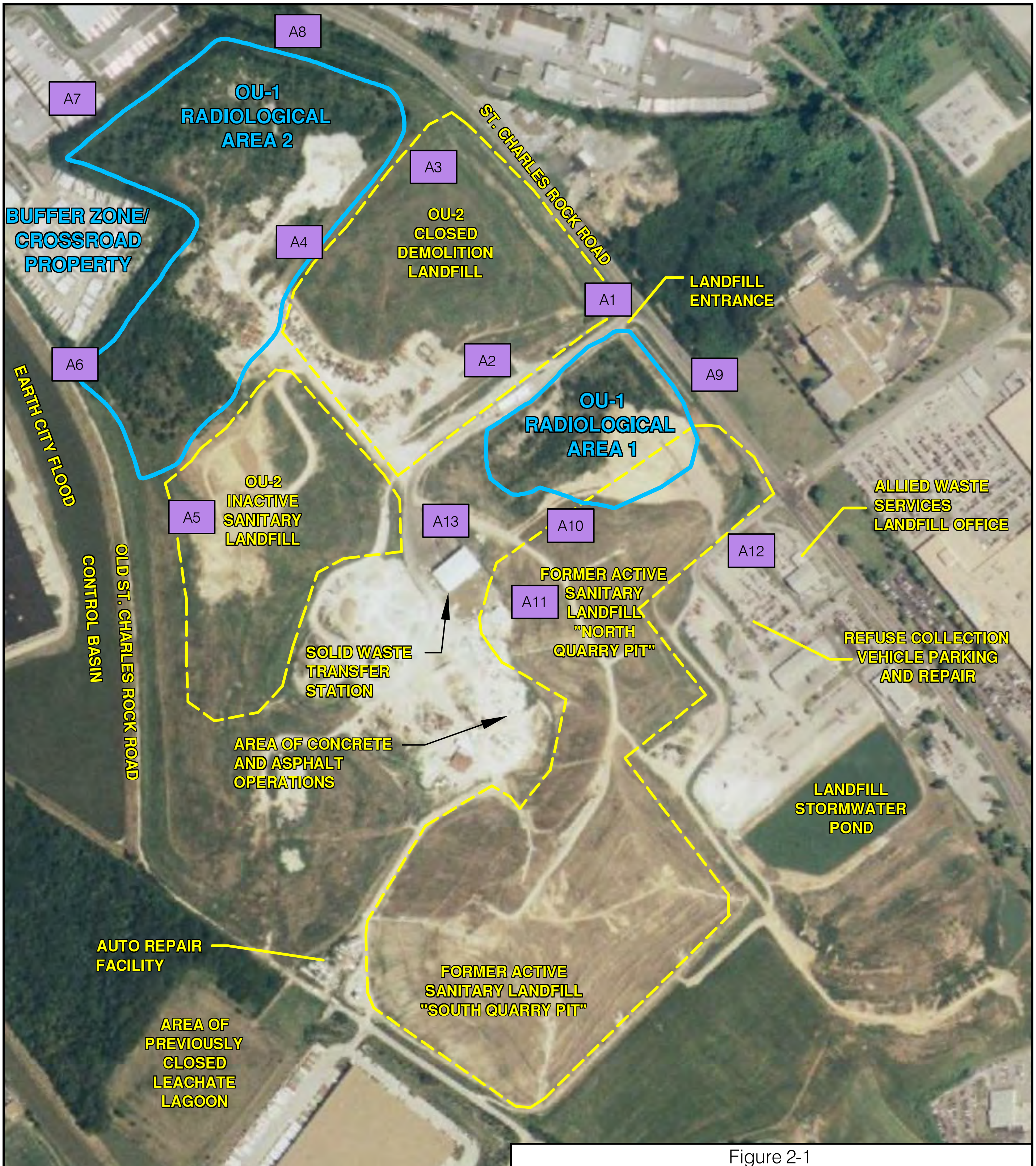
Figure 1-1

Site and Surrounding Land Uses

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

M:\clients\EMSI\westlake\2011\SFS-figs\WL-Fig-1-1.dwg plotted: 02/28/2011



Source: MyTopo.com Date of Photograph 8/9/2007

Legend

An Environmental Monitoring Station

Note: Locations for the "Background" and "Local Community" monitoring stations would be determined during the Remedial Design phase.

N

0 600
SCALE IN FEET

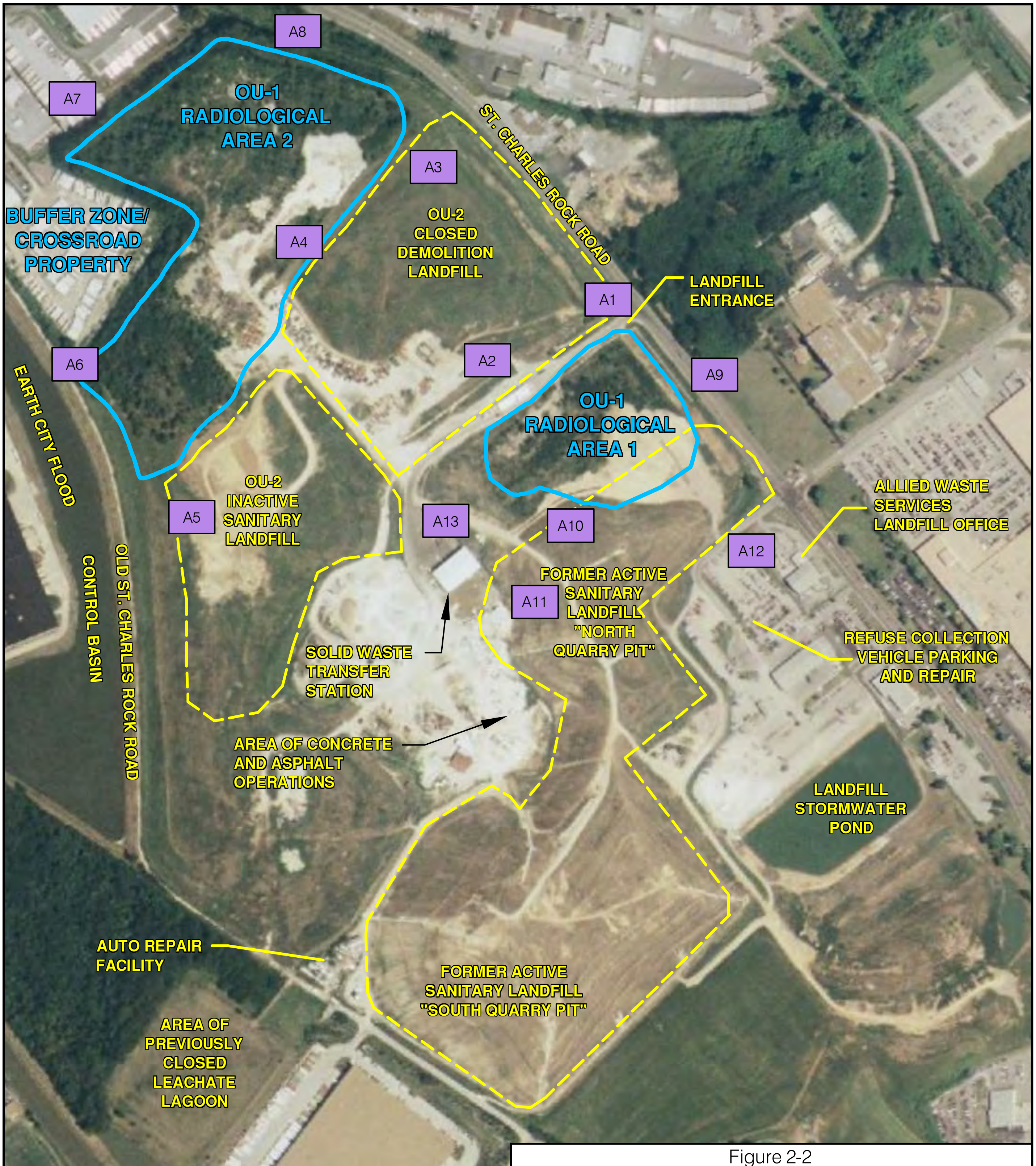
Figure 2-1

Potential Locations of Environmental Monitoring Stations for the ROD Remedy

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

M:\clients\EMSI\westlake\2011\SFS-figs\WL-Fig-2-1.dwg plotted: 09/29/2011



Source: MyTopo.com Date of Photograph 8/9/2007

Legend

An	Environmental Monitoring Station

Note: Locations for the "Background" and "Local Community" monitoring stations would be determined during the Remedial Design phase.

0 600
SCALE IN FEET

N

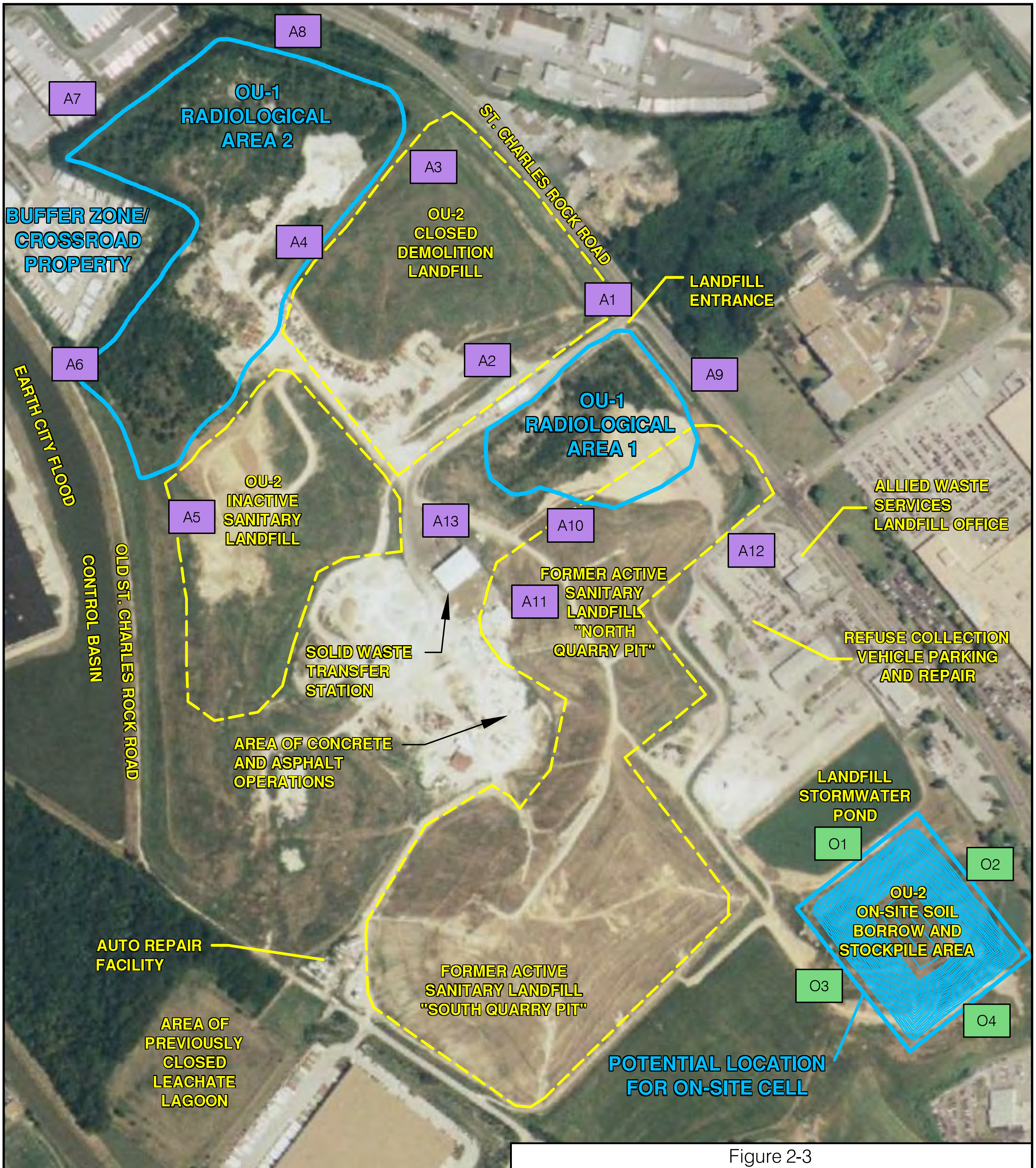
Figure 2-2

Potential Locations of Environmental Monitoring Stations for the Complete Rad Removal with Off-Site Disposal Alternative

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

M:\clients\EMSI\westlake\2011\SFS-figs\WL-Fig-2-2.dwg plotted: 09/29/2011



M:\clients\EMSI\westlake\2011\SFS-figs\WL-Fig-2-3.dwg plotted: 09/29/2011

Source: MyTopo.com Date of Photograph 8/9/2007

Legend

An Environmental Monitoring Station

On Environmental Monitoring Station for On-Site Cell (if Option Selected)

Note: Locations for the "Background" and "Local Community" monitoring stations would be determined during the Remedial Design phase.

0 600
SCALE IN FEET

N

Figure 2-3

Potential Locations of Environmental Monitoring Stations for the Complete Rad Removal with On-Site Cell Alternative

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

Source: MyTopo.com Date of Photograph 8/9/2007

Legend

Landfill Gas and Radon Monitoring Well

0 600
SCALE IN FEET

N

Figure 3-1

Potential Locations of Landfill Gas and Radon Monitoring Wells (ROD Remedy and Complete Rad Removal with Off-Site Disposal Alternative)

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

M:\clients\EMSI\westlake\2011\SFS-figs\WL-Fig-3-1.dwg plotted: 09/29/2011

Source: MyTopo.com Date of Photograph 8/9/2007

Legend

Landfill Gas and Radon Monitoring Well

Figure 3-2

Potential Locations of Landfill Gas and Radon Monitoring Wells (Complete Rad Removal with On-Site Cell Alternative)

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

M:\clients\EMSI\westlake\2011\SFS-figs\WL-Fig-3-2.dwg plotted: 09/29/2011

Source: MyTopo.com Date of Photograph 8/9/2007

Legend

Existing Monitoring Well

0 600

SCALE IN FEET

N

Figure 4-1

Potential Locations of Groundwater Monitoring Wells (ROD Remedy and Complete Rad Removal with Off-Site Disposal Alternative)

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

M:\clients\EMSI\westlake\2011\SFS-figs\WL-Fig-4-1.dwg plotted: 09/29/2011

M:\clients\EMSI\westlake\2011\SFS-figs\WL-Fig-4-2.dwg plotted: 03/01/2011

Source: Bing Maps

Legend

▲ Potential Surface Water Sample Location

0 1/4

Approximate Scale in Miles

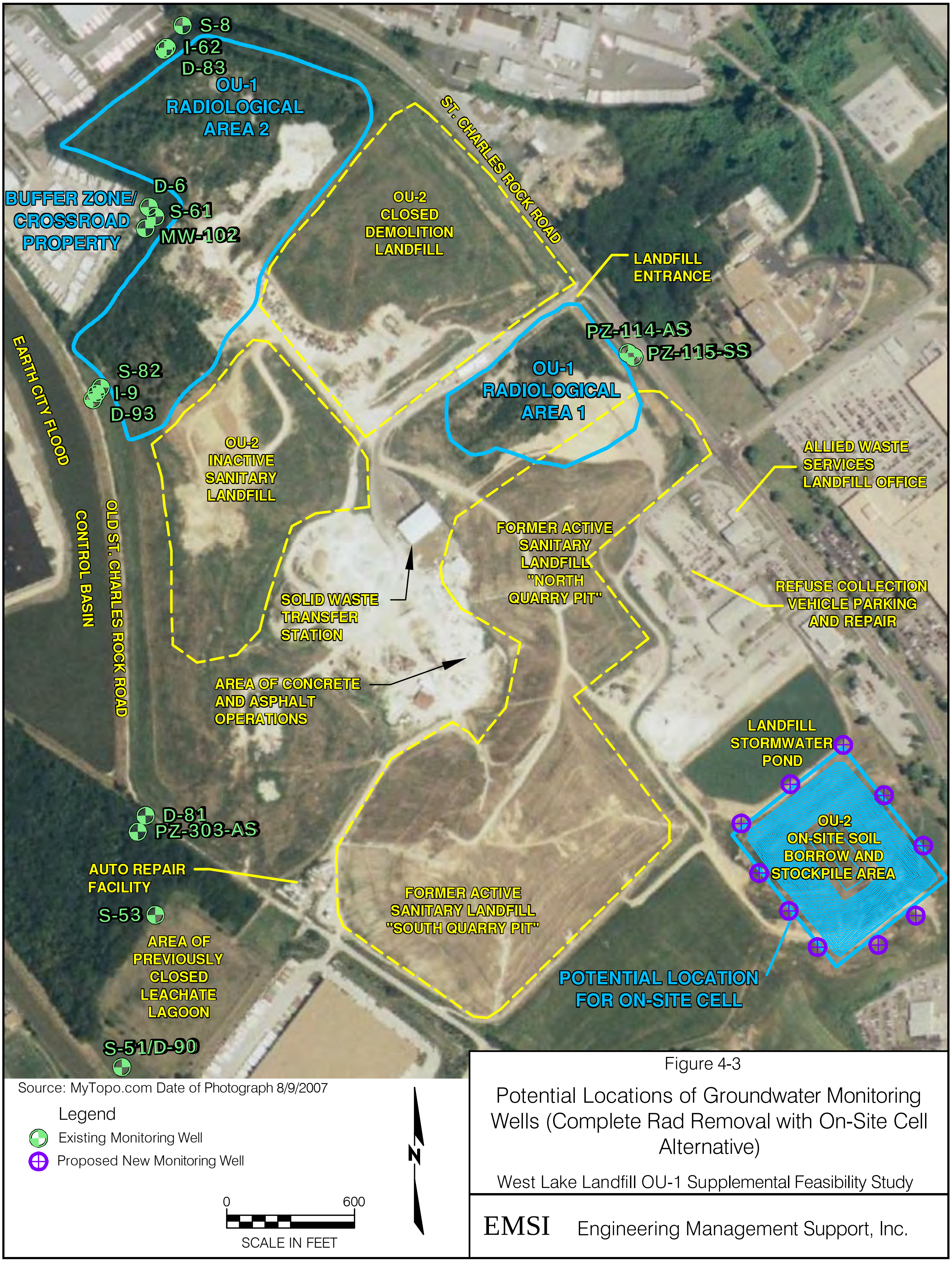
N

Figure 4-2

Potential Surface Water Sampling Locations

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.



Source: MyTopo.com Date of Photograph 8/9/2007

Figure 4-3

Potential Locations of Groundwater Monitoring Wells (Complete Rad Removal with On-Site Cell Alternative)

West Lake Landfill OU-1 Supplemental Feasibility Study

EMSI Engineering Management Support, Inc.

M:\clients\EMSI\westlake\2011\SFS-figs\WL-Fig-4-3.dwg plotted: 09/29/2011

APPENDIX H

Evaluation of Potential Risks Associated with the Proposed Remedial Alternatives

Evaluation of Potential Risks Associated with the Proposed Remedial Alternatives

FOR THE

Supplemental Feasibility Study

Radiologically-Impacted Material Excavation Alternatives Analysis West Lake Landfill Operable Unit-1

Prepared for

The United States Environmental Protection Agency Region 7

Prepared on behalf of

The West Lake Landfill OU-1 Respondents

Prepared by:

Auxier & Associates, Inc.
9821 Cogdill Road, Suite 1
Knoxville, Tennessee 37932
(865) 675-3669
www.auxier.com

December 13, 2011

TABLE OF CONTENTS

SECTION **PAGE**

LIST OF TABLES

TABLE OF FIGURES

TABLE OF EXHIBITS

1 INTRODUCTION

The Record of Decision (ROD) remedy for Operable Unit-1 (OU-1) of the West Lake Landfill (the Site) was issued by US Environmental Protection Agency (EPA) Region 7 (Region 7) in May 2008. Under the remedy described in the ROD, radiologically-impacted materials (RIM) will remain in place under an enhanced engineered cover, will be made to the Site to meet the stated goals of the ROD.

EPA determined that additional work is necessary to accomplish the objectives of the Remedial Investigation/Feasibility Study (RI/FS) for the OU-1 of the West Lake Landfill. Specifically Region 7 has requested that a Supplemental Feasibility Study (SFS) that evaluates two "Complete Rad Removal" alternatives be performed. For purposes of comparison, this SFS includes the currently selected remedy as prescribed in the ROD as one of three remedies to be evaluated. As such, the three alternatives are as follows:

> **The remedy prescribed in the Record of Decision (ROD) -** Under this alternative, the RIM would remain in place and improvements, including installation of an engineered cover as specified in the ROD. This design protects human health and the environment by using an engineered cap to cover the RIM and isolate the radioactive material from human receptors and the environment.
>
> **"Complete Rad-Removal" followed by off-site disposal -** This alternative provides for the RIM to be excavated from Areas 1 and 2 and transported to an off-site disposal facility that is permitted to receive radioactive materials. The non-RIM overburden excavated to access the RIM would be returned to the excavated areas in Areas 1 and 2 after all RIM had been excavated and Areas 1 and 2 would be covered with a Subtitle D cap.
>
> **"Complete Rad-Removal" followed by on-site disposal -** This alternative would require construction of a new disposal cell on the landfill property, followed by excavation of the RIM from Areas 1 and 2 and placement of the RIM in the new cell. The new cell would be capped after all RIM was placed in the cell. The non-RIM overburden excavated to access the RIM would be returned to the excavated areas in Areas 1 and 2 after all RIM had been excavated and Areas 1 and 2 would be covered with a Subtitle D cap.

This Appendix contains evaluations of potential short-term and long-term risks associated with each alternative and the methods used to identify and quantify those risks. This Appendix has been prepared to be consistent with guidance provided in Risk Assessment Guidance for Superfund (RAGS) Parts A, B C, and F (EPA 1989, EPA 1991a, EPA 1991b, and EPA 2009). This Appendix also contains information on projected, alternative-specific industrial hazards such as construction and traffic accidents for the three alternatives.

1.1 ORGANIZATION OF APPENDIX

Section 2 lists the objectives of this Appendix. Section 3 lists new information that has become available since publication of the ROD. An introduction to the human health risk assessment methods and general risk assessment information that applies to each of the three proposed remedies is presented in Section 4. Sections 5 through 7 present the long-term risks calculated for each alternative. Short-term risk methods and calculations common to all alternatives are presented in Section 8. Short-term assessments for the individual alternatives are presented in Sections 9 through 11. A summary of the findings presented in this Appendix are presented in Section 12. References are listed in Section 13.

2 OBJECTIVES

Evaluation of potential remedial alternatives requires assessment of potential long-term and short-term risks to help select the most appropriate remedy. The specific objectives of a risk assessment of potential remedial alternatives are:

- Estimate the magnitude of potential long-term health risks and environmental impacts that may be posed by the Site after implementation of each alternative;
- Estimate the magnitude of potential short-term health risks and environmental impacts associated with activities involved with implementation of each alternative;
- Identify the areas, environmental media, and contaminants that potentially pose human health and environmental concerns for each remedial alternative; and
- Identify the areas, environmental media, and contaminants that pose little or no threat to human health or the environment under each remedial alternative.

3 INCORPORATION OF UPDATED INFORMATION

The risk assessments in this SFS build on the baseline risk assessment (BRA) for OU-1 of the West Lake Landfill (Auxier 2000), as exposure scenarios are still applicable to the Site and its surroundings. A search of literature and on-line databases was performed to determine if subsequent changes to toxicity values had occurred that would affect the exposures or risks calculated in the BRA.

No physical changes have been made to Areas 1 and 2, and there is no reason to suspect that the nature and extent of the radiologically-impacted material (RIM) has changed since the BRA was published. Descriptions of the Site and its surroundings contained in the FS (EMSI 2006) were compared to the descriptions in the BRA and no new information was found that would impact the types and magnitudes of exposures and risks described in the BRA.

Updated information regarding toxicity, dose conversion factors, and cancer slope factors gathered from EPA's Integrated Risk Information System (IRIS) database and risk assessment websites were incorporated in this evaluation to assure that the risk assessments represent the best and most current possible evaluation of all risks. This toxicity information is presented in more detail in Section 4.2.3.

4 HUMAN HEALTH RISK ASSESSMENT METHODOLOGY

4.1 INTRODUCTION

In 2000 Auxier & Associates, Inc. completed a BRA for OU-1 of the West Lake Landfill (Auxier 2000). This assessment used EPA methodology to calculate risks to a variety of potential receptors assuming no corrective action was taken in two areas of the Site (Areas 1 and 2). The BRA determined that the reasonably maximally-exposed (RME) individual was a hypothetical on-site worker in Area 2. The total calculated risk to this RME individual would be approximately 4 x 10^{-04} with 95% of the risk attributable to exposure to radiation from radium-226 and its daughters in surface soil.

Health effects from three remedial alternatives are evaluated in this Appendix. In order to avoid repetition, methods and risk information that are common to all three alternatives are presented in the remainder of this section.

4.2 RISK ASSESSMENT INFORMATION COMMON TO ALL ALTERNATIVES

4.2.1 Identification of Constituents of Concern

OU-1 of the West Lake Landfill contains both radiological and chemical (non-radiological) constituents of concern (COC). The concentrations and toxicity of these constituents were identified and used in the BRA to focus the risk assessment on the chemicals and radionuclides most likely to produce risks above the 10^{-06} cancer risk point of departure. Since publication of the BRA, new toxicity information has been made available that required modification of some of the original values used in the BRA's toxicity screening evaluation. This information is summarized in the following two subsections.

4.2.1.1 Radionuclides of Concern

The BRA identified the radionuclides of concern at the West Lake Landfill as those associated with the naturally occurring uranium-238, thorium-232, and uranium-235 decay series. This information is still current. Table 4-1 reproduces the information in the Table of Radionuclides of Concern presented in the BRA and the indicator radionuclides for series radionuclides or coincident isotopes.

Table 4-1 Radionuclides of Concern in Soil at the West Lake Landfill

Indicator Radionuclides	Radionuclide or Decay Chain
Uranium-238	For Uranium-238 + 2 Daughters and for Uranium-234
Thorium-230	For Thorium-230 and as a source of Radium-226 in growth
Radium-226	For Radium-226 + 8 Daughters (including Radon-222 and Lead-210 and its daughters)
Thorium-232	For Thorium-232 + 10 Daughters
0.05 x [(Uranium-238+Uranium-234)/2] [a]	For Uranium-235 + 1 Daughter
Protactinium-231	For Protactinium-231 + 8 Daughters

a The BRA used this approach to calculate risks from uranium-235 (See Section A.2.2.1 of the BRA).

As in the BRA, radionuclides were not screened against local background values during the COC selection process and all detected radionuclides were carried through the risk assessment process for exposed soil. This conservative approach will slightly overestimate the site-related concentrations of the radiological component of the risk assessment.

4.2.1.2 Chemicals of Concern

The BRA also performed a toxicity screen of the chemicals that were reported at the Site. This toxicity screen has been updated to account for changes that have occurred since publication of the BRA. Table 4-2 presents the concentrations used in the screening evaluation and the results.

Table 4-2 Summary of Chemical Toxicity Screen for Surface Soil

Analyte	Risk- or HI-Based Industrial Screening Values [a] (mg/kg)	Maximum Soil Concentrations [b]: Area 1 (mg/kg)	Maximum Soil Concentrations [b]: Area 2 + Boundary (mg/kg)	Selection/Screening of COCs in Soils [c]: Area 1 0-1 ft	Selection/Screening of COCs in Soils [c]: Area 2 + Boundary 0-1 ft	Screening Result Changed from Baseline?
Inorganic Chemicals						
Arsenic	1.60×10^{00}	220	35	**YES**	**YES**	no
Beryllium	2.00×10^{03}	3.3	2.2 [f]	no	no	no
Cadmium	8.00×10^{02}	7.9	6.3 [f]	no	no	no
Chromium (VI)	5.60×10^{00}	31	49 [f]	**YES**	**YES**	**Added**
Copper	4.10×10^{04}	2,300	360	no	no	no
Lead	8.00×10^{02}	320	2,200	no	**YES**	no
Mercury	4.30×10^{01}	0.17	0.27	no	no	no
Nickel	2.00×10^{04}	3,600	680	no	no	no
Selenium	5.10×10^{03}	250	38	no	no	no
Thallium	1.00×10^{01}	1.2	NA [e]	no	no	no
Uranium	3.10×10^{03}	437.5	875	no	no	**Deleted**
Zinc	3.10×10^{05}	120	400 [f]	no	no	no
Organic Chemicals						
Acetone	6.30×10^{05}	0.034	0.038	no	no	no
Bis(2-ethylhexyl) phthalate	1.20×10^{02}	7.8	77	no	no	no
Di-n-octylphthalate	1.80×10^{03} [d]	3	12	no	no	no
1,4-Dichlorobenzene	1.20×10^{01}	0.042	0.0065	no	no	no
Fluoranthene	2.20×10^{04}	NA	8.5	no	no	no
Xylenes	2.70×10^{03}	0.037	0.012	no	no	no
Pesticides/PCBs						
Aldrin	1.00×10^{-01}	NA	0.0017	no	no	no
Aroclor-1254	7.40×10^{-01}	1.1	1.6	**YES**	**YES**	no
4,4'-DDD	7.20×10^{00}	NA	0.0076	no	no	no
4,4'-DDT	7.00×10^{00}	NA	0.0094	no	no	no

[a] Unless otherwise noted, values are from http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/, June, 2011. When carcinogenic (risk) and non-carcinogenic (hazard) based screening levels were given for a constituent, the lower of the two was selected.
[b] From Table A.2-1 of the BRA (Auxier 2000)
[c] "YES" signifies that the analyte was selected for quantitative risk evaluation, "no" signifies that analyte was not selected for quantitative risk evaluation.
[d] Value from BRA, no updated information identified.
[e] NA = not applicable/ not reported
[f] Measured on the former Ford property (current Buffer Zone and Crossroad Lot 2A2 properties) before surface grading were performed by the adjacent property owner.

Chromium (VI) has been added to the list of chemicals of concern because its maximum reported concentration exceeds the current published screening level of 5.6 mg/kg. [1] The current screening level published for elemental uranium has increased since publication of the BRA. The maximum concentration of elemental uranium is now below the current EPA Regional Screening Level of 3,100 mg/kg and elemental uranium has been removed from non-carcinogenic evaluations (individual isotopes of uranium remain as COCs because they are radiocarcinogens).

[1] http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/

4.2.2 Determination of Exposure Point Concentrations

Representative exposure point concentrations will depend on actions taken during implementation of each remedy. These concentrations will therefore differ between the evaluated alternatives. Representative concentrations for each alternative will be presented in each of the alternative-specific risk assessments.

4.2.3 Toxicity Assessment

The radionuclides selected for evaluation have not changed from those listed as COCs in the BRA. The chemical COCs have changed, based on the latest screening values (Table 4-2). This COC list is common to all alternatives.

4.2.3.1 Radiocarcinogens

EPA methodology relies on slope factors to convert the intake of radionuclides to risk. Slope factors for radionuclides have changed since the BRA was published. Slope factors for radionuclides of concern as of August 26, 2011 are listed in Table 4-3.

Table 4-3 Radiocarcinogenic Slope Factors

Radionuclide	Inhalation Slope Factor [a] (risk/pCi)	Adult Soil Ingestion Slope Factor [a] (risk/pCi)	Planer Soil External Exposure Slope Factor [a] (risk/y per pCi/g)	Immersion External Exposure Slope Factor [a] (risk/y per pCi/m^3)
Uranium Series				
Uranium-238 + dtrs	$9.35x10^{-09}$	$5.62x10^{-11}$	$1.14x10^{-07}$	$1.22x10^{-10}$
Uranium-234	$1.14x10^{-08}$	$5.11x10^{-11}$	$2.52x10^{-10}$	$5.10x10^{-13}$
Thorium-230	$2.85x10^{-08}$	$7.73x10^{-11}$	$8.19x10^{-10}$	$1.31x10^{-12}$
Radium-226 + all dtrs [b]	$2.55x10^{-08}$	$1.19x10^{-09}$	$8.49x10^{-06}$	$7.88x10^{-09}$
Radon-222 + dtrs	$1.80x10^{-11}$	NA	$8.48x10^{-06}$	$7.85x10^{-09}$
Actinium Series				
Uranium-235 + 1 dtr	$1.01x10^{-08}$	$5.03x10^{-11}$	NA	NA
Protactinium-231 + all dtrs [c]	$2.30x10^{-07}$	$3.75x10^{-10}$	$1.61x10^{-06}$	$1.71x10^{-09}$
Thorium Series				
Thorium-232 + 10 dtrs [d]	$1.81x10^{-07}$	$8.19x10^{-10}$	$2.01x10^{-05}$	$1.86x10^{-08}$

[a] Slope factor values list on this table were obtained on August 26, 2011 from http://epa-prgs.ornl.gov/cgi-bin/radionuclides/rprg_search.

[b] Composite slope factor includes contributions from Ra-226 + dtrs and Pb-210+ Po-210+Bi-210.

[c] Composite slope factor includes contributions from Pa-231, Ac-227, Th-227, and Ra-223+dtrs.

[c] Composite slope factor includes contributions from Ra-228+dtrs, Th-228¸and Ra-224 + dtrs.

4.2.3.2 Carcinogenic Chemicals

Updated oral slope factors and inhalation unit risks for chemicals of concern are listed Table 4-4.

Table 4-4 Carcinogenic Chemical Slope Factors

Chemical	CAS	Oral Slope Factor [a] (kg-day/mg)	Inhalation Unit Risk [a] ($m^3/\mu g$)
Aroclor-1254	011097-69-1	2.0×10^{00}	5.71×10^{-04}
Arsenic, Inorganic	007440-38-2	1.50×10^{00}	4.30×10^{-03}
Chromium (VI)	018540-29-9	5.00×10^{-01}	8.40×10^{-02}
Lead and Compounds	007439-92-1	ND [b]	ND [b]

[a] http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/, August 26, 2011.
[b] ND signifies that data were not defined. EPA uses modeled blood concentrations to evaluate potential health effects from lead exposures.

4.2.3.3 Non-Carcinogenic Chemicals

Information about health effects from chronic exposures to chemicals has changed since publication of the BRA in 2000. The latest information is publicly available at http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm. On August 26, 2011, updated values for chemical toxicity were retrieved from this site. Those values are reproduced in Table 4-5.

Table 4-5 Non-Carcinogenic Chemical Toxicity Values

Chemical	CAS	Chronic Oral Reference Dose [a] (mg/kg-day)	Chronic Inhalation Reference Concentration [a] (mg/m^3)
Aroclor-1254	011097-69-1	2.00×10^{-05}	-
Arsenic, Inorganic	007440-38-2	3.00×10^{-04}	1.50×10^{-05}
Chromium (VI)	018540-29-9	3.00×10^{-03}	1.00×10^{-04}
Lead and Compounds	007439-92-1	ND [b]	ND [b]

[a] http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/, August 26, 2011.
[b] ND signifies that data were not defined. EPA uses modeled blood concentrations to evaluate potential health effects from lead exposures.

4.2.4 Risk Assessment Methods Used

The construction phase of all alternatives considered in this study are expected to produce direct exposure to RIM while implementing the remedy and all will leave some RIM in place at the West Lake Landfill. Even the “Complete Rad Removal” alternatives will leave RIM with concentrations below cleanup levels in Areas 1 and 2. Any RIM remaining on-site will be covered by a RCRA Subtitle D solid waste landfill cover designed to comply with structural and performance standards associated with the closure and post-closure requirement of the Missouri solid waste regulations. In the case of Areas 1 and 2 under the ROD-Selected Remedy or the on-site disposal cell included under the “Complete Rad Removal” with on-site disposal alternative, the solid waste landfill cover would also include a rock/concrete rubble biointrusion/marker layer.

The BRA determined that, out of all the receptors evaluated, outdoor workers (long-term maintenance workers) have the highest risks from exposure to the RIM. The exposure routes that contributed over 99% of the total health effects were:

- incidental ingestion of surface soil,
- inhalation of airborne particulates emitted from surface soil, and
- direct exposure to ionizing radiation emanating from surface soils.

Sections 4.2.4.1 and 4.2.4.2 describe how risks from radiocarcinogens were assessed for exposed and covered RIM. Section 4.2.4.3 contains a quantitative comparison of the two methods. The method used to calculate carcinogenic and non-carcinogenic effects from nonradioactive chemicals in exposed RIM were evaluated in Section 4.2.4.4.

4.2.4.1 Risk Assessment Method Used for Radionuclides in Exposed RIM

Radiocarcinogenic risks involving contact with surface soils were calculated using results obtained from the EPA's web-based preliminary remediation goal (PRG) calculator[2] The PRG calculator provides PRG's radiocarcinogens in exposed soil, one for each exposure route. Using a target risk (TR) of 10^{-06} and the EPA web calculator's default parameters for outdoor worker exposures, it can be determined that the PRG for radium-226 and its short-lived daughters in soil from all exposure routes is 0.0248 pCi/g. Stated another way, every pCi/g of radium-226 in soil can increase the calculated risk of cancer to the hypothetical outdoor receptor by approximately 4.032×10^{-05} (10^{-06} / 0.0248). The EPA web calculator also provides PRGs for individual exposure routes. In this example, the PRG for the external exposure pathway is 0.0249 pCi/g and each additional pCi/g yields an incremental risk of 4.016×10^{-05} (10^{-06} / 0.0249). Comparing these risk numbers, it can be seen that direct radiation from radium and its daughters in exposed soils contribute approximately 99.6% of the risk to the receptor.[3]

In this SFS, risks to specific workers from surface soil will be evaluated using the method presented on the EPA website and illustrated above. However, assessment of carcinogenic risks to individual types of workers identified during the scheduling and manpower evaluation stages of this study may require job-specific changes in parameters such as exposure time and duration. Changes in these parameters and their justifications will be presented as part of the risk evaluation for those jobs. Because the relationship between risk and exposure is linear in nature, the risk results will change linearly with changes in either exposure times or durations. For example, if the calculated risk from 45,000 hours[4] of exposure to soil containing 1 pCi/g of radium-226 is 4.0×10^{-05}, then exposure to the same soil for only one hour will be 1/45,000th of that risk or 8.9×10^{-10} per pCi/g per hour and a 1,000 hour exposure would yield a calculated risk of 8.9×10^{-07}.

---

[2] http://epa-prgs.ornl.gov/cgi-bin/radionuclides/rprg_search

[3] Significant figures are provided for illustration and are not indicative of accuracy or precision.

[4] http://epa-prgs.ornl.gov/cgi-bin/radionuclides/rprg_search. EPA's outdoor worker receptor assumes the worker is present for 8 hours a day, 225 days/year for 25 years, or 25 years x 225 days/year x 8 hour/day = 45,000 hours of exposure.

4.2.4.2 Risk Assessment Method Used for Radionuclides in Covered RIM

EPA's PRG calculator calculates risks from radionuclides in surface soils. The PRG calculator does not evaluate risks from buried materials. Two of the alternatives assessed in this SFS involve leaving all RIM securely buried beneath an enhanced engineered cover on-site. Exposure pathways from covered RIM to receptors on the surface of the landfill are limited to exposure to any direct radiation or radon-222 that may pass through the cap. Based on that, another calculation method that incorporated shielding and radon flux attenuation algorithms was used to evaluate risks from covered RIM.

The calculation method selected is incorporated into a computer program called RESRAD 6.5 and its off-site analog RESRAD-OFFSITE 2.5. The RESRAD platform is a widely accepted industry-standard computer code used to evaluate doses and risks from media containing radionuclides via multiple transport and exposure pathways. It was selected for use in this these assessments because it is capable of calculating doses and risks from buried materials for the direct radiation and radon emanation pathways. Other software applications are capable of performing parts of these calculations, but few codes are capable of performing both sets of calculations, and no other program was found to be as widely used by national and international groups and standard setting committees for the evaluation of doses and risks from buried materials.

RESRAD and RESRAD-OFFSITE are members of the RESRAD family of environmental assessment codes maintained by Argonne National Laboratory[5]. Its user's manual describes RESRAD as "… a computer model designed to estimate radiation doses from RESidual RADioactive materials. Since its release in 1989, RESRAD has been used widely by the US Department of Energy (DOE), its operations and area offices, and its contractors for deriving limits for radionuclides in soil. RESRAD was also used by the EPA in its 1994 technical support document for the development of radionuclide cleanup levels for soil. Other entities using RESRAD include the US Army Corps of Engineers, the US Nuclear Regulatory Commission (NRC), industrial firms, universities, and foreign government agencies and institutions." [6]

RESRAD-OFFSITE has been benchmarked against other exposure assessment codes in the environmental assessment and site cleanup arena (ANL 2006). The code has been used in model validation studies such as the International Atomic Energy Agency's Biospheric Model Validation Study II and the Environmental Modeling for Radiation Safety (EMRAS) programs. Currently the EMRAS Naturally Occurring Radioactive Material working group is using RESRAD-OFFSITE in its model comparison study (ANL 2007).

RESRAD includes slope factors for inhalation, ingestion, and direct external radiation exposures. A few of these slope factors were updated to reflect published changes in EPA's slope factors up to August 26, 2011. A composite radon diffusion coefficient was also used to reproduce the radon fluxes presented in Appendix F.

While this code can be used to calculate risk from other pathways besides direct radiation and radon, in this assessment the RESRAD code was only used to evaluate risks from buried materials.

---

[5] Code obtained from DOE, February 21, 2011.

[6] Quoted from page xvii of ANL 2001.

4.2.4.3 Comparison of EPA Web Calculator and RESRAD Results

In order to determine if RESRAD was calculating risks in a manner that was consistent with EPA methodology, risks from direct radiation exposure to surface soil containing radium-226 were calculated using both methods. Risks from radon emanation are not directly addressed in the EPA soil calculator so no direct comparison between the two methodologies could be verified for the radon pathway.

EPA's standard outdoor worker was selected for this comparison. As stated in Section 4.2.4.1, using a target risk of 10^{-06}, EPA's PRG calculator[7] yields a PRG for the direct radiation exposure route of 0.0249 pCi/g.

A RESRAD calculation of risks from the external pathway was performed using parameter values for that pathway that were consistent with the exposure parameter values for radionuclides in surface soils and outdoor worker exposures found on the EPA website (see Table 4-6). Using a concentration for radium-226 and its daughters of 0.0249 pCi/g, the RESRAD calculation yielded a 1.0×10^{-06} risk value for the direct radiation exposure route. The two calculation methods are in agreement for direct exposure to external radiation from radium-226 in surface soil.

As stated in previous sections, radiocarcinogenic risks involving exposures to contaminated soils (such as may occur during remediation) were calculated using results obtained from the EPA's web-based PRG calculator. Risks from covered materials are not addressed by the EPA PRG calculator, and the ROD-Selected Remedy and the proposed "Complete Rad Removal" alternatives would leave covered materials on the Site. RESRAD was used to calculate risks only from radiation exposures from covered materials and to radon emanating from covered materials.

Table 4-6 Receptor Parameters Used to Estimate Potential Exposures

Parameter (units)	EPA's Default Outdoor Worker Age 19+
Occupancy	
ED (y)	25[a]
EF (d/y)	225[a]
ET indoors (h/d)	0[b]
ET outdoors (h/d)	8[b]
Inhalation of dusts, volatiles, and radon	
IR (m^3/h)	2.5[a]

[a] EPA Web calculator (http://epa-prgs.ornl.gov/cgi-bin/radionuclides/rprg_search), February 21, 2011.
[b] This assessment assumes an individual works outdoors for 8 hours per day.

4.2.4.4 Risk Assessment Method Used for Chemical Carcinogens in Exposed RIM

Long-term chemical effects were calculated using the Soil Screening Levels for hypothetical receptors published on the EPA website found at http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/. These screening levels in Table 4-7 are the concentration of chemical constituents that correspond to a calculated risk of 10^{-06} for carcinogens for EPA's hypothetical outside worker.

[7] http://epa-prgs.ornl.gov/cgi-bin/radionuclides/rprg_search

Table 4-7 Screening Levels for Carcinogenic Effects to Outdoor Workers Exposed to COCs in Surface Soil (mg/kg)

		Carcinogenic Effects [a]			
Chemical	**CAS Number**	**Ingestion**	**Dermal**	**Inhalation**	**Total**
Aroclor-1254	011097-69-1	1.4	1.5	29000	0.74
Arsenic, Inorganic	007440-38-2	1.9	9.6	3900	1.6
Chromium (VI)	018540-29-9	5.7	NA [b]	200	5.6
Lead and Compounds	007439-92-1	NA	NA	NA	NA

[a] http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/, February 21, 2011.
[b] NA = No value listed in EPA's SL database.

These screening levels can be used to calculate the carcinogenic effects to a hypothetical receptor from 1 mg/kg of a given chemical in soil. For example, the screening level for arsenic acting as a carcinogen in Table 4-7 is 1.6 mg/kg in surface soil. Therefore, calculated risk to EPA's outdoor worker from surface soil containing 10 mg/kg of arsenic is 6.25 x 10^{-06} (10 mg/kg x 10^{-06} /1.6 mg/kg).

4.2.4.5 Method Used to Assess Non-carcinogenic Effects of Chemicals in Exposed RIM

The effects associated with exposures to non-carcinogenic chemicals are evaluated differently from the approach used to evaluate carcinogens. Intakes are compared to a reference quantity that represents a safe level of exposure. The ratio of a receptors intake over the reference quantity is termed the Hazard Quotient (HQ) for that chemical in a given exposure scenario. If the HQ exceeds 1, there may be concern of potential health effects. In the case where a receptor receives simultaneous exposures to several chemicals, a Hazard Index (HI) is calculated as the sum of the Hazard Quotients. Table 4-8 presents soil screening levels calculated by EPA for industrial land use.

Table 4-8 Screening Levels for Non-Carcinogenic Effects to Outdoor Workers Exposed to COCs in Surface Soil (mg/kg)

		Non-Carcinogenic Effects [a]			
Chemical	**CAS Number**	**Ingestion (HQ = 1)**	**Dermal (HQ = 1)**	**Inhalation (HQ = 1)**	**Total (HQ = 1)**
Aroclor-1254	011097-69-1	20	22	NA [b]	11
Arsenic, Inorganic	007440-38-2	310	1500	89000	260
Chromium (VI)	018540-29-9	3100	NA	600000	3100
Lead and Compounds	007439-92-1	NA	NA	NA	800

[a] http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/, February 21, 2011.
[b] NA = No value listed in EPA's SL database.

4.3 LONG-TERM RISK ASSESSMENTS FOR PROPOSED REMEDIES

The following three Sections contain long-term human health risk assessments for the three alternative remedies being considered in this SFS. An evaluation of potential long-term risks associated with the ROD-Selected Remedy is presented in Section 5. An evaluation of potential long-term risks associated with the “Complete Rad Removal” with off-site disposal alternative can be found in Section 6. An evaluation of potential long-term risks associated with the “Complete Rad Removal” with on-site disposal alternative is presented in Section 7. Each of the alternative-specific risk assessments identify the source and inventory of RIM constituents, lists exposure pathways, identifies the RME individual(s) and presents alternative-specific details about the methods and data used to assess potential risks over the next 1,000 years after implementation of an alternative. Remedy-specific calculations and findings for the alternatives are also presented in Sections 5 through 7.

5 LONG-TERM RISKS FOR THE ROD-SELECTED REMEDY (CLOSURE IN PLACE)

5.1 ALTERNATIVE DESCRIPTION

In this alternative, the radiologically-impacted materials (RIM) will remain in place with Site improvements to meet the stated goals of the ROD. This remedy is a containment remedy for OU-1 intended to protect human health and the environment by regrading part of the Site, placing an engineered cap over all of OU-1, including the RIM. This provides a physical barrier above the RIM that isolates the RIM from surface receptors.

Field investigations indicate that RIM is present at or near the surface in Areas 1 and 2. The ROD-Selected Remedy requires recontouring the surface of OU-1 and installing a cover designed to meet MDNR requirements. The design also includes an underlying rock/concrete rubble layer to enhance long-term stability and protection the cover against bio- or human intrusion or erosion of the underlying waste materials. These Site improvements will bring the upper surface to an acceptable slope and improve surface drainage of Areas 1 and 2.

5.2 THE CONCEPTUAL MODEL

Under this alternative, OU-1 would be graded and covered with an engineered cap consisting of two feet of rock, two feet of soil/clay and a one foot topsoil layer that would support vegetation for the final cover. These improvements would eliminate the exposed RIM at the surface of Areas 1 and 2 and constitute a physical barrier between the RIM and the ground surface.

This section presents the conceptual model of the Site after the remedy is complete. The conceptual model used in this assessment is based on information contained in the Sections 5.2, 6.2.1, and Appendix F of the SFS.

5.2.1 Physical Setting

The physical configuration of the Site after completion of the remedy is summarized below:

- The contaminated material in Area 1 remains the same as in the description published in the BRA. The contaminated material from the Crossroads Property and Buffer Zone (formerly known as the Ford property) has been consolidated into Area 2 and is below the cap. This will add approximately 3,500 cubic yards of RIM to Area 2.
- Areas 1 and 2 will be graded to improve the drainage characteristics of the final cover.
- A two foot (0.6 m) thick rock and/or concrete rubble layer will be placed over the RIM in Areas 1 and 2.
- A two foot (0.6 m) thick clay cap will be placed over the rock/rubble layer to minimize precipitation infiltration into the underlying waste materials and to attenuate radon emissions from the RIM. The permeability of this clay will be a minimum of 10^{-07} m/s (10^{-05} cm/s).
- The clay layer will be covered with one foot (0.3 m) of soil and a vegetative cover will be established on the cap. This vegetative cover is assumed to be maintained to prevent depletion of the cap.

Figure 5-1 depicts the cap design for Areas 1 and 2.

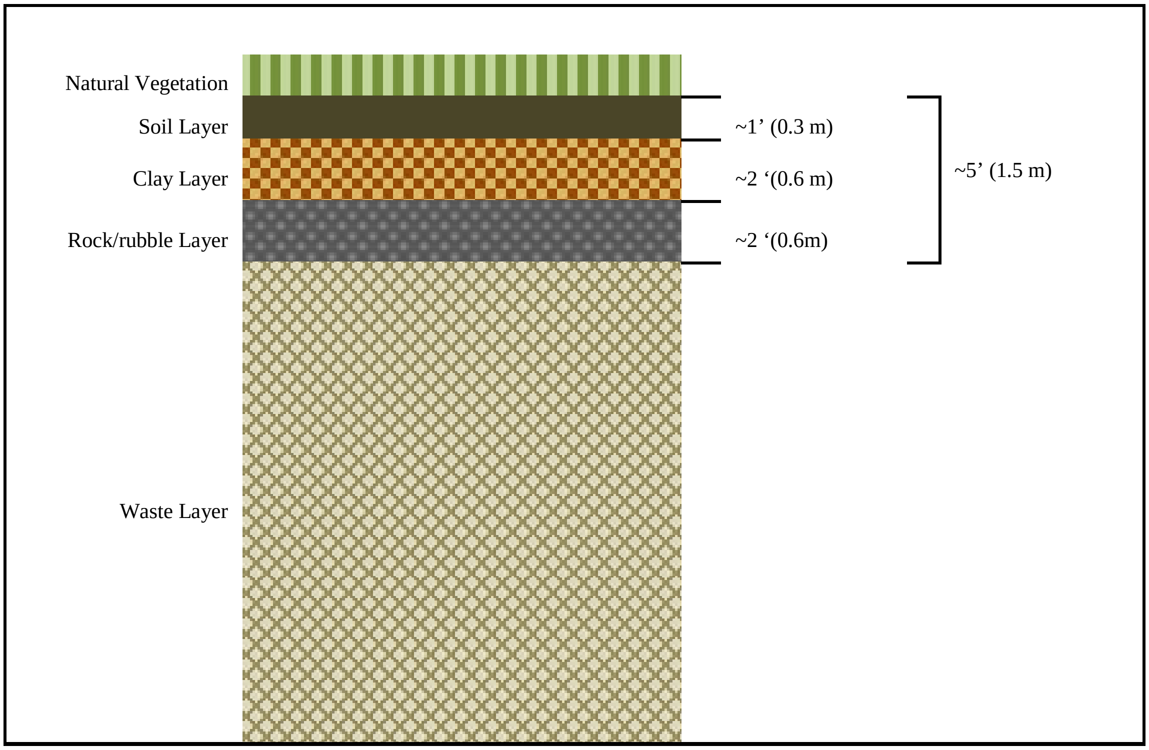


Figure 5-1 Stylized Cross-Section of Area 1 after the ROD-Selected Remedy

5.2.2 Potentially Exposed Populations

A review of the receptor screening presented in the BRA was performed for purposes of this SFS Risk Assessment. The BRA determined that the Site has historically been used as a landfill. Most property surrounding the Site is currently used for commercial or industrial purposes. Deed restrictions on the West Lake Landfill prohibit on-site residential use and a deed restriction on Areas 1 and 2 prohibits construction of buildings, installation of underground utilities or pipes, and excavation. The types of receptors that might move close to the covered waste during daily activities include transients and workers.

5.2.3 Identification of Exposure Pathways

Under this proposed remediation alternative, only a few complete exposure pathways are viable. This remedy would place a thick cap over Areas 1 and 2. This would eliminate any exposure pathway requiring close proximity to the waste such as incidental ingestion and inhalation of particulates.

5.2.3.1 Groundwater as a Potential Exposure Pathway

At the request of EPA Region 7, the potential for dissolution of the RIM and subsequent migration to groundwater was evaluated as a potential exposure pathway. To be a complete pathway, the proposed exposure route must have a source that leaches into groundwater, the groundwater must be able to transport a chemical of concern to a receptor location, and there must be a receptor that uses the water for domestic use.

First, the two main constituents in the RIM, radium and thorium, are not likely to leach. The BRA presented information on the solubility of the major contributors to risk, radium and thorium, and judged them to be generally insoluble. A recent search of the literature did not produce new information contradicting the BRA's approach[8]. This evaluation agreed with the previously published BRA and concluded that it was not reasonable to assume that leaching of the thorium-230 and radium-226 contained in the RIM would be a viable source of groundwater contamination.

Second, no evidence of groundwater transport of radium and thorium from the Site could be found. After many decades, and in the absence of an engineered cap containing the RIM material, no significant groundwater transport of radium-226 or thorium-230 has been demonstrated. Based on current knowledge of the hydrogeology beneath the landfill, no groundwater transport of the insoluble radium or thorium in the RIM is expected.

Third, domestic or other use of groundwater as a potable (drinking) water supply near the landfill appears unlikely. No domestic groundwater wells are present in the immediate vicinity of the landfill and municipal water is available to the local communities. There is no expectation that this pattern of water use will change in the future.

Finally, land use northwest of the landfill (i.e. down-gradient) is dominated by the presence of the Missouri River floodplain. Long-term residential use of land built on the floodplain is subject to zoning restrictions.

Based on these observations, the groundwater exposure pathway is judged to be incomplete and the groundwater exposure pathway was excluded from consideration in this evaluation.

5.2.3.2 Pathways Selected for Evaluation

Two exposure pathways were selected for evaluation in this assessment: direct exposure to radiation, and inhalation of radon emanating through the cap.

Placing the proposed cover over the RIM in this alternative will block almost all of the direct radiation exposure from the RIM. Exposures from the small fraction of radiation predicted to penetrate the cover were quantified in this assessment.

This cover will also attenuate almost all of the radon-222 produced in the underlying RIM. Radium-226 in the RIM decays to radon-222, which is a noble gas. About 20% of this gas is released to interstitial air and water in the pore spaces of the RIM and surrounding soils, while the other 80% remains within the solid matrix of the soil particles. Once in the pore space, this radon gas is free to move in the soil. The distance that radon can travel is greatly limited by its 3.8 day half-life. Covering the RIM with low permeability soil/clay increases the time required for the radon to reach the ground surface. This increased travel-time allows most of the radon to decay before it reaches the surface. Risks from this residual radon were quantified in this assessment.

5.3 EXPOSURE ASSESSMENT

This section contains quantitative descriptions of the source terms, exposure pathways, and receptors evaluated in this assessment. It also includes descriptions of the methods used to calculate potential human exposures from radionuclides in Areas 1 and 2.

[8] ATSDR 1990 contains additional information on radium solubility.

The description of the exposure assessment has been divided into three parts:

- Quantitative description of RIM concentrations in Areas 1 and 2,
- Identification of the receptor most likely to receive the highest exposures from the RIM beneath the cover, and
- Estimating the exposure point concentrations at the receptor locations.

5.3.1 Characterization of the RIM

Section 4.2.1 lists the radionuclides and chemicals of concern in OU-1 of the West Lake Landfill. The ROD-Selected Remedy alternative would place a thick cap over the RIM and there would be no direct contact with soil. Without a means of direct contact, only constituents that produce indirect exposures through the cap need to be considered in this assessment. The COCs arsenic, chromium VI, lead, and Aroclor-1254 were screened out of the assessment at this point because the cap prevents direct contact with these chemicals, and their lack of volatility prevents their emission in gaseous form.

5.3.1.1 Concentrations of COCs in RIM 1 Year after Remedy

The 95% upper confidence interval (UCL) on the mean for radionuclide and chemical concentrations across all depths was used to represent RIM concentrations in Areas 1 and 2 immediately after remedy construction (Table A.3-3 and Table A.3-4 of the BRA). The two columns of values listed under the "Post-Remedy" heading of Table 5-1 present RIM concentrations in Areas 1 and 2 during and immediately after construction. These concentrations were assumed to be representative of the entire volume of RIM in the respective areas underlying the proposed cover.[9]

5.3.1.2 Concentrations of COCs in RIM 1,000 Years after Remedy

The concentrations of the radionuclides in the RIM are expected to change over the course of 1,000 years due to radiological decay and in-growth[10]. Future concentrations over the next 1,000 years were calculated using the following assumptions:

- The future RIM is unaffected by chemical degradation during the study period of 1,000 years.
- Radiological decay and associated daughter in-growth over 1,000 years will change the concentrations of the radionuclides in a predictable manner.

The representative concentrations used in this risk assessment are listed in Table 5-1. The 1,000 year values include the effects of radioactive in-growth and decay for radionuclides.

[9] Soil removed from the Crossroads Property and Buffer Zone during an interim remedial action will be added to Area 2 during remedy construction. This material contains lower concentrations of RIM and adding it to the material in Area 2 would lower the average concentration in Area 2. Using the unmixed concentrations from Table A.3-4 of the BRA is a simplifying assumption that will increase risks slightly.

[10] A 1,000 year study period was selected based on design requirements of 40 CFR 192.

Table 5-1 Characterization of RIM in Areas 1 and 2, ROD-Selected Remedy

Radionuclide	Post-Remedy Area 1 [a]	Post-Remedy Area 2 [a]	1,000-year Area 1	1,000-year Area 2	Units
Uranium Series					
Uranium-238 + dtrs	16.6	27.1	16.6	27.1	pCi/g
Uranium-234	16.9	46.0	16.9	46.0	pCi/g
Thorium-230	1,060	3,730	1,051	3,697	pCi/g
Radium-226 + dtrs	71.6	338	417 [b]	1,523 [b]	pCi/g
Lead-210 + dtrs	88.6	128	417 [c]	1,523 [c]	pCi/g
Actinium Series					
Uranium-235 + 1 dtr	0.84 [d]	1.83 [d]	0.84 [d]	1.83 [d]	pCi/g
Protactinium-231 + dtrs	47.3	162	47.3	162	pCi/g
Thorium Series					
Thorium-232 + dtrs	4.14	15.9	4.14	15.9	pCi/g

[a] Immediately after construction ceases. Used 95% UCL on the arithmetic mean of the RIM concentrations listed in the BRA.
[b] Includes in-growth from the decay of thorium-230.
[c] Assumed to be in secular equilibrium with radium-226.
[d] Due to the uncertainty of the uranium-235 results, these values were calculated using the more reliable uranium-238 and uranium-234 results and the expected relative abundance of uranium-235 in natural uranium.

5.3.2 Selection and Description of Reasonably Maximally-Exposed Individual

Because postulated exposures associated with this alternative are dependent on close proximity to the RIM, the individuals with the highest potential for exposure would be those receptors spending the most time on or near the cover or the waste (Table 5-2). The maintenance of the cover is an essential element of future protective actions for the covered contaminated material. This assessment assumes there will be workers involved with these maintenance requirements and activities, such as periodically mowing the grass and checking the surface for degradation.

Table 5-2 List of Potential Receptors Identified During Post-Construction ROD-Selected Remedy

Receptors Identified	Scenario Considered? [a]	Exposure Route: Inhalation of Fugitive Dust	Exposure Route: Inhalation of Radon	Exposure Route: Incidental Soil Ingestion	Exposure Route: Dermal Contact	Exposure Route: Direct Radiation	Quantitative Evaluation of Scenario?
Grounds Keepers/Maintenance Staff	**Yes**	(shaded)	●	(shaded)	(shaded)	●	**Yes**
Transient/Visitors	**Yes**	(shaded)	{O}	(shaded)	(shaded)	{O}	No
Near-by workers	**Yes**	(shaded)	{O}	(shaded)	(shaded)	(shaded)	No

[a] An exposure scenario was considered if it included a source, a means of moving constituents of concern to a location of interest, and a receptor at that location.

●	Exposure route selected for detailed analysis
(shaded box)	A shaded box indicates that the receptor/exposure route combination was not selected for quantitative analysis.
{O}	Not quantified because other receptors identified for this scenario have higher intake rates and longer exposure times.

Based on the land use restrictions currently in place, additional restrictions described as part of the ROD-Selected Remedy and a review of the types of receptors present in the local community, a member of the grounds keeping crew was selected for this evaluation.

5.3.3 Scenario-Specific Assumptions and Exposure Parameters

Some exposure parameters are dependent on receptor-specific behavior patterns and vary from receptor scenario to receptor scenario. The following sections begin with a brief description of each set of parameters used to evaluate exposures to hypothetical receptors during this assessment. This synopsis is followed by descriptions of any site-specific parameter values and their derivation.

5.3.3.1 Receptor Behavior

This assessment of the alternative assumed that a grounds keeper on this Site is a member of a team of several workers that spends one eight-hour day per quarter mowing the covered RIM and one eight-hour day per year maintaining the integrity of the cover for a total of 40 hours over five days. The exposure duration (ED) was assumed to be 25 years.[11] The exposure factors listed in Table 5-3 provide a quantitative description of this receptor's projected behavior.

Table 5-3 Receptor Parameters Used to Estimate Potential Exposures

Pathway Parameter (units)	Updated BRA Grounds Keeper Age 19+
ED (y)	25 [a]
EF (d/y)	5 [b]
ET indoors (h/d)	0 [c]
ET outdoors (h/d)	8 [c]
Inhalation of radon	
IR (m^3/h)	2.5 [d]

[a] http://epa-prgs.ornl.gov/radionuclides/prg_guide.shtml#parameters lists 25 years as the default parameter value for EPA's outdoor worker.
[b] It is assumed that a grounds crew at the landfill can service the areas of either Area 1 or Area 2 on a regular basis. This assessment assumes an individual member of that crew works outdoors one day a quarter throughout the year. One additional day per year is spent on repairing erosion or subsidence.
[c] This assessment assumes an individual works outdoors for an 8 hours day.
[d] http://epa-prgs.ornl.gov/radionuclides/prg_guide.shtml#parameters lists 2.5 cubic meters per hour as the default parameter value for EPA's outdoor worker scenario.

5.3.3.2 Physical Attributes of the Waste and Cover

The physical properties of the RIM and cover components are presented in Table 5-4. The erosion rate of the cover layer reflects the effects of cover maintenance and the rock/rubble layer.

[11] The BRA (Auxier 2000) assumed 6.6 years per EPA/600/P-25/002Fc, pg 15-17, making the exposure evaluation presented in this appendix more conservative than the grounds keeper scenario found in the BRA.

Table 5-4 Physical Properties of RIM and Cover

Parameter	Area 1	Area 2
Contamination Zone (RIM)		
Thickness (m)	1.4	2.6
Area (m^2)	18,000	88,000
Erosion Rate (m/y)	0.001	0.001
Total Porosity (vol/vol)	0.671	0.671
Field Capacity (vol/vol)	0.292	0.292
Hydraulic Conductivity (m/y)	5.26	5.26
Radon Diffusion Coefficient (m^2/s)	$3.33x10^{-06}$	$3.33x10^{-06}$
Cover		
Thickness (m)	1.5	1.5
Erosion Rate (m/y)	0.0001	0.0001
Total Porosity (vol/vol)	0.427	0.427
Volumetric Water Content (vol/vol)	0.367	0.367
Hydraulic Conductivity (m/y)	0.000526	0.000526
Radon Diffusion Coefficient (m^2/s)[a]	$1.51x10^{-07}$	$1.23x10^{-07}$

[a] Composite diffusion coefficient for single-layer cover. Resulting radon flux matches flux estimated from multilayer cover design as calculated in Appendix F.

5.4 TOXICITY ASSESSMENT

Implementation of this remedy will not change the toxicity of the covered contaminants in the RIM. A discussion of their toxicities is presented in Section 4.2.3 of this Appendix. The purpose of the remedy is to eliminate unacceptable risks through the removal of potential exposure pathways to be protective of human health and the environment.

5.5 RISK EVALUATION

5.5.1 Quantification of Exposure

This alternative would leave no exposed RIM on the final surface of the landfill. As long as the cover remains intact, receptors would have no contact with the RIM. Exposure pathways that require physical contact with the RIM such as ingestion of soil, inhalation of particulates or dermal absorption waste were screened out of the assessment at this point.

Two exposure pathways were selected for quantitative evaluation in this assessment: exposure to direct radiation from the RIM and inhalation of radon. These two pathways are the only pathways that could deliver exposures through an intact cover (Section 5.2.3).

The cover design protects receptors on the surface by absorbing the radiation produced by the RIM and reducing the quantity of radon that reaches the ground surface. This protection increases as the thickness or density of intervening material increases.

Because the only potential exposure routes are exposure to direct radiation penetrating the cap and emanation of radon through the cover, RESRAD was used to quantify carcinogenic risks from these two pathways. The RIM concentrations used to represent the sources of potential exposures are listed in Table 5-1. The exposure factors listed in Table 5-3 describe the reasonably maximally-exposed (RME) individual receptor considered. Table 5-4 lists the scenario-specific physical information used in this simulation. Parameters describing other forms of environmental transport or other exposure mechanisms were left at their default values.

These parameters were not used during the risk calculation and changing their values would not impact calculated risks or doses.

Two RESRAD runs were performed to build the simulation: one to quantify the risks from direct radiation, and one to calculate the risks from radon. Separating the two calculations allows the EPA default inhalation parameter of 2.5 m^3/h to be used in the radon calculation.

5.5.2 Characterization of Risks

The potential for health effects from exposure to site-related contaminants was evaluated for receptors located on and off the landfill property. Due to the nature of the contaminants and the remedy, viable exposures will be limited to receptors on the surface of the landfill.

Long-term risks and doses are presented in Exhibits 5-1 through 5-4. Exhibits 5-1 and 5-3 contain excerpts of the output files generated by RESRAD's dose calculation subroutines. Doses at year 1 and year 1,000 are listed at the top of the exhibits. These are followed by the values used to represent the physical characteristics and concentrations of radionuclides in the sources of potential exposure and covers for the area modeled. The central table in the dosimetry exhibit presents the calculated doses to the receptor at selected times. The even numbered exhibits (Exhibit 5-2 and 5-4) contain excerpts of the output files generated by RESRAD's risk calculation subroutines. Risks at year 1 and year 1,000 are listed at the top of the exhibits. Summary tables listing calculated risks by nuclide and pathway are located in the center of the exhibits.

Risk and dose estimates for the most exposed potential receptor working on Areas 1 and 2 in the first year after remedy construction is complete and in the far-future are summarized in Table 5-5. Results have been rounded to two (2) significant figures.

Table 5-5 Long-term Risks and Doses to the Grounds Keeper Calculated for ROD Remedy (Closure in Place)

	Area 1	**Area 2**
Risk at 1 year	$< 10^{-07}$	2.0×10^{-07}
Risk at 1,000 years	3.1×10^{-07}	1.3×10^{-06}
Dose at 1 year (mrem/y)	1.5×10^{-03}	1.7×10^{-02}
Dose at 1,000 years (mrem/y)	1.3×10^{-02}	1.2×10^{-01}

The RME individual for carcinogenic risks under these conditions is the grounds keeper working to maintain the cover for Area 2. The cancer risk estimate for this receptor is calculated to be 1.3×10^{-06} after 1,000 years of radium-226 in-growth from thorium-230 decay. The most important single contributor to this risk is exposure to radon daughters emanating from the continued in-growth of radium-226 from the decay of thorium-230 over the 1,000 year study period. Calculated risks to the on-site grounds keeper from the two areas are all within or below EPA's acceptable risk range as stated in the National Contingency Plan (NCP) (EPA 1990).

Exhibit 5-1 Doses to Grounds Keeper in Area 1 – ROD-Selected Remedy Option

Receptor	Dose (mrem/y) Year 1	Year 1,000
Grounds Keeper (40 h/y)	1.52×10^{-03}	1.27×10^{-02}

Detailed Dose Data

Contaminated Zone Dimensions	
Working Face Area:	18,000 square meters
Thickness:	1.4 meters
Cover Depth:	1.5 meters

Cover Description	
Thickness:	1.5 meters
Rn Diff:	1.51×10^{-07} m/s

Initial Soil Concentrations, pCi/g	
Ac-227	8.40×10^{-01}
Pa-231	4.73×10^{01}
Pb-210	8.86×10^{01}
Ra-226	7.16×10^{01}
Ra-228	4.14×10^{00}
Th-228	4.14×10^{00}
Th-230	1.06×10^{03}
Th-232	4.14×10^{00}
U-234	1.69×10^{01}
U-235	8.40×10^{-01}
U-238	1.66×10^{01}

Total Dose TDOSE(t) over 1,000 Year Simulation, mrem/y

Maximum of 1.27×10^{-02} mrem/y at t = 1.00×10^{03} years

t (years):	**1.00×10^{00}**	**1.00×10^{01}**	**1.00×10^{02}**	**3.00×10^{02}**	**1.00×10^{03}**
TDOSE(t):	1.52×10^{-03}	1.60×10^{-03}	2.48×10^{-03}	4.51×10^{-03}	1.27×10^{-02}
M(t):	1.01×10^{-04}	1.07×10^{-04}	1.65×10^{-04}	3.01×10^{-04}	8.47×10^{-04}

TDOSE (t) = Total annual dose from all radionuclides in year (t)

M(t) = Fraction of 15 mrem/y received in year (t)

Exhibit 5-2 Risks to Grounds Keeper in Area 1 – ROD-Selected Remedy Option

Receptor	Risk Year 1	Risk Year 1,000
Grounds Keeper (40 h/y)	$< 10^{-07}$	$3.11x10^{-07}$

Detailed Risk Data

Excess Cancer Risks from Existent Radionuclides and Pathways in Year 1

Radio-	Ground		Radon		All pathways	
Nuclide	risk	fraction	risk	fraction	risk	fraction
Ac-227	$6.78x10^{-18}$	0.00	$0.00x10^{00}$	0.00	$6.78x10^{-18}$	0.00
Pa-231	$1.93x10^{-16}$	0.00	$0.00x10^{00}$	0.00	$1.93x10^{-16}$	0.00
Pb-210	$7.04x10^{-19}$	0.00	$0.00x10^{00}$	0.00	$7.04x10^{-19}$	0.00
Ra-226	$8.23x10^{-15}$	0.00	$3.63x10^{-08}$	0.92	$3.63x10^{-08}$	0.92
Ra-228	$2.85x10^{-13}$	0.00	$0.00x10^{00}$	0.00	$2.85x10^{-13}$	0.00
Th-228	$7.08x10^{-14}$	0.00	$0.00x10^{00}$	0.00	$7.08x10^{-14}$	0.00
Th-230	$7.18x10^{-16}$	0.00	$3.16x10^{-09}$	0.08	$3.16x10^{-09}$	0.08
Th-232	$5.86x10^{-13}$	0.00	$0.00x10^{00}$	0.00	$5.86x10^{-13}$	0.00
U-234	$8.99x10^{-22}$	0.00	$3.94x10^{-15}$	0.00	$3.94x10^{-15}$	0.00
U-235	$2.42x10^{-21}$	0.00	$0.00x10^{00}$	0.00	$2.42x10^{-21}$	0.00
U-238	$1.63x10^{-26}$	0.00	$7.13x10^{-20}$	0.00	$7.13x10^{-20}$	0.00
Total	$9.51x10^{-13}$	0.00	$3.95x10^{-08}$	1.00	$3.95x10^{-08}$	1.00

Excess Cancer Risks from Existent Radionuclides and Pathways in Year 1,000

Radio-	Ground		Radon		All pathways	
Nuclide	risk	fraction	risk	fraction	risk	fraction
Ac-227	$0.00x10^{00}$	0.00	$0.00x10^{00}$	0.00	$0.00x10^{00}$	0.00
Pa-231	$2.40x10^{-15}$	0.00	$0.00x10^{00}$	0.00	$2.40x10^{-15}$	0.00
Pb-210	$0.00x10^{00}$	0.00	$0.00x10^{00}$	0.00	$0.00x10^{00}$	0.00
Ra-226	$2.44x10^{-14}$	0.00	$3.42x10^{-08}$	0.11	$3.42x10^{-08}$	0.11
Ra-228	$0.00x10^{00}$	0.00	$0.00x10^{00}$	0.00	$0.00x10^{00}$	0.00
Th-228	$0.00x10^{00}$	0.00	$0.00x10^{00}$	0.00	$0.00x10^{00}$	0.00
Th-230	$1.98x10^{-13}$	0.00	$2.77x10^{-07}$	0.89	$2.77x10^{-07}$	0.89
Th-232	$2.55x10^{-12}$	0.00	$0.00x10^{00}$	0.00	$2.55x10^{-12}$	0.00
U-234	$1.54x10^{-17}$	0.00	$2.16x10^{-11}$	0.00	$2.16x10^{-11}$	0.00
U-235	$9.08x10^{-19}$	0.00	$0.00x10^{00}$	0.00	$9.08x10^{-19}$	0.00
U-238	$1.50x10^{-20}$	0.00	$2.11x10^{-14}$	0.00	$2.11x10^{-14}$	0.00
Total	$2.78x10^{-12}$	0.00	$3.11x10^{-07}$	1.00	$3.11x10^{-07}$	1.00

Exhibit 5-3 Doses to Grounds Keeper in Area 2 – ROD-Selected Remedy Option

Receptor	Dose (mrem/y) Year 1	Year 1,000
Grounds Keeper (40 h/y)	1.72×10^{-02}	1.17×10^{-01}

Detailed Dose Data

Contaminated Zone Dimensions

Working Face Area:	88,000 square meters
Thickness:	2.6 meters
Cover Depth:	1.5 meters

Cover Description

Thickness:	1.5 meters
Rn Diff:	1.23×10^{-07} m/s

Initial Soil Concentrations, pCi/g

Ac-227	1.83×10^{00}
Pa-231	1.62×10^{02}
Pb-210	1.28×10^{02}
Ra-226	3.38×10^{02}
Ra-228	1.59×10^{01}
Th-228	1.59×10^{01}
Th-230	3.73×10^{03}
Th-232	1.59×10^{01}
U-234	4.60×10^{01}
U-235	1.83×10^{00}
U-238	2.71×10^{01}

Total Dose TDOSE(t) over 1,000 Year Simulation, mrem/y

Maximum of 1.17×10^{-01} mrem/y at t = 1.00×10^{03} years

t (years):	1.00×10^{00}	1.00×10^{01}	1.00×10^{02}	3.00×10^{02}	1.00×10^{03}
TDOSE(t):	1.72×10^{-02}	1.79×10^{-02}	2.54×10^{-02}	4.30×10^{-02}	1.17×10^{-01}
M(t):	1.15×10^{-03}	1.20×10^{-03}	1.69×10^{-03}	2.86×10^{-03}	7.77×10^{-03}

TDOSE (t) = Total annual dose from all radionuclides in year (t)

M(t) = Fraction of 15 mrem/y received in year (t)

Exhibit 5-4 Risks to Grounds Keeper in Area 2 – ROD-Selected Remedy Option

Receptor	Risk Year 1	Risk Year 1,000
Grounds Keeper (40 h/y)	$2.03x10^{-07}$	$1.32x10^{-06}$

Detailed Risk Data

Excess Cancer Risks from Existent Radionuclides and Pathways in Year 1

Radio-Nuclide	Ground risk	Ground fraction	Radon risk	Radon fraction	All pathways risk	All pathways fraction
Ac-227	$1.48x10^{-17}$	0.00	$0.00x10^{00}$	0.00	$1.48x10^{-17}$	0.00
Pa-231	$6.61x10^{-16}$	0.00	$0.00x10^{00}$	0.00	$6.61x10^{-16}$	0.00
Pb-210	$1.02x10^{-18}$	0.00	$0.00x10^{00}$	0.00	$1.02x10^{-18}$	0.00
Ra-226	$3.89x10^{-14}$	0.00	$1.91x10^{-07}$	0.94	$1.91x10^{-07}$	0.94
Ra-228	$1.09x10^{-12}$	0.00	$0.00x10^{00}$	0.00	$1.09x10^{-12}$	0.00
Th-228	$2.72x10^{-13}$	0.00	$0.00x10^{00}$	0.00	$2.72x10^{-13}$	0.00
Th-230	$2.53x10^{-15}$	0.00	$1.23x10^{-08}$	0.06	$1.23x10^{-08}$	0.06
Th-232	$2.25x10^{-12}$	0.00	$0.00x10^{00}$	0.00	$2.25x10^{-12}$	0.00
U-234	$2.45x10^{-21}$	0.00	$1.19x10^{-14}$	0.00	$1.19x10^{-14}$	0.00
U-235	$5.27x10^{-21}$	0.00	$0.00x10^{00}$	0.00	$5.27x10^{-21}$	0.00
U-238	$2.66x10^{-26}$	0.00	$1.30x10^{-19}$	0.00	$1.30x10^{-19}$	0.00
Total	$3.66x10^{-12}$	0.00	$2.03x10^{-07}$	1.00	$2.03x10^{-07}$	1.00

Excess Cancer Risks from Existent Radionuclides and Pathways in Year 1,000

Radio-Nuclide	Ground risk	Ground fraction	Radon risk	Radon fraction	All pathways risk	All pathways fraction
Ac-227	$0.00x10^{00}$	0.00	$0.00x10^{00}$	0.00	$0.00x10^{00}$	0.00
Pa-231	$8.22x10^{-15}$	0.00	$0.00x10^{00}$	0.00	$8.22x10^{-15}$	0.00
Pb-210	$0.00x10^{00}$	0.00	$0.00x10^{00}$	0.00	$0.00x10^{00}$	0.00
Ra-226	$1.15x10^{-13}$	0.00	$1.87x10^{-07}$	0.14	$1.87x10^{-07}$	0.14
Ra-228	$0.00x10^{00}$	0.00	$0.00x10^{00}$	0.00	$0.00x10^{00}$	0.00
Th-228	$0.00x10^{00}$	0.00	$0.00x10^{00}$	0.00	$0.00x10^{00}$	0.00
Th-230	$6.96x10^{-13}$	0.00	$1.13x10^{-06}$	0.86	$1.13x10^{-06}$	0.86
Th-232	$9.80x10^{-12}$	0.00	$0.00x10^{00}$	0.00	$9.80x10^{-12}$	0.00
U-234	$4.20x10^{-17}$	0.00	$6.82x10^{-11}$	0.00	$6.82x10^{-11}$	0.00
U-235	$1.98x10^{-18}$	0.00	$0.00x10^{00}$	0.00	$1.98x10^{-18}$	0.00
U-238	$2.45x10^{-20}$	0.00	$3.98x10^{-14}$	0.00	$3.98x10^{-14}$	0.00
Total	$1.06x10^{-11}$	0.00	$1.32x10^{-06}$	1.00	$1.32x10^{-06}$	1.00

6 LONG-TERM RISKS FOR THE OFF-SITE DISPOSAL REMEDY

6.1 ALTERNATIVE DESCRIPTION

In this alternative the radiologically-impacted materials (RIM) above levels, (the "cleanup level") will be excavated and shipped to an out-of-state disposal facility to meet the stated goals. This remedial alternative will leave RIM with concentrations below cleanup levels along the bottom and edges of the excavation[12]. Areas 1 and 2 will be regraded and capped as part of the overall landfill closure plan.

This alternative would allow the site to be used as a former landfill with commensurate monitoring, maintenance and land-use restrictions. It is intended to protect human health and the environment by removing RIM above the cleanup levels from OU-1. The overburden and final cap will provide a physical barrier for other non-RIM landfill wastes and will incidentally isolate surface receptors from any RIM below cleanup levels which remains in place at the Site. Controls intended to address radiological occurrences would no longer be required under this alternative, but the same or similar controls would still be required because it will remain an inactive landfill full of municipal waste.

6.2 THE CONCEPTUAL MODEL

Under this alternative, layers of RIM at concentrations below cleanup levels would be covered with non-RIM wastes, clay and soil, and all RIM above cleanup levels would be removed from Areas 1 and 2.

This section presents the conceptual model of the Site after the remedy is complete. The conceptual model used in this assessment is based on information contained in the Sections 5.3, 6.2.2 and Appendix F of the SFS.

6.2.1 Physical Setting

The physical configuration of the Site after completion of the remedy is summarized below:

- The bulk of the RIM in Areas 1 and 2 would have been removed, leaving a layer of RIM at concentrations below cleanup levels and non-RIM wastes.
- A two foot (0.6 m) thick layer of clay would be placed over the waste materials in Areas 1 and 2. The permeability of this clay would be a minimum of 10^{-07} m/s (10^{-05} cm/s).
- Areas 1 and 2 would be covered with one foot (0.3 m) of soil and a vegetative cover will be established on the cap. This vegetative cover is assumed to be maintained to prevent depletion of the cap.

Figure 6-1 depicts the cap design for Areas 1 and 2.

[12] The radiological cleanup levels set for Areas 1 and 2 are somewhat above background, and excavating all material above these cleanup standards will leave some RIM with concentrations below the cleanup levels in Areas 1 and 2. EPA recommended the term "RIM below cleanup levels" be used to refer to this material.

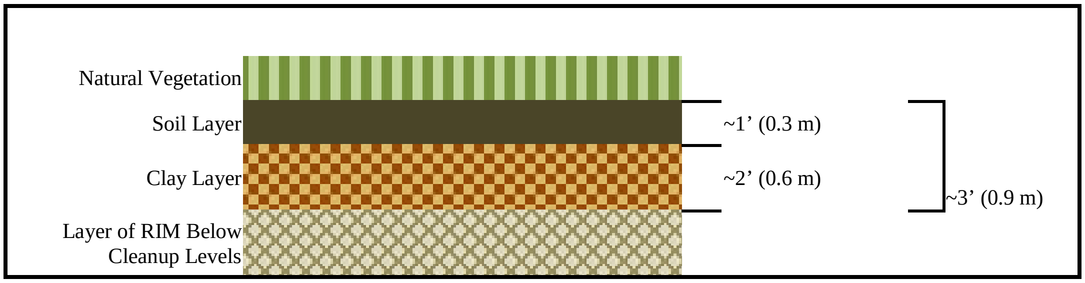


Figure 6-1 Stylized Cross-Section after RIM Has Been Excavated and Sent for Off-site Disposal

6.2.2 Potentially Exposed Populations

A review of the receptor screening presented in the BRA was performed for purposes of this SFS Risk Assessment. The BRA determined that the Site has historically been used as a landfill. Most property surrounding the Site is currently used for commercial or industrial purposes. Deed restrictions on the West Lake Landfill prohibit on-site residential use and a deed restriction on Areas 1 and 2 prohibits construction of buildings, installation of underground utilities or pipes, and excavation. The types of receptors who might be close to the covered waste during daily activities include transients and workers.

6.2.3 Identification of Exposure Pathways

Under this proposed remedy, only a few complete exposure pathways are viable. This remedy would place layers of cover material over the RIM below cleanup levels left in Areas 1 and 2. This would eliminate any exposure pathway requiring close proximity to the waste such as incidental ingestion and inhalation of particulates.

6.2.3.1 Groundwater as a Potential Exposure Pathway

At the request of EPA Region 7, the potential for dissolution of the RIM and subsequent migration to groundwater was evaluated as a potential exposure pathway. To be a complete pathway, the proposed exposure route must have a source that leaches into groundwater, the groundwater must be able to transport a chemical of concern to a receptor location, and there must be a receptor that uses the water for domestic use.

First, the two main constituents in the RIM, radium and thorium, are not likely to leach. The BRA presented information on the solubility of the major contributors to risk, radium and thorium, and judged them to be generally insoluble. A recent search of the literature did not produce new information contradicting the BRA’s approach[13]. This evaluation agreed with the previously published BRA and concluded that it was not reasonable to assume that leaching of the thorium-230 and radium-226 contained in the RIM would be a viable source of groundwater contamination.

Second, no evidence of groundwater transport of radium and thorium from the Site could be found. After many decades, and in the absence of an engineered cap containing the RIM material, no significant groundwater transport of radium-226 or thorium-230 has been demonstrated. Based on current knowledge of the hydrogeology beneath the landfill, no groundwater transport of the insoluble radium or thorium in the RIM is expected.

[13] ATSDR 1990 contains additional information on radium solubility.

Third, domestic or other use of groundwater as a potable (drinking) water supply near the landfill appears unlikely. No domestic groundwater wells are present in the immediate vicinity of the landfill and municipal water is available to the local communities. There is no expectation that this pattern of water use will change in the future.

Finally, land use northwest of the landfill (i.e. down-gradient) is dominated by the presence of the Missouri River floodplain. Long-term residential use of land built on the floodplain is subject to zoning restrictions.

Based on these observations, the groundwater exposure pathway is judged to be incomplete and the groundwater exposure pathway was excluded from consideration in this evaluation.

6.2.3.2 Pathways Selected for Evaluation

As previously described in Section 5.2.3.2, two exposure pathways were selected for evaluation in this assessment: direct exposure to radiation and inhalation of radon emanating through the cover.

The bulk of the RIM will be removed from Areas 1 and 2 under this alternative. Placing the proposed cover over the RIM below cleanup levels in this alternative will block almost all of the direct radiation exposure from the RIM below cleanup levels. Exposures from the small fraction of radiation predicted to penetrate the cover were quantified in this assessment.

This cover will also attenuate almost all of the radon-222 produced in the underlying RIM below cleanup levels. Radium-226 in the RIM below cleanup levels will decay to radon-222, which is a noble gas. About 20% of this gas is released to interstitial air and water in the pore spaces of the residual radium after cleanup and surrounding soils, while the other 80% remains within the solid matrix of the soil particles, once in the pore space, this radon gas is free to move in the soil. The distance that radon can travel is greatly limited by its 3.8 day half-life. Covering the RIM below cleanup levels with low permeability soil/clay increases the time required for the radon to reach the ground surface. This increased travel-time allows most of the radon to decay before it reaches the surface.

6.3 EXPOSURE ASSESSMENT

This section contains quantitative descriptions of the sources of potential exposures, exposure pathways, and receptors evaluated in this assessment. It also includes descriptions of the methods used to calculate potential human exposures from radionuclides in Areas 1 and 2.

The description of the exposure assessment has been divided into three parts:

- Quantitative description of the concentrations in the RIM in Areas 1 and 2,
- Identification of the receptor most likely to receive the highest exposures from the RIM below cleanup levels beneath the cover, and
- Estimating the exposure point concentrations at the receptor locations.

6.3.1 Characterization of the RIM

Section 4.2.1 lists the radionuclides and chemicals of concern in OU-1 of the West Lake Landfill. This alternative is based upon the removal of the vast majority of the known RIM in Areas 1 and 2, leaving RIM below cleanup levels along the bottom and edges of the excavation.

After completion of the remedy, any remaining RIM below cleanup levels would be covered by layers of clay and soil, precluding direct contact with the residual RIM. Without a means of direct contact, only constituents that produce indirect exposures through the cover would need to be considered in this assessment. The COCs arsenic, chromium VI, lead, and Aroclor-1254 were screened out of the assessment at this point because the cover prevents direct contact with these chemicals, and their lack of volatility prevents their emission in gaseous form.

6.3.1.1 Concentrations of COCs in RIM 1 Year after Construction

After remedy construction, this alternative would greatly reduce the radioactive inventory of Areas 1 and 2. The RIM in each area would be removed until residual concentrations of thorium-232 plus thorium-230, or radium-226 plus radium-228, were less than 5 pCi/g above background. Beginning with the RIM concentrations in Area 1 and Area 2 listed in the BRA, the concentrations of the radionuclides would be reduced proportionally until the total thorium-230 concentration in the remaining RIM would be 4.6 pCi/g (leaving a safety margin of 0.4 pCi/g). The two columns of values listed under the "Post-Construction" heading of Table 6-1 represent the remaining inventory of radionuclides in Areas 1 and 2 at one year and 1,000 years after construction.

6.3.1.2 Concentrations of COCs in RIM 1,000 Years after Construction

The concentrations of the radionuclides in the RIM below cleanup levels are expected to change over the course of 1,000 years due to radiological decay and in-growth[14]. Future concentrations over the next 1,000 years were calculated using the following assumptions:

- The future RIM is unaffected by chemical degradation during the study period of 1,000 years, and
- Radiological decay and associated daughter in-growth over 1,000 years will change the concentrations of the radionuclides in a predictable manner.

The representative concentrations used in this risk assessment are listed in Table 6-1. The 1,000 year values include the effects of radioactive in-growth and decay.

[14] A 1,000 year study period was selected based on design requirements of 40 CFR 192.

Table 6-1 COC Concentrations in Areas 1 and 2, Off-Site Disposal Alternative

Radionuclide	Post-Construction Area 1 [a]	Post-Construction Area 2 [a]	1,000-year Area 1	1,000-year Area 2	Units
Uranium Series					
Uranium-238 + dtrs	0.04	0.04	0.04	0.04	pCi/g
Uranium-234	0.06	0.06	0.06	0.06	pCi/g
Thorium-230	4.60	4.60	4.60	4.60	pCi/g
Radium-226 + dtrs	0.40	0.40	2.25 [b]	2.25 [b]	pCi/g
Lead-210 + dtrs	0.40	0.40	2.25 [c]	2.25 [c]	pCi/g
Actinium Series					
Uranium-235 + 1 dtr [d]	0.002	0.002	0.002	0.002	pCi/g
Protactinium-231 + dtrs	0.3	0.3	0.3	0.3	pCi/g
Thorium Series					
Thorium-232 + dtrs	0.02	0.02	0.02	0.02	pCi/g

[a] Immediately after construction ceases.
[b] Includes in-growth from the decay of thorium-230.
[c] Assumed to be in secular equilibrium with radium-226.
[d] Due to the uncertainty of the uranium-235 results, these values were calculated using the more reliable uranium-238 and uranium-234 results and the expected relative abundance of uranium-235 in natural uranium.

6.3.2 Selection and Description of Reasonably Maximally-Exposed Individual

Because potential exposures associated with this excavation alternative are dependent on close proximity to the RIM below cleanup levels, individuals with the highest potential for exposure would be the people spending the most time on or near the cover over OU1 (Table 6-2). Maintenance of the cover is a required element of a capping remedy for contaminated material, and this assessment assumes that there will be workers involved in this activity. In addition, to maintaining the cover in good condition, it will be necessary to mow the grass and check the surface for degradation.

Table 6-2 List of Potential Receptors Identified During Post-Construction "Complete Rad Removal" with Off-Site Disposal Alternative

Receptors Identified	Scenario Considered? [a]	Exposure Route: Inhalation of Fugitive Dust	Exposure Route: Inhalation of Radon	Exposure Route: Incidental Soil Ingestion	Exposure Route: Dermal Contact	Exposure Route: Direct Radiation	Quantitative Evaluation of Scenario?
Grounds Keepers/Maintenance Staff	**Yes**		●			●	**Yes**
Transient/Visitors	**Yes**		{O}			{O}	No
Near-by workers	**Yes**		{O}				No

[a] An exposure scenario was considered if it included a source, a means of moving constituents of concern to a location of interest, and a receptor at that location.

●	Exposure route selected for detailed analysis
(shaded)	A shaded box indicates that the receptor/exposure route combination was not selected for quantitative analysis.
{O}	Not quantified because other receptors identified for this scenario have higher intake rates and longer exposure times.

Based on the land use restrictions currently in place, plus the additional restrictions described as part of the “Complete Rad Removal” with off-site disposal alternative and a review of the types of receptors present in the local community, a member of the grounds keeping crew was selected for this evaluation.

6.3.3 Scenario-Specific Assumptions and Exposure Parameters

Some exposure parameters are dependent on receptor-specific behavior patterns and vary from receptor scenario to receptor scenario. The following sections begin with a brief description of each set of parameters used to evaluate exposures to hypothetical receptors during this assessment. This synopsis is followed by descriptions of any site-specific parameter values and their derivation.

6.3.3.1 Receptor Behavior

This assessment of the alternative assumed that a grounds keeper on this Site is a member of a team of several workers that spends one eight-hour day per quarter mowing the covered RIM and one eight-hour day per year maintaining the integrity of the cover for a total of 40 hours over five days. The exposure duration (ED) was assumed to be 25 years.[15] The exposure factors listed in Table 6-3 provide a quantitative description of this receptor’s projected behavior.

Table 6-3 Receptor Parameters Used to Estimate Potential Exposures

Pathway Parameter (units)	Updated BRA Grounds Keeper Age 19+
ED (y)	25 [a]
EF (d/y)	5 [b]
ET indoors (h/d)	0 [c]
ET outdoors (h/d)	8 [c]
Inhalation of radon	
IR (m^3/h)	2.5 [d]

[a] http://epa-prgs.ornl.gov/radionuclides/prg_guide.shtml#parameters lists 25 years as the default parameter value for EPA’s outdoor worker.
[b] It is assumed that a grounds crew at the landfill can service the areas of either Area 1 or Area 2 on a regular basis. This assessment assumes an individual member of that crew works outdoors one day a quarter throughout the year. One additional day per year is spent on repairing erosion or subsidence.
[c] This assessment assumes an individual works outdoors for an 8 hours day.
[d] http://epa-prgs.ornl.gov/radionuclides/prg_guide.shtml#parameters lists 2.5 cubic meters per hour as the default parameter value for EPA’s outdoor worker scenario.

6.3.3.2 Physical Attributes of the Waste and Cover

The physical properties of the RIM below cleanup levels and cover components are presented in Table 6-4. The erosion rate of the cover layer reflects the effects of maintenance and the rock/rubble layer.

[15] The BRA (Auxier 2000) assumed 6.6 years per EPA/600/P-25/002Fc, pg 15-17, making the exposure evaluation presented in this appendix more conservative than the grounds keeper scenario found in the BRA.

Table 6-4 Physical Properties of RIM Below Cleanup Levels and Cover

Parameter	Area 1	Area 2
Contamination Zone (RIM)		
Thickness (m)	0.25	0.25
Area (m^2)	18,000	88,000
Erosion Rate (m/y)	0.001	0.001
Total Porosity (vol/vol)	0.671	0.671
Field Capacity (vol/vol)	0.292	0.292
Hydraulic Conductivity (m/y)	5.26	5.26
Radon Diffusion Coefficient (m^2/s)	$3.33x10^{-06}$	$3.33x10^{-06}$
Cover		
Thickness (m)	0.9	0.9
Erosion Rate (m/y)	0.0001	0.0001
Total Porosity (vol/vol)	0.427	0.427
Volumetric Water Content (vol/vol)	0.367	0.367
Hydraulic Conductivity (m/y)	0.000526	0.000526

6.4 TOXICITY ASSESSMENT

Construction of this alternative will not change the toxicity of the contaminants in the RIM. A discussion of their toxicities is presented in Section 4.2.3 of this Appendix.

6.5 RISK EVALUATION

6.5.1 Quantification of Exposure

This alternative would greatly reduce the radioactive inventory of Areas 1 and 2. The RIM in each area would be removed until residual concentrations of thorium-232 plus thorium-230, or radium-226 plus radium-228, were less than 5 pCi/g above background. The concentrations of the RIM below cleanup levels that were used to represent the inventory of radionuclides remaining after construction is complete are listed in Table 6-1.

The cover over the waste would prevent contact with any RIM below cleanup levels, limiting the plausible types of exposures to two pathways: exposure to direct radiation and inhalation of radon. These two pathways were selected for a more detailed evaluation in this assessment as they are the only pathways that could deliver exposures through an intact landfill cover (Section 6.2.3).

The clay and soil cover would also slow the movement of radon gas. This is important because delaying radon's arrival at the surface allows radioactive decay to reduce the amount of radon emerging from the soil's surface. The rate at which radon escapes the cover's surface (the radon flux rate) is measured in pCi/m2/s. The radon flux through the cover from the remaining RIM below cleanup criteria was evaluated using REACOM (See the cover design description in Appendix F for details on this model and its use). The RAECOM simulation used input values that described the cover design (Section 6.2.1) and the estimated radium-226 inventory at 1000 years (Table 6-1). Additional material properties for each layer are listed in Appendix F. Table 6-5 summarizes the parameters used to calculate radon flux from this configuration.

Table 6-5 Parameters Used to Calculate Radon Flux from Areas 1 and 2 after Removal of RIM Above Cleanup Criteria

Layer description	Thickness (m)	Ra-226 (pCi/g)	Emanation Fraction	Porosity	Moisture (dry wt_%)
RIM below Cleanup Levels	0.25	4.6	0.2 [a]	0.671 [a]	25 [a]
Clay	0.6 [a]	1	0.2 [a]	0.427 [a]	23.7 [a]
Soil	0.3 [a]	1	0.2 [a]	0.419 [a]	11.5 [a]

[a] From the cover design description in Appendix F.

These calculations predicted that no radon-222 from the RIM below cleanup levels would reach the surface of the cover, so radon doses and risks were not quantitatively evaluated for this source-cover configuration.

In both areas, the landfill cover design greatly reduces the amount of radiation that reaches the ground surface above the cover. This shielding increases as the thickness or density of intervening material increases. Because there will be no exposed waste after construction in this alternative, RESRAD was used to quantify carcinogenic risks from this alternative. The RIM concentrations used to represent the sources of potential exposure are listed in Table 6-1. The exposure factors listed in Table 6-3 describe the RME receptor considered. Table 6-4 lists the scenario-specific information used in this simulation. Parameters describing other forms of environmental transport or other exposure mechanisms were left at their default values. These parameters were not used during the calculation and changing their values would not impact calculated risks or doses.

6.5.2 Characterization of Risks

The potential for health effects from exposure to site-related contaminants was evaluated for receptors located on and off the landfill property. Due to the nature of the contaminants and the remedy, viable exposures would be limited to receptors on the surface of the landfill.

Long-term risks and doses are presented in Exhibits 6-1 through 6-4. The odd-numbered Exhibits 6-1 and 6-3 contain excerpts of the output files generated by RESRAD's dose calculation subroutines. Doses at year 1 and year 1,000 are listed at the top of the exhibits. These are followed by the values used to represent the physical characteristics and concentrations of radionuclides in the RIM and cover layer for the area modeled. The central table in the dosimetry exhibit presents the calculated doses to the receptor at selected times. The figure at the bottom of the exhibit presents the calculated doses over time in graphical form. The even-numbered exhibits (Exhibit 6-2 and 6-4) contain excerpts of the output files generated by RESRAD's risk calculation subroutines. Risks at year 1 and year 1,000 are listed at the top of the exhibits. Summary tables listing calculated risks by nuclide and pathway are located in the center of the exhibits.

Risk and dose estimates for the most exposed potential receptor working on Areas 1 and 2 in the first year after remedy construction and in the far-future are listed in Table 6-6. Calculated exposures to the outdoor worker receptors were dominated by exposures from radon daughters produced by decay of radium-226 in any residual RIM below cleanup levels.

Table 6-6 Long-term Risks and Doses to the Grounds Keeper over Areas 1 and 2 after "Complete Rad Removal"

	Area 1	Area 2
Risk at 1 year	$< 10^{-07}$	$< 10^{-07}$
Risk a 1,000 years	$< 10^{-07}$	$< 10^{-07}$
Dose at 1 year (mrem/y)	5.8×10^{-07}	5.8×10^{-07}
Dose at 1,000 years (mrem/y)	1.7×10^{-06}	9.1×10^{-06}

The RME individual for carcinogenic risks under these conditions is the grounds keeper in Area 2. 1,000 years after remedy construction is complete, the cancer risk estimate for this receptor is 4.6×10^{-07}. This risk is below EPA's acceptable risk range as stated in the NCP (EPA 1990).

Exhibit 6-1 Doses from Area 1 After Removal of RIM

	Dose (mrem/y)	
Receptor	**Year 1**	**Year 1,000**
Grounds Keeper (40 h/y)	5.84×10^{-07}	1.68×10^{-06}

Detailed Dose Data

Contaminated Zone Dimensions	
Area:	18,000 square meters
Thickness:	0.25 meter
Cover Depth:	0.9 meters

Cover Description	
Thickness:	0.9 meters
Rn Diff:	2.89×10^{-05} m/s

Initial Soil Concentrations, pCi/g	
Ac-227	2.00×10^{-03}
Pa-231	3.00×10^{-01}
Pb-210	1.90×10^{-01}
Ra-226	4.00×10^{-01}
Ra-228	2.00×10^{-02}
Th-228	2.00×10^{-02}
Th-230	4.60×10^{00}
Th-232	2.00×10^{-01}
U-234	2.00×10^{-01}
U-235	2.00×10^{-03}
U-238	4.00×10^{-02}

Total Dose TDOSE(t) over 1,000 Year Simulation, mrem/y

Maximum of 1.63×10^{-06} mrem/y at t = 1.00×10^{03} years

t (years):	**1.00×10^{00}**	**1.00×10^{01}**	**1.00×10^{02}**	**3.00×10^{02}**	**1.00×10^{03}**
TDOSE(t):	5.84×10^{-07}	6.82×10^{-07}	1.03×10^{-07}	1.38×10^{-06}	1.68×10^{-06}
M(t):	3.89×10^{-08}	4.55×10^{-08}	6.87×10^{-08}	9.22×10^{-08}	1.22×10^{-07}

TDOSE (t) = Total annual dose from all radionuclides in year (t)

M(t) = Fraction of 15 mrem/y received in year (t)

Exhibit 6-2 Risks from Area 1 After Removal of RIM

Receptor	Risk Year 1	Risk Year 1,000
Grounds Keeper (40 d/y)	$< 10^{-07}$	$< 10^{-07}$

Detailed Risk Results

Excess Cancer Risks from Existent Radionuclides and Pathways in Year 1

Radio-Nuclide	Ground		Radon		All Pathways	
	risk	fraction	risk	fraction	risk	fraction
Ac-227	$1.04x10^{-16}$	0.00	$0.00x10^{00}$	0.00	$1.04x10^{-16}$	0.00
Pa-231	$8.32x10^{-15}$	0.00	$0.00x10^{00}$	0.00	$8.32x10^{-15}$	0.00
Pb-210	$4.06x10^{-18}$	0.00	$0.00x10^{00}$	0.00	$4.06x10^{-18}$	0.00
Ra-226	$4.10x10^{-13}$	0.03	$0.00x10^{00}$	0.94	$4.10x10^{-13}$	0.03
Ra-228	$5.19x10^{-13}$	0.04	$0.00x10^{00}$	0.00	$5.19x10^{-13}$	0.04
Th-228	$1.23x10^{-13}$	0.01	$0.00x10^{00}$	0.00	$1.23x10^{-13}$	0.01
Th-230	$2.78x10^{-14}$	0.00	$0.00x10^{00}$	0.06	$2.78x10^{-14}$	0.00
Th-232	$1.08x10^{-11}$	0.91	$0.00x10^{00}$	0.00	$1.08x10^{-11}$	0.91
U-234	$9.47x10^{-20}$	0.00	$0.00x10^{00}$	0.00	$9.47x10^{-20}$	0.00
U-235	$9.88x10^{-19}$	0.00	$0.00x10^{00}$	0.00	$9.88x10^{-19}$	0.00
U-238	$3.50x10^{-25}$	0.00	$0.00x10^{00}$	0.00	$3.50x10^{-25}$	0.00
Total	$1.19x10^{-11}$	1.00	$0.00x10^{00}$	0.00	$1.19x10^{-11}$	1.00

Excess Cancer Risks from Existent Radionuclides and Pathways in Year 1,000

Radio-Nuclide	Ground		Radon		All Pathways	
	risk	fraction	risk	fraction	risk	fraction
Ac-227	$0.00x10^{00}$	0.00	$0.00x10^{00}$	0.00	$0.00x10^{00}$	0.00
Pa-231	$1.05x10^{-13}$	0.00	$0.00x10^{00}$	0.00	$1.05x10^{-13}$	0.00
Pb-210	$0.00x10^{00}$	0.00	$0.00x10^{00}$	0.00	$0.00x10^{00}$	0.00
Ra-226	$1.21x10^{-12}$	0.02	$0.00x10^{00}$	0.14	$1.21x10^{-12}$	0.02
Ra-228	$0.00x10^{00}$	0.00	$0.00x10^{00}$	0.00	$0.00x10^{00}$	0.00
Th-228	$0.00x10^{00}$	0.00	$0.00x10^{00}$	0.00	$0.00x10^{00}$	0.00
Th-230	$7.63x10^{-12}$	0.14	$0.00x10^{00}$	0.86	$7.63x10^{-12}$	0.14
Th-232	$4.75x10^{-11}$	0.84	$0.00x10^{00}$	0.00	$4.75x10^{-11}$	0.84
U-234	$1.62x10^{-15}$	0.00	$0.00x10^{00}$	0.00	$1.62x10^{-15}$	0.00
U-235	$2.24x10^{-17}$	0.00	$0.00x10^{00}$	0.00	$2.24x10^{-17}$	0.00
U-238	$3.22x10^{-19}$	0.00	$0.00x10^{00}$	0.00	$3.22x10^{-19}$	0.00
Total	$5.65x10^{-11}$	1.00	$0.00x10^{00}$	0.00	$5.65x10^{-11}$	1.00

Exhibit 6-3 Doses from Area 2 After Removal of RIM

Receptor	Dose (mrem/y) Year 1	Year 1,000
Grounds Keeper (40 d/y)	5.84×10^{-06}	9.14×10^{-06}

Detailed Dose Data

Contaminated Zone Dimensions	
Area:	88,000 square meters
Thickness:	0.25 meter
Cover Depth:	0.9 meters

Cover Description	
Thickness:	0.9 meters
Rn Diff:	2.89×10^{-05} m/s

Initial Soil Concentrations, pCi/g	
Ac-227	2.00×10^{-03}
Pa-231	3.00×10^{-01}
Pb-210	1.90×10^{-01}
Ra-226	4.00×10^{-01}
Ra-228	2.00×10^{-02}
Th-228	2.00×10^{-02}
Th-230	4.60×10^{00}
Th-232	2.00×10^{-01}
U-234	2.00×10^{-01}
U-235	2.00×10^{-03}
U-238	4.00×10^{-02}

Total Dose TDOSE(t) over 1,000 Year Simulation, mrem/y

Maximum of 9.14×10^{-06} mrem/y at t = 1.00×10^{03} years

t (years):	1.00×10^{00}	1.00×10^{01}	1.00×10^{02}	3.00×10^{02}	1.00×10^{03}
TDOSE(t):	5.84×10^{-06}	1.03×10^{-06}	1.63×10^{-06}	2.63×10^{-06}	9.14×10^{-06}
M(t):	3.84×10^{-08}	6.87×10^{-08}	1.12×10^{-07}	1.75×10^{-07}	6.09×10^{-07}

TDOSE (t) = Total annual dose from all radionuclides in year (t)

M(t) = Fraction of 15 mrem/y received in year (t)

Exhibit 6-4 Risks from Area 2 After Removal of RIM

Receptor	Risk Year 1	Risk Year 1,000
Grounds Keeper (40 d/y)	$< 10^{-07}$	$< 10^{-07}$

Detailed Risk Results

Excess Cancer Risks from Existent Radionuclides and Pathways in Year 1

Radio-Nuclide	Ground risk	Ground fraction	Radon risk	Radon fraction	All Pathways risk	All Pathways fraction
Ac-227	1.04×10^{-16}	0.00	0.00×10^{00}	0.00	1.04×10^{-16}	0.00
Pa-231	8.32×10^{-15}	0.00	0.00×10^{00}	0.00	8.32×10^{-15}	0.00
Pb-210	4.06×10^{-18}	0.00	0.00×10^{00}	0.00	4.06×10^{-18}	0.00
Ra-226	4.10×10^{-13}	0.03	0.00×10^{00}	0.00	4.10×10^{-13}	0.03
Ra-228	5.19×10^{-13}	0.04	0.00×10^{00}	0.00	5.19×10^{-13}	0.04
Th-228	1.23×10^{-13}	0.01	0.00×10^{00}	0.00	1.23×10^{-13}	0.01
Th-230	2.78×10^{-14}	0.00	0.00×10^{00}	0.00	2.78×10^{-14}	0.00
Th-232	1.08×10^{-11}	0.91	0.00×10^{00}	0.00	1.08×10^{-11}	0.91
U-234	9.47×10^{-20}	0.00	0.00×10^{00}	0.00	9.47×10^{-20}	0.00
U-235	9.88×10^{-19}	0.00	0.00×10^{00}	0.00	9.88×10^{-19}	0.00
U-238	3.50×10^{-25}	0.00	0.00×10^{00}	0.00	3.50×10^{-25}	0.00
Total	1.19×10^{-11}	1.00	0.00×10^{00}	0.00	1.19×10^{-11}	1.00

Excess Cancer Risks from Existent Radionuclides and Pathways in Year 1,000

Radio-Nuclide	Ground risk	Ground fraction	Radon risk	Radon fraction	All Pathways risk	All Pathways fraction
Ac-227	0.00×10^{00}	0.00	0.00×10^{00}	0.00	0.00×10^{00}	0.00
Pa-231	1.05×10^{-13}	0.00	0.00×10^{00}	0.00	1.05×10^{-13}	0.00
Pb-210	0.00×10^{00}	0.00	0.00×10^{00}	0.00	0.00×10^{00}	0.00
Ra-226	1.21×10^{-12}	0.02	0.00×10^{00}	0.00	1.21×10^{-12}	0.02
Ra-228	0.00×10^{00}	0.00	0.00×10^{00}	0.00	0.00×10^{00}	0.00
Th-228	0.00×10^{00}	0.00	0.00×10^{00}	0.00	0.00×10^{00}	0.00
Th-230	7.63×10^{-12}	0.14	0.00×10^{00}	0.00	7.63×10^{-12}	0.14
Th-232	4.75×10^{-11}	0.84	0.00×10^{00}	0.00	4.75×10^{-11}	0.84
U-234	1.62×10^{-15}	0.00	0.00×10^{00}	0.00	1.62×10^{-15}	0.00
U-235	2.24×10^{-17}	0.00	0.00×10^{00}	0.00	2.24×10^{-17}	0.00
U-238	3.22×10^{-19}	0.00	0.00×10^{00}	0.00	3.22×10^{-19}	0.00
Total	5.65×10^{-11}	1.00	0.00×10^{00}	0.00	5.65×10^{-11}	1.00

7 LONG-TERM RISKS FOR THE ON-SITE DISPOSAL REMEDY

7.1 ALTERNATIVE DESCRIPTION

In this alternative, the radiologically-impacted materials (RIM) will be excavated and placed in an on-site engineered disposal cell. This provides a series of physical barriers around the RIM which isolates the RIM from surface receptors.

7.2 THE CONCEPTUAL MODEL

Under this alternative, a large engineered cell would be constructed on the Site. A large portion of Areas 1 and 2 would be excavated and the RIM encountered during these excavations would be placed inside the engineered disposal cell. After the RIM above cleanup levels was removed from Areas 1 and 2, the remaining material would be recontoured and covered with a new landfill cover. The final configuration of Area 1 and Area 2 was considered to be identical to their configuration under the off-site disposal alternative evaluated in Section 6.

Because the risks associated with Areas 1 and 2 following excavation of RIM above cleanup levels have been evaluated in Section 6, the focus of this evaluation will be on the performance of the engineered disposal cell. This section presents the conceptual model of the engineered disposal cell after the remedy is complete. The conceptual model used in this assessment is based on information contained in the Sections 5.3, 6.2.3 and Appendix F of the SFS.

7.2.1 Physical Setting

The physical configuration of the on-site disposal cell after completion of the remedy is summarized below:

- RIM above cleanup levels in Areas 1 and 2 would have been moved to an engineered disposal cell.
- The material in the engineered disposal cell would be covered by a two-foot layer of rock/rubble.
- The rock/rubble layer in the engineered disposal cell would be covered by a one foot (0.3 m) thick clay layer with a minimum of 10^{-07} m/s (10^{-05} cm/s) permeability.
- The clay layer in the engineered disposal cell would be covered by a one foot (0.3 m) layer of sand.
- The sand layer in the engineered disposal cell would be covered by a two foot (0.6 m) layer of soil.
- The engineered disposal cell would be vegetated.
- The vegetation on the surface of the engineered disposal cell would be maintained.

Figure 7-1 depicts a stylized cross-section of the on-site engineered disposal cell’s cover. A geomembrane is included in the engineered cover design, but it is not reproduced in this conceptual cross-section. The longevity of this membrane is uncertain and the membrane was not considered during the calculation of long-term risks. The conceptual models of the RIM below cleanup levels in Areas 1 and 2 after removal of RIM are identical to those presented in Section 6.2.1.

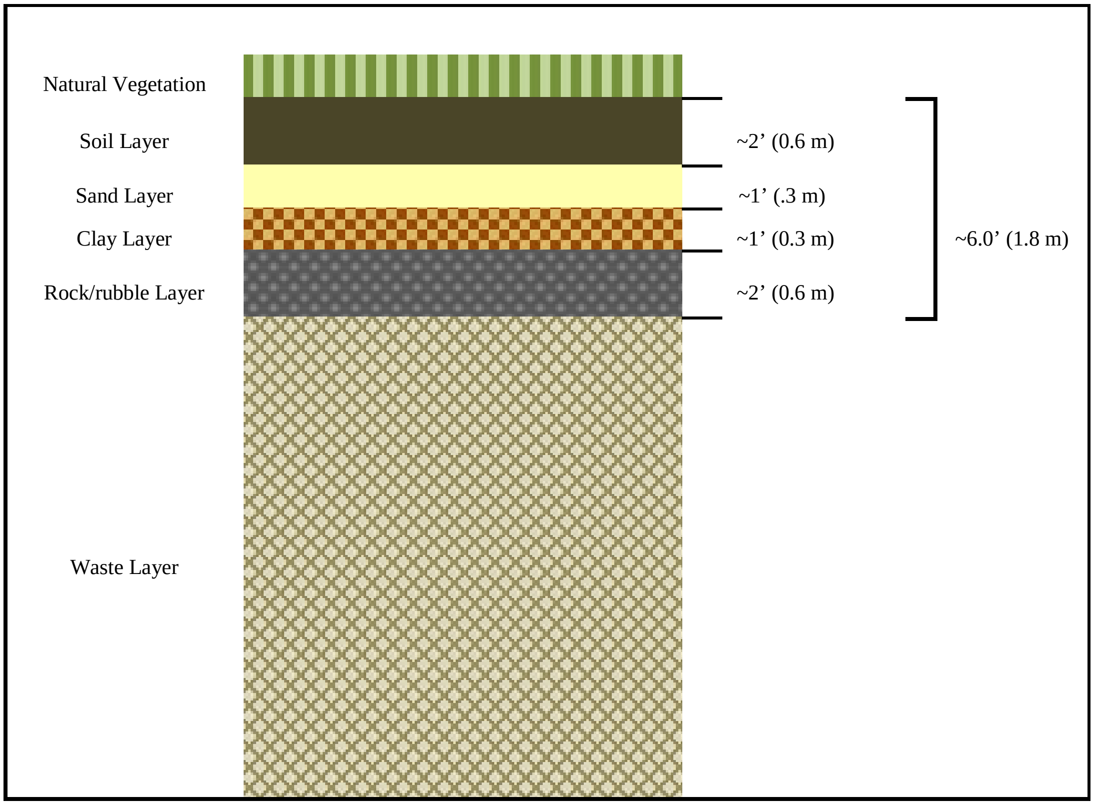


Figure 7-1 Stylized Cross-Section of the On-site Cell

7.2.2 Potentially Exposed Populations

A review of the receptor screening presented in the BRA was performed to determine if this remedy changes the receptor screening process around the landfill. It was judged that this remedy selection will not change the receptor screening process described in the BRA.

The BRA determined that the Site has historically been used as a landfill and most property surrounding the Site is currently used for commercial or industrial purposes. Deed restrictions on the West Lake Landfill prohibit on-site residential use and a deed restriction on Areas 1 and 2 prohibits construction of buildings, installation of underground utilities or pipes, and excavation. The types of receptors who might be found close to the covered waste during daily activities include transients and workers.

7.2.3 Identification of Exposure Pathways

Under this proposed remedy, only a few complete exposure pathways are viable. This remedy would move the RIM above cleanup levels into an engineered cell and place a landfill cover over Areas 1 and 2. This would eliminate any exposure pathway requiring close proximity to the waste like incidental ingestion and inhalation of particulates.

7.2.3.1 Groundwater as a Potential Exposure Pathway

At the request of EPA Region 7, the potential for dissolution of the RIM and subsequent migration to groundwater was evaluated as a potential exposure pathway. To be a complete pathway, the proposed exposure route must have a source that leaches into groundwater, the groundwater must be able to transport a chemical of concern to a receptor location, and there must be a receptor that uses the water for domestic use.

First, the two main constituents in the RIM, radium and thorium, are not likely to leach. The BRA presented information on the solubility of the major contributors to risk, radium and thorium, and judged them to be generally insoluble. A recent search of the literature did not produce new information contradicting the BRA's approach[16]. This evaluation agreed with the previously published BRA and concluded that it was not reasonable to assume that leaching of the thorium-230 and radium-226 contained in the RIM would be a viable source of groundwater contamination.

Second, no evidence of groundwater transport of radium and thorium from the Site could be found. After many decades, and in the absence of an engineered cap containing the RIM material, no significant groundwater transport of radium-226 or thorium-230 has been demonstrated. Based on current knowledge of the hydrogeology beneath the landfill, no groundwater transport of the insoluble radium or thorium in the RIM is expected.

Third, domestic or other use of groundwater as a potable (drinking) water supply near the landfill appears unlikely. No domestic groundwater wells are present in the immediate vicinity of the landfill and municipal water is available to the local communities. There is no expectation that this pattern of water use will change in the future.

Finally, land use northwest of the landfill (i.e. down-gradient) is dominated by the presence of the Missouri River floodplain. Long-term residential use of land built on the floodplain is subject to zoning restrictions.

Based on these observations, the groundwater exposure pathway is judged to be incomplete and the groundwater exposure pathway was excluded from consideration in this evaluation.

7.2.3.2 Pathways Selected for Evaluation

Two exposure pathways were selected for evaluation in this assessment: direct exposure to radiation, and inhalation of radon emanating through the cover.

Entombing the RIM in an engineered disposal cell in this alternative will block almost all of the direct radiation exposure from the RIM. Exposures from the small fraction of radiation predicted to penetrate the cover were quantified in this assessment.

This cover will also attenuate almost all of the radon-222 produced in the underlying RIM. Radium-226 in the RIM decays to radon-222, which is a noble gas. About 20% of this gas is released to interstitial air and water in the pore spaces of the RIM and surrounding soils and trash, while the other 80% remains within the solid matrix of the soil particles. Once in the pore space, this radon gas is free to move in the soil. The distance that radon can travel is greatly limited by its 3.8 day half-life. Covering the RIM in the cell with low permeability soil/clay increases the time required for the radon to reach the ground surface. This increased travel-time allows most of the radon to decay before it reaches the surface. Risks from this remaining radon were quantified in this assessment.

[16] ATSDR 1990 contains additional information on radium solubility.

7.3 EXPOSURE ASSESSMENT

This section contains quantitative descriptions of the RIM, exposure pathways, and receptors evaluated in this assessment. It also includes descriptions of the methods used to calculate potential human exposures from radionuclides in the on-site cell.

The description of the exposure assessment has been divided into three parts:

- Quantitative description of the RIM inventory in the engineered on-site cell, Area 1 and Area 2,
- Identification of the receptor most likely to receive the highest exposures from the RIM beneath the cover, and
- Estimating the exposure point concentrations at the receptor location.

7.3.1 Characterization of the RIM

Section 4.2.1 lists the radionuclides and chemicals of concern in OU-1 of the West Lake Landfill. This alternative would involve excavation of the RIM, followed by its placement in an engineered on-site cell. Once in the cell, there would be no opportunity for receptors to directly contact the RIM. Without a means of direct contact, only constituents that produce indirect exposures through the cap would need to be considered in this assessment. The COCs arsenic, chromium VI, lead, and Aroclor-1254 were screened out of the assessment at this point because the cap prevents direct contact with these chemicals, and their lack of volatility prevents their emission in gaseous form.

7.3.1.1 Concentrations of COCs in RIM 1 Year after Construction

According to the ROD, about 8,700 tons of material containing approximately 3 mg of radium per ton [17]were mixed with 39,000 tons of uncontaminated soil and sent to West Lake Landfill. Assuming the mass estimate of radium-226 in the original 8,700 tons of material was correct, then 25.8 Curies (Ci) of radium-226 would have been present in the material received by the landfill and the radium-226 concentration in the shipped materials would have been about 595 pCi/g. This is higher than the value reported as the 95% UCL on the mean for either Area 1 or Area 2. To be conservative and notwithstanding the field data from the Remedial Investigation which indicates a lower total, the activity of 25.8 Ci of radium-226 was used to calculate radionuclide and chemical concentrations inside the completed cell.

The concentration of radium-226 was calculated by assuming all RIM was removed from Areas 1 and 2 and placed uniformly in the on-site cell. Approximately 335,000 bank cubic yards of material weighing approximately 250,000 tons would be excavated during this process. If the activity of 25.8 Ci of radium-226 were uniformly distributed throughout the excavated material, the average radium-226 concentration would be about 113 pCi/g in the finished cell.

Projected concentrations of other radionuclides were calculated by assuming their relative abundance to each other would remain unchanged during excavation and placement in the cell (See Table 7-1).

---

[17] Section 2 and Figure 2-2, Record of Decision, West Lake Landfill Site, Bridgeton, Missouri, Operable Unit 1, May 2008, U.S. Environmental Protection Agency, Region 7, Kansas City

Table 7-1 Calculated Concentrations of RIM within On-site Cell

Radionuclides	Total Activity Reportedly Delivered to West Lake (Ci)	Average Conc. in Samples (pCi/g)	Ratio of Conc. to Radium-226 Conc.	Calculated Post-Construction Conc. in Cell (pCi/g)	Calculated 1,000 y Construction Conc. in Cell (pCi/g)
Uranium Series					
Uranium-238 + dtrs [a]	1.3	15.7	0.122	13.8	13.8
Uranium-234 [a]	1.3	25.8	0.200	22.6	22.6
Thorium-230	309	1,528	-	1,384	1,384
Radium-226 + dtrs	25.8[b]	129	-	113	557
Lead-210 + dtrs	NA	76	0.589	66.6	557
Actinium Series					
Uranium-235 + dtr [a]	NA	7.22	0.0560	6.3	6.3
Protactinium-231 + dtrs	NA	89.3	0.692	78.2	78.2
Thorium Series					
Thorium-232 + dtrs	NA	9.37	0.0726	8.2	8.2

[a] These values do not agree with the relative isotopic abundances expected in natural uranium. They are used here to be consistent with the original radioanalytical results. The risk assessment results are relatively insensitive to minor variations in these values.
[b] ~3 mg of radium per ton of residue. 8,700 tons of residue mixed with 39,000 tons of uncontaminated soil or about 595 pCi/g.

7.3.1.2 Concentrations of COCs in RIM 1,000 Years after Construction

The concentrations of the radionuclides in the RIM are expected to change over the course of 1,000 years due to radiological decay and in-growth[18]. Future concentrations over the next 1,000 years were calculated (Table 7-1) using the following assumptions:

- The future RIM is unaffected by chemical degradation during the study period of 1,000 years, and
- Radiological decay and associated daughter in-growth over 1,000 years will change the concentrations of the radionuclides in a predictable manner.

7.3.1.3 Characterization of Areas 1 and 2 after Construction

The potential emission sources for these areas after complete removal of the RIM will be identical to those described in Section 6.3.1.

7.3.2 Selection and Description of Reasonably Maximally-Exposed Individual

Because the potential exposures associated with this alternative are dependent on close proximity to the RIM, the individuals with the highest potential for exposure would be the people spending the most time on or near the new engineered disposal cell (Table 7-2). Maintenance of the cell's cover is a required element of the covered RIM excavation remedy and this assessment assumes that there will be workers involved in this activity. In addition, to maintain the cell's cover in good condition, it will be necessary to mow the grass and check the surface for degradation.

[18] A 1,000 year study period was selected based on design requirements of 40 CFR 192.

Table 7-2 List of Potential Receptors Identified During Post-Construction "Complete Rad Removal" with On-Site Disposal Alternative

Receptors Identified	Scenario Considered? [a]	Exposure Route: Inhalation of Fugitive Dust	Exposure Route: Inhalation of Radon	Exposure Route: Incidental Soil Ingestion	Exposure Route: Dermal Contact	Exposure Route: Direct Radiation	Quantitative Evaluation of Scenario?
Grounds Keepers/Maintenance Staff	**Yes**		●			●	**Yes**
Transient/Visitors	**Yes**		{O}			{O}	No
Near-by workers	**Yes**		{O}				No

[a] An exposure scenario was considered if it included a source, a means of moving constituents of concern to a location of interest, and a receptor at that location.

● Exposure route selected for detailed analysis

(shaded) A shaded box indicates that the receptor/exposure route combination was not selected for quantitative analysis.

{O} Not quantified because other receptors identified for this scenario have higher intake rates and longer exposure times.

Based on the land use restrictions currently in place, plus additional restrictions described as part of the "Complete Rad Removal" with on-site disposal alternative and a review of the types of receptors present in the local community, a member of the ground skeeping crew was selected for this evaluation.

7.3.3 Scenario-Specific Assumptions and Exposure Parameters

Some exposure parameters are dependent on receptor-specific behavior patterns and vary from receptor scenario to receptor scenario. The following sections begin with a brief description of each set of parameters used to evaluate exposures to hypothetical receptors during this assessment. This synopsis is followed by descriptions of any site-specific parameter values and their derivation.

7.3.3.1 Receptor Behavior

This assessment of the alternative assumed that a grounds keeper on this Site is a member of a team who spends one day per quarter mowing the cell and one day per year maintaining the integrity of the cell's cover or the cover of Areas 1 and 2. A reasonable estimate of the time required for a worker participating in these activities is 40 man-hours. The time of 40 hours/year was used to quantify risks from this activity. The exposure duration was assumed to be 25 years.[19] The exposure factors listed in Table 7-3 provide a quantitative description of this receptor's projected behavior.

[19] The BRA (Auxier 2000) assumed 6.6 years per EPA/600/P-25/002Fc, pg 15-17, making the exposure evaluation presented in this appendix more conservative than the grounds keeper scenario found in the BRA.

Table 7-3 Receptor Parameters Used to Estimate Potential Exposures

Pathway Parameter (units)	Updated BRA Grounds Keeper Age 19+
ED (yr)	25 [a]
EF (d/yr)	5 [b]
ET indoors (hr/d)	0 [c]
ET outdoors (hr/d)	8 [c]
Inhalation of radon	
IR (m^3/h)	2.5 [d]

[a] http://epa-prgs.ornl.gov/radionuclides/prg_guide.shtml#parameters lists 25 years as the default parameter value for EPA's outdoor worker.

[b] It is assumed that a grounds crew at the landfill can service the areas of either Area 1 or Area 2 on a regular basis. This assessment assumes an individual member of that crew works outdoors one day a quarter throughout the year. One additional day per year is spent on repairing erosion or subsidence

[c] This assessment assumes an individual works outdoors for an 8 hours day.

[d] http://epa-prgs.ornl.gov/radionuclides/prg_guide.shtml#parameters lists 2.5 cubic meters per hour as the default parameter value for EPA's outdoor worker scenario.

7.3.3.2 Physical Attributes of the Waste and Cover

The physical properties of the RIM and cover components are presented in Table 7-4.

Table 7-4 Physical Description of On-Site Cell

Parameter	Value
Contamination Zone (RIM)	
Thickness (m)	6.0
Area (m^2)	40,000
Erosion Rate (m/y)	0.001
Total Porosity (vol/vol)	0.671
Field Capacity (vol/vol)	0.292
Radon Diffusion Coefficient (m^2/s)	3.33×10^{-06}
Cover	
Thickness (m)	1.8
Erosion Rate (m/y)	0.0001
Total Porosity (vol/vol)	0.427
Volumetric Water Content (vol/vol)	0.367
Radon Diffusion Coefficient (m^2/s)	2.85×10^{-07}

[a] Composite diffusion coefficient for single-layer cover. Resulting radon flux matches flux estimated from multilayer cover design as calculated in Appendix F.

7.4 TOXICITY ASSESSMENT

Implementation of this remedy will not change the toxicity of the covered contaminants in the RIM. A discussion of their toxicities is presented in Section 4.2.3 of this Appendix.

7.5 RISK EVALUATION

7.5.1 Quantification of Exposure

Two exposure pathways were selected for quantitative evaluation in this assessment: exposure to direct radiation and inhalation of radon. These two pathways were the only pathways that could deliver exposures through an intact cap (Section 7.2.3).

In both cases, the cell design greatly reduces the amount of exposure from the RIM inside the cell. Encapsulating the RIM with layers of soil and clay would reduce the amount of radiation penetrating the surfaces of the cell. This shielding increases as the thickness or density of intervening material increases. The clay layer of the design will also slow the movement of radon gas. This is important because delaying radon's arrival at the surface allows radioactive decay to reduce the amount of radon emerging from the soil's surface.

Because there will be no exposed waste after construction in this alternative, RESRAD was used to quantify carcinogenic risks from these two pathways. The RIM concentrations used to represent the on-site cell's contents are listed in Table 7-1. The exposure factors listed in Table 7-3 describe the RME receptor considered. Table 7-4 lists the scenario-specific information used in this simulation. Parameters describing other forms of environmental transport or other exposure mechanisms were left at their default values. These parameters were not used during the calculation and changing their values would not impact calculated risks or doses.

Two RESRAD runs were performed to build the simulation: one to quantify the risks from direct radiation, and one to calculate the risks from radon. Separating the two calculations allows the EPA default inhalation parameter of 2.5 m^3/h to be used in the radon calculation.

7.5.2 Characterization of Risks

The potential for health effects from exposure to site-related contaminants was evaluated for receptors located on and off the landfill property. Due to the nature of the contaminants and the remedy, viable exposures would be limited to receptors on the surface of the landfill.

Long-term doses and risks are presented in Exhibits 7-1 and 7-2. Exhibit 7-1 contains excerpts of the output files generated by RESRAD's dose calculation subroutines. Doses at year 1 and year 1,000 are listed at the top of the Exhibit. These are followed by the values used to represent the physical characteristics of the cell contents and cover layer and the concentrations of radionuclides in the RIM after it has been placed in the cell. The central table in the dosimetry exhibit presents the calculated doses to the receptor at selected times. Exhibit 7-2 contains excerpts of the output files generated by RESRAD's risk calculation subroutines. Risks at year 1 and year 1,000 are listed at the top of the Exhibits. Summary tables listing calculated risks by nuclide and pathway are located in the center of the exhibits.

Risk and dose estimates for the most exposed potential receptor working on the engineered disposal cell and over Areas 1 and 2 after remediation are presented in Table 7-5. Risks from Areas 1 and 2 after "complete rad removal" would be identical to those calculated in Section 6.

Table 7-5 Long-term Risks and Doses to the Grounds Keeper Calculated for On-site Disposal

	On-site Cell (Grounds Keeper)	Remediated Area 1 (Grounds Keeper)	Remediated Area 2 (Grounds Keeper)
Risk at 1 year	$2.4x10^{-07}$	$< 10^{-07}$	$< 10^{-07}$
Risk at 1,000 years	$1.5x10^{-06}$	$< 10^{-07}$	$< 10^{-07}$
Dose at 1 year (mrem/y)	$1.4x10^{-02}$	$5.8x10^{-07}$	$5.8x10^{-07}$
Dose at 1,000 years (mrem/y)	$9.0x10^{-02}$	$1.7x10^{-06}$	$9.1x10^{-06}$

The RME receptor for carcinogenic risks under these conditions is the grounds keeper working to maintain the cover for the on-site cell. The cancer risk estimate for this hypothetical receptor is 1.49×10^{-06}. The most important single contributor to this risk is exposure to radon daughters emanating from the continued in-growth of radium-226 from the decay of thorium-230 over 1,000 years. In all cases, exposures to outdoor receptors were calculated to be all at or below EPA's acceptable risk range as stated in the NCP (EPA 1990).

Exhibit 7-1 Doses to Grounds Keeper – On-Site Disposal Option

Receptor	Dose (mrem/yr) Year 1	Dose (mrem/yr) Year 1,000
Grounds Keeper (40 h/y)	1.40×10^{-02}	9.01×10^{-02}

Detailed Dose Data

Contaminated Zone Dimensions

Area:	40,000 square meters
Thickness:	6.0 meters
Cover Depth:	1.8 meters

Cover Description

Thickness:	1.8 meters
Rn Diff:	2.85×10^{-07} m/s

Initial Soil Concentrations, pCi/g

Ac-227	6.30×10^{00}
Pa-231	7.82×10^{01}
Pb-210	6.66×10^{01}
Ra-226	1.13×10^{02}
Ra-228	8.20×10^{00}
Th-228	8.20×10^{00}
Th-230	1.38×10^{03}
Th-232	8.20×10^{00}
U-234	2.26×10^{01}
U-235	6.30×10^{00}
U-238	1.38×10^{01}

Total Dose TDOSE(t) over 1,000 Year Simulation, mrem/y

Maximum of 9.01×10^{-02} mrem/yr at t = 1.00×10^{03} years

t (years):	**1.00×10^{00}**	**1.00×10^{01}**	**1.00×10^{02}**	**3.00×10^{02}**	**1.00×10^{03}**
TDOSE(t):	1.40×10^{-02}	1.47×10^{-02}	2.12×10^{-02}	3.58×10^{-02}	9.01×10^{-02}
M(t):	9.35×10^{-04}	9.78×10^{-04}	1.41×10^{-03}	2.39×10^{-03}	6.01×10^{-03}

TDOSE (t) = Total annual dose from all radionuclides in year (t)
M(t) = Fraction of 15 mrem/y received in year (t)

Exhibit 7-2 Risks to Grounds Keeper– On-Site Disposal Option

Receptor	Risk Year 1	Risk Year 1,000
Grounds Keeper (40 h/y)	$2.44x10^{-07}$	$1.49x10^{-06}$

Detailed Risk Data

Excess Cancer Risks from Existent Radionuclides and Pathways in Year 1

Radio- Nuclide	Ground risk	Ground fraction	Radon risk	Radon fraction	All pathways risk	All pathways fraction
Ac-227	$6.66x10^{-19}$	0.00	$0.00x10^{00}$	0.00	$6.66x10^{-19}$	0.00
Pa-231	$4.15x10^{-18}$	0.00	$0.00x10^{00}$	0.00	$4.15x10^{-18}$	0.00
Pb-210	$1.03x10^{-20}$	0.00	$0.00x10^{00}$	0.00	$1.03x10^{-20}$	0.00
Ra-226	$1.36x10^{-16}$	0.00	$2.27x10^{-07}$	0.93	$2.27x10^{-07}$	0.93
Ra-228	$2.84x10^{-14}$	0.00	$0.00x10^{00}$	0.00	$2.84x10^{-14}$	0.00
Th-228	$7.10x10^{-15}$	0.00	$0.00x10^{00}$	0.00	$7.10x10^{-15}$	0.00
Th-230	$9.83x10^{-18}$	0.00	$1.63x10^{-08}$	0.07	$1.63x10^{-08}$	0.07
Th-232	$5.83x10^{-14}$	0.00	$0.00x10^{00}$	0.00	$5.83x10^{-14}$	0.00
U-234	$1.26x10^{-23}$	0.00	$2.09x10^{-14}$	0.00	$2.09x10^{-14}$	0.00
U-235	$9.27x10^{-23}$	0.00	$0.00x10^{00}$	0.00	$9.27x10^{-23}$	0.00
U-238	$1.40x10^{-28}$	0.00	$2.35x10^{-19}$	0.00	$2.35x10^{-19}$	0.00
Total	$9.40x10^{-14}$	0.00	$2.44x10^{-07}$	1.00	$2.44x10^{-07}$	1.00

Excess Cancer Risks from Existent Radionuclides and Pathways in Year 1,000

Radio- Nuclide	Ground risk	Ground fraction	Radon risk	Radon fraction	All pathways risk	All pathways fraction
Ac-227	$0.00x10^{00}$	0.00	$0.00x10^{00}$	0.00	$0.00x10^{00}$	0.00
Pa-231	$5.14x10^{-17}$	0.00	$0.00x10^{00}$	0.00	$5.14x10^{-17}$	0.00
Pb-210	$0.00x10^{00}$	0.00	$0.00x10^{00}$	0.00	$0.00x10^{00}$	0.00
Ra-226	$4.03x10^{-16}$	0.00	$1.93x10^{-07}$	0.13	$1.93x10^{-07}$	0.13
Ra-228	$0.00x10^{00}$	0.00	$0.00x10^{00}$	0.00	$0.00x10^{00}$	0.00
Th-228	$0.00x10^{00}$	0.00	$0.00x10^{00}$	0.00	$0.00x10^{00}$	0.00
Th-230	$2.70x10^{-15}$	0.00	$1.30x10^{-06}$	0.87	$1.30x10^{-06}$	0.87
Th-232	$2.54x10^{-13}$	0.00	$0.00x10^{00}$	0.00	$2.54x10^{-13}$	0.00
U-234	$2.16x10^{-19}$	0.00	$1.04x10^{-10}$	0.00	$1.04x10^{-10}$	0.00
U-235	$8.71x10^{-20}$	0.00	$0.00x10^{00}$	0.00	$8.71x10^{-20}$	0.00
U-238	$1.31x10^{-22}$	0.00	$6.28x10^{-14}$	0.00	$6.28x10^{-14}$	0.00
Total	$2.57x10^{-13}$	0.00	$1.49x10^{-06}$	1.00	$1.49x10^{-06}$	1.00

8 SHORT-TERM RISK ASSESSMENT METHODOLOGY

This risk analysis identifies and evaluates risks associated with construction of the three alternatives. These construction activities would be of limited duration and are evaluated as short-term risks in this assessment.

These short-term risks were grouped into two major categories in this report: risks to human health from exposures to RIM, and risks of injury or fatalities from industrial and construction accidents. Human health risks include carcinogenic and non-carcinogenic effects from exposure to any RIM that might be uncovered, excavated, transported or handled while on the Site or during transportation from the Site. The risks from construction, material handling, and transportation accidents have been grouped together under “industrial hazards”.

The remainder of this section presents the methods used to evaluate short-term human health risks and introduces information that is common to all three alternatives. It uses EPA default scenarios to illustrate the approach and methods used.

The following three sections (Sections 9 through 11) contain alternative-specific presentations of how these methods and information were used to assess potential risks for each alternative evaluated. These alternative-specific discussions include the rationale used to select the RME individual(s) from a list of potential receptors, identify the potential exposures to that receptor, and present the risk that an individual could potentially realize from the presence of COCs in the RIM. These scenarios consider all reasonable pathways that may produce a measurable exposure to harmful substances or emissions. Each alternative-specific discussion also presents the methods and information used to evaluate the risk of injuries and fatalities associated with construction of that particular alternative.

8.1 HUMAN HEALTH ASSESSMENT METHODS

8.1.1 Exposure Point Concentrations in Soil

The calculated risks published in the BRA indicate that risks to receptors associated with Area 2 were consistently higher than risks to the same receptors in Area 1. In order to simplify the following evaluations, the radiological and chemical concentrations in Area 2 were used to evaluate human health exposures from RIM in the short-term risk assessments for each alternative (Column two of Table 8-2). This is expected to overestimate the risk to hypothetical receptors as receptors in other areas will be exposed to lower concentrations of the constituents producing the greatest human health effects.

8.1.2 Exposure Point Concentrations in Worker Breathing Zone

EPA’s web calculators estimate the exposure point concentrations in air as an intermediate step in the process used to calculate PRGs and SLs. This is done by using a Particle Emission Factor (PEF). The derived air concentration is assumed to be the amount of suspended, respirable particles that is available for respiration from undisturbed surface soil. It is not generally appropriate for evaluation of site emissions from disturbed soils like those produced during prolonged construction work.

While there will be construction activities on this site, the surface that will be disturbed is not truly soil. The material handled will consist of a mixture of paper, rags, plastic, bottles and cans, lumber and pipe, old food and refuse, with some soil mixed into the matrix. It is likely that the exposed/processed material will have a much lower resuspension rate than soil undergoing similar processes. In addition, dust suppression measures, partial excavation of areas, and a properly managed health and safety monitoring program will further reduce dust emissions within the working areas.

Thus there are two competing considerations when modeling air concentrations over this site: Construction activities would tend to raise dust levels while the nature of the materials being handled would lower it. Given the large uncertainty surrounding the likely resuspension potential of disturbing this material, the PEF for soil calculated by the EPA web calculators was used to evaluate exposures in this assessment.

8.1.3 Exposure Point Concentrations in Off-site Air

The baseline risk assessment (Auxier 2000) concluded that the RME was an on-site receptor. This reflects the dominance of the gamma exposure pathway in the risk assessment calculations. Off-site receptors would not be exposed to direct gamma from the soil and the primary pathway for those receptors would be potential inhalation of airborne emissions from the site.

A very simple calculation was done to assess the magnitude of these exposures to determine if a more detailed assessment was needed. The method selected assumed some quantity of site soil was suspended in air above OU1. A fraction of this dust-air mixture was assumed to reach a receptor. This air concentration was then used to calculate risks to a hypothetical resident.

This method is full of conservative assumptions and calculations. It is intended to provide a bounding dose and does not attempt to predict actual doses or risks to off-site receptors. Actual doses and risks are likely to be lower than the results of these calculations. The site-specific, conservative calculations in Section 9, 10, and 11 yielded risks that were less than 10^{-4}, and it was judged that no additional evaluations of risks to this sub-population was needed.

8.1.3.1 Selection of Soil to Air Suspension Factor

To evaluate exposures from dust in the air, it was assumed that operations that handle or disturb the RIM could produce some suspended particulates within the working area. The concentration of suspended particulates in near-ground conditions varies. Gilbert et al. 1983 reported that ambient concentrations of "transportable" airborne particles range from 9 x 10^{-06} to 2.54 x 10^{-04} g/m^3. Using all transportable airborne particles to assess inhalation exposures is not appropriate as only a small portion of transportable particles is the right size to be inhaled and retained by the lungs and upper respiratory tract.

As noted in the previous subsection, EPA uses a PEF to quantify the estimated amount of respirable, suspended material in air when calculating its published PRGs and SLs. The default PEF of 1.36 x 10^{09} m^3/kg is equivalent to a mass concentration of 7.35 x 10^{-07} g/m^3 of respirable dust particles[20] and is intended for assessment of exposures from undisturbed surface soil. It is not generally not considered appropriate for evaluation of off-site emissions from disturbed soils like those produced during prolonged construction work on dirt surfaces.

Evaluation of off-site air concentrations from this landfill is complicated for the same reasons described in the previous section. Construction activities will disturb the surface. If the material was soil, this activity would increase the resuspension rate of dust from the material. However,

[20] Particle size with a mean aerodynamic diameter in the range of 0.5 - 10 micron.

the material is not truly "soil". The material being disturbed is trash. It is made up of paper, rags, plastic, bottles and cans, lumber and pipe, old food and refuse, with some dirt mixed in to the matrix. It is likely that the exposed/processed material will have a much lower resuspension rate than soil undergoing similar processes. In addition, dust suppression measures, partial excavation of areas, and a properly managed health and safety monitoring program will further reduce dust emissions within the working areas.

Given the level of concern regarding exposures to members of the public in the areas surrounding OU 1, and the stated intent to provide an upper-bound estimate of risks to off-site receptors, a more conservative approach was taken to calculate off-site air concentrations than was used to calculate worker exposures. A relatively high initial dust concentration was selected to provide an "upper-bound" estimate of suspended material during construction. The former annual average PM_{10} standard of 5 x 10^{-05} µg/m^3 was selected for this purpose. While the former annual average PM_{10} standard is no longer enforceable, it does provide a recognizable air concentration number on which to base the rest of the calculation. It is likely that this value will overestimate the amount of suspended particulates available to be transported from Areas 1 and 2 to an off-site receptor.

8.1.3.2 Estimation of Dust Concentrations at the Site Boundary

The calculated annual concentrations of suspended soil at the boundary of Area 2 were used to represent dust concentrations in air at off-site residential locations. These were calculated using methods and information published in EPA's "Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, Appendix D"[21] This guidance allows the user to estimate the relationship between the rate that material moves from the soil into the air over the soil (the source flux) and the resulting air concentrations at various distances away from the center of the source:

$$Q/Conc_{loc} = A \times \exp\{[\ln(Area_{site}) - B]^2/C\}$$

Where:

$Q/Conc_{(loc)}$	=	Inverse of the ratio of the geometric mean air concentration to the emission flux at the boundary of the source (g/m^2-s per kg/m)
Q	=	Emission Flux (g/m-s)
$Conc_{(loc)}$	=	Concentration at a location (kg/m^3)
$Area_{site}$	=	Areal extent of the site or contamination (acres)
A, B & C	=	Constants based on air dispersion modeling for specific climate zones

Using this relationship, a $Q/Conc_{(loc)}$ value for the center of the working area and another one for the boundary of the Site were calculated (Table 8-1).

[21] http://www.epa.gov/superfund/health/conmedia/soil/pdfs/ssg_appd-e.pdf

Table 8-1 Calculated Q/C for West Lake Landfill

Locations	Dispersion Parameter [a] A	B	C	Q/C for 200 Acre Site [b]
Q/C_{center}	16.8653	18.7848	215.0624	39.3
$Q/C_{boundary}$	20.1837	21.6367	264.0685	55.5
			$Q/C_{center} \div Q/C_{boundary}$=	**0.71**

[a] Parameter values from Exhibit D-2 (center) and Exhibit D-4 (boundary) of the supplemental guidance.[22]

[b] West Lake Landfill is approximately 200 acres (Section 2.1 of the SFS).

The emission flux from the source (Q) does not change as a function of the receptor's distance, and it is possible to calculate what fraction of the air concentrations at the center of the working area make it to the boundary of the Site by dividing the Q/C_{center} value by the $Q/C_{boundary}$ value (leaving $C_{boundary}/C_{center}$). For the purpose of calculating risks to off-site residents the calculated air concentrations at the Site boundary during remediation activities involving exposed RIM will be 71% (39..3/55.5) of the air concentration within the on-site working area (Column four of Table 8-2). It is recognized that this value may overestimate the average air concentration at the receptor location during the period of remediation.

8.1.3.3 Estimation of Constituent Concentrations in Boundary Air

As discussed in Section 8.1.1, it was assumed that all human health effects were evaluated using the exposed RIM in Area 2 as the source of those exposures. The concentrations of radionuclide and chemicals in air at the boundary was calculated by multiplying the 95% UCL concentration of the radionuclide in Area 2 by the soil to air suspension factor and the fraction of the particles that disperse to the boundary. These boundary air concentrations are listed in Table 8-2.

[22] http://www.epa.gov/superfund/health/conmedia/soil/pdfs/ssg_appd-e.pdf

Table 8-2 Exposure Point Concentrations Used to Evaluate Short-term Human Health Effects to Off-site Receptors

Category / Constituent	95% UCL Soil Conc. in Area 2 [a, b]	Soil to Air Suspension Factor (g/m^3)	Q/C(onsite) / Q/C(boundary)	Annual Average Concentrations in Air at Site Boundary
Radionuclide				
Actinium-227	$1.62x10^{02}$ pCi/g	$5.00x10^{-05}$ [c]	$7.1x10^{-01}$ [d]	$5.74x10^{-03}$ pCi/m^3
Bismuth-210	$1.28x10^{02}$ pCi/g	$5.00x10^{-05}$	$7.1x10^{-01}$	$4.53x10^{-03}$ pCi/m^3
Lead-210	$1.28x10^{02}$ pCi/g	$5.00x10^{-05}$	$7.1x10^{-01}$	$4.53x10^{-03}$ pCi/m^3
Polonium-210	$1.28x10^{02}$ pCi/g	$5.00x10^{-05}$	$7.1x10^{-01}$	$4.53x10^{-03}$ pCi/m^3
Protactinium-231	$1.62x10^{02}$ pCi/g	$5.00x10^{-05}$	$7.1x10^{-01}$	$5.74x10^{-03}$ pCi/m^3
Radium-223 + dtrs	$1.62x10^{02}$ pCi/g	$5.00x10^{-05}$	$7.1x10^{-01}$	$5.74x10^{-03}$ pCi/m^3
Radium-226 + dtrs	$3.38x10^{02}$ pCi/g	$5.00x10^{-05}$	$7.1x10^{-01}$	$1.20x10^{-02}$ pCi/m^3
Radium-228 + dtrs	$1.59x10^{01}$ pCi/g	$5.00x10^{-05}$	$7.1x10^{-01}$	$5.63x10^{-04}$ pCi/m^3
Thorium-227 + dtrs	$1.62x10^{02}$ pCi/g	$5.00x10^{-05}$	$7.1x10^{-01}$	$5.74x10^{-03}$ pCi/m^3
Thorium-228	$1.59x10^{01}$ pCi/g	$5.00x10^{-05}$	$7.1x10^{-01}$	$5.63x10^{-04}$ pCi/m^3
Thorium-230	$3.73x10^{03}$ pCi/g	$5.00x10^{-05}$	$7.1x10^{-01}$	$1.32x10^{-01}$ pCi/m^3
Thorium-232	$1.59x10^{01}$ pCi/g	$5.00x10^{-05}$	$7.1x10^{-01}$	$5.63x10^{-04}$ pCi/m^3
Uranium-234	$4.60x10^{01}$ pCi/g	$5.00x10^{-05}$	$7.1x10^{-01}$	$1.63x10^{-03}$ pCi/m^3
Uranium-235 + dtrs	$1.83x10^{00}$ pCi/g	$5.00x10^{-05}$	$7.1x10^{-01}$	$6.48x10^{-05}$ pCi/m^3
Uranium-238 + dtrs	$2.71x10^{01}$ pCi/g	$5.00x10^{-05}$	$7.1x10^{-01}$	$9.59x10^{-04}$ pCi/m^3
Metals				
Arsenic	$7.70x10^{00}$ µg/g	$5.00x10^{-05}$	$7.1x10^{-01}$	$2.73x10^{-04}$ $\mu g/m^3$
Chromium (VI)	$2.27x10^{01}$ µg/g	$5.00x10^{-05}$	$7.1x10^{-01}$	$8.04x10^{-04}$ $\mu g/m^3$
Lead	$4.79x10^{02}$ µg/g	$5.00x10^{-05}$	$7.1x10^{-01}$	$1.69x10^{-02}$ $\mu g/m^3$
PCBs				
Aroclor-1254	$5.00x10^{-01}$ µg/g	$5.00x10^{-05}$	$7.1x10^{-01}$	$1.77x10^{-05}$ $\mu g/m^3$

[a] Radionuclide values from BRA (Auxier 2000).
[b] 95% UCLs on the mean for metals and Aroclor-1254 were not reported for all depths in the BRA. The soil concentrations listed in this table were calculated from analytical data reported by the laboratory.
[c] 5×10^{-05} g/m^3 is the annual average PM_{10} standard.
[d] 0.71 from Table 8-1, above.

8.1.4 Potential Receptors

The activities expected to occur during construction of the alternatives were examined to identify potential receptors. Some of the tasks and activities employed during construction of the ROD-Selected Remedy and the two "Complete Rad Removal" alternatives are common to all three alternatives. Other activities would be limited to one or two of the alternatives. Each alternative-specific evaluation in Sections 9 through 11 contains a list of hypothetical receptors considered for that particular risk assessment.

8.1.5 Exposure Pathways

RIM will be disturbed by grading or excavation during construction of the three alternatives. Receptors may be exposed to this material by inhalation of suspended particulates, inhalation of radon, incidental ingestion of soil, and direct exposure to gamma radiation. The details of these exposures are alternative-specific and are addressed in the short-term evaluations for each alternative presented in Sections 9 through 11.

8.1.6 Quantification of Human Health Effects

EPA has published web-based risk calculators on two public websites[23]. These calculators allow the user to estimate a site's PRGs for radionuclides and SLs for chemicals in soil and air, assuming a target cancer risk of 10^{-06}. The risk results from these web-based calculators were used to calculate human health risks to outdoor workers and residents for the three alternatives.

8.1.6.1 Calculation of Outdoor Worker Risks

The outdoor worker scenario from EPA's PRG and SL calculators was selected to illustrate the method used to calculate the PRGs and SLs used to estimate human health effects to workers at the Site. Table 8-3 presents the exposure parameter values used by EPA to calculate the concentration of radionuclides and chemicals in soil that would yield a target risk of 10^{-06} to their default outdoor worker (Table 8-4).

Table 8-3 Default Input for EPA's Soil PRG and SL Calculators - Outdoor Worker

Variable	PRG Calculator Value	SL Calculator Value
Slab size for ACF (area correction factor) m^2	Default (isotope-specific)	Default (isotope-specific)
TR (target cancer risk) unitless	0.000001	0.000001
t_{ow} (time - outdoor worker) y	25	25
ED_{ow} (exposure duration - outdoor worker) y	25	25
ET_{ow} (exposure time - outdoor worker) h/d	8	8
EF_{ow} (exposure frequency) d/y	225	225
$AT_{ow(c)}$ (Averaging time, Carcinogens) d	NA [a]	25,550
$AT_{ow(n)}$ (Averaging time, Noncarcinogens) d	NA	730
BW_{ow} (Body weight, adult) kg	NA	70
IR_{ow} (soil intake rate) mg/d	100	100
IRA_{ow} (inhalation rate - outdoor worker) m^3/d	60	60
SA_w (exposed skin surface) cm^2/day	NA	3,300
AF_w (soil-to-skin adherence factor)	NA	0.2
GSF (gamma shielding factor) unitless	1	NA

[a] NA – Not applicaple.

[23] The PRG calculator's URL is: http://epa-prgs.ornl.gov/cgi-bin/radionuclides/rprg_search and the Screening Level calculators' URL is http://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search.

Table 8-4 Soil PRG's and SLs for Carcinogenic Effects to EPA's Default Outdoor Worker

Category (units) Constituent	**PRG or SL, 10^{-06} Risk, Exposed for 225 Days/Year During 25 Years, Ingestion**	**PRG or SL, 10^{-06} Risk, Exposed for 225 Days/Year During 25 Years, Inhalation**	**PRG or SL, 10^{-06} Risk, Exposed for 225 Days/Year During 25 Years, External Exposure**	**PRG or SL, 10^{-06} Risk, Exposed for 225 Days/Year During 25 Years, Dermal**	**PRG or SL, 10^{-06} Risk, Exposed for 225 Days/Year During 25 Years, All Pathways**
Radionuclides (pCi/g)					
Actinium-227	$1.28x10^{01}$	$1.23x10^{02}$	$8.11x10^{02}$	NA	$1.15x10^{01}$
Bismuth-210	$6.00x10^{05}$	$5.05x10^{07}$	$9.60x10^{04}$	NA	$8.26x10^{04}$
Lead-210	$4.27x10^{00}$	$6.59x10^{03}$	$1.99x10^{02}$	NA	$4.18x10^{00}$
Polonium-210	$2.74x10^{02}$	$5.37x10^{04}$	$2.62x10^{05}$	NA	$2.73x10^{02}$
Protactinium-231	$1.15x10^{01}$	$2.79x10^{02}$	$1.41x10^{00}$	NA	$1.25x10^{00}$
Radium-223 + dtrs	NA	NA	$1.05x10^{02}$	NA	$1.05x10^{02}$
Radium-224 + dtrs	NA	NA	$4.82x10^{01}$	NA	$4.82x10^{01}$
Radium-226 + dtrs	$6.06x10^{00}$	$1.10x10^{03}$	$2.49x10^{-02}$	NA	$2.48x10^{-02}$
Radium-228 + dtrs	$8.41x10^{00}$	$7.68x10^{03}$	$5.42x10^{-02}$	NA	$5.38x10^{-02}$
Thorium-227	$2.96x10^{04}$	$1.55x10^{05}$	$1.79x10^{02}$	NA	$1.78x10^{02}$
Thorium-228	$2.52x10^{02}$	$8.70x10^{02}$	$3.22x10^{02}$	NA	$1.21x10^{02}$
Thorium-230	$2.30x10^{01}$	$4.45x10^{02}$	$2.38x10^{02}$	NA	$2.00x10^{01}$
Thorium-232	$2.10x10^{01}$	$2.93x10^{02}$	$5.70x10^{02}$	NA	$1.89x10^{01}$
Uranium-234	$3.48x10^{01}$	$1.11x10^{03}$	$7.74x10^{02}$	NA	$3.23x10^{01}$
Uranium-235 + dtrs	$3.53x10^{01}$	$1.26x10^{03}$	NA	NA	$3.44x10^{01}$
Uranium-238 + dtrs	$3.16x10^{01}$	$1.36x10^{03}$	$1.74x10^{00}$	NA	$1.65x10^{00}$
Metals (ppm, µg/g or mg/kg)					
Arsenic	$2.12x10^{00}$	$4.52x10^{03}$	NA	$1.07x10^{01}$	$1.77x10^{00}$
Chromium (VI)	$6.36x10^{00}$	$2.31x10^{02}$	NA	NA	$6.19x10^{00}$
PCBs (ppm, µg/g or mg/kg)					
Aroclor-1254	$1.59x10^{00}$	$3.40x10^{04}$	NA	$1.72x10^{00}$	$8.26x10^{-01}$

Notes: The PRG calculator's URL is: http://epa-prgs.ornl.gov/cgi-bin/radionuclides/rprg_search and the SL calculator's URL is http://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search.

NA denotes value not applicable.

8.1.6.2 Calculation of Non-Carcinogenic Effects to Outdoor Workers

The outdoor worker scenario from EPA's SL calculator was selected to illustrate the method used to calculate the non-carcinogenic SLs used to estimate non-carcinogenic effects to workers at the West Lake Landfill. Table 8-3 includes the exposure parameter values used by EPA to calculate the concentration of chemicals in soil that would yield a hazard quotient of one (HQ = 1) to the EPA's outdoor worker (Table 8-5).

Table 8-5 Regional Soil Screening Levels for Non-Carcinogenic Effects to the Outdoor Worker from Chronic Exposures

Category (units) Constituent	**SL, HQ = 1, EPA's Default Outdoor Worker Exposed for 225 d/y During 25 Years, Ingestion**	**SL, HQ = 1, EPA's Default Outdoor Worker Exposed for 225 d/y During 25 Years, Inhalation**	**SL, HQ = 1, EPA's Default Outdoor Worker Exposed for 225 d/y During 25 Years, Dermal**	**SL, HQ = 1, EPA's Default Outdoor Worker Exposed for 225 d/y During 25 Years, All Pathways**
Metals (ppm, µg/g or mg/kg) [a]				
Arsenic	3.41×10^{02}	1.04×10^{05}	1.72×10^{03}	2.84×10^{02}
Chromium (VI)	3.41×10^{03}	6.94×10^{05}	NA [b]	3.39×10^{03}
Lead	NA	NA	NA	8.00×10^{02} [c]
PCBs (ppm, µg/g or mg/kg) [a]				
Aroclor-1254	2.27×10^{01}	NA	2.46×10^{01}	1.18×10^{01}

[a] The SL calculator's URL is http://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search.
[b] NA denotes value not applicable.
[c] EPA's Adult Lead Model will be used to evaluate health effects of lead found in OU-1.

8.1.6.3 Calculation of Off-site Residential Risks

Off-site residents may be exposed to suspended particulates and gases released during construction at the West Lake Landfill. These postulated exposures are similar to exposure pathways evaluated used by EPA to calculate PRGs and SLs for airborne exposures in their default residential scenario. The PRG calculator includes exposures from inhalation and immersion in a cloud in its evaluation, and the SL calculator considers inhalation alone. The two airborne exposure pathways evaluated by EPA (inhalation and immersion) were included in the short-term risk evaluations for each alternative.

Table 8-6 presents the exposure parameter values used by EPA to calculate the concentration of radionuclides and chemicals in air that would yield a target risk of 10^{-06} to their default resident receptor (Table 8-7).

Table 8-6 Default Input for EPA's Soil PRG and SL Calculators – Resident

Variable	PRG Calculator Value	SL Calculator Value
TR (target cancer risk) unitless	0.000001	0.000001
THQ (target hazard quotient) unitless	NA	1
EF_r (exposure frequency) days/year	350	350
ED_r (exposure duration - resident) year	30	30
ED_c (exposure duration - child) year	6	6
ED_r (exposure duration - resident adult) hours/day	24	24
ED_{0-2} (exposure duration first phase) year	NA	2
ED_{2-6} (exposure duration second phase) year	NA	4
ED_{6-16} (exposure duration third phase) year	NA	10
ED_{16-30} (exposure duration fourth phase) year	NA	14
ET_r (exposure time - resident) hour/day	24	24
LT (lifetime - resident) year	70	70
AT_{carc} (Averaging Time, Carcinogens) days	70	70
AT_{non} (Averaging Time, Noncarcinogens) days	NA	AT = ED
BW_a (body weight - adult) kg	70	70
BW_c (body weight - child) kg	15	15
IRA_r (inhalation rate - resident adult) m^3/d	20	20
IRA_c (inhalation rate - resident child) m^3/d	10	10

Note: The PRG calculator's URL is : http://epa-prgs.ornl.gov/cgi-bin/radionuclides/rprg_search and the SL's URL is http://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search

Table 8-7 PRG's and SLs for Carcinogenic Effects to the Resident

Category (units) Constituent	PRG or SL, 10^{-06} Risk, Resident Exposed for 350 d/y During 30 Years, Inhalation	PRG or SL, 10^{-06} Risk, Resident Exposed for 350 d/y During 30 Years, Immersion	PRG or SL, 10^{-06} Risk, Resident Exposed for 350 d/y During 30 Years, Air Pathways
Radionuclide (pCi/m^3) [a]			
Actinium-227	$3.55x10^{-05}$	$7.51x10^{04}$	$3.55x10^{-05}$
Bismuth-210	$1.67x10^{-02}$	$6.58x10^{03}$	$1.67x10^{-02}$
Lead-210	$1.91x10^{-03}$	$9.25x10^{03}$	$1.91x10^{-03}$
Polonium-210	$4.90x10^{-04}$	$9.50x10^{05}$	$4.90x10^{-04}$
Protactinium-231	$1.16x10^{-04}$	$2.40x10^{02}$	$1.16x10^{-04}$
Radium-223 + dtrs	NA	$3.00x10^{01}$	$3.00x10^{01}$
Radium-224 + dtrs	NA	$4.84x10^{00}$	$4.84x10^{00}$
Radium-226 + dtrs	$4.56x10^{-04}$	$4.42x10^{00}$	$4.56x10^{-04}$
Radium-228 + dtrs	$1.01x10^{-03}$	$3.05x10^{00}$	$1.01x10^{-03}$
Thorium-227	$1.51x10^{-04}$	$8.50x10^{01}$	$1.51x10^{-04}$
Thorium-228	$4.01x10^{-05}$	$4.73x10^{03}$	$4.01x10^{-05}$
Thorium-230	$1.86x10^{-04}$	$2.65x10^{04}$	$1.86x10^{-04}$
Thorium-232	$1.22x10^{-04}$	$5.56x10^{04}$	$1.22x10^{-04}$
Uranium-234	$4.64x10^{-04}$	$6.82x10^{04}$	$4.64x10^{-04}$
Uranium-235 + dtrs	$5.24x10^{-04}$	NA	$5.24x10^{-04}$
Uranium-238 + dtrs	$5.66x10^{-04}$	$2.85x10^{02}$	$5.66x10^{-04}$
Metals (ppm, µg/g or mg/kg) [b]			
Arsenic	$5.66x10^{-04}$	NA	$5.66x10^{-04}$
Chromium (VI)	$1.14x10^{-05}$	NA	$1.14x10^{-05}$
PCBs (ppm, µg/g or mg/kg) [b]			
Aroclor-1254	$4.26x10^{-03}$	NA	$4.26x10^{-03}$

[a] http://epa-prgs.ornl.gov/cgi-bin/radionuclides/rprg_search
[b] http://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search

8.1.6.4 Calculation of Non-Carcinogenic Effects to Hypothetical Off-site Residents

EPA's default residential scenario was selected as the basis for calculating non-carcinogenic effects to residents in the vicinity of the West Lake Landfill. Table 8-6 presents the exposure parameter values used by EPA to calculate the concentration of chemicals in air that would yield a hazard quotient (HQ) of 1 to a receptor in their residential scenario (Table 8-8).

Table 8-8 Screening Levels for Non-Carcinogenic Effects to the Resident

Category / Constituent	SL, HQ = 1, Resident Exposed for 350 d/y During 30 Years, Inhalation	SL, HQ = 1, Resident Exposed for 350 d/y During 30 Years, All Pathways
Metals (µg/m³)		
Arsenic	$1.56x10^{-02}$	$1.56x10^{-02}$
Chromium (VI)	$1.04x10^{-01}$	$1.04x10^{-01}$
Lead	NA	NA
PCBs (µg/m³)		
Aroclor-1254	NA	NA

Notes: The SL's URL is http://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search
NA denotes value not applicable.

8.2 SHORT-TERM RISK ASSESSMENTS FOR PROPOSED REMEDIES

Sections 9, 10, and 11 provide the calculations and results of the short-term risk assessment for each of the three alternatives.

9 SHORT-TERM RISKS FOR THE ROD-SELECTED REMEDY

This risk analysis identifies and evaluates the major short-term hazards and exposures from the construction and transportation activities during grading and capping of Areas 1 and 2 under the ROD-Selected Remedy. It also evaluates the human health risks from chemicals and radionuclides that may occur during the construction of the remedy.

9.1 DESCRIPTION OF ACTIVITIES EVALUATED

As construction proceeds, a variety of activities will be underway; and many will expose workers to a variety of physical hazards and some will place workers in close proximity to the RIM. Construction of the ROD-Selected Remedy will involve use of heavy equipment to move any contaminated materials from the Crossroads Property and Buffer Zone, reshape the steep sloped section of Area 2, re-grade or place cover materials on the top of Areas 1 and 2 and construct a multilayer, vegetated cover over the areas. A large quantity of materials must be hauled to the Site along public roads from off-site suppliers to improve the surfaces of the radiological area and construct the cover on Areas 1 and 2.

9.2 HUMAN HEALTH ASSESSMENT OF REMEDY CONSTRUCTION

This human health assessment considers exposure point concentrations, potential receptors, and exposure pathways when calculating health risks to both on-site and off-site receptors.

9.2.1 Exposure Point Concentrations

The exposure point concentration is the concentration of a contaminant in an exposure medium that may be contacted by a real or hypothetical receptor. Concentrations in Area 2 were selected to evaluate human health effects because radionuclide concentrations in this area are greater than in Area 1. Table 8-2 presents the representative concentrations of radionuclides in soil and air used in this short-term risk assessment.

9.2.2 Potential Receptors

The tasks proposed to construct the ROD-Selected Remedy were examined to identify potential receptors. Potential receptors identified include:

- **Radiation Survey/Radiation Control Technicians (RadCon Techs)** – One or more RadCon Techs were assumed to be involved in surveying any RIM that is being moved from the Crossroads Property and Buffer Zone, in identifying the areas of contamination on the surface of OU-1 and surveying the equipment that has to move into and out of the contamination areas. They will likely be exposed to higher concentrations of RIM for longer periods of time than any other potential receptor identified.
- **Laborers** – One or more qualified radiation workers may perform manual labor within OU-1 as part of the remediation. Activities could range from carrying equipment to cleaning equipment. It is expected that the exposure times required to perform these activities will be shorter that the exposure times of the RadCon Techs.
- **Truck Drivers** – One or more truck drivers were assumed to be involved with hauling any RIM from the Crossroads Property and Buffer Zone and placing it on the top of Area 2. This driver is also assumed to haul fill material and cover material in order to re-slope

and build the cover on OU-1. The driver would remain seated in his truck during the majority of his work shift.

- **Engineers/Management** – This group of receptors include qualified radiation workers who direct operations and respond to atypical occurrences but typically spend limited time in close proximity to exposed RIM.
- **Heavy Equipment Operator** – One or more heavy equipment operators were assumed to be involved in regrading the RIM, spreading this material on the surface of the area, and spreading the fill material on that same area. The worker might later be involved with constructing the OU-1 cover. These workers will be riding above the surface of the RIM in an enclosed cab with portions of the vehicle shielding them from the underlying RIM.
- **Transients/Visitors** – Individuals may visit the Site to service or repair equipment, deliver items or inspect operations. Exposures to these individuals are expected to be transitory.
- **Off-property Residents** – One or more off-property but nearby local residents were assumed to have come in contact with fugitive dust and/or radon during the construction of the remedy.
- **Nearby Workers** – Businesses located near the Site employ workers. These workers may be exposed to transient plumes of dust transported from the Site by wind. The average exposure concentrations in air (if any) would be lower than those encountered by RadCon Techs. Exposures to a given off-site receptor could only occur when the wind blows in the direction of the receptor. If the wind does blow in the direction of off-site receptors, near ground turbulence would mix the particulates into a larger volume of air, thus reducing average exposure concentrations in air.

A subset of these receptors was identified as having a higher potential for exposure than other comparable receptors. These are listed in Table 9-1.

9.2.3 Exposure Pathways

During remedy construction, the RIM will be disturbed by grading and limited excavation, for example from the Crossroads Property and Buffer Zone. The receptors identified in the previous section could be exposed to this material by inhalation of suspended particulates, inhalation of radon, incidental ingestion of soil, and direct exposure to radiation, depending on the receptor and their locations.

Table 9-1 contains a matrix presenting identified potential receptors and plausible exposure pathways. Table 9-1 also identifies the receptors and pathways selected for quantification in this short-term risk assessment.

Table 9-1 Potential Receptors Identified During Construction ROD-Selected Remedy

Receptors Identified	Scenario Considered? [a]	Exposure Route: Inhalation of Fugitive Dust	Inhalation of Radon	Incidental Soil Ingestion	Dermal Contact	Direct Radiation	Quantitative Evaluation of Scenario?
RadCon Techs	**Yes**	●	●	●	●	●	**Yes**
Laborers	**Yes**	{O}	{O}	{O}	{O}	{O}	No
Truck Drivers	**Yes**	{O}	{O}			{O}	No
Engineers/Management	**Yes**	{O}	{O}			{O}	No
Heavy Equipment Operators	**Yes**	{O}	{O}			{O}	No
Transients/Visitors	**Yes**	{O}	{O}	{O}	{O}	{O}	No
Off-property Residents	**Yes**	●	{O}				**Yes**
Nearby Workers	**Yes**	{O}	{O}				No

[a] An exposure scenario was considered if it included a source, a means of moving constituents of concern to a location of interest, and a receptor at that location.

● Exposure route selected for detailed analysis

(shaded) A shaded box indicates that the receptor/exposure route combination was not selected for quantitative analysis.

{O} Not quantified because other receptors identified for this scenario have higher intake rates and/or longer exposure times.

9.2.4 Quantification of Human Health Effects

9.2.4.1 Calculation of Carcinogenic Risk to Selected Receptors

Calculations of carcinogenic risks to potential receptors were based on the relationships between risk and concentration produced by default scenarios incorporated in EPA's PRG and SL calculators. The major differences between EPA's receptor's and receptors associated with this Site are the times the receptors are assumed to spend exposed to RIM. For example, EPA's PRG calculations for an outdoor worker assume the worker spends 5,625 days on a generic Site[24] during a 25 year period, and scheduling information suggests a West Lake Landfill remediation worker would be exposed to RIM for 8 hours a day over 27 days[25] during the relocation of the RIM from the Crossroads Property and Buffer Zone and grading of Areas 1 and 2.

The EPA calculators for PRGs and SLs were set to provide the exposure results for a 27 day period. This is the period of time that a worker will be working in direct contact with RIM. All other work in radiologically-impacted areas will be spent operating earth-moving equipment with much lower worker exposure to the RIM. The off-site resident will potentially be exposed to lower air concentrations during the entire time the RIM is exposed. A total of 79 days[26] are scheduled when RIM will be exposed during grading or relocation.

[24] Total days = Exposure Duration (25 y/lifetime) x 225 (d/y) = 5,625 (d/lifetime)

[25] Work days from ROD schedule lines 56-58 and 63, plus 8 days for initial walkover survey. When Areas 1 & 2 open simultaneously, only Area 2 time counted.

[26] Calendar days from ROD schedule, lines 56-58, 63, and 125-127. When Areas 1 & 2 are open simultaneously, only Area 2 time counted.

Table 9-2 provides the input parameters used in EPA's Soil PRG and SL Calculators to estimate risks to remediation workers. Table 9-3 presents those estimates. Tables 9-4 and 9-5 provide similar input values and results for off-site residents.

Table 9-2 Site-Specific Input for EPA's Soil PRG and SL Calculators, RadCon Tech, ROD-Selected Remedy

Variable	PRG Calculator Value	SL Calculator Value
Slab size for ACF (area correction factor) m^2	10,000	NA
t_{ow} (time - outdoor worker) yr	1	NA
ED_{ow} (exposure duration - worker) yr	1	1
ET_{ow} (exposure time - worker) hr/day	8	8
EF_{ow} (exposure frequency - worker) day/yr	27	27

Note: Other parameters were left at default values.

Table 9-3 Calculated Risks to the Hypothetical RadCon Tech During Construction of the ROD-Selected Remedy

Category / Constituent	95% UCL Soil Concentrations in Area 2 [a]	PRG or SL, 10^{-06} Risk, RadCon Tech Exposed for 27 Days, All Pathways [b]	Calculated Risk to RadCon Tech Exposed for 27 Days, All Pathways [c]
Radionuclides			
Actinium-227	$1.62x10^{02}$ pCi/g	$1.67x10^{03}$ pCi/g	$9.70x10^{-08}$
Bismuth-210	$1.28x10^{02}$ pCi/g	$6.88x10^{05}$ pCi/g	$1.86x10^{-10}$
Lead-210	$1.28x10^{02}$ pCi/g	$6.14x10^{02}$ pCi/g	$2.08x10^{-07}$
Polonium-210	$1.28x10^{02}$ pCi/g	$2.71x10^{03}$ pCi/g	$4.72x10^{-08}$
Protactinium-231	$1.62x10^{02}$ pCi/g	$2.60x10^{02}$ pCi/g	$6.23x10^{-07}$
Radium-223 + dtrs	$1.62x10^{02}$ pCi/g	$8.71x10^{02}$ pCi/g	$1.86x10^{-07}$
Radium-224 + dtrs	$1.59x10^{01}$ pCi/g	$4.02x10^{02}$ pCi/g	$3.96x10^{-08}$
Radium-226 + dtrs	$3.38x10^{02}$ pCi/g	$5.14x10^{00}$ pCi/g	$6.58x10^{-05}$
Radium-228 + dtrs	$1.59x10^{01}$ pCi/g	$3.76x10^{00}$ pCi/g	$4.23x10^{-06}$
Thorium-227	$1.62x10^{02}$ pCi/g	$1.48x10^{03}$ pCi/g	$1.09x10^{-07}$
Thorium-228	$1.59x10^{01}$ pCi/g	$3.33x10^{03}$ pCi/g	$4.77x10^{-09}$
Thorium-230	$3.73x10^{03}$ pCi/g	$4.17x10^{03}$ pCi/g	$8.94x10^{-07}$
Thorium-232	$1.59x10^{01}$ pCi/g	$3.94x10^{03}$ pCi/g	$4.04x10^{-09}$
Uranium-234	$4.60x10^{01}$ pCi/g	$6.73x10^{03}$ pCi/g	$6.84x10^{-09}$
Uranium-235 + dtrs	$1.83x10^{00}$ pCi/g	$7.16x10^{03}$ pCi/g	$2.56x10^{-10}$
Uranium-238 + dtrs	$2.71x10^{01}$ pCi/g	$3.44x10^{02}$ pCi/g	$7.88x10^{-08}$
		Total Radiocarcinogenic Risk	$7.23x10^{-05}$
Metals			
Arsenic	$7.70x10^{00}$ µg/g	$3.68x10^{02}$ µg/g	$2.09x10^{-08}$
Chromium (VI)	$2.27x10^{01}$ µg/g	$1.29x10^{03}$ µg/g	$1.76x10^{-08}$
PCBs			
Aroclor-1254	$5.00x10^{-01}$ µg/g	$1.72x10^{02}$ µg/g	$2.91x10^{-09}$
		Total Chemocarcenogenic Risk	$4.14x10^{-08}$
		Total Risk	**$7.23x10^{-05}$**

[a] From Table 8-2.

[b] http://epa-prgs.ornl.gov/cgi-bin/radionuclides/rprg_search
http://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search

[c] Calculated risk for radionuclide = [10^{-06} (risk) x 1/PRG (g/pCi)] x Soil Conc. (pCi/g)
Calculated risk for chemical = [10^{-06} (risk) x 1/SL (g/µg)] x Soil Conc. (µg/g)

Table 9-4 Site Specific Input for EPA's Soil PRG and SL Calculators, Off-site Resident, ROD-Selected Remedy

Variable	PRG Calculator Value	SL Calculator Value
TR (target cancer risk) unitless	0.000001	0.000001
THQ (target hazard quotient) unitless	NA	1
EF_r (exposure frequency) day/yr	79	79
ET_r (exposure time - resident) hr	24	24
ED_{rc-a} (exposure duration, carcinogenic, resident adult) yr	1	1
ED_{nc0-2} (exposure duration, non-carcinogenic, first phase) year	NA	1
ED_{nc2-6} (exposure duration, non-carcinogenic, second phase) year	NA	0
ED_{nc6-16} (exposure duration, non-carcinogenic, third phase) year	NA	0
$ED_{nc16-30}$ (exposure duration, non-carcinogenic, fourth phase) year	NA	0
LT (lifetime - resident) year	NA	70
t_r (time - resident) yr	1	NA
IRA_{r-c} (inhalation rate - resident child) m^3/day	10	NA
IRA_{r-a} (inhalation rate - resident adult) m^3/day	20	NA
GSF_o (gamma shielding factor - outdoor) unitless	1	NA

Table 9-5 Calculated Risks to the Off-site Resident During Construction of the ROD-Selected Remedy

Category / Constituent	Annual Average Air Concentrations at Site Boundary [a]	PRG or SL, 10^{-06} Risk, Resident Exposed During 79 Days of Construction, Air Pathways [b]	Calculated Risk to Resident Exposed During 79 Days of Construction, Air Pathways [c]
Radionuclide			
Actinium-227	$5.74x10^{-03}$ pCi/m^3	$2.93x10^{-02}$ pCi/m^3	$1.96x10^{-07}$
Bismuth-210	$4.53x10^{-03}$ pCi/m^3	$1.38x10^{01}$ pCi/m^3	$3.29x10^{-10}$
Lead-210	$4.53x10^{-03}$ pCi/m^3	$1.58x10^{00}$ pCi/m^3	$2.87x10^{-09}$
Polonium-210	$4.53x10^{-03}$ pCi/m^3	$4.04x10^{-01}$ pCi/m^3	$1.12x10^{-08}$
Protactinium-231	$5.74x10^{-03}$ pCi/m^3	$9.59x10^{-02}$ pCi/m^3	$5.98x10^{-08}$
Radium-223 + dtrs	$5.74x10^{-03}$ pCi/m^3	$3.98x10^{03}$ pCi/m^3	$1.44x10^{-12}$
Radium-224 + dtrs	$5.63x10^{-04}$ pCi/m^3	$6.43x10^{02}$ pCi/m^3	$8.76x10^{-13}$
Radium-226 + dtrs	$1.20x10^{-02}$ pCi/m^3	$3.76x10^{-01}$ pCi/m^3	$3.18x10^{-08}$
Radium-228 + dtrs	$5.63x10^{-04}$ pCi/m^3	$8.33x10^{-01}$ pCi/m^3	$6.76x10^{-10}$
Thorium-227	$5.74x10^{-03}$ pCi/m^3	$1.24x10^{-01}$ pCi/m^3	$4.63x10^{-08}$
Thorium-228	$5.63x10^{-04}$ pCi/m^3	$3.31x10^{-02}$ pCi/m^3	$1.70x10^{-08}$
Thorium-230	$1.32x10^{-01}$ pCi/m^3	$1.53x10^{-01}$ pCi/m^3	$8.63x10^{-07}$
Thorium-232	$5.63x10^{-04}$ pCi/m^3	$1.01x10^{-01}$ pCi/m^3	$5.58x10^{-09}$
Uranium-234	$1.63x10^{-03}$ pCi/m^3	$3.83x10^{-01}$ pCi/m^3	$4.25x10^{-09}$
Uranium-235 + dtrs	$6.48x10^{-05}$ pCi/m^3	$4.32x10^{-01}$ pCi/m^3	$1.50x10^{-10}$
Uranium-238 + dtrs	$9.60x10^{-04}$ pCi/m^3	$4.67x10^{-01}$ pCi/m^3	$2.06x10^{-06}$
		Total Radiocarcinogenic Risk	$1.24x10^{-06}$
Metals			
Arsenic	$2.73x10^{-04}$ µg/m^3	$7.52x10^{-02}$ µg/m^3	$3.63x10^{-09}$
Chromium (VI)	$8.04x10^{-04}$ µg/m^3	$3.85x10^{-04}$ µg/m^3	$2.09x10^{-06}$
PCBs			
Aroclor-1254	$1.77x10^{-05}$ µg/m^3	$5.66x10^{-01}$ µg/m^3	$3.13x10^{-11}$
		Total Chemocarcinogenic Risk	$2.09x10^{-06}$
		Sum of Risks	**$3.33x10^{-06}$**

[a] From Table 8-2.
[b] http://epa-prgs.ornl.gov/cgi-bin/radionuclides/rprg_search
http://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search
[c] Calculated risk for radionuclide = [10^{-06} (risk) x 1/PRG (m^3/pCi)] x Air Conc. (pCi/m^3)
Calculated risk for chemical = [10^{-06} (risk) x 1/SL (m^3/µg)] x Soil Conc. (µg/m^3)

The calculated risks to the hypothetical RadCon Tech are 7.23 x 10^{-05}. The risks to a hypothetical receptor living immediately adjacent to the property boundary were calculated as 3.33 x 10^{-06}.

9.2.4.2 Calculation of Non-Carcinogenic Effects to Selected Receptors

Site-specific parameters listed in Tables 9-2 and 9-4 were used in the EPA SL calculator to calculate the hazard quotients to the RadCon Tech and off-site resident, respectively. The results for the hypothetical RadCon Tech are presented in Table 9-6. Table 9-7 presents the hazard quotients and hazard index calculated for the hypothetical off-site resident.

Table 9-6 Hazard Index Calculated for the RadCon Tech During Construction of the ROD-Selected Remedy

Category / Constituent	95% UCL Soil Concentrations in Area 2 [a]	SL, HQ = 1, RadCon Tech Exposed for 27 Days of Construction, All Pathways [b]	Calculated HQ to RadCon Tech During 27 Days of Construction, All Pathways
Metals			
Arsenic	7.70×10^{00} µg/g	2.36×10^{03} µg/g	3.26×10^{-03}
Chromium (VI)	2.27×10^{01} µg/g	1.83×10^{05} µg/g	1.24×10^{-04}
Lead	4.79×10^{02} µg/g	8.00×10^{02} µg/g [c]	NA [c]
PCBs			
Aroclor-1254	5.00×10^{-01} µg/g	1.48×10^{02} µg/g	3.38×10^{-03}
		Hazard Index (HI) =	**6.77×10^{-03} [d]**

[a] From Table 8-2.
[b] http://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search, sub-chronic values when available.
[c] See discussion regarding EPA's Adult Lead Model in Section 9.2.4.3.
[d] HI = ∑HQ, excluding lead.

Table 9-7 Hazard Index Calculated for the Off-site Resident During Construction of the ROD-Selected Remedy

Category / Constituent	Annual Average Concentrations in Air at Site Boundary [a]	SL, HQ = 1, Resident Exposed for 79 Days of Construction, Air Pathways [b]	Calculated HQ to Resident Exposed for 79 Days of Construction, Air Pathways
Metals			
Arsenic	2.73×10^{-04} µg/m^3	6.93×10^{-02} µg/m^3	3.93×10^{-03}
Chromium (VI)	8.04×10^{-04} µg/m^3	4.62×10^{-01} µg/m^3	1.74×10^{-03}
Lead	1.69×10^{-02} µg/m^3	NA [c]	NA [c]
PCBs			
Aroclor-1254	1.77×10^{-05} µg/m^3	NA [d]	NA [d]
		Hazard Index (HI) =	**5.67×10^{-03} [e]**

[a] From Table 8-2.
[b] http://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search
[c] See discussion regarding EPA's Adult Lead Model in Section 9.2.4.3.
[d] Not published by EPA.
[e] HI = ∑HQ.

The calculated HI for the hypothetical RadCon Tech is 6.77×10^{-03}. The HI for a hypothetical receptor living immediately adjacent to the property boundary was calculated as 5.67×10^{-03}.

9.2.4.3 Blood Lead Levels

Blood levels of lead were also calculated for the RME receptors, the RadCon Tech, using EPA's Adult Lead Methodology (ALM).[27] For a soil concentration of 479 µg/g and an exposure duration of 27 days, the blood lead level in the hypothetical RadCon Tech was calculated to be 1.2 µg/dL (12% of the target level of 10 µg/dL). The probability that the blood level in a fetus carried by that RadCon Tech would exceed its target blood level was calculated to be approximately 0.006%, which is well below the target percentile of 5%. It should be noted that applying the ALM to the short exposure durations scheduled for this alternative introduces additional uncertainty to the results.

[27] http://www.epa.gov/superfund/lead/products/ALM_2009.xls

9.3 HAZARD ASSESSMENT OF CONSTRUCTION AND TRANSPORTATION ACTIVITIES

Earth-moving on-site and transportation of materials on public roads generates a risk of occupational and traffic accidents. Generally, the risk of occurrence is time dependent, increasing as the duration of the activity lengthens. The severity of the accident depends, in part, on the activity itself.

In order to assess the likelihood and severity of possible accidents, Occupational Safety and Health Administration (OSHA) and National Highway Traffic Safety Administration (NHTSA) statistics for workers in different occupations and transportation records were used in conjunction with manpower and resource projections from remedy construction schedules to calculate the risks for accidents.

9.3.1 Transportation Hazards

Table 9-8 lists statistics on the rate that traffic accidents involving heavy trucks occurred in 2007 (NCSA 2008)[28]. The projection for heavy truck use on public roads during construction of the ROD-Selected Remedy is 1,754,000 miles. Multiplying this mileage by the injury and fatality rates in Table 9-8 yields the transportation incident forecast presented Table 9-9.

Table 9-8 Accident Incident Rate for Trucks on Public Roads

Incident	Published Rate [a]	Per mile rate [b]
Injury Crashes	$3.30x10^{01}$	$3.30x10^{-07}$
Fatal Crashes	$2.04x10^{00}$	$2.04x10^{-08}$

[a] Rate per 100 million miles (NCSA 2008).

[b] Derived from rate (incidents/100,000,000 mi)

Table 9-9 Traffic Injury and Fatality Forecast for ROD-Selected Remedy

Parameter	Value
Total miles for all hauling on public roads	$1.75x10^{06}$
Injury risk for the project	$5.79x10^{-01}$
Fatality risk for the project	$3.58x10^{-02}$
Forecast of accidents involving injuries or fatalities	$\mathbf{6.15x10^{-01}}$

The projected number of transportation accidents involving injury or death (0.62) related primarily to the large number of trucks hauling materials onto the Site. It should be noted that this projection includes injuries and deaths of people other than the truck occupants. In 2007, 74% of the injuries and 84% of the fatalities from traffic accidents were to people not riding in the truck involved in the incident.

9.3.2 Industrial Accidents

For the purpose of this assessment, the workers involved with remedy construction have been divided into groups: general construction and driver/operators. The Bureau of Labor Statistics (BLS) maintains historical information on the rate that accidents occur in the US[29]. These statistics are available grouped by job description, and Table 9-10 and Table 9-11 list occupational accident statistics for general construction and off-road drivers, respectively.

---

[28] The latest data available at the time of this SFS was 2007 data, published in 2008.

[29] The latest data available at the time of this SFS was 2008 data, published in 2009.

Table 9-10 Accident Rate for General Construction and Support Workers

Parameter	Value
Injury accident rate per 100 full-time workers [a]	$4.20x10^{00}$
Accident rate per man-hour worked	$2.10x10^{-05}$
Accident rate per man-day worked	$1.68x10^{-04}$
Number of general construction + support man-days worked [b]	$9.85x10^{03}$
Number of Accidents Forecast	**$1.66x10^{00}$**

[a] Bureau of Labor Statistics News Release, October 29, 2009 "Workplace Injuries and Illnesses – 2008" for Heavy and civil engineering construction (237).

[b] From the Engineering Estimate of Man-days and Cost

Table 9-11 Occupational Accident Rate for Vehicle Operation

Parameter	Value
Injury accident rate per 100 full-time workers [a]	$5.20x10^{00}$
Accident rate per hour worked	$2.60x10^{-05}$
Hours spent driving [b]	$9.84x10^{04}$
Other transportation activities (hrs) [c]	$1.97x10^{04}$
Total transportation man-hours worked	$1.18x10^{05}$
Number of Accidents Forecast	**$3.07x10^{00}$ [d]**

[a] Bureau of Labor Statistics News Release, October 29, 2009 "Workplace Injuries and Illnesses – 2008" for Truck Transportation (484)

[b] From the Engineering Estimate of Man-days and Cost

[c] Hours assumed - Driving hours x 0.2.

[d] Accident Rate per hour x Total Transportation Man-hours

Table 9-10 and Table 9-11 also list the remedy construction time in either man-days or man-hours that can be grouped into each of those broad labor categories. Multiplying the total time by the appropriate accident rate will yield a projected forecast of an accident for this group's activities during this project. This accident forecasts for the general construction and off-road drivers are presented in bold on the last line of Table 9-10 and Table 9-11, respectively. Summing the projected accident forecast for both labor groups yields the total accident projection for the project.

For example, it is estimated that it will require 9,852 man-days of general construction and support labor to construct the ROD-Selected Remedy. Multiplying this duration by the injury and fatality rate of 1.68×10^{-04} accidents per man-day in Table 9-10 yields the construction incident forecast of 1.66 in Table 9-10. Adding this to the projected risk of non-traffic accidents for truck drivers in Table 9-11 yields a total injury accident projection for project activities of 4.73.

9.4 OCCUPATIONAL DOSES

Remedial workers were assumed to be classified as radiation workers in this assessment. Doses to those workers were calculated using RESRAD and those doses were compared to occupational dose limits.

The dose rate to workers will change as the remedy progresses because the area of exposed materials will shrink as they are covered. The Total Effective Dose Equivalent (TEDE) was calculated for an individual exposed to Area 2 as remediation starts, and a second dose of 0 was assumed for the final configuration. The multiplying the average of these dose rates and the total projected time spent exposed to Areas 1 and 2 yields the estimated annual TEDE to RadCon Techs on the project (Table 9-12).

Table 9-12 Radiation Dose to Reasonably Maximally-Exposed Individual

	Area 2
Beginning TEDE on surface (mrem/1,800 h) [a]	834
Ending TEDE on surface (mrem/1,800 h) [a]	0
Average TEDE on surface (mrem/1,800 h)	417
Time spent exposed to RIM (fraction of year) [b]	0.12
TEDE for Reasonably Maximally-Exposed Individual (mrem/y)	**50**

[a] Calculated by RESRAD.
[b] 27 days /225 days/year = 0.12

The calculated TEDE to the hypothetical RadCon Tech would be approximately 417 mrem/y if the RadCon Tech spent 1,800 hours per year working on the RIM. Currently, the best estimate of the time this receptor would spend exposed to the RIM in Areas 1, 2 and the boundary areas is 27 days.[30] The annual TEDE to the RadCon Tech working for 27 days is about 50 mrem. To put this in perspective, a RadCon Tech has an occupational exposure limit of 5,000 mrem/y assuming no project-specific administrative limits are imposed for the Site.

9.5 SUMMARY

The human health risks and hazard projections are summarized in Table 9-13.

Table 9-13 Summary of Hazards and Risks Associated with ROD-Selected Remedy

Category of Hazard or Risk	**Value[a]**
Projected Incidence of Transportation Accidents	6.2×10^{-01}
Projected Incidence of Industrial Accidents	4.7×10^{00}
Carcinogenic Risk to Reasonably Maximally-Exposed Individual	7.2×10^{-05}
HI to Reasonably Maximally-Exposed Individual	6.8×10^{-03}
TEDE to Reasonably Maximally-Exposed Individual	5.0×10^{-01}

Industrial and transportation hazards dominate the human impacts evaluated by this short-term assessment. It is projected that 4.73 workers will be injured in work-related accidents during construction of the remedy (out of the 22,174 man-days worked). There is a 3% chance of a fatal traffic accident and a 57% chance that a person will be injured as a result of a transportation accident. If there is a transportation accident, there is a 3 out of 4 chance that the injured/killed person will be a member of the public.

The greatest calculated risks from exposed RIM are expected to be to the RadCon Tech (7.2×10^{-05}). This calculated risk is within the target risk range of 10^{-06} to 10^{-04}. The most important single contributor to this risk is direct radiation exposure from exposed RIM on and near the surface of the contamination area.

[30] See Section 9.2.4.1 for derivation of worker exposure time.

10 SHORT-TERM RISKS FOR THE "COMPLETE RAD REMOVAL" WITH OFF-SITE DISPOSAL OPTION

This risk analysis identifies and evaluates the major short-term hazards and exposures from the construction and transportation activities during excavation, restoration and capping of Areas 1 and 2 that would occur during construction of the off-site remedy. It also evaluates the human health risks from chemicals and radiation that may occur during remedy construction.

10.1 DESCRIPTION OF ACTIVITIES EVALUATED

Construction activities during remedy construction involve the use of heavy equipment to:

- move any contaminated materials from the Crossroads Property and the Buffer Zone,
- excavate RIM from Areas 1 and 2,
- move excavated material around the Site,
- ship excavated RIM to an off-site location,
- ship cover materials into the Site,
- grade the landfill surface, and
- construct a multilayer, vegetated cover over the landfill.

Many of these activities will expose workers to a variety of physical hazards and some will place a subset of the workers in close proximity to the RIM. For example, a large quantity of materials will be hauled to the off-site disposal site, and additional material will be hauled to the Site from off-site suppliers to improve the surfaces and construct the cover on Areas 1 and 2. Historically, this kind of material handling has produced an increased risk of traffic and occupational accidents.

In addition, tasks like: guiding excavation of the RIM, verification that cleanup criteria have been meet, and construction work in OU-1 will require that remediation workers like RadCon Techs and equipment operators be in close proximity to the RIM for extended periods of time. This may introduce an increased risk of carcinogenic effects in those workers.

10.2 HUMAN HEALTH ASSESSMENT OF REMEDY CONSTRUCTION

As discussed in Section 8, a human health assessment considers the following components: exposure point concentrations, potential receptors, and exposure pathways. These components are used to extrapolate the quantification of health risks to both on-site and off-site receptors. Some of these factors are common to all three remedies. The following information takes the common factors from Section 8 and presents the calculations specific to the "Complete Rad Removal" with off-site disposal option.

10.2.1 Exposure Point Concentrations

The exposure point concentration is the concentration of a contaminant in an exposure medium that may be contacted by a real or hypothetical receptor. Concentrations in Area 2 were selected to evaluate human health effects because the majority of radionuclide concentrations in this area are greater than in Area 1. Table 8-2 presents the representative concentrations of radionuclides used in this short-term risk assessment.

10.2.2 Potential Receptors

The tasks involved in the work outlined above were examined to identify potential receptors. Potential receptors identified include:

- **Radiation Survey/Radiation Control Technicians (RadCon Techs)** – One or more RadCon Techs were assumed to be involved in identifying areas of soil containing RIM, directing the excavation and movement of RIM on the Site, and surveying the equipment that has to move into and out of the exclusion zones set up around work areas. These receptors will spend most of their work day standing on or next to areas containing RIM. They will likely be exposed to higher concentrations of RIM for longer periods of time than any other potential receptor identified.
- **Heavy Equipment Operator** – One or more heavy equipment operators were assumed to be involved in excavating the RIM, loading this material into trucks, spreading any fill or cover materials placed on the excavated areas, and regrading the surface of OU-1. These workers will be riding above the surface of the RIM in an enclosed cab with portions of the vehicle shielding them from the underlying RIM.
- **Truck to Rail Transfer Facility Operators** – One or more qualified radiation workers may be involved with material handling operations at a waste transfer facility. Activities might include operating heavy equipment, inspecting trucks and railcars, spill cleanup, waste sampling, and general housekeeping. These workers would be partially shielded by the sides of the trucks and the railcars and would often be working at some distance from the waste.
- **Truck Drivers** – One or more truck drivers were assumed to be involved with hauling any RIM from OU-1 to a waste transfer. This driver is also assumed to haul fill material and cover material into OU-1 during construction of a cover. The drive would remain seated in his truck during the majority of his work shift.
- **Laborers** – One or more qualified radiation workers may perform manual labor within the OU-1 as part of the remediation. Activities could range from carrying equipment to cleaning equipment. It is expected that the exposure times required to perform these activities will be shorter that the exposure times of the RadCon Techs.
- **Engineers/Management** – This group of receptors include qualified radiation workers who direct operations and respond to atypical occurrences but typically spend limited time in close proximity to exposed RIM.
- **Nearby Workers** – Businesses located near the Site employ workers. These workers may be exposed to transient plumes of dust transported from the Site by wind. The average exposure concentrations in air (if any) would be lower than those encountered by RadCon Techs because exposures to a given receptor will only occur during times when the wind blows in their direction and when the wind does blow in the direction of the workers, near ground turbulence will mix the particulates into a larger volume of air, lowering their concentrations.
- **Off-property Residents** – One or more off-property residents may be exposed to fugitive dust and/or gases during the construction of the remedy.
- **Highway Users** – If RIM is shipped on public roads, the trucks containing the RIM would pass near members of the public on those same roads. The RIM on the trucks

would be placed in strong-tight packaging, and any radiation from the RIM would be partially shielded by the body of the truck. Trucks will be inspected for loose contamination before being allowed to leave the Site. In the event of an accident, any spillage would be removed from the road as part of incident response. Any routine or accidental exposures would be transitory and receptors would be separated from the truck carrying the RIM by at least two to three meters.

- **Transients/Visitors** – Individuals may visit the Site to service or repair equipment, deliver items or inspect operations. Exposures to these individuals are expected to be transitory.
- **Rail Users** – If RIM is shipped by rail, the trains containing the RIM would pass near members of the public adjacent to the rail line. The RIM in the railcars would be contained in super sacks, and any radiation from the RIM would be partially shielded by the body of the railcar. Any exposures would be transitory and receptors would be separated from the train carrying the RIM by at least three to five meters.
- **Rail Workers** – One or more rail workers were assumed to be involved with hauling any RIM from the Site to the disposal site. These workers would be shielded from the RIM in the railcars by at least one diesel engine and separated from the RIM by many yards of distance.

A subset of these receptors was identified as having a higher potential for exposure than other comparable receptors. These are listed in Table 10-1.

10.2.3 Exposure Pathways

During remedy construction, the RIM will be disturbed by excavation and loading into open-topped trucks. The receptors identified in the previous section could be exposed to this material by inhalation of suspended particulates, inhalation of radon, incidental ingestion of soil, and direct exposure to radiation, depending on the receptor and their locations.

Table 10-1 contains a matrix presenting identified potential receptors and plausible exposure pathways. Table 10-1 also identifies the receptors and pathways selected for quantification in this short-term risk assessment.

Table 10-1 Potential Receptors Identified During Construction of the "Complete Rad Removal" with Off-site Disposal Option

Receptors Identified	Scenario Considered? [a]	Exposure Route: Inhalation of Fugitive Dust	Inhalation of Radon	Incidental Soil Ingestion	Dermal Contact	Direct Radiation	Quantitative Evaluation of Scenario?
RadCon Techs	**Yes**	●	●	●	●	●	**Yes**
Heavy Equipment Operators	**Yes**	{O}	{O}	{O}	{O}	{O}	No
Truck to Rail Transfer Facility Operators	**Yes**	{O}	{O}	{O}	{O}	{O}	No
Truck Drivers	**Yes**	{O}	{O}			{O}	No
Laborers	**Yes**	{O}	{O}			{O}	No
Engineers/Management	**Yes**	{O}	{O}			{O}	No
Nearby Workers	**Yes**	{O}	{O}			{O}	No
Off-property Residents	**Yes**	●	{O}				**Yes**
Highway Users	**Yes**					{S}	No
Transients/Visitors	**Yes**	{O}	{O}				No
Rail Users	**Yes**					{O}	No
Rail Workers	**Yes**					{O}	No

[a] An exposure scenario was considered if it included a source, a means of moving constituents of concern to a location of interest, and a receptor at that location.

●	Exposure route selected for detailed analysis
(shaded)	A shaded box indicates that the receptor/exposure route combination was not selected for quantitative analysis.
{O}	Not quantified because other receptors identified for this scenario have higher intake rates and longer exposure times.
{S}	Scoping level analysis of possible spillage of RIM performed using MicroShield indicates doses < 1 mrem/y. Source evaluated was 1 mm thick soil containing 338 pCi Ra-226/g (Area 2 conc) spread across one 100 ft. long lane (16 ft. wide). Dose point 3 feet over road through 2 mm iron (car floor).

10.2.4 **Quantification of Human Health Risks**

10.2.4.1 Calculation of Carcinogenic Risk to Selected Receptors

Calculations of carcinogenic risks to potential receptors were based on the relationships between risk and concentration produced by site-specific scenario descriptions input into EPA's PRG and SL calculators. The major differences between the default parameter values used by EPA to calculate health effects to default receptors and the values used to describe site-specific receptors at this Site are the times the receptors are assumed to spend exposed to RIM. For example, EPA's PRG calculations for an outdoor worker assume the workers spends 5,625 days on the Site[31] during a 25 year period, and scheduling information suggests the worker will be exposed to RIM for 8 hours a day over a 283 day period[32] during the two year excavation of the RIM from the three areas were RIM has been identified (Areas 1 and 2 and the Crossroads Property/Buffer Zone).

[31] Total days = Exposure Duration (25 y/lifetime) x 225 (d/y) = 5,625 (d/lifetime)

[32] Work days from Off-site schedule lines 69-73, 79, 156-163, plus 8 days for initial walkover survey. 28 work days subtracted for stoppage due to hauling bags. When Areas 1 & 2 are open simultaneously, only Area 2 time counted.

The work is scheduled to be performed over two years, and the period of exposure was allocated equally between the two years. The RadCon Tech was assumed to be exposed for 142 days a year over the two year period. The off-site resident may also be exposed for a longer period (393 days)[33] while the RIM is exposed but no work is on-going (nights, weekends, etc.). The annual exposure frequency was assumed to be 197 days a year for the off-site resident. Tables 10-2 and 10-4 provide the input parameters for EPA's Soil PRG and SL Calculators for outdoor workers and off-site residents. Tables 10-3 and 10-5 provide the results of the calculations using these parameters.

Table 10-2 Input for EPA's Soil PRG and SL Calculators, RadCon Tech, "Complete Rad Removal" with Off-site Disposal Option

Variable	PRG Calculator Value	SL Calculator Value
Slab size for ACF (area correction factor) m^2	10000	NA
t_{ow} (time - worker) yr	2	NA
ED_{ow} (exposure duration - worker) yr	2	2
ET_{ow} (exposure time - worker) hr/day	8	8
EF_{ow} (exposure frequency - worker) day/yr	142	142

Note: Other parameters were left at their default values.

[33] Calendar days from schedule lines 69-73, 79, and 156-163. 37 work days subtracted for stoppage due to hauling bags. When Areas 1 & 2 are open simultaneously, only Area 2 time counted.

Table 10-3 Calculated Risks to the Hypothetical RadCon Tech During "Complete Rad Removal" with Off-site Disposal Option

Category / Constituent	95% UCL Soil Concentrations in Area 2 [a]	PRG or SL, 10^{-06} Risk, RadCon Tech Exposed for 142 d/y During 2 Years of Construction, All Pathways [b]	Calculated Risk to RadCon Tech in Area 2, Exposed for 142 d/y During 2 Years of Construction, All Pathways [c]
Radionuclides			
Actinium-227	$1.62x10^{02}$ pCi/g	$1.61x10^{02}$ pCi/g	$1.01x10^{-06}$
Bismuth-210	$1.28x10^{02}$ pCi/g	$1.31x10^{05}$ pCi/g	$9.77x10^{-10}$
Lead-210	$1.28x10^{02}$ pCi/g	$5.93x10^{01}$ pCi/g	$2.16x10^{-06}$
Polonium-210	$1.28x10^{02}$ pCi/g	$4.44x10^{02}$ pCi/g	$2.88x10^{-07}$
Protactinium-231	$1.62x10^{02}$ pCi/g	$2.48x10^{01}$ pCi/g	$6.53x10^{-06}$
Radium-223 + dtrs	$1.62x10^{02}$ pCi/g	$1.66x10^{02}$ pCi/g	$9.76x10^{-07}$
Radium-224 + dtrs	$1.59x10^{01}$ pCi/g	$7.64x10^{01}$ pCi/g	$2.08x10^{-07}$
Radium-226 + dtrs	$3.38x10^{02}$ pCi/g	$4.89x10^{-01}$ pCi/g	$6.91x10^{-04}$
Radium-228 + dtrs	$1.59x10^{01}$ pCi/g	$3.79x10^{-01}$ pCi/g	$4.20x10^{-05}$
Thorium-227	$1.62x10^{02}$ pCi/g	$2.82x10^{02}$ pCi/g	$5.74x10^{-07}$
Thorium-228	$1.59x10^{01}$ pCi/g	$3.73x10^{02}$ pCi/g	$4.26x10^{-08}$
Thorium-230	$3.73x10^{03}$ pCi/g	$3.97x10^{02}$ pCi/g	$9.40x10^{-06}$
Thorium-232	$1.59x10^{01}$ pCi/g	$3.75x10^{02}$ pCi/g	$4.24x10^{-08}$
Uranium-234	$4.60x10^{01}$ pCi/g	$6.40x10^{02}$ pCi/g	$7.19x10^{-08}$
Uranium-235 + dtrs	$1.83x10^{00}$ pCi/g	$6.81x10^{02}$ pCi/g	$2.69x10^{-09}$
Uranium-238 + dtrs	$2.71x10^{01}$ pCi/g	$3.27x10^{01}$ pCi/g	$8.29x10^{-07}$
		Total Radiocarcinogenic Risk	$7.55x10^{-04}$
Metals			
Arsenic	$7.70x10^{00}$ µg/g	$3.50x10^{01}$ µg/g	$2.20x10^{-07}$
Chromium (VI)	$2.27x10^{01}$ µg/g	$1.23x10^{02}$ µg/g	$1.85x10^{-07}$
PCBs			
Aroclor-1254	$5.00x10^{-01}$ µg/g	$1.64x10^{01}$ µg/g	$3.05x10^{-08}$
		Total Chemocarcenogenic Risk	$4.35x10^{-07}$
		Total Risk	**$7.56x10^{-04}$**

[a] From Table 8-2.
[b] http://epa-prgs.ornl.gov/cgi-bin/radionuclides/rprg_search
http://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search
[c] Calculated risk for radionuclide = [10^{-06} (risk) x 1/PRG (g/pCi)] x Soil Conc. (pCi/g)
Calculated risk for chemical = [10^{-06} (risk) x 1/SL (g/µg)] x Soil Conc. (µg/g)

Table 10-4 Input for EPA's Soil PRG and SL Calculators, Off-site Resident, "Complete Rad Removal" with Off-site Disposal Option

Variable	PRG Calculator Value	SL Calculator Value
TR (target cancer risk) unitless	0.000001	0.000001
THQ (target hazard quotient) unitless	NA	1
EF_r (exposure frequency) day/yr	197	197
ET_r (exposure time - resident) hr	24	24
ED_{rc-a} (exposure duration, carcinogenic, resident adult) yr	2	2
ED_{nc0-2} (exposure duration, non-carcinogenic, first phase) year	NA	2
ED_{nc2-6} (exposure duration, non-carcinogenic, second phase) year	NA	0
ED_{nc6-16} (exposure duration, non-carcinogenic, third phase) year	NA	0
$ED_{nc16-30}$ (exposure duration, non-carcinogenic, fourth phase) year	NA	0
LT (lifetime - resident) year	NA	70
t_r (time - resident) yr	2	NA
IRA_{r-c} (inhalation rate - resident child) m^3/day	10	NA
IRA_{r-a} (inhalation rate - resident adult) m^3/day	20	NA
GSF_o (gamma shielding factor - outdoor) unitless	1	NA

Table 10-5 Calculated Risks to the Hypothetical Off-site Resident During "Complete Rad Removal" with Off-site Disposal Option

Category / Constituent	Annual Average Air Concentrations at Site Boundary [a]	PRG or SL, 10^{-06} Risk, Resident Exposed for 197 d/y During 2 Years of Construction, Air Pathways [b]	Calculated Risk to Resident Exposed for 197 d/y During 2 Years of Construction, Air Pathways [c]
Radionuclide			
Actinium-227	$5.74x10^{-03}$ pCi/m^3	$3.41x10^{-03}$ pCi/m^3	$1.68x10^{-06}$
Bismuth-210	$4.53x10^{-03}$ pCi/m^3	$1.60x10^{00}$ pCi/m^3	$2.83x10^{-09}$
Lead-210	$4.53x10^{-03}$ pCi/m^3	$1.83x10^{-01}$ pCi/m^3	$2.48x10^{-08}$
Polonium-210	$4.53x10^{-03}$ pCi/m^3	$4.70x10^{-02}$ pCi/m^3	$9.64x10^{-08}$
Protactinium-231	$5.74x10^{-03}$ pCi/m^3	$1.12x10^{-02}$ pCi/m^3	$5.12x10^{-07}$
Radium-223 + dtrs	$5.74x10^{-03}$ pCi/m^3	$7.99x10^{02}$ pCi/m^3	$7.18x10^{-12}$
Radium-224 + dtrs	$5.63x10^{-04}$ pCi/m^3	$1.29x10^{02}$ pCi/m^3	$4.36x10^{-12}$
Radium-226 + dtrs	$1.20x10^{-02}$ pCi/m^3	$4.37x10^{-02}$ pCi/m^3	$2.74x10^{-07}$
Radium-228 + dtrs	$5.63x10^{-04}$ pCi/m^3	$9.69x10^{-02}$ pCi/m^3	$5.81x10^{-09}$
Thorium-227	$5.74x10^{-03}$ pCi/m^3	$1.45x10^{-02}$ pCi/m^3	$3.96x10^{-07}$
Thorium-228	$5.63x10^{-04}$ pCi/m^3	$3.85x10^{-03}$ pCi/m^3	$1.46x10^{-07}$
Thorium-230	$1.32x10^{-01}$ pCi/m^3	$1.78x10^{-02}$ pCi/m^3	$7.42x10^{-06}$
Thorium-232	$5.63x10^{-04}$ pCi/m^3	$1.17x10^{-02}$ pCi/m^3	$4.81x10^{-08}$
Uranium-234	$1.63x10^{-03}$ pCi/m^3	$4.45x10^{-02}$ pCi/m^3	$3.66x10^{-08}$
Uranium-235 + dtrs	$6.48x10^{-05}$ pCi/m^3	$5.03x10^{-02}$ pCi/m^3	$1.29x10^{-09}$
Uranium-238 + dtrs	$9.59x10^{-04}$ pCi/m^3	$5.43x10^{-02}$ pCi/m^3	$1.77x10^{-08}$
		Total Radiocarcinogenic Risk	$1.07x10^{-05}$
Metals			
Arsenic	$2.73x10^{-04}$ µg/m^3	$1.51x10^{-02}$ µg/m^3	$1.81x10^{-08}$
Chromium (VI)	$8.04x10^{-04}$ µg/m^3	$7.72x10^{-05}$ µg/m^3	$1.04x10^{-05}$
PCBs			
Aroclor-1254	$1.77x10^{-05}$ µg/m^3	$1.13x10^{-01}$ µg/m^3	$1.57x10^{-10}$
		Total Chemocarcinogenic Risk	$1.04x10^{-05}$
		Sum of Risks	$\mathbf{2.11x10^{-05}}$

[a] From Table 8-2.
[b] http://epa-prgs.ornl.gov/cgi-bin/radionuclides/rprg_search
http://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search
[c] Calculated risk for radionuclide = [10^{-06} (risk) x 1/PRG (m^3/pCi)] x Air Conc. (pCi/m^3)
Calculated risk for chemical = [10^{-06} (risk) x 1/SL (m^3/µg)] x Soil Conc. (µg/m^3)

The calculated lifetime risk to the hypothetical RadCon Tech is 7.56 x 10^{-04}. The risks to a hypothetical receptor living immediately adjacent to the property boundary were calculated as 2.11 x 10^{-05}.

10.2.4.2 Calculation of Non-Carcinogenic Effects to Selected Receptors

Site-specific parameters listed in Tables 10-2 and 10-4 were used in the EPA SL calculator to calculate the hazard quotients to the RadCon Tech and off-site resident, respectively. The results for the hypothetical RadCon Tech are presented in Table 10-6. Table 10-7 presents the hazard quotients calculated for the hypothetical off-site resident.

Table 10-6 Hazard Index Calculated for the Hypothetical RadCon Tech During "Complete Rad Removal" with Off-site Disposal Option

Category Constituent	**95% UCL Soil Concentrations in Area 2** [a]	**SL, HQ = 1, RadCon Tech Exposed for 142 d/y During 2 Years of Construction, All Pathways** [b]	**Calculated HQ to RadCon Tech in Area 2, Exposed for 142 d/y During 2 Years of Construction, All Pathways**
Metals			
Arsenic	7.70×10^{00} µg/g	4.49×10^{02} µg/g	1.71×10^{-02}
Chromium (VI)	2.27×10^{01} µg/g	3.48×10^{04} µg/g	6.52×10^{-04}
Lead	4.79×10^{02} µg/g	8.00×10^{02} µg/g [c]	NA [c]
PCBs			
Aroclor-1254	5.00×10^{-01} µg/g	2.81×10^{01} µg/g	1.78×10^{-02}
		Hazard Index (HI)	**3.56×10^{-02}** [d]

[a] From Table 8-2.
[b] http://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search, sub-chronic values when available.
[c] This lead value is produced by the web calculator. It is provided here for completeness. See discussion regarding EPA's Adult Lead Model in Section 10.2.4.3.
[d] HI = ∑HQ, excluding lead.

Table 10-7 Hazard Index Calculated for the Hypothetical Off-site Resident During "Complete Rad Removal" with Off-site Disposal Option

Category Constituent	**Annual Average Concentrations in Air at Boundary** [a]	**SL, HQ = 1 Resident Exposed for 197 d/y During 2 Years of Construction, Air Pathways** [b]	**Calculated HQ to Resident Exposed for 197 d/y During 2 Years of Construction, Air Pathways**
Metals			
Arsenic	2.73×10^{-04} µg/m^3	2.78×10^{-02} µg/m^3	9.81×10^{-03}
Chromium (VI)	8.04×10^{-04} µg/m^3	1.85×10^{-01} µg/m^3	4.34×10^{-03}
Lead	1.69×10^{-02} µg/m^3	NA [c]	NA
PCBs			
Aroclor-1254	1.77×10^{-05} µg/m^3	NA [d]	NA
		Hazard Index (HI)	**1.42×10^{-02}** [e]

[a] From Table 8-2.
[b] http://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search
[c] See discussion regarding EPA's Adult Lead Model in Section 10.2.4.3.
[d] Not published by EPA
[e] HI = ∑HQ.

The calculated HI for the hypothetical RadCon Tech is 3.56×10^{-02}. The HI for a hypothetical receptor living immediately adjacent to the property boundary was calculated as 1.42×10^{-02}.

10.2.4.3 Blood Lead Levels

Blood levels of lead were also calculated for the RME receptor, the RadCon Tech exposed to soil, using EPA's Adult Lead Methodology (ALM).[34] For a soil concentration of 479 µg/g and an exposure duration of 283 days, the blood lead level in the hypothetical RadCon Tech was calculated to be 1.9 µg/dL (19% of the target level of 10 µg/dL). The probability that the blood level in a fetus carried by that RadCon Tech would exceed its target blood level was calculated to be approximately 0.13%, which is well below the target percentile of 5%. It should be noted that applying the ALM to the short durations scheduled for this alternative introduces additional uncertainty to the results.

10.3 HAZARD ASSESSMENT OF CONSTRUCTION AND TRANSPORTATION ACTIVITIES

Regrettably, there is a risk of occupational and traffic accidents during earthmoving or transportation of materials on public roads. Generally, the risk of occurrence is time dependent, increasing as the duration of the activity lengthens. The severity of the accident depends, in part, on the activity itself.

In order to assess the likelihood and severity of possible accidents, Occupational Safety and Health Administration (OSHA) and National Highway Traffic Safety Administration (NHTSA) statistics for workers in different occupations and transportation records were used in conjunction with manpower and resource projections from remedy construction schedules to calculate the risks for accidents.

10.3.1 **Transportation Hazards**

Table 10-8 lists statistics on the rate that traffic accidents involving heavy trucks occurred in 2007 (NCSA 2008)[35]. The projection for heavy truck use on public roads during construction of the off-site remedy is 3,004,896 miles (2,688,536 miles if an on-site siding is used). Multiplying this mileage by the injury and fatality rates in Table 10-8 yields the transportation incident forecast presented Table 10-9.

Table 10-8 Accident Incident Rate for Trucks on Public Roads

Incident	Published Rate [a]	Per mile rate [b]
Injury Crashes	$3.30x10^{01}$	$3.30x10^{-07}$
Fatal Crashes	$2.04x10^{00}$	$2.04x10^{-08}$

[a] Rate per 100 million miles (NCSA 2008).
[b] Derived from rate (incidents/100,000,000 mi)

[34] http://www.epa.gov/superfund/lead/products/ALM_2009.xls

[35] The latest data available at the time of this SFS was 2007 data, published in 2008.

Table 10-9 Traffic Injury and Fatality Forecast for the "Complete Rad Removal" with Off-site Disposal Option

Parameter	Value Off-site Rail Siding	Value On-site Rail Siding
Total miles for all hauling on public roads	3.00×10^{06}	2.67×10^{06}
Injury risk for the project	9.92×10^{-01}	8.82×10^{-01}
Fatality risk for the project	6.13×10^{-02}	5.45×10^{-02}
Forecast of truck accidents involving injuries or fatalities	**1.05×10^{00}**	**9.37×10^{-01}**

Hazards from transporting the RIM by rail from the local railhead to the off-site destination can be similarly assessed (Table 10-10 and Table 10-11).

Table 10-10 Accident Incident Rate for Railroads

Incident	**Published Per Mile Rate [a]**
Injury Rate	2.80×10^{-06}
Fatality Rate	6.00×10^{-09}

[a] Rate per mile (FRAOSA 2009).

Table 10-11 Railroad Injury and Fatality Forecast for the "Complete Rad Removal" with Off-site Disposal Option

Parameter	**Value**
Rail mile [a]	1.15×10^{05}
Injury risk for the project	3.23×10^{-01}
Fatality risk for the project	6.91×10^{-04}
Forecast of rail accidents involving injuries or fatalities	**3.23×10^{-01}**

[a] Rail distance calculated as 36 trains x 3,200 miles round trip

The projected number of on-site and off-site transportation accidents involving injury or death during construction of the off-site disposal remedy is related primarily to the large number of trucks hauling materials onto the Site. It should be noted that this projection includes injuries and deaths of people other than the truck occupants. In 2007, 74% of the injuries and 84% of the fatalities from traffic accidents on public roads were to people not riding in the truck involved in the incident.

10.3.2 Industrial Accidents

As in the previous assessment, the workers involved with remedy construction have been divided into two groups: general construction and driver/operators. The Bureau of Labor Statistics (BLS) maintains historical information on the rate that accidents occur in the US[36]. These statistics are available grouped by job description, and Table 10-12 and Table 10-13 list accident statistics for general construction and off-road drivers, respectively.

[36] The latest data available at the time of this SFS was 2008 data, published in 2009.

Table 10-12 Accident Rate for General Construction and Support Workers

Parameter	Value
Injury accident rate per 100 full-time workers [a]	4.20×10^{00}
Accident rate per man-hour worked	2.10×10^{-05}
Accident rate per man-day worked	1.68×10^{-04}
Number of general construction + support man-days worked [b]	2.06×10^{04}
Number of Accidents Forecast	**3.46×10^{00}**

[a] Bureau of Labor Statistics News Release, October 29, 2009 "WORKPLACE INJURIES AND ILLNESSES – 2008" for Heavy and civil engineering construction (237).
[b] From the Engineering Estimate of Man-days and Cost

Table 10-13 Occupational Accident Rate for Truck Drivers

Parameter	Value
Injury accident rate per 100 full-time workers [a]	5.20×10^{00}
Accident rate per hour worked	2.60×10^{-05}
Hours spent driving [b]	1.34×10^{05}
Other transportation activities (hrs) [c]	2.68×10^{04}
Total transportation man-hours worked	1.61×10^{05}
Number of Accidents Forecast	**4.18×10^{00} [d]**

[a] Bureau of Labor Statistics News Release, October 29, 2009 "WORKPLACE INJURIES AND ILLNESSES – 2008" for Truck Transportation (484)

[b] From the Engineering Estimate of Man-days and Cost

[c] Hours assumed - Driving hours x 0.2.

[d] Accident Rate per hour x Total Transportation Man-hours

Table 10-12 and Table 10-13 also list the remedy construction time in either man-days or man-hours that can be grouped into each of those broad labor categories. Multiplying the total time by the appropriate accident rate will yield an accident forecast for this group's activities during this project. This accident forecasts for the general construction and off-road drivers are presented in bold on the last line of Table 10-12 and Table 10-13, respectively. Summing the number of accidents forecast for both labor groups yields the total accident projection for the project.

For example, it is estimated that it will require 20,600 man-days of general construction and support labor to construct the off-site remedy. Multiplying this duration by the injury and fatality rate of 1.68×10^{-04} accidents per man-day in Table 10-12 yields the construction incident forecast of 3.46 accidents. Adding this to the project risk of non-traffic accidents for truck drivers in Table 10-13 yields a total accident projection for project activities of 7.64.

10.4 OCCUPATIONAL DOSES

Remedial workers were assumed to be classified as radiation workers in this assessment. Doses to those workers were calculated using RESRAD and those doses were compared to occupational dose limits.

The dose rate to workers will change as the remedy progresses because the area of exposed materials will shrink as they are covered. The Total Effective Dose Equivalent (TEDE) was calculated for an individual exposed to Area 2 as remediation starts, and a second dose was assumed to be 0 the final configuration. The multiplying the average of these dose rates and the total projected time spent exposed to Areas 1 and 2 yields the estimated annual TEDE to RadCon Techs on the project (Table 10-14).

Table 10-14 Radiation Dose to RME Individual

	Area 2
Beginning TEDE on surface (mrem/1,800 h) [a]	834
Ending TEDE on surface (mrem/1,800 h) [a]	0
Average TEDE on surface (mrem/1,800 h)	417
Time spent exposed to RIM (fraction of year)	0.631 [b]
TEDE for Reasonably Maximally-Exposed Individual (mrem/y)	**263**

[a] Calculated by RESRAD.
[b] 142 days/year / 225 days/year = 0.631.

The calculated TEDE to the hypothetical RadCon Tech will be approximately 417 mrem/y if the RadCon Tech spent 1,800 hours per year working on the RIM. Currently, the best estimate of the time this receptor would spend exposed to the RIM in Areas 1, 2 and the boundary area is 283 days[37]. Dividing this time equally over the 2 year project yields an annual exposure time of 142 days. The annual TEDE to the RadCon Tech working for 142 days is about 263 mrem/y. To put this in perspective, a radiation worker has an occupational exposure limit of 5,000 mrem/y, assuming no administrative limits are imposed for the Site.

10.5 SUMMARY

The short-term human health risks and hazard projections are summarized in Table 10-15.

Table 10-15 Summary of Short-Term Hazards and Risks Associated with "Complete Rad Removal" with Off-site Disposal Option

Category of Hazard or Risk	Value
Projected Incidence of Transportation Accidents	1.4×10^{00} [a]
Projected Incidence of Industrial Accidents	7.6×10^{00}
Carcinogenic Risk to Reasonably Maximally-Exposed Individual	7.6×10^{-04}
HI to Reasonably Maximally-Exposed Individual	3.6×10^{-02}
TEDE to Reasonably Maximally-Exposed Individual	2.6×10^{02}

[a] Includes risks from using off-site rail siding. Use of an on-site rail siding reduces the incident rate to 1.3.

Industrial and transportation hazards dominate the human impacts evaluated by this short-term assessment. It is projected that 7.6 workers will be injured in work-related accidents during construction of the remedy (out of the 37,363 man-days worked). There is also a 6% chance of a fatal transportation accident. The number of transportation-related injuries forecast for this option is 1.4. Using an on-site rail siding reduces this projected incident rate by 0.1. If there is a transportation accident, there is a 3 out of 4 chance that the injured/killed person will be a member of the public.

Carcinogenic risks from exposure to RIM encountered during construction are expected to be no greater than the risk calculated for remediation workers like the RadCon Tech. The lifetime risk to the RadCon Tech was calculated to be 7.6×10^{-04}. This calculated risk exceeded EPA's acceptable risk range of 10^{-06} to 10^{-04}. The most important single contributor to this risk is the gamma radiation from RIM on and near the surface of the contamination area.

[37] See Section 10.2.4.1 for derivation of worker exposure time.

11 SHORT-TERM RISKS FOR THE "COMPLETE RAD REMOVAL" WITH ON-SITE DISPOSAL OPTION

This risk analysis identifies and evaluates the major short-term hazards and exposures from the construction and transportation activities during excavation, restoration and capping of Areas 1 and 2 that would occur during construction of the on-site remedy. It also evaluates the human health risks from chemicals and radiation that may occur during remedy construction.

11.1 DESCRIPTION OF ACTIVITIES EVALUATED

Construction activities during remedy construction involve use of heavy equipment to:

- move the contaminated materials from the Crossroads Property and Buffer zone,
- excavate RIM from Areas 1 and 2,
- move excavated material around the Site,
- haul excavated RIM to an on-site disposal cell,
- ship cover materials into the Site,
- grade the landfill surface, and
- construct a multilayer, vegetated cover over the landfill.

Many of these activities will expose workers to a variety of physical hazards and some will place a subset of the workers in close proximity to the RIM. For example, large quantity of materials will be hauled to the on-site disposal cell, and additional material will be hauled to the Site from off-site suppliers to build the cell itself, restore the surface of the excavated area, and construct the landfill cover on the remediated portions of OU-1. Historically, this kind of material handling has produced an increased risk of traffic and occupational accidents.

In addition, tasks like: guiding excavation of the RIM, verification that cleanup criteria have been meet, and construction work in OU-1 will require that remediation workers like RadCon Techs and equipment operators will be in close proximity to the RIM for extended periods of time. This may introduce an increased risk of carcinogenic effects in those workers.

11.2 HUMAN HEALTH ASSESSMENT OF REMEDY CONSTRUCTION

As discussed in Section 8, a human health assessment considers the following components: exposure point concentrations, potential receptors, and exposure pathways. These components are used to extrapolate the quantification of health risks to both an on-site and off-site receptor. Some of these factors are common to all three remedies. The following information takes the common factors from Section 8 and presents the calculations specific to the "Complete Rad Removal" with on-site disposal option below.

11.2.1 Exposure Point Concentrations

The exposure point concentration is the concentration of a contaminant in an exposure medium that may be contacted by a real or hypothetical receptor. Concentrations in Area 2 were selected to evaluate human health effects because radionuclide concentrations in this area are greater than in Area 1 and higher than the concentrations in the mixture of RIM from OU-1 that will be placed in the on-site cell. Table 8-2 presents the representative concentrations of radionuclides used in this short-term risk assessment.

11.2.2 Potential Receptors

The tasks involved in the work outlined above were examined to identify potential receptors. Potential receptors identified include:

- **Radiation Survey/Radiation Control Technicians (RadCon Techs)** – One or more RadCon Techs were assumed to be involved in identifying areas of soil containing RIM, directing the excavation and movement of RIM on the Site, monitoring the placement of RIM in the engineered on-site disposal cell, and surveying the equipment that has to move into and out of the exclusion zones set up around work areas. These receptors will spend most of their work day standing on or next to areas containing RIM. They will likely be exposed to higher concentrations of RIM for longer periods of time than any other potential receptor identified.
- **Laborers** – One or more qualified radiation workers may perform manual labor within the OU-1 or the on-site cell as part of the remediation. Activities could range from carrying equipment to cleaning equipment. It is expected that the exposure times required to perform these activities will be shorter that the exposure times of the RadCon Techs.
- **Truck Drivers** – One or more truck drivers were assumed to be involved with hauling any RIM from OU-1 to the engineered on-site disposal cell. This driver is also assumed to haul fill material and cover material in order to re-slope and build the cover on OU-1 and the on-site cell. The driver would remain seated in his truck during the majority of his work shift.
- **Engineers/Management** – This group of receptors include qualified radiation workers who direct operations and respond to atypical occurrences but typically spend limited time in close proximity to exposed RIM.
- **Heavy Equipment Operator** – One or more heavy equipment operators were assumed to be involved in excavating the RIM, placing RIM in the on-site cell, and spreading cover materials over OU-1. These workers will be riding above the surface of the RIM in an enclosed cab with portions of the vehicle shielding them from the underlying RIM.
- **Transients/Visitors** – Individuals may visit the Site to service or repair equipment, deliver items or inspect operations. Exposures to these individuals are expected to be transitory.
- **Off-property Residents** – One or more off-property residents may be exposed to fugitive dust and/or gases during the construction of the remedy.
- **Nearby Workers** – Businesses located near the Site employ workers. These workers may be exposed to transient plumes of dust transported from the Site by wind. The average exposure concentrations in air (if any) would be lower than those encountered by RadCon Techs because exposures to a given receptor will only occur during times when the wind blows in their direction and when the wind does blow in the direction of the workers, near ground turbulence will mix the particulates into a larger volume of air, lowering their concentrations.

A subset of these receptors was identified as having a higher potential for exposure than other comparable receptors. These are listed in Table 11-1.

11.2.3 Exposure Pathways

During remedy construction, the RIM will be disturbed by excavation of the RIM, loading RIM into open-topped trucks, and delivery and placement of RIM in the on-site cell. These trucks will be inspected for loose RIM before leaving the RIM loading area. The receptors identified in the previous section could be exposed to this material by inhalation of suspended particulates, inhalation of radon, incidental ingestion of soil, and direct exposure to radiation, depending on the receptor and their locations.

Table 11-1 contains a matrix presenting identified potential receptors and plausible exposure pathways. Table 11-1 also identifies the receptors and pathways selected for quantification in this short-term risk assessment.

Table 11-1 List of Potential Receptors Identified During Construction of the "Complete Rad Removal" with On-site Disposal Option

Receptors Identified	Scenario Considered? [a]	Exposure Route: Inhalation of Fugitive Dust	Exposure Route: Inhalation of Radon	Exposure Route: Incidental Soil Ingestion	Exposure Route: Dermal Contact	Exposure Route: Direct Radiation	Quantitative Evaluation of Scenario?
RadCon Techs	**Yes**	●	●	●	●	●	**Yes**
Laborers	**Yes**	{O}	{O}	{O}	{O}	{O}	No
Truck Drivers	**Yes**	{O}	{O}			{O}	No
Engineers/Management	**Yes**	{O}	{O}			{O}	No
Heavy Equipment Operators	**Yes**	{O}	{O}			{O}	No
Transients/Visitors	**Yes**	{O}	{O}	{O}	{O}	{O}	No
Off-property Residents	**Yes**	●	{O}				**Yes**
Nearby Workers	**Yes**	{O}	{O}				No

[a] An exposure scenario was considered if it included a source, a means of moving constituents of concern to a location of interest, and a receptor at that location.

● Exposure route selected for detailed analysis

(shaded box) A shaded box indicates that the receptor/exposure route combination was not selected for quantitative analysis.

{O} Not quantified because other receptors identified for this scenario have higher intake rates and longer exposure times.

11.2.4 Quantification of Human Health Effects

11.2.4.1 Calculation of Carcinogenic Risk to Selected Receptors

Calculations of carcinogenic risks to potential receptors were based on the relationships between risk and concentration produced by site-specific scenario descriptions input into EPA's PRG and SL calculators. The major differences between the default parameter values used by EPA to calculate health efforts to default receptors and the values used to describe site-specific receptors at this Site are the times the receptors are assumed to spend exposed to RIM. For example, EPA's PRG calculations for an outdoor worker assume the worker spends 5,625 days on the Site[38] during a 25 year period, and scheduling information suggests the RIM will be exposed for

[38] Total days = Exposure Duration (25 y/lifetime) x 225 (d/y) = 5,625 (d/lifetime)

8 hours a day over a for a 278 day[39] period during the two year excavation of the RIM from the three areas were RIM has been identified (Areas 1 and 2 and the Crossroads Property/Buffer Zone).

The work is scheduled to be performed over two years, and the period of exposure was allocated equally between the two years. The RadCon Tech was assumed to be exposed for 139 days a year over the two year period. The off-site resident may also be exposed for a longer period (375 days)[40] while the RIM is exposed when no work is on-going (nights, weekends, etc.). The annual exposure frequency was assumed to be 188 days a year for the off-site resident. Tables 11-2 and 11-4 provide the input parameters for EPA's Soil PRG and SL Calculators for outdoor workers and off-site residents. Tables 11-3 and 11-5 provide the results of the calculations using these parameters.

Table 11-2 Input for EPA's Soil PRG and SL Calculators, RadCon Tech, "Complete Rad Removal" and On-site Disposal Option

Variable	PRG Calculator Value	SL Calculator Value
Slab size for ACF (area correction factor) m^2	10,000	NA
t_{ow} (time - worker) yr	2	NA
ED_{ow} (exposure duration - worker) yr	2	2
ET_{ow} (exposure time - worker) hr/day	8	8
EF_{ow} (exposure frequency - worker) day/yr	139	139

Note: All other parameter values were left at their default values.

[39] Work days from On-site Disposal schedule lines 145-146, 152, 232-234, plus 8 days for initial walkover survey. When Areas 1 & 2 are open simultaneously, only Area 2 time counted.

[40] Calendar days from On-site Disposal schedule lines 145-146, 152, 232-234. When Areas 1 & 2 are open simultaneously, only Area 2 time counted.

Table 11-3 Calculated Risks to the Hypothetical RadCon Tech During "Complete Rad Removal" and On-site Disposal

Category / Constituent	95% UCL Soil Concentrations in Area 2 [a]		PRG or RSL, 10^{-06} Risk, RadCon Tech Exposed 139 d/y During 2 Years of Construction, All Pathways [b]		Calculated Risk to RadCon Tech in Area 2, Exposed 139 d/y During 2 Years of Construction, All Pathways [c]
Radionuclides					
Actinium-227	1.62×10^{02}	pCi/g	1.65×10^{02}	pCi/g	9.82×10^{-07}
Bismuth-210	1.28×10^{02}	pCi/g	1.34×10^{05}	pCi/g	9.55×10^{-10}
Lead-210	1.28×10^{02}	pCi/g	6.06×10^{01}	pCi/g	2.11×10^{-06}
Polonium-210	1.28×10^{02}	pCi/g	4.53×10^{02}	pCi/g	2.83×10^{-07}
Protactinium-231	1.62×10^{02}	pCi/g	2.53×10^{01}	pCi/g	6.40×10^{-06}
Radium-223 + dtrs	1.62×10^{02}	pCi/g	1.69×10^{02}	pCi/g	9.59×10^{-07}
Radium-224 + dtrs	1.59×10^{01}	pCi/g	7.80×10^{01}	pCi/g	2.04×10^{-07}
Radium-226 + dtrs	3.38×10^{02}	pCi/g	4.99×10^{-01}	pCi/g	6.77×10^{-04}
Radium-228 + dtrs	1.59×10^{01}	pCi/g	3.87×10^{-01}	pCi/g	4.11×10^{-05}
Thorium-227	1.62×10^{02}	pCi/g	2.88×10^{02}	pCi/g	5.63×10^{-07}
Thorium-228	1.59×10^{01}	pCi/g	3.82×10^{02}	pCi/g	4.16×10^{-08}
Thorium-230	3.73×10^{03}	pCi/g	4.05×10^{02}	pCi/g	9.21×10^{-06}
Thorium-232	1.59×10^{01}	pCi/g	3.83×10^{02}	pCi/g	4.15×10^{-08}
Uranium-234	4.60×10^{01}	pCi/g	6.54×10^{02}	pCi/g	7.03×10^{-08}
Uranium-235 + dtrs	1.83×10^{00}	pCi/g	6.96×10^{02}	pCi/g	2.63×10^{-09}
Uranium-238 + dtrs	2.71×10^{01}	pCi/g	3.34×10^{01}	pCi/g	8.11×10^{-07}
			Total Radiocarcinogenic Risk		7.40×10^{-04}
Metals					
Arsenic	7.70×10^{00}	µg/g	3.58×10^{01}	µg/g	2.15×10^{-07}
Chromium (VI)	2.27×10^{01}	µg/g	1.25×10^{02}	µg/g	1.82×10^{-07}
PCBs					
Aroclor-1254	5.00×10^{-01}	µg/g	1.67×10^{01}	µg/g	2.99×10^{-08}
			Total Chemocarcinogenic Risk		4.27×10^{-07}
			Total Risk		$\mathbf{7.41\times10^{-04}}$

[a] From Table 8-2.
[b] http://epa-prgs.ornl.gov/cgi-bin/radionuclides/rprg_search
http://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search
[c] Calculated risk for radionuclide = [10^{-06} (risk) x 1/PRG (g/pCi)] x Soil Conc. (pCi/g)
Calculated risk for chemical = [10^{-06} (risk) x 1/SL (g/µg)] x Soil Conc. (µg/g)

Table 11-4 Input for EPA's Soil PRG and SL Calculators, Off-site Resident, "Complete Rad Removal" and On-site Disposal Option

Variable	PRG Calculator Value	SL Calculator Value
TR (target cancer risk) unitless	0.000001	0.000001
THQ (target hazard quotient) unitless	NA	1
EF_r (exposure frequency) day/yr	188	188
ET_r (exposure time - resident) hr	24	24
ED_{rc-a} (exposure duration, carcinogenic, resident adult) yr	2	2
ED_{nc0-2} (exposure duration, non-carcinogenic, first phase) year	NA	2
ED_{nc2-6} (exposure duration, non-carcinogenic, second phase) year	NA	0
ED_{nc6-16} (exposure duration, non-carcinogenic, third phase) year	NA	0
$ED_{nc16-30}$ (exposure duration, non-carcinogenic, fourth phase) year	NA	0
LT (lifetime - resident) year	NA	70
t_r (time - resident) yr	2	NA
IRA_{r-c} (inhalation rate - resident child) m^3/day	10	NA
IRA_{r-a} (inhalation rate - resident adult) m^3/day	20	NA
GSF_o (gamma shielding factor - outdoor) unitless	1	NA

Table 11-5 Calculated Risks to the Hypothetical Off-site Resident During "Complete Rad Removal" and On-site Disposal

Category / Constituent	Annual Average Air Concentrations at Site Boundary [a]	PRG or SL, 10^{-06} Risk, Resident Exposed for 137 d/y During 2 Years of Construction, Air Pathways [b]	Calculated Risk to Resident Exposed During 188 d/y During 2 Years of Construction, Air Pathways [c]
Radionuclide			
Actinium-227	$5.74x10^{-03}$ pCi/m^3	$3.59x10^{-03}$ pCi/m^3	$1.60x10^{-06}$
Bismuth-210	$4.53x10^{-03}$ pCi/m^3	$1.69x10^{-00}$ pCi/m^3	$2.68x10^{-09}$
Lead-210	$4.53x10^{-03}$ pCi/m^3	$1.92x10^{-01}$ pCi/m^3	$2.35x10^{-08}$
Polonium-210	$4.53x10^{-03}$ pCi/m^3	$4.95x10^{-02}$ pCi/m^3	$9.16x10^{-08}$
Protactinium-231	$5.74x10^{-03}$ pCi/m^3	$1.18x10^{-02}$ pCi/m^3	$4.86x10^{-07}$
Radium-223 + dtrs	$5.74x10^{-03}$ pCi/m^3	$8.41x10^{02}$ pCi/m^3	$6.82x10^{-12}$
Radium-224 + dtrs	$5.63x10^{-04}$ pCi/m^3	$1.36x10^{02}$ pCi/m^3	$4.14x10^{-12}$
Radium-226 + dtrs	$1.20x10^{-02}$ pCi/m^3	$4.61x10^{-02}$ pCi/m^3	$2.60x10^{-07}$
Radium-228 + dtrs	$5.63x10^{-04}$ pCi/m^3	$1.02x10^{-01}$ pCi/m^3	$5.52x10^{-09}$
Thorium-227	$5.74x10^{-03}$ pCi/m^3	$1.52x10^{-02}$ pCi/m^3	$3.77x10^{-07}$
Thorium-228	$5.63x10^{-04}$ pCi/m^3	$4.05x10^{-03}$ pCi/m^3	$1.39x10^{-07}$
Thorium-230	$1.32x10^{-01}$ pCi/m^3	$1.88x10^{-02}$ pCi/m^3	$7.02x10^{-06}$
Thorium-232	$5.63x10^{-04}$ pCi/m^3	$1.24x10^{-02}$ pCi/m^3	$4.54x10^{-08}$
Uranium-234	$1.63x10^{-03}$ pCi/m^3	$4.69x10^{-02}$ pCi/m^3	$3.47x10^{-08}$
Uranium-235 + dtrs	$6.48x10^{-05}$ pCi/m^3	$5.29x10^{-02}$ pCi/m^3	$1.22x10^{-09}$
Uranium-238 + dtrs	$9.60x10^{-04}$ pCi/m^3	$5.72x10^{-02}$ pCi/m^3	$1.68x10^{-08}$
		Total Radiocarcinogenic Risk	$1.01x10^{-05}$
Metals			
Arsenic	$2.73x10^{-04}$ µg/m^3	$1.59x10^{-02}$ µg/m^3	$1.71x10^{-08}$
Chromium (VI)	$8.04x10^{-04}$ µg/m^3	$8.13x10^{-05}$ µg/m^3	$9.89x10^{-06}$
PCBs			
Aroclor-1254	$1.77x10^{-05}$ µg/m^3	$1.20x10^{-01}$ µg/m^3	$1.48x10^{-10}$
		Total Chemocarcinogenic Risk	$9.90x10^{-06}$
		Sum of Risks	**$2.00x10^{-05}$**

[a] From Table 8-2.
[b] http://epa-prgs.ornl.gov/cgi-bin/radionuclides/rprg_search
http://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search
[c] Calculated risk for radionuclide = [10^{-06} (risk) x 1/PRG (m^3/pCi)] x Air Conc. (pCi/m^3)
Calculated risk for chemical = [10^{-06} (risk) x 1/SL (m^3/µg)] x Soil Conc. (µg/m^3)

The calculated lifetime risk to the hypothetical RadCon Tech is 7.41 x 10^{-04}. The risks to a hypothetical receptor living immediately adjacent to the property boundary were calculated as 2.00 x 10^{-05}.

11.2.4.2 Calculation of Non-Carcinogenic Effects to Selected Receptors

Site-specific parameters listed in Tables 11-2 and 11-4 were used in the EPA SL calculator to calculate the short-term hazard quotients to the RadCon Tech and off-site resident, respectively. The results for the hypothetical RadCon Tech are presented in Table 11-6. Table 11-7 presents the short-term hazard quotients calculated for the hypothetical off-site resident.

Table 11-6 Hazard Index Calculated for the Hypothetical RadCon Tech During "Complete Rad Removal" and On-site Disposal

Category Constituent	**95% UCL Soil Concentrations in Area 2** [a]	**SL, HQ = 1, RadCon Tech Exposed for 139 d/y During 2 Years of Construction, Air Pathways** [b]	**Calculated HQ to RadCon Tech Exposed for 139 d/y During 2 Years of Construction, Air Pathways**
Metals			
Arsenic	7.70×10^{00} µg/g	4.59×10^{02} µg/g	1.68×10^{-02}
Chromium (VI)	2.27×10^{01} µg/g	3.56×10^{04} µg/g	6.38×10^{-04}
Lead	4.79×10^{02} µg/g	8.00×10^{02} µg/g [c]	NA [c]
PCBs			
Aroclor-1254	5.00×10^{-01} µg/g	2.87×10^{01} µg/g	1.74×10^{-02}
		Hazard Index (HI)	**3.48×10^{-02} [d]**

[a] From Table 8-2.
[b] http://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search, sub-chronic values when available.
[c] This lead value is produced by the web calculator. It is provided here for completeness. See discussion regarding EPA's Adult Lead Model in Section 11.2.4.3.
[d] HI = ∑HQ, excluding lead.

Table 11-7 Hazard Index Calculated for the Hypothetical Off-site Resident During "Complete Rad Removal" and On-site Disposal

Category **Constituent**	**Annual Average Concentrations in Air at Site Boundary** [a]	**SL, HQ = 1, Resident Exposed for 187 d/y During 2 Years of Construction, Air Pathways** [b]	**Calculated HQ to Resident Exposed for 188 d/y During 2 Years of Construction, Air Pathways**
Metals			
Arsenic	2.73×10^{-04} µg/m^3	2.93×10^{-02} µg/m^3	9.30×10^{-03}
Chromium (VI)	8.04×10^{-04} µg/m^3	1.95×10^{-01} µg/m^3	4.12×10^{-03}
Lead	1.69×10^{-02} µg/m^3	NA [c]	NA
PCBs			
Aroclor-1254	1.77×10^{-05} µg/m^3	NA [d]	NA
		Hazard Index (HI)	**1.34×10^{-02} [e]**

[a] From Table 8-2.
[b] http://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search
[c] See discussion regarding EPA's Adult Lead Model in Section 11.2.4.3.
[d] Not published by EPA
[e] HI = ∑HQ.

The calculated HI for the hypothetical RadCon Tech is 3.48×10^{-2}. The HI for a hypothetical receptor living immediately adjacent to the property boundary was calculated as 1.34×10^{-02}.

11.2.4.3 Blood Lead Levels

Blood levels of lead were also calculated for the RME receptor, the RadCon Tech exposed to soil, using EPA's Adult Lead Methodology (ALM).[41] For a soil concentration of 479 µg/g and an exposure duration of 139 days, the blood lead level in the hypothetical RadCon Tech was calculated to be 1.9 µg/dL (19% of the target level of 10 µg/dL). The probability that the blood

[41] http://www.epa.gov/superfund/lead/products/ALM_2009.xls

level in a fetus carried by that RadCon Tech would exceed its target blood level was calculated to be approximately 0.12%, which is well below the target percentile of 5%. It should be noted that applying the ALM to the short durations scheduled for this alternative introduces additional uncertainty to the results.

11.3 HAZARD ASSESSMENT OF CONSTRUCTION AND TRANSPORTATION ACTIVITIES

Regrettably, there is a risk of occupational and traffic accidents during earthmoving or transportation of materials on public roads. Generally, the risk of occurrence is time dependent, increasing as the duration of the activity lengthens. The severity of the accident depends, in part, on the activity itself.

In order to assess the likelihood and severity of possible accidents, Occupational Safety and Health Administration (OSHA) and National Highway Traffic Safety Administration (NHTSA) statistics for workers in different occupations and transportation records were used in conjunction with manpower and resource projections from remedy construction schedules to calculate the risks for accidents.

11.3.1 Transportation Hazards

Table 11-8 lists statistics on the rate that traffic accidents involving heavy trucks occurred in 2007 (NCSA 2008)[42]. The projection for heavy truck use on-site roads during construction of the on-site remedy is 2,149,000 miles. Multiplying this mileage by the injury and fatality rates in Table 11-8 yields the transportation incident forecast presented Table 11-9.

Table 11-8 Accident Incident Rate for Trucks on Public Roads

Incident	Published Rate [a]	Per mile rate [b]
Injury Crashes	$3.30x10^{01}$	$3.30x10^{-07}$
Fatal Crashes	$2.04x10^{00}$	$2.04x10^{-08}$

[a] Rate per million miles (NCSA 2008).
[b] Derived from rate (incidents/100,000,000 mi)

Table 11-9 Traffic Injury and Fatality Forecast for Trucks on Public Roads

Parameter	Value
Total miles for all hauling all material except RIM	$2.15x10^{06}$
Injury risk for the project	$7.09x10^{-01}$
Fatality risk for the project	$4.38x10^{-02}$
Forecast of truck accidents involving injuries or fatalities	$\mathbf{7.53x10^{-01}}$

This remedy involves hauling RIM into the on-site cell. This will be done with trucks, so there will be a risk of traffic related accidents associated with this movement. Statistics on off-road hauling accidents were not available during the preparation of this SFS, so the assumption was made that traffic control and lower traffic density on-site haul roads would combine to lower the accident incident rate by 50%. The modified off-road incident rate is presented in Table 11-10. The current mileage projection for heavy truck use on on-site haul roads during construction of the on-site remedy is 188,000 miles. Multiplying this mileage by the injury and fatality rates in Table 11-10 yields the transportation incident forecast presented Table 11-11.

[42] The latest data available at the time of this SFS was 2007 data, published in 2008.

Table 11-10 Accident Incident Rate for Trucks On-Site Haul Roads

Incident	Published Rate [a]	Per mile rate [b]
Injury Crashes	$1.65x10^{01}$	$1.65x10^{-07}$
Fatal Crashes	$1.02x10^{00}$	$1.02x10^{-08}$

[a] Modified by 50% from rates in Table 11-8.
[b] Derived from rate (incidents/100,000,000 mi)

Table 11-11 Traffic Injury and Fatality Forecast for On-site Hauling

Parameter	Value
Total miles for all hauling all material except RIM	$1.88x10^{05}$
Injury risk for the project	$3.10x10^{-02}$
Fatality risk for the project	$1.92x10^{-03}$
Forecast of truck accidents involving injuries or fatalities	**$3.29x10^{-02}$**

The projected number of on-site and off-site transportation accidents involving injury or death (0.79) related primarily to the large number of trucks hauling materials onto the Site. It should be noted that this projection includes injuries and deaths of people other than the truck occupants. In 2007, 74% of the injuries and 84% of the fatalities from traffic accidents on public roads were to people not riding in the truck involved in the incident.

11.3.2 Industrial Accidents

As in the previous assessments, the workers involved with remedy construction have been divided into two groups: general construction and driver/operators. The Bureau of Labor Statistics (BLS) maintains historical information on the rate that accidents occur in the US[43]. These statistics are available grouped by job description, and Table 11-12 and Table 11-13 list accident statistics for general construction and off-road drivers, respectively.

Table 11-12 Accident Rate for General Construction and Support Workers

Parameter	Value
Injury accident rate per 100 full-time workers [a]	$4.20x10^{00}$
Accident rate per man-hour worked	$2.10x10^{-05}$
Accident rate per man-day worked	$1.68x10^{-04}$
Number of general construction + support man-days worked [b]	$2.64x10^{04}$
Number of accidents forecast	**$4.43x10^{00}$**

[a] Bureau of Labor Statistics News Release, October 29, 2009 "WORKPLACE INJURIES AND ILLNESSES – 2008" for Heavy and civil engineering construction (237).

[b] From the Engineering Estimate of Man-days and Cost

[43] The latest data available at the time of this SFS was 2008 data, published in 2009.

Table 11-13 Occupational Accident Rate for Vehicle Operation

Parameter	Value
Injury accident rate per 100 full-time workers [a]	$5.20x10^{00}$
Accident rate per hour worked	$2.60x10^{-05}$
Hours spent driving [b]	$1.47x10^{05}$
Hours involved with other transportation activities [c]	$2.94x10^{04}$
Total transportation man-hours worked	$1.76x10^{05}$
Number of accidents forecast	**$4.58x10^{00}$ [d]**

[a] Bureau of Labor Statistics News Release, October 29, 2009 "WORKPLACE INJURIES AND ILLNESSES – 2008" for Truck Transportation (484)
[b] From the Engineering Estimate of Man-days and Cost
[c] Hours assumed - Driving hours x 0.2.
[d] Accident Rate per Hour x Total Transportation Man-hours.

Table 11-12 and Table 11-13 also list the remedy construction time in either man-days or man-hours that can be grouped into each of those broad labor categories. Multiplying the total time by the appropriate accident rate will yield an accident forecast for this group's activities during this project. This accident forecasts for the general construction and off-road drivers are presented in bold on the last line of Table 11-12 and Table 11-13, respectively. Summing the number of accidents forecast for both labor groups yields the total accident projection for the project.

For example, it is estimated that it will require 26,382 man-days of general construction and support labor to construct the on-site remedy. Multiplying this duration by the injury and fatality rate of 1.68×10^{-04} accidents per man-day in Table 11-12 yields the construction incident forecast of 4.43 accidents. Adding this to the projected risk of non-traffic accidents for truck drivers in Table 11-13 yields 9.01 projected industrial accidents construction of the on-site remedy.

11.4 OCCUPATIONAL DOSES

Remedial workers were assumed to be classified as radiation workers in this assessment. Doses to those workers were calculated using RESRAD and those doses were compared to occupational dose limits.

The dose rate to workers will change as the remedy progresses because the area of exposed materials will shrink as they are covered. The Total Effective Dose Equivalent (TEDE) was calculated for an individual exposed to Area 2 as remediation starts, and a second dose was assumed to be zero for the final configuration. The multiplying the average of these dose rates and the total projected time spent exposed to Areas 1 and 2 yields the estimated annual TEDE to RadCon Techs on the project (Table 11-14).

Table 11-14 Radiation Dose to RME Individual

	Area 2
Beginning TEDE on surface (mrem/1,800 h) [a]	834
Ending TEDE on surface (mrem/1,800 h) [a]	0
Average TEDE on surface (mrem/1,800 h)	417
Time spent exposed to RIM (fraction of year)	0.62
TEDE for Reasonably Maximally-Exposed Individual (mrem/y)	**258**

[a] Calculated by RESRAD.
[b] 139 days/year / 225 days/year = 0.617.

The calculated TEDE to the hypothetical RadCon Tech be approximately 417 mrem/y if the RadCon Tech spent 1,800 hours per year working on the RIM. Currently, the best estimate of the time this receptor would spend exposed to the RIM is 278 days in Areas 1, 2 and the Crossroads/Boundary Area. Dividing this time equally between over the 2 year project yields an annual exposure time of 139 days.[44] The time spent on the Crossroads Property and Buffer Zone is included in the time estimate. The annual TEDE to the RadCon Tech working for 139 days is about 258 mrem/y. To put this in perspective, a radiation surveyor has an occupational exposure limit of 5,000 mrem/y, assuming no administrative limits are imposed for the Site.

11.5 SUMMARY

The short-term human health risks and hazard projections are summarized in Table 11-15.

Table 11-15 Summary of Short-Term Hazards and Risks Associated with "Complete Rad Removal" with On-site Disposal Option

Category of Hazard or Risk	Value
Projected Incidence of Transportation Accidents	$7.9x10^{-01}$
Projected Incidence of Industrial Accidents	$9.0x10^{00}$
Carcinogenic Risk to Reasonably Maximally-Exposed Individual	$7.4x10^{-04}$
HI to Reasonably Maximally-Exposed Individual	$3.5x10^{-02}$
TEDE to Reasonably Maximally-Exposed Individual	$2.6x10^{-02}$

Industrial and transportation hazards dominate the human impacts evaluated by this short-term assessment. It is projected that 9.01 workers will be injured in work-related accidents during construction of the remedy (out of the 44,748 man-days worked). There is also a 5% chance of a fatal transportation accident and a 74% chance that a person will be injured as a result of a transportation accident. If there is a transportation accident, there is a 3 out of 4 chance that the injured/killed person will be a member of the public.

Carcinogenic risks from exposure to RIM encountered during construction are expected to be no greater than the risk calculated for remediation workers like the RadCon Tech. The risks to the RadCon Tech were calculated to be 7.4×10^{-04}. This calculated risk exceeds EPA's acceptable risk range of 10^{-06} to 10^{-04}. The most important single contributor to this risk is the gamma radiation from RIM on and near the surface of the contamination area.

[44] See Section 11.2.4.1 for derivation of worker exposure time.

12 SUMMARY

12.1 PRESENTATION OF CALCULATED RESULTS

A compilation of short and long term risks calculated during this risk assessment is presented in Table 12-1.

Table 12-1 Compilation of Calculated Short-term and Long-term Risks

	Category of Hazard or Risk	ROD selected Value	Off-site Value	On-site Value
Short-term	Projected Incidence of Transportation Accidents [a]	$6.1x10^{-01}$	$1.4x10^{00}$	$7.9x10^{-01}$
	Projected Incidence of Industrial Accidents [b]	$4.7x10^{00}$	$7.6x10^{00}$	$9.0x10^{00}$
	Carcinogenic Risk to Reasonably Maximally-Exposed RadCon Tech during Remedy Construction [c]	$7.2x10^{-05}$	$7.6x10^{-04}$	$7.4x10^{-04}$
	Hazard Index for Reasonably Maximally-Exposed RadCon Tech during Remedy Construction [c]	$6.8x10^{-03}$	$3.6x10^{-02}$	$3.5x10^{-02}$
	Carcinogenic Risk to Reasonably Maximally-Exposed Off-site Resident during Construction [c]	$3.3x10^{-06}$	$2.1x10^{-05}$	$2.0x10^{-05}$
	Hazard Index for Reasonably Maximally-Exposed Off-site Resident during Remedy Construction [c]	$5.7x10^{-03}$	$1.4x10^{-02}$	$1.4x10^{-02}$
	Dose (TEDE) to Qualified Radiation Remediation Worker (mrem/y) [d]	$5.0x10^{01}$	$2.6 x10^{02}$	$2.6 x10^{02}$
Long-term	Carcinogenic Risk to Reasonably Maximally-Exposed Individual after Remedy Construction [e]	$1.3x10^{-06}$	$< 10^{-07}$	$1.5x10^{-06}$

[a] Dependent on mileage on public roads.
[b] Dependent on man-hours worked.
[c] Dependent on man-hours worked while RIM exposed and will vary depending on length of project.
[d] Annual dose limited by concentration and 1 year reporting period.
[e] Highest risks are in year 1,000.

12.2 UNCERTAINTIES ASSOCIATED WITH HUMAN HEALTH EFFECTS AND ACCIDENT PROJECTIONS

A risk assessment contains uncertainties associated with measured or estimated quantities and uncertainties associated with a lack of information. Use of the numerical results of a risk assessment without consideration of the uncertainties, limitations, and assumptions inherent in the risk assessment process can be misleading. For example, a 10^{-06} lifetime risk of cancer may be calculated for an individual from exposure to a particular source of contamination. However, if the uncertainty in this result is several orders of magnitude, the actual risk from this source of contamination may in fact be higher than another calculated value 10^{-04} that has a small degree of uncertainty.

Alternatively, a 10^{-02} calculated lifetime risk with a high uncertainty may appear to represent an unacceptable risk when the actual risk may actually be orders of magnitude smaller. This situation may arise when the estimated risk is based on limited information and conservative assumptions on lifestyles and land-use scenarios. To compensate for these data uncertainties, risk assessors often use numerical values that are in the higher range of the distribution of data to ensure that the result of any single step is not underestimated. When this is done repeatedly for many parameters, the compound effect is to elevate the calculated risk well above what individuals would likely encounter. Although it is possible that such an exposure involving the highest possible value at each step in the evaluation process can occur, the probability of an individual actually being exposed to this combination of events and conditions is considered low. The human health results of the risk assessments for the three Operable Unit 1 alternatives presented in this Appendix are based on such conservatism.

Traffic and industrial accident predictions for the alternatives are based on observed incident rates among the American population and must be regarded as a more reliable predictor of events. There are uncertainties associated with those predictions, but given enough operational time, the injury and fatality rate of any remediation project, or collection of projects, would be expected to approach industry norms.

12.3 COMPARISON OF ALTERNATIVE RESULTS

Short-term risks associated with construction of the ROD-Selected Remedy (Table 12-1) are lower than those associated with the two “Complete Rad Removal” alternatives in all risk categories evaluated. Construction and industrial accident forecasts were for both “Complete Rad Removal” alternatives were higher than the ROD-Selected Remedy, with the On-site Disposal alternative generating an industrial accident prediction that was almost twice the ROD-Selected Remedy prediction. Short-term human health risks associated with construction of any “Complete Rad Removal” alternative exceeded the acceptable risk range by a factor of seven (7) or more. These risks are to the RME, which is a hypothetical RadCon Tech involved with constructing the alternatives.

All long-term risks are within a factor of three of each other and all are well below EPA’s maximum acceptable risk of 10^{-04}. The alternative producing the greatest risk is “Complete Rad Removal” with On-site Disposal Option. This is reflects the prediction that the 1,000 year radon flux predicted to penetrate the cover from the consolidated material in the on-site cell will be slightly higher that the calculated 1,000 year radon flux from Area 2 after it has been regraded and covered. However, it should be emphasized that all long-term risks calculated from the final configurations of these alternatives are one to two orders of magnitude below 10^{-4}.

The short-term and long-term risks from the ROD-Selected Remedy are the only set of risks that are less than the upper-bound of EPA’s acceptable risk range.

12.4 COMPARISON OF RADIOCARCINOGENIC RISKS WITH RISKS FROM OTHER RADIATION SOURCES

The long-term and short-term human health risks are dominated by radiological exposures. These calculated long-term and short-term risks can be compared to radiological risks from other commonly encountered radiation sources to provide perspective on the numerical results (Table 12-2). For example, the long-term risks from any of the alternatives are all less than one transcontinental airplane flight. The short-term risks from the two “Complete Rad Removal” options exceed the lifetime risk from a radon flux of 20 $pCi/m^2/s$ but fall short of the risk from radiation encountered during one year of cigarette smoking.

Table 12-2 Comparison of Risks from a Variety of Radiation Sources

Activity/Exposure	Risk (___ x 10^{-6})
Long-term risk to West Lake RME (Grounds Keeper), "Complete Rad Removal" with Off-site Disposal	**< 0.1 [a]**
Point of departure for EPA's generally acceptable risk range at CERCLA Sites	**1**
Long-term risk to West Lake RME (Grounds Keeper), ROD-Selected Remedy	**1.3 [a]**
Long-term risk to West Lake RME (Grounds Keeper), "Complete Rad Removal" with On-site Disposal	**1.5 [a]**
Radiation from a transcontinental plane flight, one-way	2 [b]
Cooking or heating with natural gas (radon in the gas)	5 [b]
Radiation from one routine chest X-ray	6 [b]
Annual radiation exposure to cosmic rays at sea-level	18 [b]
Watching a cathode-ray TV or computer screen	18 [b]
Annual radiation exposure from internal exposure to naturally-occurring radionuclides in the human body (such as potassium-40)	23 [b]
Annual radiation exposure from cosmic rays in Denver	30 [b]
Living in a brick house	45 [b]
Short-term risk to West Lake RME (RadCon Tech) during construction of ROD Remedy	**72 [a]**
Top of EPA's generally acceptable risk range at CERCLA Sites	**100**
Annual exposure to naturally occurring radon in air	120 [b]
Nuclear medicine bone scan (Tc-99)	258 [b]
EPA published value for acceptable risk from 20 pCi/m^2/s radon emitted by tailings piles (preamble to NESHAPS)	300 [c]
Short-term risk to West Lake RME (RadCon Tech) during "Complete Rad Removal" with On-site Disposal of Soil	**740 [a]**
Short-term risk to West Lake RME (RadCon Tech) during "Complete Rad Removal" with Off-site Disposal of Soil	**760 [a]**
Annual radiation exposure from smoking a pack and a half of cigarettes a day	780 [b]

[a] Calculated in this report and values greater than 10^{-7} rounded to two (2) significant figures.

[b] Calculated using the dose to risk conversion factor of 6 x 10^{-04} per rem Total Effective Dose Equivalent (TEDE) recommended by EPA (ISCORS, 2003) (http://homer.ornl.gov/oepa/guidance/risk/iscors.pdf).
Dose information supplied by the University of Iowa,
http://www.uihealthcare.com/topics/medicaldepartments/cancercenter/prevention/preventionradiation.html.

[e] Preamble to 40 CFR 61, "National Emission Standards of Hazardous Air Pollutants; Radionuclides; Final Rule and Notice of Reconsideration Federal Register" Vol. 54, No.240, pg 51682. (Subsection VI.L.3 Disposal of Uranium Mill Tailings Piles).

13 REFERENCES

ANL 2001	User's Manual for RESRAD Version 6, ANL/EAD-4, Environmental Assessment Division, Argonne National Laboratory, United States Department of Energy, July, 2001.
ANL 2006	Benchmarking of RESRAD-OFFSITE: Transition from RESRAD (onsite) to RESRAD-OFFSITE and Comparison of the RESRAD- OFFSITE Predictions with Peer Codes, Environmental Science Division of Argonne National Laboratory, 2006.
ANL 2007	RESRAD-OFFSITE, Version 2 found at "web.evs.anl.gov/resrad", Environmental Science Division of Argonne National Laboratory, August, 2007.
ATSDR 1990	Toxicological Profile For Radium, Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, In collaboration with: U.S. Environmental Protection Agency, December 1990.
AUXIER 2000	Baseline Risk Assessment, West Lake Landfill Operable Unit 1, Auxier & Associates, Inc., April 24, 2000.
DOE 2007	RESRAD-OFFSITE A Tool for Evaluating Radiation Doses and Risks to Humans, HS-20-IB-2007-5, Office of Nuclear Safety and Environment, United States Department of Energy, August, 2007.
EMSI 2006	Feasibility Study Report, West Lake Landfill Operable Unit 1, EMSI, May 8, 2006.
EPA 1989	Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part A), Interim Final, EPA/540/1-89/002, December, 1989, , hosted at http://www.epa.gov/oswer/riskassessment/ragsa/.
EPA 1990	National Oil and Hazardous Substances Pollution Contingency Plan; Final Rule, 40 CFR Part 300, Environmental Protection Agency, March 8, 1990.
EPA 1991a	Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B, Development of Risk-based Remediation Goals), EPA/540/R-92/003, December 1991, hosted at http://www.epa.gov/oswer/riskassessment/ragsb/.
EPA 1991b	Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part C, Risk Evaluation of Remedial Alternatives, Pub 9285.7-01C, October, 1991, hosted at http://www.epa.gov/oswer/riskassessment/ragsc/.
EPA 2000	Soil Screening Guidance for Radionuclides: Technical Background Document EPA/540-R-00-006 US Environmental Protection Agency Office of Radiation and Indoor Air Office of Solid Waste and Emergency Response, Washington, DC. October, 2000.
EPA 2004	Integrated Risk Information System, Lead and compounds (inorganic) (CASRN 7439-92-1), USEPA, hosted at http://www.epa.gov/iris/subst/0277.htm

EPA 2009 — Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment), EPA-540-R-070-002, January, 2009, hosted at http://www.epa.gov/oswer/riskassessment/ragsf/.

EPA 2010a — Regional Screening Levels (Formerly PRGs), Screening Levels for Chemical Contaminants, EPA Region 9, hosted at http://www.epa.gov/region9/superfund/prg/index.html

EPA 2010b — Integrated Risk Information System, USEPA, hosted at http://www.epa.gov/IRIS.

FRAOSA 2009 — Federal Railroad Administration Office of Safety Analysis – Accident Overview, 2009.

Gilbert 1983 — Gilbert, TL et al. "Pathways Analysis and Radiation Dose Estimates of Radioactive Residues at Formerly Utilized MED/AEC Sites, ORO-832 (Rev), Division of Environmental Impact Studies, Argonne Laboratory, Argonne, IL. March 1983.

ISCORS, 2003 — "Estimating Radiation Risk from Total Effective Dose Equivalent (TEDE) ISCORS Technical Report No. 1" U.S. Department of Energy Office of Environmental Policy and Guidance Air, Water & Radiation Info Brief DOE/EH-412/0015/0802 rev.1 (January 2003).

NCSA 2008 — National Center for Statistics and Analysis, Traffic Safety Facts 2008 Data-Large Trucks DOT HS B11 158.

UIHC 2001 — "Radiation Exposure: The Facts Verses Fiction" University of Iowa, 2001

APPENDIX I:

Estimated Greenhouse Gas Emissions Associated with the Alternatives

Appendix I

Estimated Greenhouse Gas Emissions Associated with the Alternatives

Introduction

This appendix presents the results of calculations to estimate the quantity of greenhouse gas emissions (equivalent tons of carbon dioxide (CO_2) predicted for each remedial alternative. Each alternative will involve the use of various types of vehicles and heavy equipment to implement the remedy, resulting in the combustion of diesel fuel and subsequent emission of greenhouse gas into the atmosphere. The resulting tons of greenhouse gas CO_2 emissions resulting from the estimated amount of diesel fuel burned was calculated for each remedy alternative for the equipment anticipated to be used onsite during construction, as well as by trucks transporting materials and supplies to the West Lake Landfill site, and by truck and rail transport of RIM to an off-site disposal site (for the "Complete Rad Removal" with Off-site Disposal alternative only).

Step 1) Calculate Diesel Fuel Consumption

Diesel consumption was calculated as outlined below.

The "Construction Cost Estimate" pages for each of the remedial alternatives (Appendix I) list the estimated Crew Type (from RS Means) and Time of Construction for each construction task.

- The Crew Type assigned to each line item in the cost estimate was assessed for the type, size, and quantity of construction equipment used.

- To the extent practicable, the type and size of each piece of construction equipment was then equated to a Caterpiller® construction equipment model number, and the hourly fuel consumption rate for that equipment was estimated using fuel consumption tables and load factor guidelines provided in the Caterpiller® Performance Handbook, Edition 38 (Caterpillar, 2008). A "medium" load factor was considered in most cases. For equipment where Caterpiller®-equivalents could not be determined, such as flatbed trucks and general service vehicles and tools, professional judgment was applied in estimating an hourly fuel consumption rate. Table G-1 provides the unit fuel consumption estimated for each Crew Type.

- The hourly fuel consumption rates were then multiplied by the Time of Construction (i.e., the number of crew-days worked) times 9 hours per crew-day. The product was gallons of diesel fuel burned for each construction task in the cost estimate.

- For hauling RIM material off-site to and from truck/rail transloading facilities at railroad spurs, fuel consumption was based on a semi-truck transporting 35 loose cubic yards (lcy) with a unit weight of 1,000 pounds per lcy, at a diesel fuel consumption rate of 4 miles per gallon. For purposes of this analysis, the round-trip distance between the West Lake Landfill site and a truck/rail transloading spur in the nearby St. Louis, Missouri area was assumed to be 20 miles. The round-trip distance between the US Ecology Idaho rail/truck transloading facility rail spur and the final disposal site in Grand View, Idaho was 70 miles. The estimated time to load semi-trucks with waste material on-site and unload 35 lcy of RIM from gondola cars offsite was assumed to be approximately one hour each. It was assumed that a trackhoe excavator with a 3.5 cy bucket would be used to fill the semi-trucks at the West Lake Landfill as well as to unload the gondola cars at the rail/truck transloading facility rail spur site in Idaho. It was further assumed that heavy construction equipment would not be needed to transfer the waste from the semi-trucks to the gondola railcars at the truck/rail transloading spur in St. Louis, but that the semi-trucks would back onto a truck-to-rail ramp and dump the waste directly in the railcar.

- For transporting RIM via railcar the 1,600 rail miles between the St. Louis and Idaho rail/truck transloading facilities, a rail fuel consumption rate of 408 ton-miles per gallon of diesel fuel was used (UPRR, 2007). Considering that gondola railcars with waste would travel 1,600 miles from St. Louis to Idaho, then return empty another 1,600 miles to St. Louis, an average round trip consumption rate of 612 ton-miles of RIM per gallon of diesel was used. At 0.5 tons per lcy, the rail diesel fuel consumption rate was calculated to be 2.61 gallons per lcy of RIM.

The calculated diesel fuel consumption for each remedial alternative by task was developed based on the vehicle activities identified during preparation of the cost estimates for the alternatives (Appendix K) . For each alternative, the unit fuel consumption from Table G-1 was multiplied by the estimated duration of each equipment/crew type by task; and the summation of these quantities yielded the estimate of the total diesel fuel consumption for each respective alternative.

Step 2) Conversion of Diesel Fuel Consumption to CO_2 Equivalents

One pound of burned diesel fuel yields the equivalent of 22 pounds of CO_2 greenhouse gas emissions (EPA, 2005b). Accordingly, the estimated gallons of diesel fuel consumed for each alternative was converted to the equivalent tons of CO_2 gas to obtain the resulting total estimated greenhouse gas emissions.

Results

The estimated total greenhouse gas emissions for each remedial alternative is presented in the table below.

Remedial Alternative	Diesel Fuel Consumed (gallons)	Total Greenhouse Gas Emissions (tons CO_2)
ROD Remedy	759,000	8,349
"Complete Rad Removal" with Off-site Disposal	3,217,000	35,387
"Complete Rad Removal" with On-site Disposal	1,624,000	17,864

Reference

Union Pacific Railroad (UPRR), 2007, Environmental Facts.

Table I-1 - Unit Fuel Consumption Rates

Crew Type	Equipment	Fuel (diesel) consumption (gph) a/	Fuel (diesel) consumption (gal/crew day) b/
CLAB	none	0	0
C8	1 concrete pump (prof jdgmt)	6	54
B6	1 backhoe loader, 48 hp (use Cat 416E)	2.8	25.2
B7	1 brush clipper, 130 hp (prof jdgmt) + 1 loader, 3cy (use Cat 930), + 2 chain saws (prof jdgmt)	6	54
B9A	1 Truck Tractor, 220 HP (prof jdmt)	6	54
B10B	1 dozer, 200 hp (use Cat D-6)	7.7	69.3
B10G	1 sheepsft roller, 240 hp (use Cat 815F2)	10	90
B10I	1 diaphram water pump, (assume 5 hp)	1	9
B10L	1 dozer, 80 hp (use Cat D-4)	3.9	35.1
B10P	1 crawler loader, 3CY (use CAT 930H)	3.5	31.5
B10Y	1 vib roller, 12 ton, towed (use Cat D-4)	3.9	35.1
B12D	1 excavator, 3.5 cy (use Cat 365CL)	16.5	148.5
B13	1 hydraulic crane, 25 ton (use Cat 587T)	3	27
B14	1 backhoe loader, 48 hp (use Cat 416E)	2.8	25.2
B20	none	0	0
B21	0.5 SP Crane, 5 ton (use Cat 561N)	1.25	11.25
B22A	1 SP Crane, 5 ton (use Cat 561N)	2.5	22.5
B33E	1 SP scraper (21 CY) and 0.25 dozer (300 hp) (assume Cat 623G and Cat D-8)	13.5	121.5
B34D	1 truck tractor, 380 hp (use Cat 735)	6.5	58.5
B34F	1 dump truck, 35 ton (use Cat 725)	5	45
B34K	1 truck tractor, 450 hp (use CAT 770)	8.3	74.7
B34N	1 dump truck, 40 ton (use Cat 772)	10	90
B80C	1 flatbed truck (prof jdgmt)	1	9
B81	1 truck tractor, 200 hp (use Cat 725) + 1 hydromulcher (prof jdgmt)	6	54
B84	1 rotary mower/tractor (prof jdgmt)	2	18
C20	2 gas engine vibrators, 1 concr pump (small)	3	27
E8	1 lattice boom crane, 90 ton (Use Cat 587T) + 4 welders, 300 amp (prof jdgmt)	4	36
RIM A = Exc, Load, and Tnsp to Gondola	For transportation, assume 35 lcy per load, 20 miles R/T, and 4 miles/gal equals 0.14 gal/lcy. Then assume loading requires 1 hr of loader time per 35 lcy, at 5 gal/hr, equals 0.14 gal/lcy. Total is 0.28 gal/lcy.	0.28	gal/lcy
RIM B = Tnsp via Gondola to Idaho Offload Spur	Use 408 ton miles/gal for rail transport between Missouri and Idaho (UPRR Env facts, 2007). Assume 150% of this rate for return trip empty. Therefore, use average of 612 ton miles/gal for R/T of 3200 miles. Use 1,000 lbs/lcy = 0.5 tons/lcy. Therefore,	2.61	gal/cy
RIM C = Tnsp via truck from Offload Spur to disposal	For material handling at Idaho spur, also assume 1 hr of loader time per 35 lcy = 0.14 gal/lcy. R/T transportation between spur and disposal facility is 70 miles. At 4 mpg, this equals 0.49 gal/lcy. Total is 0.63 gal/lcy.	0.63	gal/lcy
Import Trans 1	For transportation of imported soil and clay cover from Central Stone. Use 4.4 miles/LCY. At 4 mpg, this translates to 1.1 gal/lcy.	1.1	gal/lcy
Import Trans 2	For transportation of imported topsoil from Central Stone. Use 1.2 miles/LCY. At 4 mpg, this translates to 0.3 gal/lcy.	0.3	gal/lcy
Import Trans 3	For transportation of imported geotextile to the Site. Use 0.18 miles/SY. At 4 mpg, this translates to 0.3 gal/SY.	0.045	gal/SY
Import Trans 4	For transportation of imported shot rock per Weber estimate to the Site. Use 0.89 miles/lcy. At 4 mpg, this translates to 0.22 gal/lcy.	0.22	gal/lcy
a/ From Caterpillar Performance Handbook, Edition 38. Assumes medium fuel consumption factor.			
b/ Assumes 9 hr/day			
	Shaded cells indicate fuel consumption for transport to Idaho at unit rates of gallons of diesel per loose cubic yard of RIM material		

Estimated Diesel Fuel Consumption - ROD Remedy

Step #	Category	Sub-Category	Task	Quantity: ROD Area 1	Quantity: ROD Area 2	Type of Material Handled	Units	Crew Type	Truckloads for Delivery: ROD Area 1	Truckloads for Delivery: ROD Area 2	Total Miles for Delivery: ROD Area 1	Total Miles for Delivery: ROD Area 2	Gallons of fuel (diesel) per crew day or loose cubic yard — See "Unit Fuel Consumption" Worksheet for cost basis	Gallons of fuel (diesel) consumed: Off-Site Area 1	Gallons of fuel (diesel) consumed: Off-Site Area 2
ROD 1	Temporary Construction Facilities / Utilities / Personnel	*Construction Trailers*	Capital Expenses	2		Group of Trailers			10	-	200	-	4 miles/gal	50	
ROD 2			Operating Expenses	23		Group of Trailers	Months								
ROD 3			Parking Area	4,444		Gravel Area	S.Y.	B14					25.2	940	-
ROD 4			Portable Toilets in Construction areas	7	19	Portable Toilets	Month								
ROD 5		*Contractor's Construction Management Personnel*	Project Manager	89		Personnel	Week								
ROD 6			Construction Superintendent(s)	99		Personnel	Week								
ROD 7			Clerk(s)	99		Personnel	Week								
ROD 8			Field Engineer(s) / Safety Officer(s)	99		Personnel	Week								
ROD 9	Temporary Stormwater Infrastructure (for stormwater during construction)	*Temporary Stormwater Lagoon*	Excavate soil for 4th berm at former leachate lagoon area	21,379		Soil	B.C.Y.	B10B					69.3	8,231	-
ROD 10			Place soil for berm	29,930		Soil	L.C.Y.	B10B					69.3	3,111	-
ROD 11			Compact berm	21,379		Soil	E.C.Y.	B10Y					35.1	216	-
ROD 12			Install geomembrane liner	495		60 mil HDPE	M.S.F.	3 Skwk, Import Trans 3	5	-	10,000	-	4 miles/gal	2,500	
ROD 13			Install force main from Areas 1 and 2 to lagoon	3,671	832	HDPE Pipe	L.F.	B22A					22.5	1,032	234
ROD 14			Install force main from lagoon to treatment facility	551		HDPE Pipe	L.F.	B22A					22.5	155	-
ROD 15		*Treatment Facility*	Construct Treatment Facility	1		Treatment Facility	Each								
ROD 16			Monthly Operation during construction	11		Treatment Facility Operation	Months								
ROD 17		*Stormwater events during construction*	Dewater construction after rain events	101	249	Construction stormwater	Days of Pumping	B10I					9	340	839
ROD 18			Dispose of contact stormwater to MSD	560,000	560,000	Contact stormwater	Gallons								
ROD 19		*Post-project Stormwater Demolition*	Dispose of geomembrane liner	495		60 mil HDPE	M.S.F.								
ROD 20			Deconstruct 4th berm	21,379		Soil	B.C.Y.	B10B					69.3	8,231	-
ROD 21			Grade berm material in lagoon for proper drainage	29,930		Soil	L.C.Y.	B10B					69.3	3,111	-
ROD 22	Site-wide Preparation	*Mobilization*	Mobilize and Demobilize Equipment Under 150HP	8		Units of Equipment up to 150HP (up to 50 miles)	Ea.	B34N					90	180	-
ROD 23			*Extra Mileage for Mobilizations*	80		Per 5 additional miles		B34N					90	100	-
ROD 24			Mobilize and Demobilize Equipment Over 150HP	56		Units of Equipment over 150HP (up to 50 miles)	Ea.	B34K					74.7	1,394	-
ROD 25			*Extra Mileage for Mobilizations*	560		Per 5 additional miles		B34K					74.7	581	-
ROD 26			Mobilize and Demobilize Equipment, Towed	4		Units of Towed Equipment (up to 50 miles)	Ea.	B34K					74.7	100	-
ROD 27			*Extra Mileage for Mobilizations*	40		Per 5 additional miles		B34K					74.7	42	-
ROD 28		*Supplemental Mobilizations*	Mobilize and Demobilize Equipment Under 150HP	8		Units of Equipment up to 150HP (up to 50 miles)	Ea.	B34N					90	180	-
ROD 29			*Extra Mileage for Mobilizations*	80		Per 5 additional miles		B34N					90	100	-
ROD 30			Mobilize and Demobilize Equipment Over 150HP	56		Units of Equipment over 150HP (up to 50 miles)	Ea.	B34K					74.7	1,394	-
ROD 31		*Supplemental Mobilizations (cont.)*	*Extra Mileage for Mobilizations*	560		Per 5 additional miles		B34K					74.7	581	-
ROD 32			Mobilize and Demobilize Equipment, Towed	4		Units of Towed Equipment (up to 50 miles)	Ea.	B34K					74.7	100	-

Estimated Diesel Fuel Consumption - ROD Remedy

Step #	Category	Sub-Category	Task	Quantity: ROD Area 1	Quantity: ROD Area 2	Type of Material Handled	Units	Crew Type	Truckloads for Delivery: ROD Area 1	Truckloads for Delivery: ROD Area 2	Total Miles for Delivery: ROD Area 1	Total Miles for Delivery: ROD Area 2	Gallons of fuel (diesel) per crew day or loose cubic yard — See "Unit Fuel Consumption" Worksheet for cost basis	Gallons of fuel (diesel) consumed: Off-Site Area 1	Gallons of fuel (diesel) consumed: Off-Site Area 2
ROD 33	Site-wide Preparation (cont.)		*Extra Mileage for Mobilizations*	40		Per 5 additional miles		B34K					74.7	42	-
ROD 34			Create Temporary Roads	6,667	13,333	Gravel Roads	S.Y.	B14					25.2	1,410	2,820
ROD 35			Install TBD Traffic Improvements	$ 100,000	$ 100,000	TBD (shown as budget estimate)	$							-	-
ROD 36		Dust Control	Water Truck Depreciation	1	1	Water Trucks	Trucks								
ROD 37			Water Truck Operation	6	16	Water Trucks	Months	B9A					54	6,838	17,810
ROD 38			Use Water to Control Dust	1,270,000	3,300,000	Water	Gal								
ROD 39	Site Preparation		Prepare area with Stormwater BMPs	4,166	6,448	Silt Fence	L.F.	2 Clab							
ROD 40		Decontamination Area	Materials	56	56	Concrete	C.Y.								
ROD 41			Installation	56	56	Concrete	C.Y.	C20					27	65	65
ROD 42			Clear Vegetation (Light)	14.5	12.1	Vegetation	Acre	B84					18	131	109
ROD 43			Clear Vegetation (Heavy)	3.5	27.8	Vegetation	Acre	B7					54	1,134	9,007
ROD 44	Regrading		Apply daily cover to remaining excavation of Landfilled Material	2,974	6,649	Soil	B.C.Y.	B10L					35.1	681	1,522
ROD 45			Relocate Landfilled Material on-site - Excavate	32,718	73,142	Landfilled Material	B.C.Y.	B12D					148.5	4,049	9,051
ROD 46			*(additional cost to previous line)*	32,718	73,142	Landfilled Material	B.C.Y.	B12D					148.5	598	1,336
ROD 47			Relocate Landfilled Material on-site - Haul and Dump	47,590	106,389	Landfilled Material	L.C.Y.	B34F					45	5,726	12,801
ROD 48			Apply daily cover to relocated Landfilled Material	2,974	6,649	Soil	B.C.Y.	B10L					35.1	681	1,522
ROD 49			Spread Landfilled Material	50,565	113,038	Landfilled Material	L.C.Y.	B10B					69.3	5,256	11,750
ROD 50			Compact Landfilled Material	35,693	79,792	Landfilled Material	E.C.Y.	B10G					90	1,853	4,143
ROD 51	Buffer Zone		Buffer Zone Activity	-	1	See separate Assumptions sheet									
ROD 52	Backfill and Slope Correction	Additional Fill	Excavate additional fill material for grading	17,229	169,803	Overburden Soil	B.C.Y.	B12D					148.5	2,132	21,013
ROD 53			*(additional cost to previous line)*	17,229	169,803	Overburden Soil	B.C.Y.	B12D					148.5	315	3,103
ROD 54			Haul additional fill for grading	21,536	212,254	Overburden Soil	L.C.Y.	B34F						-	-
ROD 55			Spread additional fill	21,536	212,254	Overburden Soil	L.C.Y.	B10B					69.3	2,239	22,064
ROD 56		Starter Berms	Purchase material	12,667	29,333	Soil	B.C.Y.								
ROD 57			Deliver and Stockpile	17,733	41,067	Soil	L.C.Y.	Import Trans 1	1,109	2,567	77,630	179,690	1.1	19,507	45,173
ROD 58			Load material from stockpile to off road haul trucks	12,667	29,333	Soil	B.C.Y.	B12D					148.5	1,568	3,630
ROD 59			*(additional cost to previous line)*	12,667	29,333	Soil	B.C.Y.	B12D					148.5	231	536
ROD 60			Haul loose lift material for berm	17,733	41,067	Soil	L.C.Y.	B34F					45	1,343	3,111
ROD 61			Spread loose lift before compaction	17,733	41,067	Soil	L.C.Y.	B10B					69.3	1,843	4,269
ROD 62			Compact starter berms	12,667	29,333	Soil	E.C.Y.	B10Y					35.1	128	297

Estimated Diesel Fuel Consumption - ROD Remedy

Step #	Category	Sub-Category	Task	Quantity ROD Area 1	Quantity ROD Area 2	Type of Material Handled	Units	Crew Type	Truckloads for Delivery ROD Area 1	Truckloads for Delivery ROD Area 2	Total Miles for Delivery ROD Area 1	Total Miles for Delivery ROD Area 2	Gallons of fuel (diesel) per crew day or loose cubic yard See "Unit Fuel Consumption" Worksheet for cost basis	Gallons of fuel (diesel) consumed Off-Site Area 1	Gallons of fuel (diesel) consumed Off-Site Area 2
ROD 63	Final Cover		Purchase of Bio-Intrusion Layer Material	84,444	208,372	8 inch Shot Rock	L.C.Y.								
ROD 64		*Bio-Intrusion*	Deliver Bio-Intrusion Layer Material	84,444	208,372	8 inch Shot Rock	L.C.Y.	Import Trans 4	4,692	11,577	75,072	185,232	0.22	18,578	45,842
ROD 65			Spread Bio-Intrusion Layer Material	84,444	208,372	8 inch Shot Rock	L.C.Y.	B10B					69.3	8,778	21,660
ROD 66			Purchase clay material	51,178	126,286	Clay Material	B.C.Y.								
ROD 67		*Clay*	Deliver clay material to site	71,649	176,800	Clay Material	L.C.Y.	Import Trans 1	4,479	11,051	313,530	773,570	1.1	78,814	194,480
ROD 68			Spread loose lift before compaction	71,649	176,800	Clay Material	L.C.Y.	B10B					69.3	7,448	18,378
ROD 69			Compact Clay (Final Cover)	51,178	126,286	Clay Material	E.C.Y.	B10G					90	2,657	6,557
ROD 70			Purchase Topsoil	27,824	66,944	Topsoil	B.C.Y.								
ROD 71		*Top Soil*	Deliver Topsoil	34,780	83,680	Topsoil	L.C.Y.	Import Trans 2	2,046	4,923	40,920	98,460	0.3	10,434	25,104
ROD 72			Move and place Topsoil (Final Cover)	31,986	78,929	Topsoil	L.C.Y.	B10B					69.3	3,325	8,205
ROD 73			Install Terraces	2,794	4,751	Topsoil	L.C.Y.	B10B					69.3	290	494
ROD 74			Construct Ditches	2,630	7,245	Topsoil	B.C.Y.	B10L					35.1	602	1,658
ROD 75			Load Overburden Material from stockpile to off road haul truck for pond	4,694	7,944	Overburden Soil	B.C.Y.	B12D					148.5	581	983
ROD 76			*(additional cost to previous line)*	4,694	7,944	Overburden Soil	B.C.Y.	B12D					148.5	86	145
ROD 77	Stormwater Controls (for stormwater after cover is constructed)	*Pond*	Haul loose lift soil for Pond	6,572	11,122	Overburden Soil	L.C.Y.	B34F					45	498	843
ROD 78			Spread loose lift before compaction (Pond)	6,572	11,122	Overburden Soil	L.C.Y.	B10B					69.3	683	1,156
ROD 79			Compact Berm (Pond)	4,694	7,944	Overburden Soil	E.C.Y.	B10Y					35.1	48	80
ROD 80			Final Stormwater Controls	84	482	Riprap	S.Y.	B13					27	198	1,138
ROD 81			Install 500 year floodplain barrier		9,743	Riprap	S.Y.	B13					27	-	23,018
ROD 82			Apply seeding to cover	972	2,152	Seeding	M.S.F.	B81					54	1,968	4,358
ROD 83	Site Completion		Apply seeding to soil stockpile	790		Seeding	M.S.F.	B81					54	1,599	-
ROD 84			Install temporary irrigation system	80,987	179,348	Irrigation System	S.F.	B20					0	-	-
ROD 85			Install Fencing	4,166	6,448	Fencing	L.F.	B80C					9	625	967
									Totals		***Totals***		***Totals***		
									12,000	30,000	517,000	1,237,000		227,650	531,273
										42,000		**1,754,000**			758,924

Estimated Diesel Fuel Consumption -
"Complete Rad Removal" with Off-site Disposal Alternati

				Quantity					Truckloads for Delivery		Total Miles for Delivery	
Step #	Category	Sub-Category	Task	Off-Site Area 1	Off-Site Area 2	Type of Material Handled	Units	Crew Type	Off-Site Area 1	Off-Site Area 2	Off-Site Area 1	Off-Site Area 2
Off-Site 1	Temporary Construction Facilities / Utilities / Personnel	*Construction Trailers*	Capital Expenses	3		Group of Trailers			15	-	300	-
Off-Site 2			Operating Expenses	64		Group of Trailers	Months					
Off-Site 3			Parking Area	6,667		Gravel Area	S.Y.	B14				
Off-Site 4			Portable Toilets in Construction areas	13	69	Portable Toilets	Month					
Off-Site 5		*Contractor's Construction Management Personnel*	Project Manager	154		Personnel	Week					
Off-Site 6			Construction Superintendent(s)	276		Personnel	Week					
Off-Site 7			Clerk(s)	276		Personnel	Week					
Off-Site 8			Field Engineer(s) / Safety Officer(s)	276		Personnel	Week					
Off-Site 9	Temporary Stormwater Infrastructure (for stormwater during construction)	*Temporary Stormwater Lagoon*	Excavate soil for 4th berm at former leachate lagoon area	21,379		Soil	B.C.Y.	B10B				
Off-Site 10			Place soil for berm	29,930		Soil	L.C.Y.	B10B				
Off-Site 11			Compact berm	21,379		Soil	E.C.Y.	B10Y				
Off-Site 12			Install geomembrane liner	495		60 mil HDPE	M.S.F.	3 Skwk	5	-	10,000	-
Off-Site 13			Install force main from Areas 1 and 2 to lagoon	3,641	607	HDPE Pipe	L.F.	B22A				
Off-Site 14			Install force main from lagoon to treatment facility	551		HDPE Pipe	L.F.	B22A				
Off-Site 15		*Treatment Facility*	Construct Treatment Facility	1		Treatment Facility	Each					
Off-Site 16			Monthly Operation during construction	28		Treatment Facility Operation	Months					
Off-Site 17		*Stormwater events during construction*	Dewater construction after rain events	309	759	Construction stormwater	Days of Pumping	B10I				
Off-Site 18			Dispose of contact stormwater to MSD	1,500,000	3,000,000	Contact stormwater	Gallons					
Off-Site 19		*Post-project Stormwater Demolition*	Dispose of geomembrane liner in Area 1 or 2	495		60 mil HDPE	M.S.F.					
Off-Site 20			Deconstruct 4th berm	21,379		Soil	B.C.Y.	B10B				
Off-Site 21			Grade berm material in lagoon for proper drainage	29,930		Soil	L.C.Y.	B10B				
Off-Site 22	Site-wide Preparation	*Mobilization*	Mobilize and Demobilize Equipment Under 150HP	8		Units of Equipment up to 150HP (up to 50 miles)	Ea.	B34N				
Off-Site 23			*Extra Mileage for Mobilizations*	80		Per 5 additional miles		B34N				
Off-Site 24			Mobilize and Demobilize Equipment Over 150HP	56		Units of Equipment over 150HP (up to 50 miles)	Ea.	B34K				
Off-Site 25			*Extra Mileage for Mobilizations*	560		Per 5 additional miles		B34K				
Off-Site 26			Mobilize and Demobilize Equipment, Towed	4		Units of Towed Equipment (up to 50 miles)	Ea.	B34K				
Off-Site 27			*Extra Mileage for Mobilizations*	40		Per 5 additional miles		B34K				
Off-Site 28	Site-wide Preparation (cont.)	*Supplemental Mobilizations*	Mobilize and Demobilize Equipment Under 150HP	16		Units of Equipment up to 150HP (up to 50 miles)	Ea.	B34N				
Off-Site 29			*Extra Mileage for Mobilizations*	160		Per 5 additional miles		B34N				
Off-Site 30			Mobilize and Demobilize Equipment Over 150HP	112		Units of Equipment over 150HP (up to 50 miles)	Ea.	B34K				
Off-Site 31			*Extra Mileage for Mobilizations*	1,120		Per 5 additional miles		B34K				
Off-Site 32			Mobilize and Demobilize Equipment, Towed	8		Units of Towed Equipment (up to 50 miles)	Ea.	B34K				
Off-Site 33			*Extra Mileage for Mobilizations*	80		Per 5 additional miles		B34K				
Off-Site 34			Create Temporary Roads	13,333	26,667	Gravel Roads	S.Y.	B14				
Off-Site 35			Install TBD Traffic Improvements	$ 100,000	$ 100,000	TBD (shown as budget estimate)	$					
Off-Site 36		*Dust Control*	Water Truck Depreciation	1	2	Water Trucks	Trucks					
Off-Site 37			Water Truck Operation	12	65	Water Trucks	Months	B9A				
Off-Site 38			Use Water to Control Dust	2,390,000	13,100,000	Water	Gal					

Estimated Diesel Fuel Consumption -
"Complete Rad Removal" with Off-site Disposal Alternati

				Quantity					Truckloads for Delivery		Total Miles for Delivery	
Step #	Category	Sub-Category	Task	Off-Site Area 1	Off-Site Area 2	Type of Material Handled	Units	Crew Type	Off-Site Area 1	Off-Site Area 2	Off-Site Area 1	Off-Site Area 2
Off-Site 39			Prepare area with Stormwater BMPs	4,078	8,285	Silt Fence	L.F.	2 Clab				
Off-Site 40		Decontamination Areas	Materials	111	56	Concrete	C.Y.					
Off-Site 41			Installation	111	56	Concrete	C.Y.	C20				
Off-Site 42	Site Preparation		Clear Vegetation (Light)	16.0	21.4	Vegetation	Acre	B84				
Off-Site 43			Clear Vegetation (Heavy)	3.5	27.8	Vegetation	Acre	B7				
Off-Site 44			Purchase material	2,963	4,444	Soil	B.C.Y.					
Off-Site 45		Berms for Overburden	Deliver and Stockpile	4,148	6,222	Soil	L.C.Y.	Import Trans 1	260	389	18,200	27,230
Off-Site 46			Develop earthen berms to store relocated overburden wastes	4,148	6,222	Soil	L.C.Y.	B10B				
Off-Site 47			Relocate overburden wastes - Excavate	67,475	408,031	Non RAD Waste	B.C.Y.	B12D				
Off-Site 48			*(additional cost to previous line)*	67,475	408,031	Non RAD Waste	B.C.Y.	B12D				
Off-Site 49	Overburden Relocation		Relocate overburden wastes - Haul and Dump	101,213	612,047	Non RAD Waste	L.C.Y.	B34F				
Off-Site 50			Apply daily cover to relocated overburden wastes	6,748	40,803	Soil	B.C.Y.	B10L				
Off-Site 51			Spread overburden wastes	107,960	652,850	Non RAD Waste	L.C.Y.	B10B				
Off-Site 52			Compact overburden wastes	74,223	448,834	Non RAD Waste	E.C.Y.	B10G				
Off-Site 53			Apply daily cover to remaining excavation of RIM Wastes	3,350	30,200	Soil	B.C.Y.	B10L				
Off-Site 54			Relocate RIM Wastes on-site - Excavate	36,850	332,200	RAD Waste	B.C.Y.	B12D				
Off-Site 55			*(additional cost to previous line)*	36,850	332,200	RAD Waste	B.C.Y.	B12D				
Off-Site 56	RIM Relocation		Relocate RIM Wastes on-site - Haul and Dump	55,275	498,300	RAD Waste	L.C.Y.	B34F				
Off-Site 57			Transfer RIM Wastes into On-Road Trailers	36,850	332,200	RAD Waste	B.C.Y.	B10P				
Off-Site 58			*(additional cost to previous line)*	36,850	332,200	RAD Waste	B.C.Y.	B10P				
Off-Site 59			Bag and Transport RIM Wastes to Off-Site Disposal Facility via Rail	55,275	498,300	RAD Waste	L.C.Y.	RIM A RIM B RIM C	1,580	14,238	31,600	284,760
Off-Site 60			Off-Site Disposal Facility Disposal Fee	55,275	498,300	RAD Waste	L.C.Y.	see above				
Off-Site 61	Buffer Zone		Buffer Zone Activity	-	1	See separate Assumptions sheet						
Off-Site 62	Rad. Survey		Conduct final radiological survey and wait for approval	1	1	others, and does not have a direct cost to the contractor.						
Off-Site 63			Move non-RIM waste to correct slopes in excavation - Excavate	15,915	137,914	Non RAD Waste	B.C.Y.	B12D				
Off-Site 64			*(additional cost to previous line)*	15,915	137,914	Non RAD Waste	B.C.Y.	B12D				
Off-Site 65		Slope Correction Cuts	Move non-RIM waste to correct slopes in excavation - Haul and Dump	23,873	206,871	Non RAD Waste	L.C.Y.	B34F				
Off-Site 66			Spread cut material	23,873	206,871	Non RAD Waste	L.C.Y.	B10B				
Off-Site 67			Compact cut material	15,915	137,914	Non RAD Waste	E.C.Y.	B10G				
Off-Site 68			Backfill Overburden Materials stored in berms - Excavate	21,000	63,000	Non RAD Waste	B.C.Y.	B12D				
Off-Site 69		Backfill Overburden	*(additional cost to previous line)*	21,000	63,000	Non RAD Waste	B.C.Y.	B12D				
Off-Site 70	Backfill and Slope Correction		Backfill Overburden Materials stored in berms - Haul and Dump	31,500	94,500	Non RAD Waste	L.C.Y.	B34F				

Estimated Diesel Fuel Consumption -
"Complete Rad Removal" with Off-site Disposal Alternati

Step #	Category	Sub-Category	Task	Quantity Off-Site Area 1	Quantity Off-Site Area 2	Type of Material Handled	Units	Crew Type	Truckloads for Delivery Off-Site Area 1	Truckloads for Delivery Off-Site Area 2	Total Miles for Delivery Off-Site Area 1	Total Miles for Delivery Off-Site Area 2
Off-Site 71		*Additional Fill*	Excavate additional fill material for grading	127,923	159,363	Overburden Soil	B.C.Y.	B12D				
Off-Site 72		*Additional Fill*	*(additional cost to previous line)*	127,923	159,363	Overburden Soil	B.C.Y.	B12D				
Off-Site 73		*Additional Fill*	Haul additional fill for grading	159,904	199,204	Overburden Soil	L.C.Y.	B34F				
Off-Site 74		*Additional Fill*	Spread additional fill	159,904	199,204	Overburden Soil	L.C.Y.	B10B				
Off-Site 75		*Daily Cover*	Use geotextile as a daily cover for backfill waste to reclaim slopes	33,688	194,117	Geotextile	S.Y.	2 Clab, Import Trans 3	3	17	6,000	34,000
Off-Site 76		*Daily Cover*	Use geotextile as a daily cover on bermed overburden	5,000	11,111	Geotextile	S.Y.	2 Clab, Import Trans 3	1	1	2,000	2,000
Off-Site 77	**Final Cover**	*Clay*	Purchase clay material	61,537	151,279	Clay Material	B.C.Y.					
Off-Site 78	**Final Cover**	*Clay*	Deliver clay material to site	86,152	211,791	Clay Material	L.C.Y.	Import Trans 1	5,385	13,237	376,950	926,590
Off-Site 79	**Final Cover**	*Clay*	Spread loose lift before compaction	86,152	211,791	Clay Material	L.C.Y.	B10B				
Off-Site 80	**Final Cover**	*Clay*	Compact Clay (Final Cover)	61,537	151,279	Clay Material	E.C.Y.	B10G				
Off-Site 81	**Final Cover**	*Top Soil*	Purchase Topsoil	32,008	81,190	Topsoil	B.C.Y.					
Off-Site 82	**Final Cover**	*Top Soil*	Deliver Topsoil	40,009	101,487	Topsoil	L.C.Y.	Import Trans 2	2,354	5,970	47,080	119,400
Off-Site 83	**Final Cover**	*Top Soil*	Move and place Topsoil (Final Cover)	38,461	94,550	Topsoil	L.C.Y.	B10B				
Off-Site 84	**Stormwater Controls (for stormwater after cover is constructed)**		Install Terraces	1,549	6,938	Topsoil	L.C.Y.	B10B				
Off-Site 85	**Stormwater Controls (for stormwater after cover is constructed)**		Construct Ditches	2,630	7,245	Topsoil	B.C.Y.	B10L				
Off-Site 86	**Stormwater Controls (for stormwater after cover is constructed)**	*Pond*	Load Overburden Material from stockpile to off road haul truck for pond	4,023	7,944	Overburden Soil	B.C.Y.	B12D				
Off-Site 87	**Stormwater Controls (for stormwater after cover is constructed)**	*Pond*	*(additional cost to previous line)*	4,023	7,944	Overburden Soil	B.C.Y.	B12D				
Off-Site 88	**Stormwater Controls (for stormwater after cover is constructed)**	*Pond*	Haul loose lift soil for Pond	5,632	11,122	Overburden Soil	L.C.Y.	B34F				
Off-Site 89	**Stormwater Controls (for stormwater after cover is constructed)**	*Pond*	Spread loose lift before compaction (Pond)	5,632	11,122	Overburden Soil	L.C.Y.	B10B				
Off-Site 90	**Stormwater Controls (for stormwater after cover is constructed)**	*Pond*	Compact Berm (Pond)	4,023	7,944	Overburden Soil	E.C.Y.	B10Y				
Off-Site 91	**Stormwater Controls (for stormwater after cover is constructed)**		Final Stormwater Controls	-	2,332	Riprap	S.Y.	B13				
Off-Site 92	**Site Completion**		Apply seeding to cover	1,051	2,653	Seeding	M.S.F.	B81				
Off-Site 93	**Site Completion**		Apply seeding to soil stockpile	790		Seeding	M.S.F.	B81				
Off-Site 94	**Site Completion**		Install temporary irrigation system	87,550	221,114	Irrigation System	S.F.	B20				
Off-Site 95	**Site Completion**		Install Fencing	4,078	8,285	Fencing	L.F.	B80C				
									Totals		***Totals***	
									10,000	34,000	492,000	1,394,000
										44,000		**1,886,000**

$ 82,990,000
$ 47,100,000
$ 36,300,000
$ 166,390,000

Estimated Diesel Fuel Consumption -
"Complete Rad Removal" with Off-site Disposal Alternati

Step #	Category	Sub-Category	Task	Quantity: Off-Site Area 1	Quantity: Off-Site Area 2	Type of Material Handled	Units	Crew Type	Truckloads for Delivery: Off-Site Area 1	Truckloads for Delivery: Off-Site Area 2	Total Miles for Delivery: Off-Site Area 1	Total Miles for Delivery: Off-Site Area 2
Off-Site 1	Temporary Construction Facilities / Utilities / Personnel	*Construction Trailers*	Capital Expenses	3		Group of Trailers			15	-	300	-
Off-Site 2			Operating Expenses	64		Group of Trailers	Months					
Off-Site 3			Parking Area	6,667		Gravel Area	S.Y.	B14				
Off-Site 4			Portable Toilets in Construction areas	13	69	Portable Toilets	Month					
Off-Site 5		*Contractor's Construction Management Personnel*	Project Manager	154		Personnel	Week					
Off-Site 6			Construction Superintendent(s)	276		Personnel	Week					
Off-Site 7			Clerk(s)	276		Personnel	Week					
Off-Site 8			Field Engineer(s) / Safety Officer(s)	276		Personnel	Week					
Off-Site 9	Temporary Stormwater Infrastructure (for stormwater during construction)	*Temporary Stormwater Lagoon*	Excavate soil for 4th berm at former leachate lagoon area	21,379		Soil	B.C.Y.	B10B				
Off-Site 10			Place soil for berm	29,930		Soil	L.C.Y.	B10B				
Off-Site 11			Compact berm	21,379		Soil	E.C.Y.	B10Y				
Off-Site 12			Install geomembrane liner	495		60 mil HDPE	M.S.F.	3 Skwk	5	-	10,000	-
Off-Site 13			Install force main from Areas 1 and 2 to lagoon	3,641	607	HDPE Pipe	L.F.	B22A				
Off-Site 14			Install force main from lagoon to treatment facility	551		HDPE Pipe	L.F.	B22A				
Off-Site 15		*Treatment Facility*	Construct Treatment Facility	1		Treatment Facility	Each					
Off-Site 16			Monthly Operation during construction	28		Treatment Facility Operation	Months					
Off-Site 17		*Stormwater events during construction*	Dewater construction after rain events	309	759	Construction stormwater	Days of Pumping	B10I				
Off-Site 18			Dispose of contact stormwater to MSD	1,500,000	3,000,000	Contact stormwater	Gallons					
Off-Site 19		*Post-project Stormwater Demolition*	Dispose of geomembrane liner in Area 1 or 2	495		60 mil HDPE	M.S.F.					
Off-Site 20			Deconstruct 4th berm	21,379		Soil	B.C.Y.	B10B				
Off-Site 21			Grade berm material in lagoon for proper drainage	29,930		Soil	L.C.Y.	B10B				
Off-Site 22	Site-wide Preparation	*Mobilization*	Mobilize and Demobilize Equipment Under 150HP	8		Units of Equipment up to 150HP (up to 50 miles)	Ea.	B34N				
Off-Site 23			*Extra Mileage for Mobilizations*	80		Per 5 additional miles		B34N				
Off-Site 24			Mobilize and Demobilize Equipment Over 150HP	56		Units of Equipment over 150HP (up to 50 miles)	Ea.	B34K				
Off-Site 25			*Extra Mileage for Mobilizations*	560		Per 5 additional miles		B34K				
Off-Site 26			Mobilize and Demobilize Equipment, Towed	4		Units of Towed Equipment (up to 50 miles)	Ea.	B34K				
Off-Site 27			*Extra Mileage for Mobilizations*	40		Per 5 additional miles		B34K				
Off-Site 28	Site-wide Preparation (cont.)	*Supplemental Mobilizations*	Mobilize and Demobilize Equipment Under 150HP	16		Units of Equipment up to 150HP (up to 50 miles)	Ea.	B34N				
Off-Site 29			*Extra Mileage for Mobilizations*	160		Per 5 additional miles		B34N				
Off-Site 30			Mobilize and Demobilize Equipment Over 150HP	112		Units of Equipment over 150HP (up to 50 miles)	Ea.	B34K				
Off-Site 31			*Extra Mileage for Mobilizations*	1,120		Per 5 additional miles		B34K				
Off-Site 32			Mobilize and Demobilize Equipment, Towed	8		Units of Towed Equipment (up to 50 miles)	Ea.	B34K				
Off-Site 33			*Extra Mileage for Mobilizations*	80		Per 5 additional miles		B34K				
Off-Site 34			Create Temporary Roads	13,333	26,667	Gravel Roads	S.Y.	B14				
Off-Site 35			Install TBD Traffic Improvements	$ 100,000	$ 100,000	TBD (shown as budget estimate)	$					
Off-Site 36		*Dust Control*	Water Truck Depreciation	1	2	Water Trucks	Trucks					
Off-Site 37			Water Truck Operation	12	65	Water Trucks	Months	B9A				
Off-Site 38			Use Water to Control Dust	2,390,000	13,100,000	Water	Gal					

Estimated Diesel Fuel Consumption -
"Complete Rad Removal" with Off-site Disposal Alternati

Step #	Category	Sub-Category	Task	Quantity Off-Site Area 1	Quantity Off-Site Area 2	Type of Material Handled	Units	Crew Type	Truckloads for Delivery Off-Site Area 1	Truckloads for Delivery Off-Site Area 2	Total Miles for Delivery Off-Site Area 1	Total Miles for Delivery Off-Site Area 2
Off-Site 39			Prepare area with Stormwater BMPs	4,078	8,285	Silt Fence	L.F.	2 Clab				
Off-Site 40		*Decontamination Areas*	Materials	111	56	Concrete	C.Y.					
Off-Site 41			Installation	111	56	Concrete	C.Y.	C20				
Off-Site 42	Site Preparation		Clear Vegetation (Light)	16.0	21.4	Vegetation	Acre	B84				
Off-Site 43			Clear Vegetation (Heavy)	3.5	27.8	Vegetation	Acre	B7				
Off-Site 44			Purchase material	2,963	4,444	Soil	B.C.Y.					
Off-Site 45		*Berms for Overburden*	Deliver and Stockpile	4,148	6,222	Soil	L.C.Y.	Import Trans 1	260	389	18,200	27,230
Off-Site 46			Develop earthen berms to store relocated overburden wastes	4,148	6,222	Soil	L.C.Y.	B10B				
Off-Site 47			Relocate overburden wastes - Excavate	67,475	408,031	Non RAD Waste	B.C.Y.	B12D				
Off-Site 48			*(additional cost to previous line)*	67,475	408,031	Non RAD Waste	B.C.Y.	B12D				
Off-Site 49	Overburden Relocation		Relocate overburden wastes - Haul and Dump	101,213	612,047	Non RAD Waste	L.C.Y.	B34F				
Off-Site 50			Apply daily cover to relocated overburden wastes	6,748	40,803	Soil	B.C.Y.	B10L				
Off-Site 51			Spread overburden wastes	107,960	652,850	Non RAD Waste	L.C.Y.	B10B				
Off-Site 52			Compact overburden wastes	74,223	448,834	Non RAD Waste	E.C.Y.	B10G				
Off-Site 53			Apply daily cover to remaining excavation of RIM Wastes	3,350	30,200	Soil	B.C.Y.	B10L				
Off-Site 54			Relocate RIM Wastes on-site - Excavate	36,850	332,200	RAD Waste	B.C.Y.	B12D				
Off-Site 55			*(additional cost to previous line)*	36,850	332,200	RAD Waste	B.C.Y.	B12D				
Off-Site 56	RIM Relocation		Relocate RIM Wastes on-site - Haul and Dump	55,275	498,300	RAD Waste	L.C.Y.	B34F				
Off-Site 57			Transfer RIM Wastes into On-Road Trailers	36,850	332,200	RAD Waste	B.C.Y.	B10P				
Off-Site 58			*(additional cost to previous line)*	36,850	332,200	RAD Waste	B.C.Y.	B10P				
Off-Site 59			Bag and Transport RIM Wastes to Off-Site Disposal Facility via Rail	55,275	498,300	RAD Waste	L.C.Y.	RIM A RIM B RIM C	1,580	14,238	31,600	284,760
Off-Site 60			Off-Site Disposal Facility Disposal Fee	55,275	498,300	RAD Waste	L.C.Y.	see above				
Off-Site 61	Buffer Zone		Buffer Zone Activity	-	1	See separate Assumptions sheet						
Off-Site 62	Rad. Survey		Conduct final radiological survey and wait for approval	1	1	others, and does not have a direct cost to the contractor.						
Off-Site 63			Move non-RIM waste to correct slopes in excavation - Excavate	15,915	137,914	Non RAD Waste	B.C.Y.	B12D				
Off-Site 64			*(additional cost to previous line)*	15,915	137,914	Non RAD Waste	B.C.Y.	B12D				
Off-Site 65		*Slope Correction Cuts*	Move non-RIM waste to correct slopes in excavation - Haul and Dump	23,873	206,871	Non RAD Waste	L.C.Y.	B34F				
Off-Site 66			Spread cut material	23,873	206,871	Non RAD Waste	L.C.Y.	B10B				
Off-Site 67			Compact cut material	15,915	137,914	Non RAD Waste	E.C.Y.	B10G				
Off-Site 68			Backfill Overburden Materials stored in berms - Excavate	21,000	63,000	Non RAD Waste	B.C.Y.	B12D				
Off-Site 69		*Backfill Overburden*	*(additional cost to previous line)*	21,000	63,000	Non RAD Waste	B.C.Y.	B12D				
Off-Site 70	Backfill and Slope Correction		Backfill Overburden Materials stored in berms - Haul and Dump	31,500	94,500	Non RAD Waste	L.C.Y.	B34F				

APPENDIX J:

Estimated Project Schedules for the Remedial Alternatives

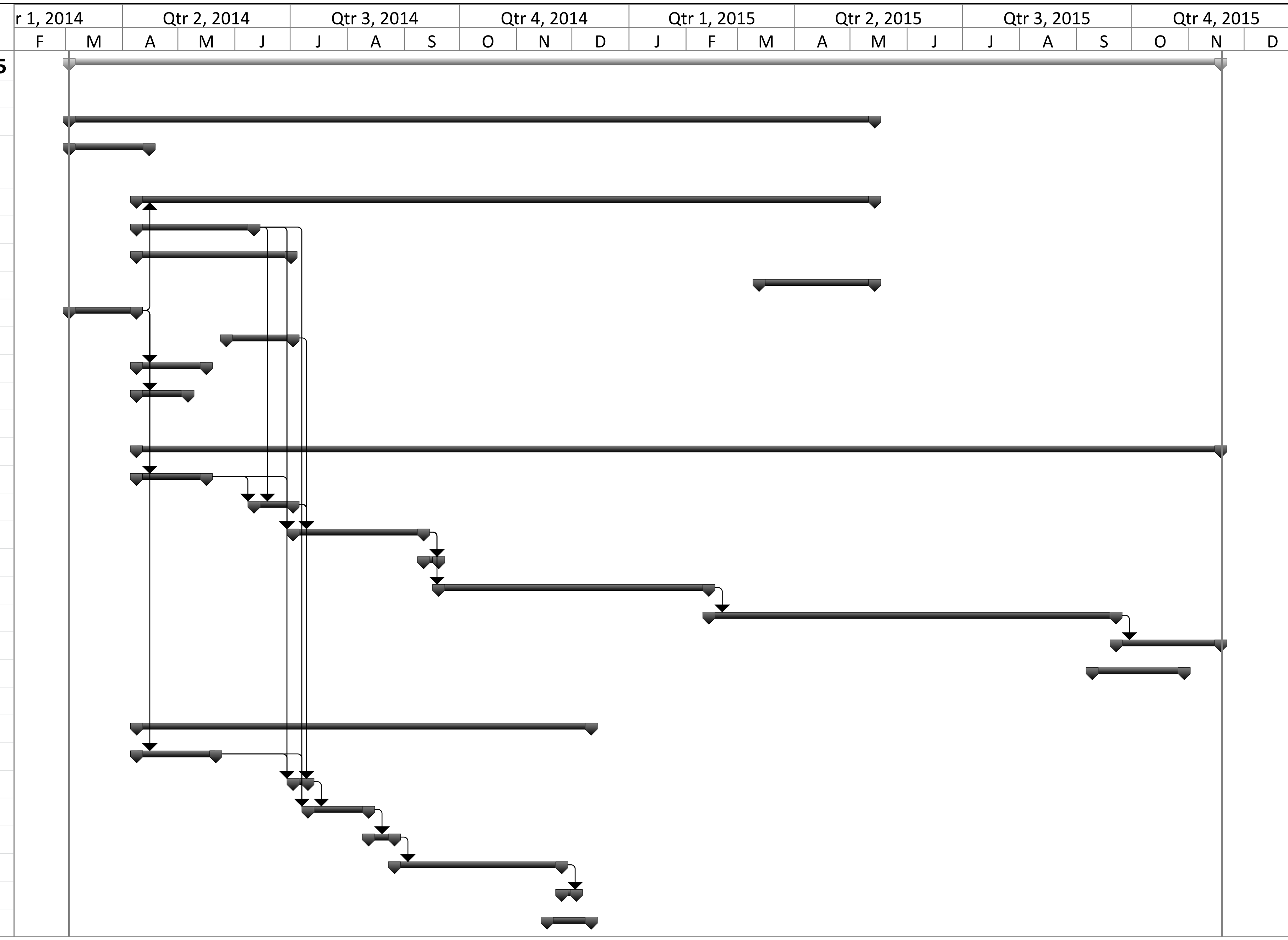
Appendix J-1:

Estimated Project Schedules for the ROD remedy

Estimated Schedule

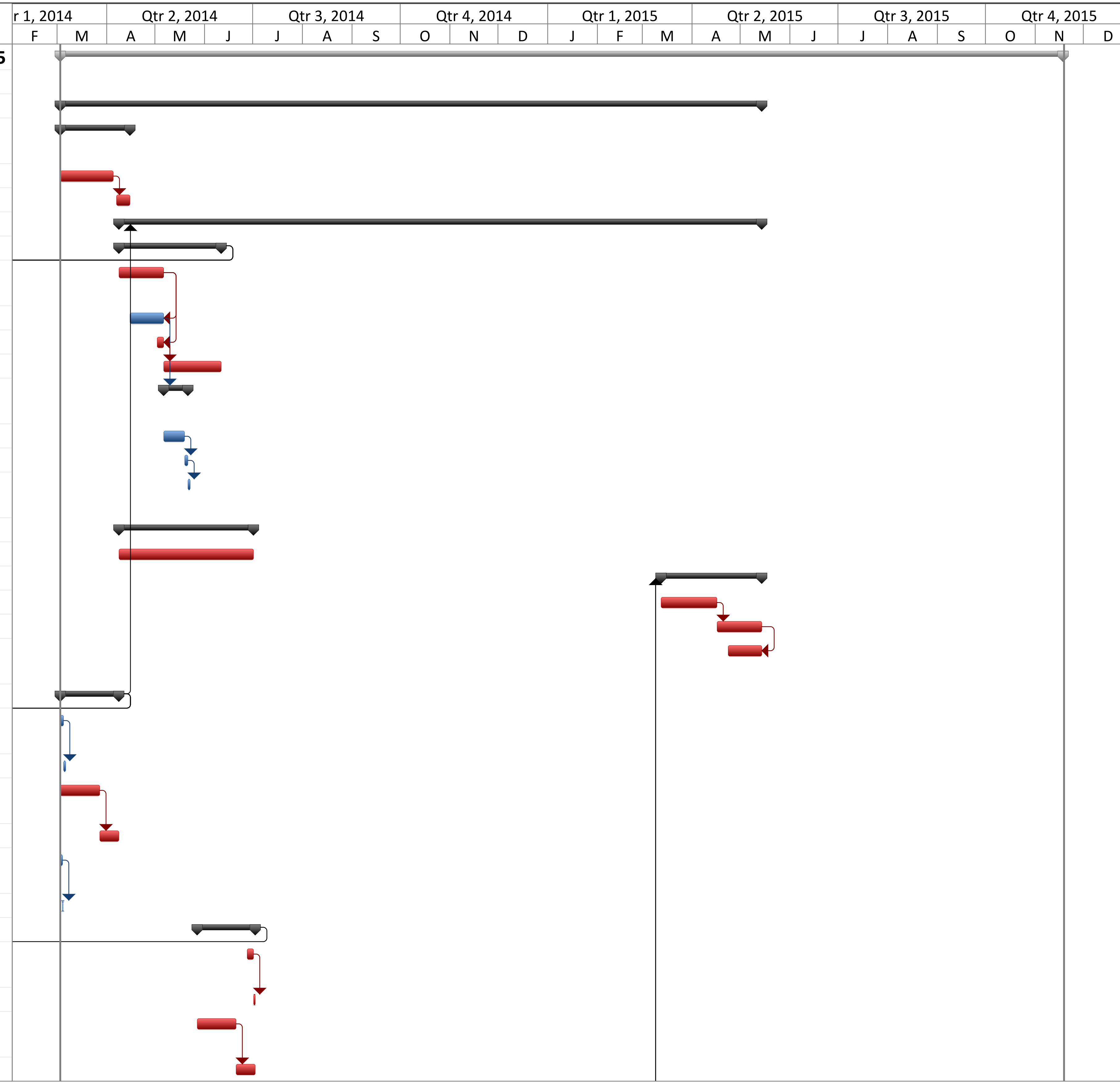
ROD-Selected Remedy

ID	Task Name	Estimated Duration	Start	Finish
0	**ROD Remedy**	**447 days**	**Mon 3/3/14**	**Wed 11/18/15**
1				
2	**Site-wide Preparation**	**313 days**	**Mon 3/3/14**	**Thu 5/14/15**
3	**Temporary Construction Facilities / Utilities / Personnel**	**31 days**	**Mon 3/3/14**	**Tue 4/15/14**
6	**Temporary Stormwater Infrastructure**	**287 days**	**Tue 4/8/14**	**Thu 5/14/15**
7	**Temporary Stormwater Lagoon**	**46 days**	**Tue 4/8/14**	**Wed 6/11/14**
16	**Treatment Facility**	**60 days**	**Tue 4/8/14**	**Tue 7/1/14**
18	**Post-project Stormwater Demolition**	**45 days**	**Thu 3/12/15**	**Thu 5/14/15**
22	**Mobilization**	**27 days**	**Mon 3/3/14**	**Tue 4/8/14**
29	**Supplemental Mobilization**	**27 days**	**Tue 5/27/14**	**Wed 7/2/14**
36	**Create Temporary Roads**	**28 days**	**Tue 4/8/14**	**Fri 5/16/14**
39	**Install TBD Traffic Improvements**	**20 days**	**Tue 4/8/14**	**Tue 5/6/14**
42				
43	**Area 2**	**421 days**	**Tue 4/8/14**	**Wed 11/18/15**
44	**Site Preparation**	**28 days**	**Tue 4/8/14**	**Fri 5/16/14**
51	**Stormwater Events (Weather Delays)**	**16 days**	**Wed 6/11/14**	**Wed 7/2/14**
53	**Regrading**	**51 days**	**Wed 7/2/14**	**Thu 9/11/14**
62	**Buffer Zone**	**7 days**	**Thu 9/11/14**	**Fri 9/19/14**
64	**Backfill and Slope Correction**	**104 days**	**Fri 9/19/14**	**Fri 2/13/15**
71	**Final Cover**	**157 days**	**Fri 2/13/15**	**Tue 9/22/15**
94	**Post-Construction Stormwater Controls**	**41 days**	**Tue 9/22/15**	**Wed 11/18/15**
106	**Site Completion**	**36 days**	**Wed 9/9/15**	**Thu 10/29/15**
111				
112	**Area 1**	**177 days**	**Tue 4/8/14**	**Thu 12/11/14**
113	**Site Preparation**	**31 days**	**Tue 4/8/14**	**Wed 5/21/14**
120	**Stormwater Events (Weather Delays)**	**6 days**	**Wed 7/2/14**	**Thu 7/10/14**
122	**Regrading**	**23 days**	**Thu 7/10/14**	**Tue 8/12/14**
131	**Backfill and Slope Correction**	**10 days**	**Tue 8/12/14**	**Tue 8/26/14**
138	**Final Cover**	**65 days**	**Tue 8/26/14**	**Tue 11/25/14**
161	**Post-Construction Stormwater Controls**	**6 days**	**Tue 11/25/14**	**Wed 12/3/14**
172	**Site Completion**	**18 days**	**Mon 11/17/14**	**Thu 12/11/14**



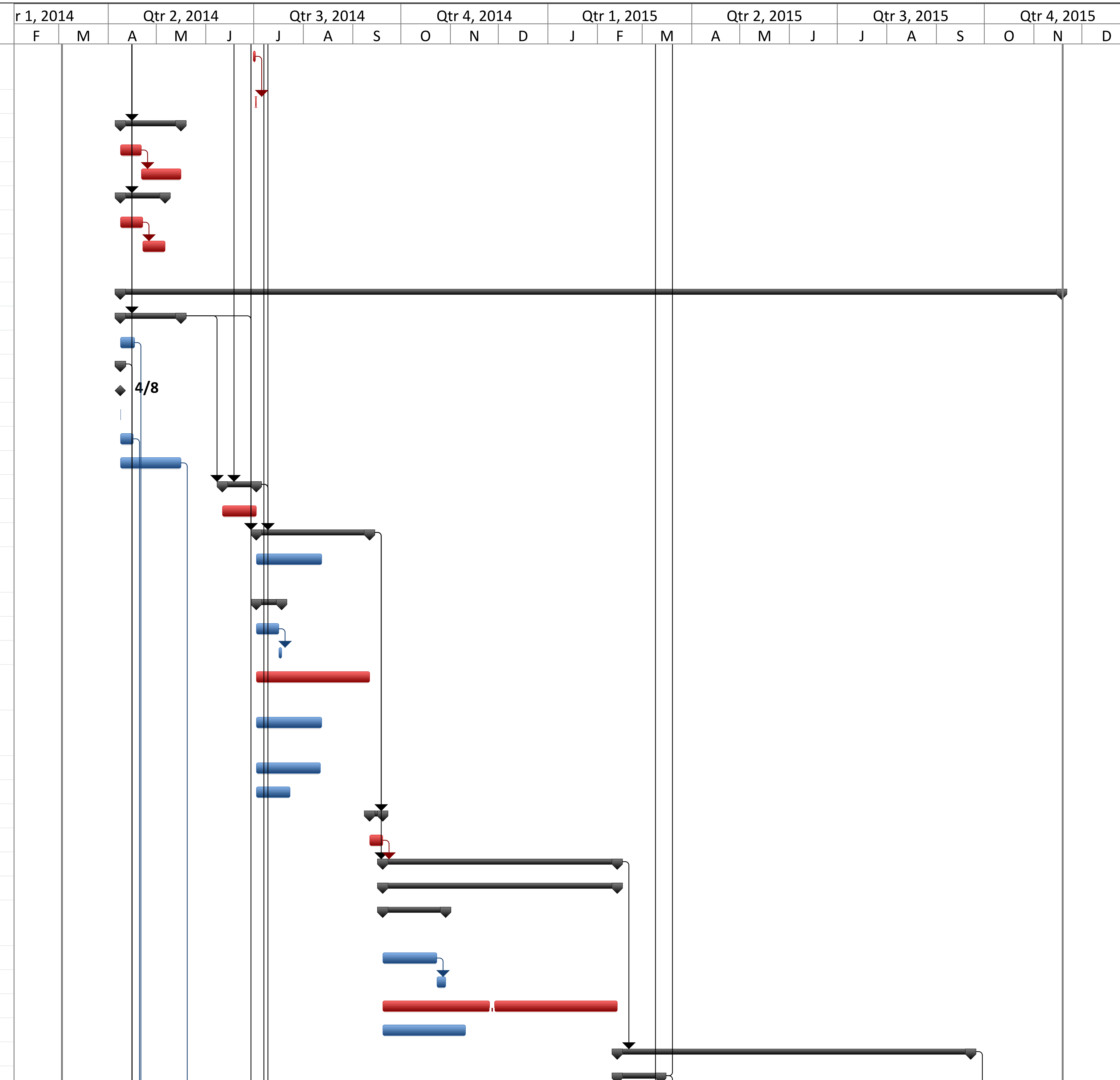
Note: All dates are for planning purposes only - not actual dates.

ID	Task Name	Estimated Duration	Start	Finish
0	**ROD Remedy**	**447 days**	**Mon 3/3/14**	**Wed 11/18/15**
1				
2	**Site-wide Preparation**	**313 days**	**Mon 3/3/14**	**Thu 5/14/15**
3	**Temporary Construction Facilities / Utilities / Personnel**	**31 days**	**Mon 3/3/14**	**Tue 4/15/14**
4	Construction Trailers	25 days	Mon 3/3/14	Fri 4/4/14
5	Parking Area	6 days	Mon 4/7/14	Tue 4/15/14
6	**Temporary Stormwater Infrastructure**	**287 days**	**Tue 4/8/14**	**Thu 5/14/15**
7	**Temporary Stormwater Lagoon**	**46 days**	**Tue 4/8/14**	**Wed 6/11/14**
8	Excavate soil for 4th berm at former leachate lagoon area	20 days	Tue 4/8/14	Tue 5/6/14
9	Place soil for berm	15 days	Tue 4/15/14	Tue 5/6/14
10	Compact berm	2 days	Fri 5/2/14	Tue 5/6/14
11	Install geomembrane liner	26 days	Tue 5/6/14	Wed 6/11/14
12	**Install force main from Areas 1 and 2 to lagoon**	**11 days**	**Tue 5/6/14**	**Wed 5/21/14**
13	Area 1	9 days	Tue 5/6/14	Mon 5/19/14
14	Area 2	2 days	Mon 5/19/14	Wed 5/21/14
15	Install force main from lagoon to treatment facility	1 day	Wed 5/21/14	Thu 5/22/14
16	**Treatment Facility**	**60 days**	**Tue 4/8/14**	**Tue 7/1/14**
17	Construction	60 days	Tue 4/8/14	Tue 7/1/14
18	**Post-project Stormwater Demolition**	**45 days**	**Thu 3/12/15**	**Thu 5/14/15**
19	Dispose of geomembrane liner	25 days	Thu 3/12/15	Thu 4/16/15
20	Deconstruct 4th berm	20 days	Thu 4/16/15	Thu 5/14/15
21	Grade berm material in lagoon for proper drainage	15 days	Thu 4/23/15	Thu 5/14/15
22	**Mobilization**	**27 days**	**Mon 3/3/14**	**Tue 4/8/14**
23	Mobilize and Demobilize Equipment Under 150HP	2 days	Mon 3/3/14	Tue 3/4/14
24	Extra Mileage for Mobilizations	1 day	Wed 3/5/14	Thu 3/6/14
25	Mobilize and Demobilize Equipment Over 150HP	19 days	Mon 3/3/14	Thu 3/27/14
26	Extra Mileage for Mobilizations	8 days	Thu 3/27/14	Tue 4/8/14
27	Mobilize and Demobilize Equipment, Towed	1 day	Mon 3/3/14	Tue 3/4/14
28	Extra Mileage for Mobilizations	1 day	Tue 3/4/14	Tue 3/4/14
29	**Supplemental Mobilization**	**27 days**	**Tue 5/27/14**	**Wed 7/2/14**
30	Mobilize and Demobilize Equipment Under 150HP	2 days	Fri 6/27/14	Tue 7/1/14
31	Extra Mileage for Mobilizations	1 day	Tue 7/1/14	Wed 7/2/14
32	Mobilize and Demobilize Equipment Over 150HP	19 days	Tue 5/27/14	Fri 6/20/14
33	Extra Mileage for Mobilizations	8 days	Fri 6/20/14	Wed 7/2/14



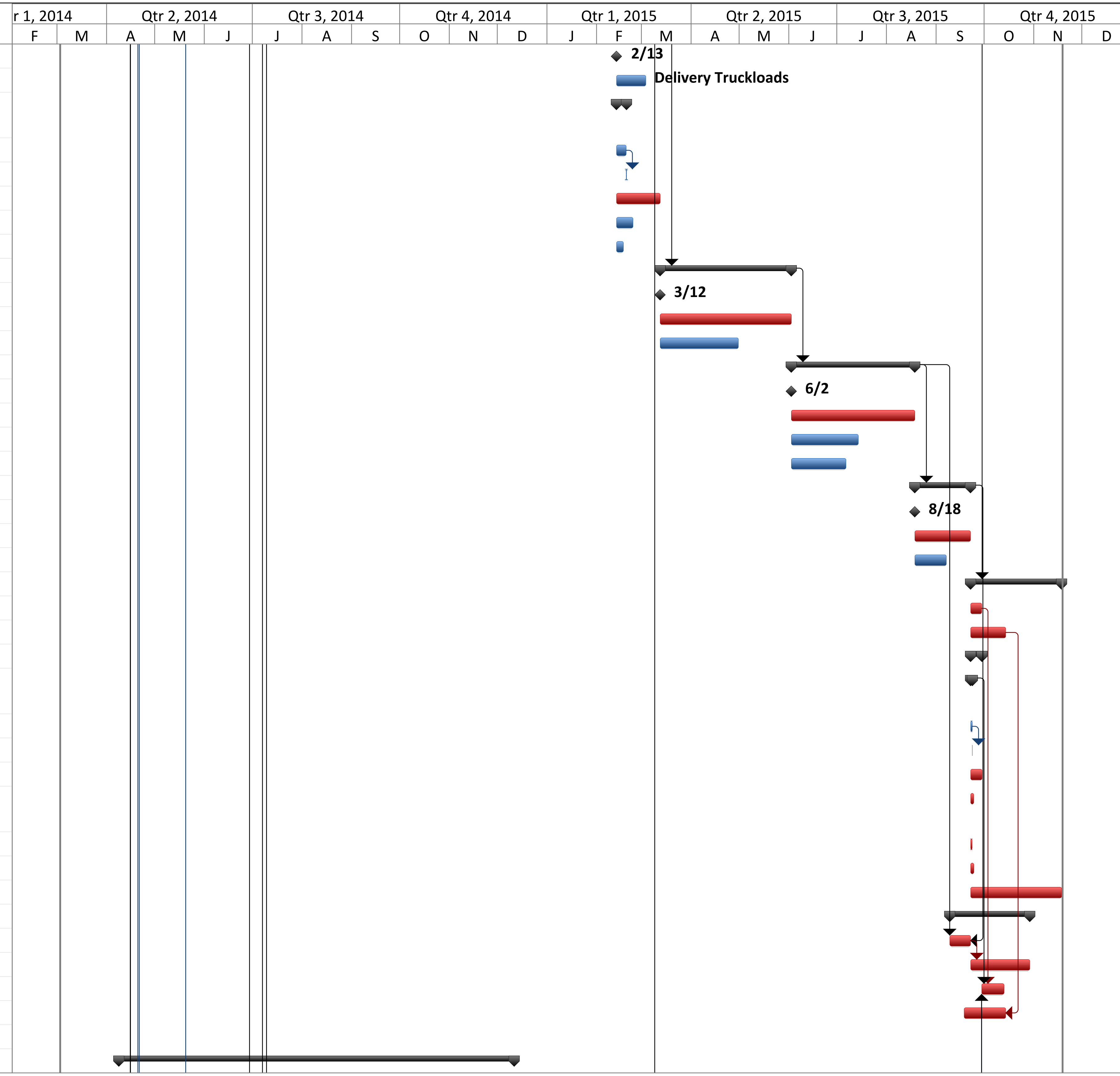
Note: All dates are for planning purposes only - not actual dates.

ID	Task Name	Estimated Duration	Start	Finish
34	Mobilize and Demobilize Equipment, Towed	1 day	Mon 6/30/14	Tue 7/1/14
35	Extra Mileage for Mobilizations	1 day	Wed 7/2/14	Wed 7/2/14
36	**Create Temporary Roads**	**28 days**	**Tue 4/8/14**	**Fri 5/16/14**
37	Area 1	9 days	Tue 4/8/14	Mon 4/21/14
38	Area 2	19 days	Mon 4/21/14	Fri 5/16/14
39	**Install TBD Traffic Improvements**	**20 days**	**Tue 4/8/14**	**Tue 5/6/14**
40	Area 1	10 days	Tue 4/8/14	Tue 4/22/14
41	Area 2	10 days	Tue 4/22/14	Tue 5/6/14
42				
43	**Area 2**	**421 days**	**Tue 4/8/14**	**Wed 11/18/15**
44	**Site Preparation**	**28 days**	**Tue 4/8/14**	**Fri 5/16/14**
45	Prepare area with Stormwater BMPS	7 days	Tue 4/8/14	Thu 4/17/14
46	**Decontamination Area**	**0 days**	**Tue 4/8/14**	**Tue 4/8/14**
47	Materials	0 days	Tue 4/8/14	Tue 4/8/14
48	Installation	0 days	Tue 4/8/14	Tue 4/8/14
49	Clear Vegetation (Light)	6 days	Tue 4/8/14	Wed 4/16/14
50	Clear Vegetation (Heavy)	28 days	Tue 4/8/14	Fri 5/16/14
51	**Stormwater Events (Weather Delays)**	**16 days**	**Wed 6/11/14**	**Wed 7/2/14**
52	Dewater construction after rain events	16 days	Wed 6/11/14	Wed 7/2/14
53	**Regrading**	**51 days**	**Wed 7/2/14**	**Thu 9/11/14**
54	Apply daily cover to remaining excavation of Landfilled Material	29 days	Wed 7/2/14	Tue 8/12/14
55	**Relocate Landfilled Material on-site**	**12 days**	**Wed 7/2/14**	**Fri 7/18/14**
56	Excavate	10 days	Wed 7/2/14	Wed 7/16/14
57	Load	2 days	Wed 7/16/14	Fri 7/18/14
58	Relocate Landfilled Material on-site - Haul and Dump	51 days	Wed 7/2/14	Thu 9/11/14
59	Apply daily cover to relocated Landfilled Material	29 days	Wed 7/2/14	Tue 8/12/14
60	Spread Landfilled Material	28 days	Wed 7/2/14	Mon 8/11/14
61	Compact Landfilled Material	15 days	Wed 7/2/14	Wed 7/23/14
62	**Buffer Zone**	**7 days**	**Thu 9/11/14**	**Fri 9/19/14**
63	Buffer Zone Activity	7 days	Thu 9/11/14	Fri 9/19/14
64	**Backfill and Slope Correction**	**104 days**	**Fri 9/19/14**	**Fri 2/13/15**
65	**Additional Fill**	**104 days**	**Fri 9/19/14**	**Fri 2/13/15**
66	**Excavate additional fill material for grading**	**27 days**	**Fri 9/19/14**	**Tue 10/28/14**
67	Excavate	24 days	Fri 9/19/14	Thu 10/23/14
68	Load	4 days	Thu 10/23/14	Tue 10/28/14
69	Haul additional fill for grading	101 days	Fri 9/19/14	Fri 2/13/15
70	Spread additional fill	35 days	Fri 9/19/14	Mon 11/10/14
71	**Final Cover**	**157 days**	**Fri 2/13/15**	**Tue 9/22/15**
72	**Starter Berms**	**20 days**	**Fri 2/13/15**	**Thu 3/12/15**

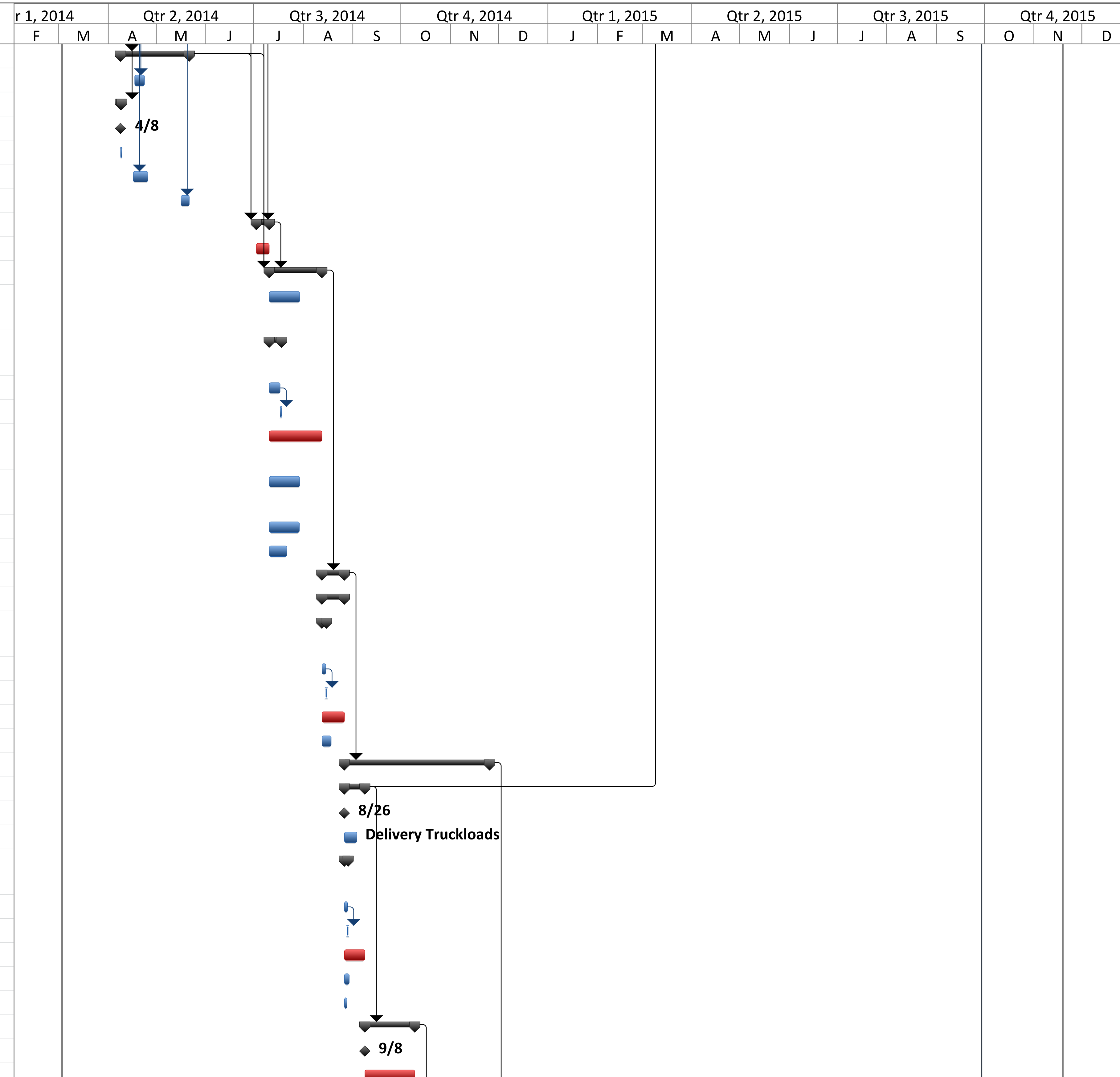


Note: All dates are for planning purposes only - not actual dates.

ID	Task Name	Estimated Duration	Start	Finish
73	Purchase material	0 days	Fri 2/13/15	Fri 2/13/15
74	Deliver and Stockpile	13 days	Fri 2/13/15	Tue 3/3/15
75	**Load material from stockpile to off road haul trucks**	**5 days**	**Fri 2/13/15**	**Thu 2/19/15**
76	Excavate	4 days	Fri 2/13/15	Thu 2/19/15
77	Load	1 day	Thu 2/19/15	Thu 2/19/15
78	Haul loose lift material for berm	20 days	Fri 2/13/15	Thu 3/12/15
79	Spread loose lift before compaction	7 days	Fri 2/13/15	Mon 2/23/15
80	Compact starter berms	3 days	Fri 2/13/15	Tue 2/17/15
81	**Bio-Intrusion**	**58 days**	**Thu 3/12/15**	**Tue 6/2/15**
82	Purchase of Bio-Intrusion Layer Material	0 days	Thu 3/12/15	Thu 3/12/15
83	Deliver Bio-Intrusion Layer Material	58 days	Thu 3/12/15	Tue 6/2/15
84	Spread Bio-Intrusion Layer Material	35 days	Thu 3/12/15	Thu 4/30/15
85	**Clay**	**55 days**	**Tue 6/2/15**	**Tue 8/18/15**
86	Purchase clay material	0 days	Tue 6/2/15	Tue 6/2/15
87	Deliver clay material to site	55 days	Tue 6/2/15	Tue 8/18/15
88	Spread loose lift before compaction	30 days	Tue 6/2/15	Tue 7/14/15
89	Compact Clay (Final Cover)	24 days	Tue 6/2/15	Mon 7/6/15
90	**Top Soil**	**25 days**	**Tue 8/18/15**	**Tue 9/22/15**
91	Purchase Topsoil	0 days	Tue 8/18/15	Tue 8/18/15
92	Deliver Topsoil	25 days	Tue 8/18/15	Tue 9/22/15
93	Move and place Topsoil (Final Cover)	13 days	Tue 8/18/15	Mon 9/7/15
94	**Post-Construction Stormwater Controls**	**41 days**	**Tue 9/22/15**	**Wed 11/18/15**
95	Install Terraces	5 days	Tue 9/22/15	Tue 9/29/15
96	Construct Ditches	16 days	Tue 9/22/15	Wed 10/14/15
97	**Pond**	**5 days**	**Tue 9/22/15**	**Tue 9/29/15**
98	**Load Overburden Material from stockpile to off road haul truck for pond**	**1 day**	**Tue 9/22/15**	**Wed 9/23/15**
99	Excavate	1 day	Tue 9/22/15	Wed 9/23/15
100	Load	0 days	Wed 9/23/15	Wed 9/23/15
101	Haul loose lift soil for Pond	5 days	Tue 9/22/15	Tue 9/29/15
102	Spread loose lift before compaction (Pond)	2 days	Tue 9/22/15	Thu 9/24/15
103	Compact Berm (Pond)	1 day	Tue 9/22/15	Wed 9/23/15
104	Final Stormwater Controls	2 days	Tue 9/22/15	Thu 9/24/15
105	Install 500 year floodplain barrier	41 days	Tue 9/22/15	Wed 11/18/15
106	**Site Completion**	**36 days**	**Wed 9/9/15**	**Thu 10/29/15**
107	Install temporary irrigation system	9 days	Wed 9/9/15	Tue 9/22/15
108	Apply seeding to cover	27 days	Tue 9/22/15	Thu 10/29/15
109	Apply seeding to soil stockpile	10 days	Tue 9/29/15	Tue 10/13/15
110	Install Fencing	18 days	Fri 9/18/15	Wed 10/14/15
111				
112	**Area 1**	**177 days**	**Tue 4/8/14**	**Thu 12/11/14**

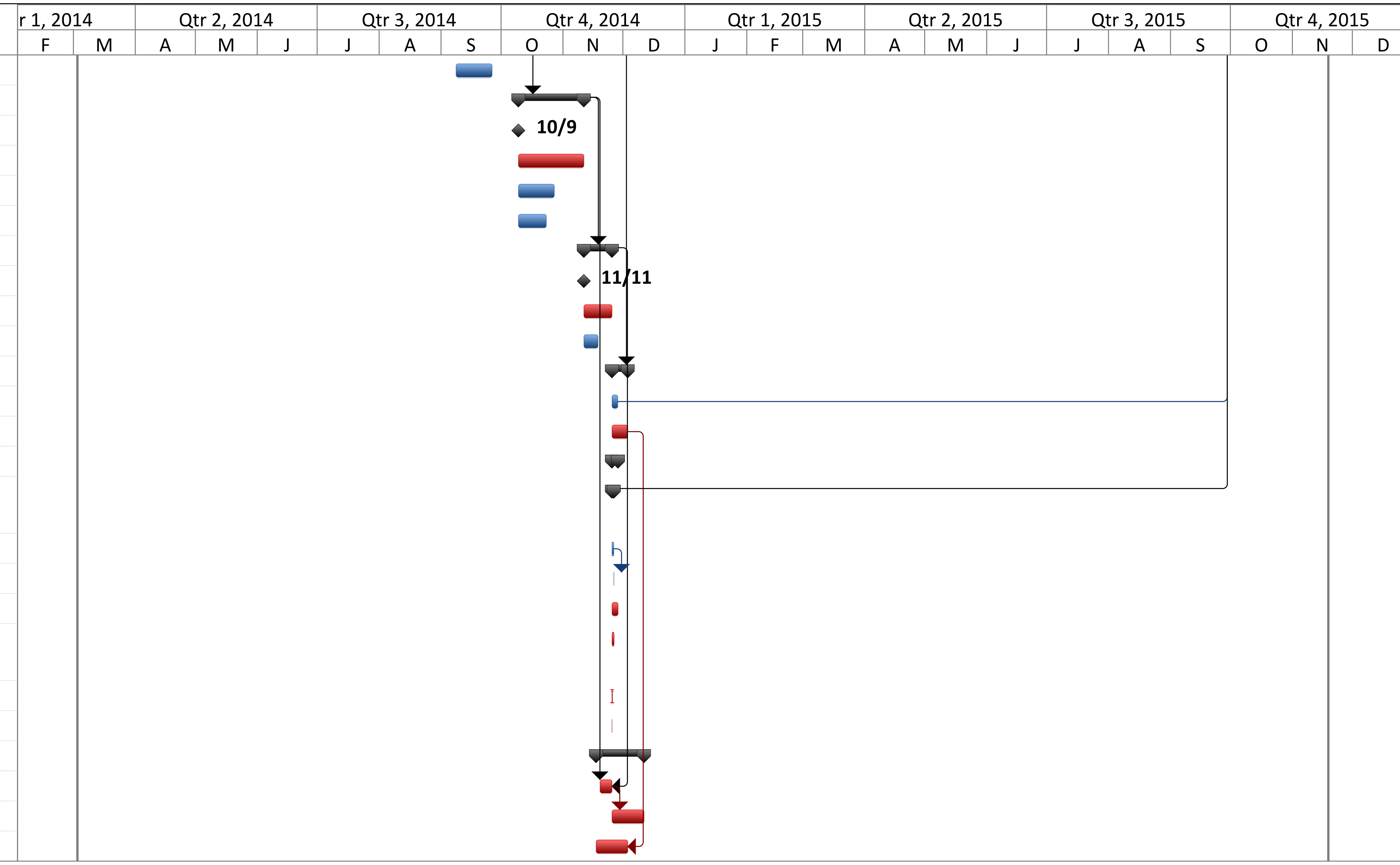


ID	Task Name	Estimated Duration	Start	Finish
113	**Site Preparation**	**31 days**	**Tue 4/8/14**	**Wed 5/21/14**
114	Prepare area with Stormwater BMPS	4 days	Thu 4/17/14	Wed 4/23/14
115	**Decontamination Area**	**0 days**	**Tue 4/8/14**	**Wed 4/9/14**
116	Materials	0 days	Tue 4/8/14	Tue 4/8/14
117	Installation	0 days	Tue 4/8/14	Wed 4/9/14
118	Clear Vegetation (Light)	7 days	Wed 4/16/14	Fri 4/25/14
119	Clear Vegetation (Heavy)	4 days	Fri 5/16/14	Wed 5/21/14
120	**Stormwater Events (Weather Delays)**	**6 days**	**Wed 7/2/14**	**Thu 7/10/14**
121	Dewater construction after rain events	6 days	Wed 7/2/14	Thu 7/10/14
122	**Regrading**	**23 days**	**Thu 7/10/14**	**Tue 8/12/14**
123	Apply daily cover to remaining excavation of Landfilled Material	13 days	Thu 7/10/14	Tue 7/29/14
124	**Relocate Landfilled Material on-site - Excavate**	**5 days**	**Thu 7/10/14**	**Fri 7/18/14**
125	Excavate	5 days	Thu 7/10/14	Thu 7/17/14
126	Load	1 day	Thu 7/17/14	Fri 7/18/14
127	Relocate Landfilled Material on-site - Haul and Dump	23 days	Thu 7/10/14	Tue 8/12/14
128	Apply daily cover to relocated Landfilled Material	13 days	Thu 7/10/14	Tue 7/29/14
129	Spread Landfilled Material	13 days	Thu 7/10/14	Tue 7/29/14
130	Compact Landfilled Material	7 days	Thu 7/10/14	Mon 7/21/14
131	**Backfill and Slope Correction**	**10 days**	**Tue 8/12/14**	**Tue 8/26/14**
132	**Additional Fill**	**10 days**	**Tue 8/12/14**	**Tue 8/26/14**
133	**Excavate additional fill material for grading**	**3 days**	**Tue 8/12/14**	**Fri 8/15/14**
134	Excavate	2 days	Tue 8/12/14	Thu 8/14/14
135	Load	0 days	Fri 8/15/14	Fri 8/15/14
136	Haul additional fill for grading	10 days	Tue 8/12/14	Tue 8/26/14
137	Spread additional fill	4 days	Tue 8/12/14	Mon 8/18/14
138	**Final Cover**	**65 days**	**Tue 8/26/14**	**Tue 11/25/14**
139	**Starter Berms**	**8 days**	**Tue 8/26/14**	**Mon 9/8/14**
140	Purchase material	0 days	Tue 8/26/14	Tue 8/26/14
141	Deliver and Stockpile	6 days	Tue 8/26/14	Wed 9/3/14
142	**Load material from stockpile to off road haul truck**	**2 days**	**Tue 8/26/14**	**Thu 8/28/14**
143	Excavate	2 days	Tue 8/26/14	Thu 8/28/14
144	Load	0 days	Thu 8/28/14	Thu 8/28/14
145	Haul loose lift material for berm	8 days	Tue 8/26/14	Mon 9/8/14
146	Spread loose lift before compaction	3 days	Tue 8/26/14	Fri 8/29/14
147	Compact starter berms	1 day	Tue 8/26/14	Thu 8/28/14
148	**Bio-Intrusion**	**24 days**	**Mon 9/8/14**	**Thu 10/9/14**
149	Purchase of Bio-Intrusion Layer Material	0 days	Mon 9/8/14	Mon 9/8/14
150	Deliver Bio-Intrusion Layer Material	24 days	Mon 9/8/14	Thu 10/9/14



Note: All dates are for planning purposes only - not actual dates.

ID	Task Name	Estimated Duration	Start	Finish
151	Spread Bio-Intrusion Layer Material	14 days	Mon 9/8/14	Fri 9/26/14
152	**Clay**	**22 days**	**Thu 10/9/14**	**Tue 11/11/14**
153	Purchase clay material	0 days	Thu 10/9/14	Thu 10/9/14
154	Deliver clay material to site	22 days	Thu 10/9/14	Tue 11/11/14
155	Spread loose lift before compaction	12 days	Thu 10/9/14	Mon 10/27/14
156	Compact Clay (Final Cover)	10 days	Thu 10/9/14	Thu 10/23/14
157	**Top Soil**	**10 days**	**Tue 11/11/14**	**Tue 11/25/14**
158	Purchase Topsoil	0 days	Tue 11/11/14	Tue 11/11/14
159	Deliver Topsoil	10 days	Tue 11/11/14	Tue 11/25/14
160	Move and place Topsoil (Final Cover)	5 days	Tue 11/11/14	Tue 11/18/14
161	**Post-Construction Stormwater Controls**	**6 days**	**Tue 11/25/14**	**Wed 12/3/14**
162	Install Terraces	3 days	Tue 11/25/14	Fri 11/28/14
163	Construct Ditches	6 days	Tue 11/25/14	Wed 12/3/14
164	**Pond**	**3 days**	**Tue 11/25/14**	**Fri 11/28/14**
165	**Load Overburden Material from stockpile to off road haul truck for pond**	**1 day**	**Tue 11/25/14**	**Wed 11/26/14**
166	Excavate	1 day	Tue 11/25/14	Wed 11/26/14
167	Load	0 days	Wed 11/26/14	Wed 11/26/14
168	Haul loose lift soil for Pond	3 days	Tue 11/25/14	Fri 11/28/14
169	Spread loose lift before compaction (Pond)	1 day	Tue 11/25/14	Wed 11/26/14
170	Compact Berm (Pond)	1 day	Tue 11/25/14	Tue 11/25/14
171	Final Stormwater Controls	0 days	Tue 11/25/14	Tue 11/25/14
172	**Site Completion**	**18 days**	**Mon 11/17/14**	**Thu 12/11/14**
173	Install temporary irrigation system	4 days	Wed 11/19/14	Tue 11/25/14
174	Apply seeding to cover	12 days	Tue 11/25/14	Thu 12/11/14
175	Install Fencing	12 days	Mon 11/17/14	Wed 12/3/14



Note: All dates are for planning purposes only - not actual dates.

Estimated Schedule

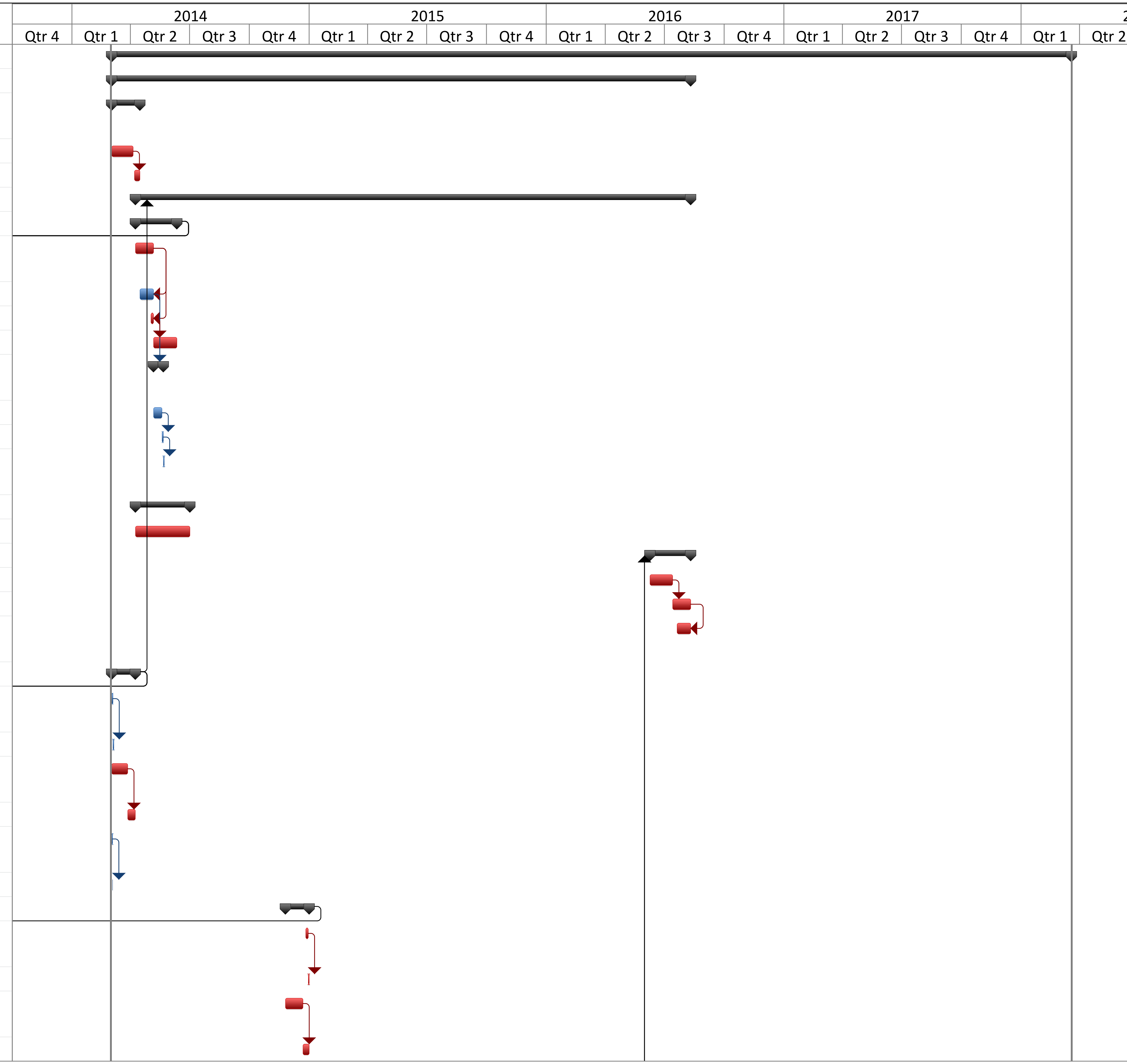
ROD-Selected Remedy
(with $10 million/year limitation)

9-14-11

ID	Task Name	Estimated Duration	Start	Finish
1	**ROD Remedy**	**1055 days**	**Mon 3/3/14**	**Mon 3/19/18**
2	**Site-wide Preparation**	**637 days**	**Mon 3/3/14**	**Wed 8/10/16**
3	**Temporary Construction Facilities / Utilities / Personnel**	**31 days**	**Mon 3/3/14**	**Tue 4/15/14**
6	**Temporary Stormwater Infrastructure**	**611 days**	**Tue 4/8/14**	**Wed 8/10/16**
7	**Temporary Stormwater Lagoon**	**46 days**	**Tue 4/8/14**	**Wed 6/11/14**
16	**Treatment Facility**	**60 days**	**Tue 4/8/14**	**Tue 7/1/14**
18	**Post-project Stormwater Demolition**	**45 days**	**Wed 6/8/16**	**Wed 8/10/16**
22	**Mobilization**	**27 days**	**Mon 3/3/14**	**Tue 4/8/14**
29	**Supplemental Mobilization**	**27 days**	**Tue 11/25/14**	**Wed 12/31/14**
36	**Create Temporary Roads**	**28 days**	**Tue 4/8/14**	**Fri 5/16/14**
39	**Install TBD Traffic Improvements**	**20 days**	**Tue 4/8/14**	**Tue 5/6/14**
42				
43	**Area 2**	**1029 days**	**Tue 4/8/14**	**Mon 3/19/18**
44	**Site Preparation**	**28 days**	**Tue 4/8/14**	**Fri 5/16/14**
51	**Stormwater Events (Weather Delays)**	**16 days**	**Wed 6/11/14**	**Wed 7/2/14**
53	**Regrading**	**127 days**	**Thu 1/1/15**	**Fri 6/26/15**
62	**Buffer Zone**	**7 days**	**Fri 6/26/15**	**Tue 7/7/15**
64	**Backfill and Slope Correction**	**202 days**	**Tue 7/7/15**	**Thu 4/14/16**
71	**Final Cover**	**461 days**	**Thu 4/14/16**	**Fri 1/19/18**
72	**Starter Berms**	**39 days**	**Thu 4/14/16**	**Wed 6/8/16**
81	**Bio-Intrusion**	**116 days**	**Wed 6/8/16**	**Thu 11/17/16**
85	**Clay**	**75 days**	**Mon 1/2/17**	**Fri 4/14/17**
90	**Top Soil**	**15 days**	**Mon 1/1/18**	**Fri 1/19/18**
94	**Post-Construction Stormwater Controls**	**41 days**	**Fri 1/19/18**	**Mon 3/19/18**
106	**Site Completion**	**36 days**	**Mon 1/8/18**	**Tue 2/27/18**
111				
112	**Area 1**	**249 days**	**Tue 4/8/14**	**Mon 3/23/15**
113	**Site Preparation**	**7 days**	**Tue 4/8/14**	**Thu 4/17/14**
120	**Stormwater Events (Weather Delays)**	**6 days**	**Wed 6/11/14**	**Thu 6/19/14**
122	**Regrading**	**45 days**	**Thu 6/19/14**	**Thu 8/21/14**
131	**Backfill and Slope Correction**	**21 days**	**Thu 8/21/14**	**Fri 9/19/14**
138	**Final Cover**	**119 days**	**Fri 9/19/14**	**Thu 3/5/15**
161	**Post-Construction Stormwater Controls**	**6 days**	**Thu 3/5/15**	**Thu 3/12/15**
172	**Site Completion**	**18 days**	**Wed 2/25/15**	**Mon 3/23/15**

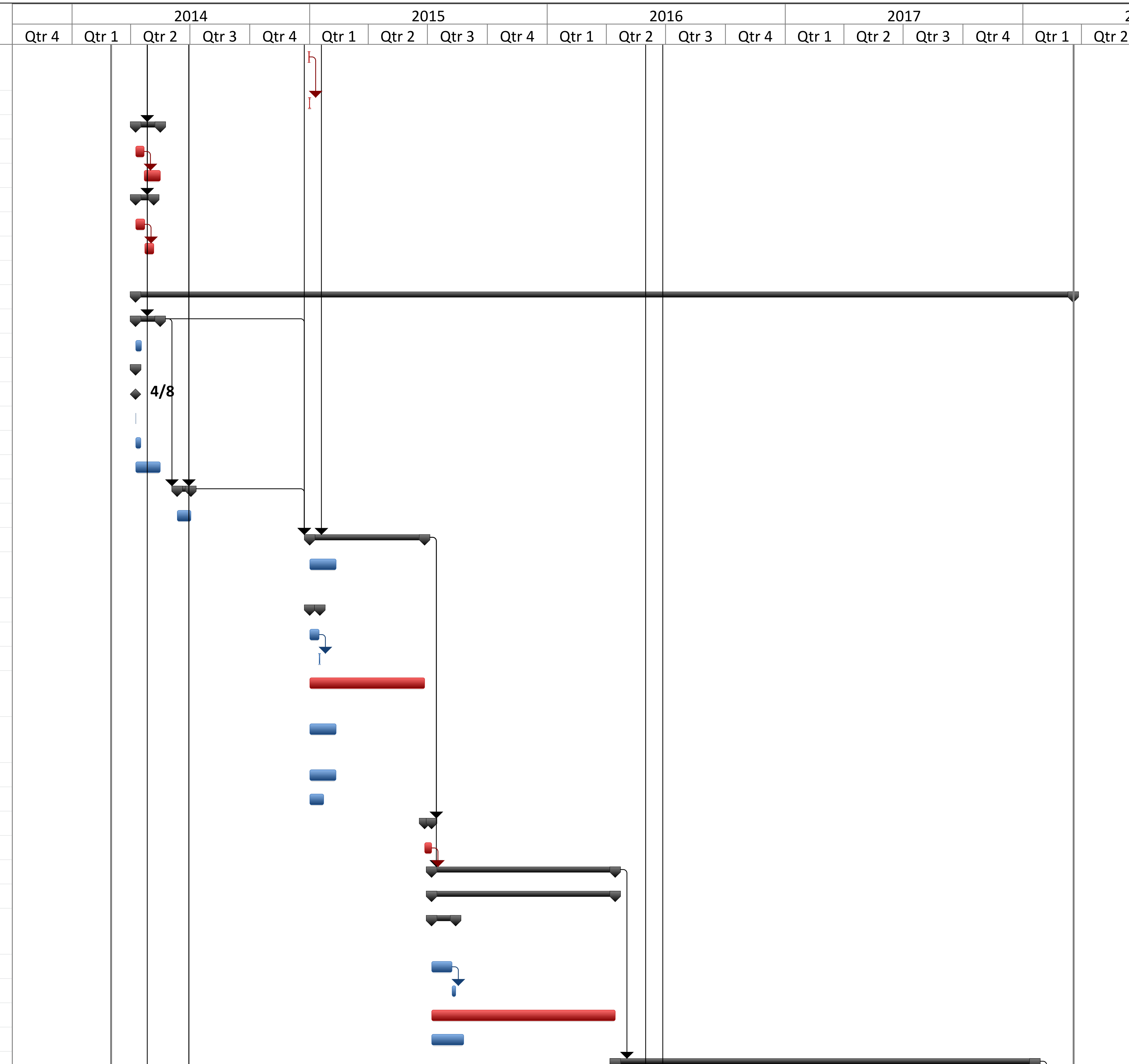
Note: All dates are for planning purposes only - not actual dates.

ID	Task Name	Estimated Duration	Start	Finish
1	**ROD Remedy**	**1055 days**	**Mon 3/3/14**	**Mon 3/19/18**
2	**Site-wide Preparation**	**637 days**	**Mon 3/3/14**	**Wed 8/10/16**
3	**Temporary Construction Facilities / Utilities / Personnel**	**31 days**	**Mon 3/3/14**	**Tue 4/15/14**
4	Construction Trailers	25 days	Mon 3/3/14	Fri 4/4/14
5	Parking Area	6 days	Mon 4/7/14	Tue 4/15/14
6	**Temporary Stormwater Infrastructure**	**611 days**	**Tue 4/8/14**	**Wed 8/10/16**
7	**Temporary Stormwater Lagoon**	**46 days**	**Tue 4/8/14**	**Wed 6/11/14**
8	Excavate soil for 4th berm at former leachate lagoon area	20 days	Tue 4/8/14	Tue 5/6/14
9	Place soil for berm	15 days	Tue 4/15/14	Tue 5/6/14
10	Compact berm	2 days	Fri 5/2/14	Tue 5/6/14
11	Install geomembrane liner	26 days	Tue 5/6/14	Wed 6/11/14
12	**Install force main from Areas 1 and 2 to lagoon**	**11 days**	**Tue 5/6/14**	**Wed 5/21/14**
13	Area 1	9 days	Tue 5/6/14	Mon 5/19/14
14	Area 2	2 days	Mon 5/19/14	Wed 5/21/14
15	Install force main from lagoon to treatment facility	1 day	Wed 5/21/14	Thu 5/22/14
16	**Treatment Facility**	**60 days**	**Tue 4/8/14**	**Tue 7/1/14**
17	Construction	60 days	Tue 4/8/14	Tue 7/1/14
18	**Post-project Stormwater Demolition**	**45 days**	**Wed 6/8/16**	**Wed 8/10/16**
19	Dispose of geomembrane liner	25 days	Wed 6/8/16	Wed 7/13/16
20	Deconstruct 4th berm	20 days	Wed 7/13/16	Wed 8/10/16
21	Grade berm material in lagoon for proper drainage	15 days	Wed 7/20/16	Wed 8/10/16
22	**Mobilization**	**27 days**	**Mon 3/3/14**	**Tue 4/8/14**
23	Mobilize and Demobilize Equipment Under 150HP	2 days	Mon 3/3/14	Tue 3/4/14
24	Extra Mileage for Mobilizations	1 day	Wed 3/5/14	Thu 3/6/14
25	Mobilize and Demobilize Equipment Over 150HP	19 days	Mon 3/3/14	Thu 3/27/14
26	Extra Mileage for Mobilizations	8 days	Thu 3/27/14	Tue 4/8/14
27	Mobilize and Demobilize Equipment, Towed	1 day	Mon 3/3/14	Tue 3/4/14
28	Extra Mileage for Mobilizations	1 day	Tue 3/4/14	Tue 3/4/14
29	**Supplemental Mobilization**	**27 days**	**Tue 11/25/14**	**Wed 12/31/14**
30	Mobilize and Demobilize Equipment Under 150HP	2 days	Fri 12/26/14	Tue 12/30/14
31	Extra Mileage for Mobilizations	1 day	Tue 12/30/14	Wed 12/31/14
32	Mobilize and Demobilize Equipment Over 150HP	19 days	Tue 11/25/14	Mon 12/22/14
33	Extra Mileage for Mobilizations	8 days	Mon 12/22/14	Wed 12/31/14



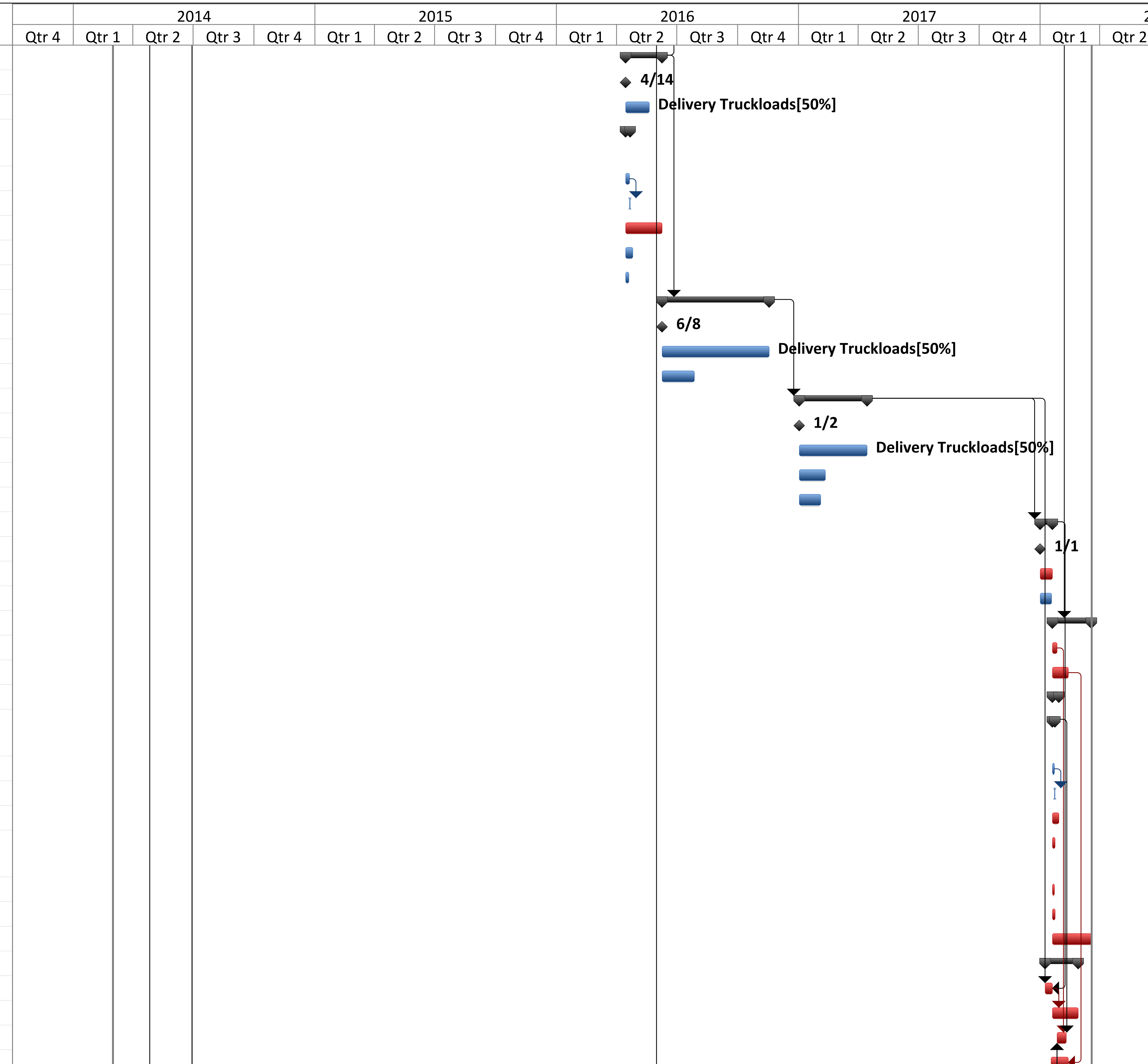
Note: All dates are for planning purposes only - not actual dates.

ID	Task Name	Estimated Duration	Start	Finish
34	Mobilize and Demobilize Equipment, Towed	1 day	Tue 12/30/14	Wed 12/31/14
35	Extra Mileage for Mobilizations	1 day	Wed 12/31/14	Wed 12/31/14
36	**Create Temporary Roads**	**28 days**	**Tue 4/8/14**	**Fri 5/16/14**
37	Area 1	9 days	Tue 4/8/14	Mon 4/21/14
38	Area 2	19 days	Mon 4/21/14	Fri 5/16/14
39	**Install TBD Traffic Improvements**	**20 days**	**Tue 4/8/14**	**Tue 5/6/14**
40	Area 1	10 days	Tue 4/8/14	Tue 4/22/14
41	Area 2	10 days	Tue 4/22/14	Tue 5/6/14
42				
43	**Area 2**	**1029 days**	**Tue 4/8/14**	**Mon 3/19/18**
44	**Site Preparation**	**28 days**	**Tue 4/8/14**	**Fri 5/16/14**
45	Prepare area with Stormwater BMPS	7 days	Tue 4/8/14	Thu 4/17/14
46	**Decontamination Area**	**0 days**	**Tue 4/8/14**	**Tue 4/8/14**
47	Materials	0 days	Tue 4/8/14	Tue 4/8/14
48	Installation	0 days	Tue 4/8/14	Tue 4/8/14
49	Clear Vegetation (Light)	6 days	Tue 4/8/14	Wed 4/16/14
50	Clear Vegetation (Heavy)	28 days	Tue 4/8/14	Fri 5/16/14
51	**Stormwater Events (Weather Delays)**	**16 days**	**Wed 6/11/14**	**Wed 7/2/14**
52	Dewater construction after rain events	16 days	Wed 6/11/14	Wed 7/2/14
53	**Regrading**	**127 days**	**Thu 1/1/15**	**Fri 6/26/15**
54	Apply daily cover to remaining excavation of Landfilled Material	29 days	Thu 1/1/15	Tue 2/10/15
55	**Relocate Landfilled Material on-site**	**12 days**	**Thu 1/1/15**	**Fri 1/16/15**
56	Excavate	10 days	Thu 1/1/15	Thu 1/15/15
57	Load	2 days	Thu 1/15/15	Fri 1/16/15
58	Relocate Landfilled Material on-site - Haul and Dump	127 days	Thu 1/1/15	Fri 6/26/15
59	Apply daily cover to relocated Landfilled Material	29 days	Thu 1/1/15	Tue 2/10/15
60	Spread Landfilled Material	28 days	Thu 1/1/15	Tue 2/10/15
61	Compact Landfilled Material	15 days	Thu 1/1/15	Thu 1/22/15
62	**Buffer Zone**	**7 days**	**Fri 6/26/15**	**Tue 7/7/15**
63	Buffer Zone Activity	7 days	Fri 6/26/15	Tue 7/7/15
64	**Backfill and Slope Correction**	**202 days**	**Tue 7/7/15**	**Thu 4/14/16**
65	**Additional Fill**	**202 days**	**Tue 7/7/15**	**Thu 4/14/16**
66	**Excavate additional fill material for grading**	**27 days**	**Tue 7/7/15**	**Thu 8/13/15**
67	Excavate	24 days	Tue 7/7/15	Fri 8/7/15
68	Load	4 days	Fri 8/7/15	Thu 8/13/15
69	Haul additional fill for grading	202 days	Tue 7/7/15	Thu 4/14/16
70	Spread additional fill	35 days	Tue 7/7/15	Tue 8/25/15
71	**Final Cover**	**461 days**	**Thu 4/14/16**	**Fri 1/19/18**

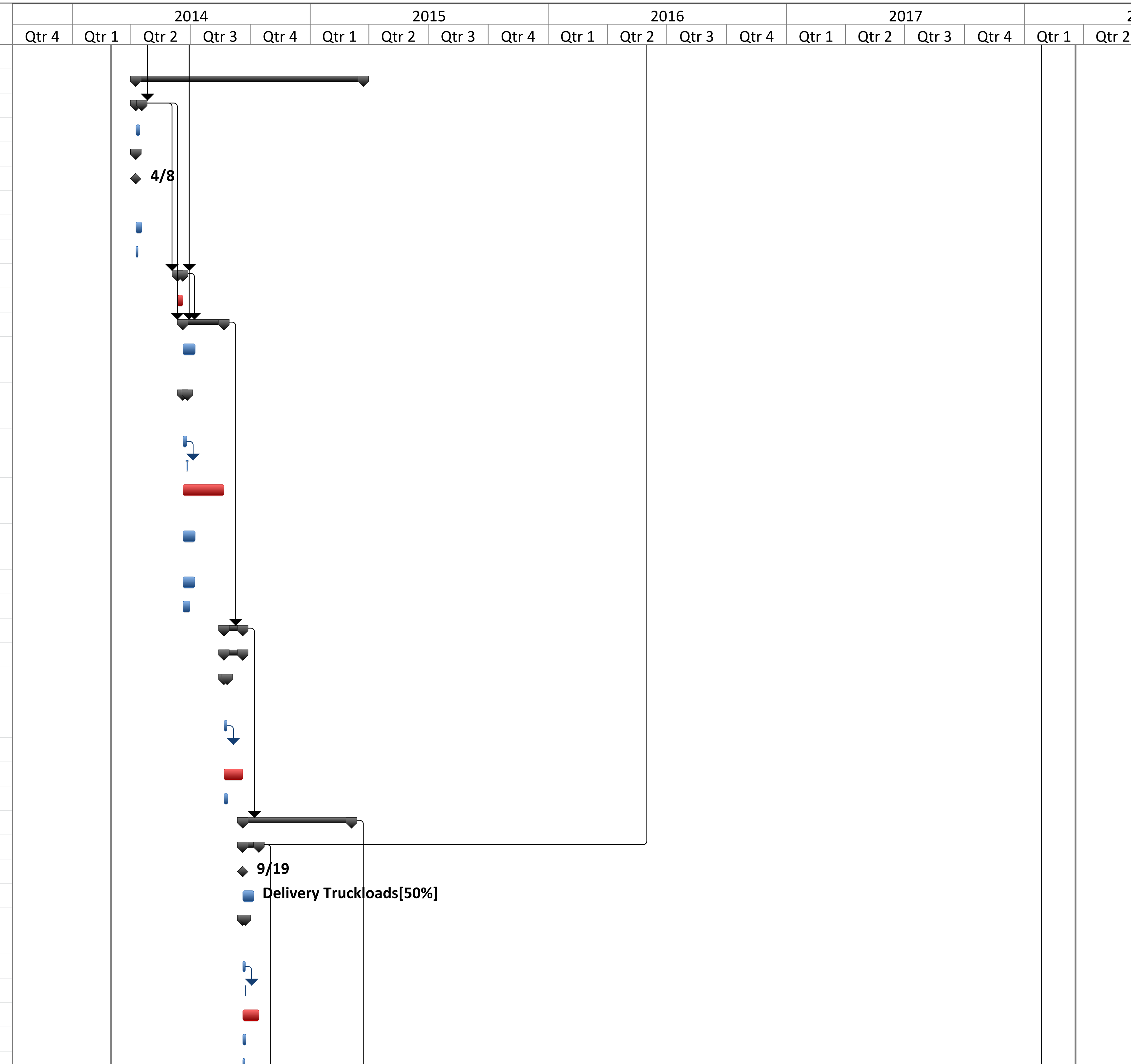


Note: All dates are for planning purposes only - not actual dates.

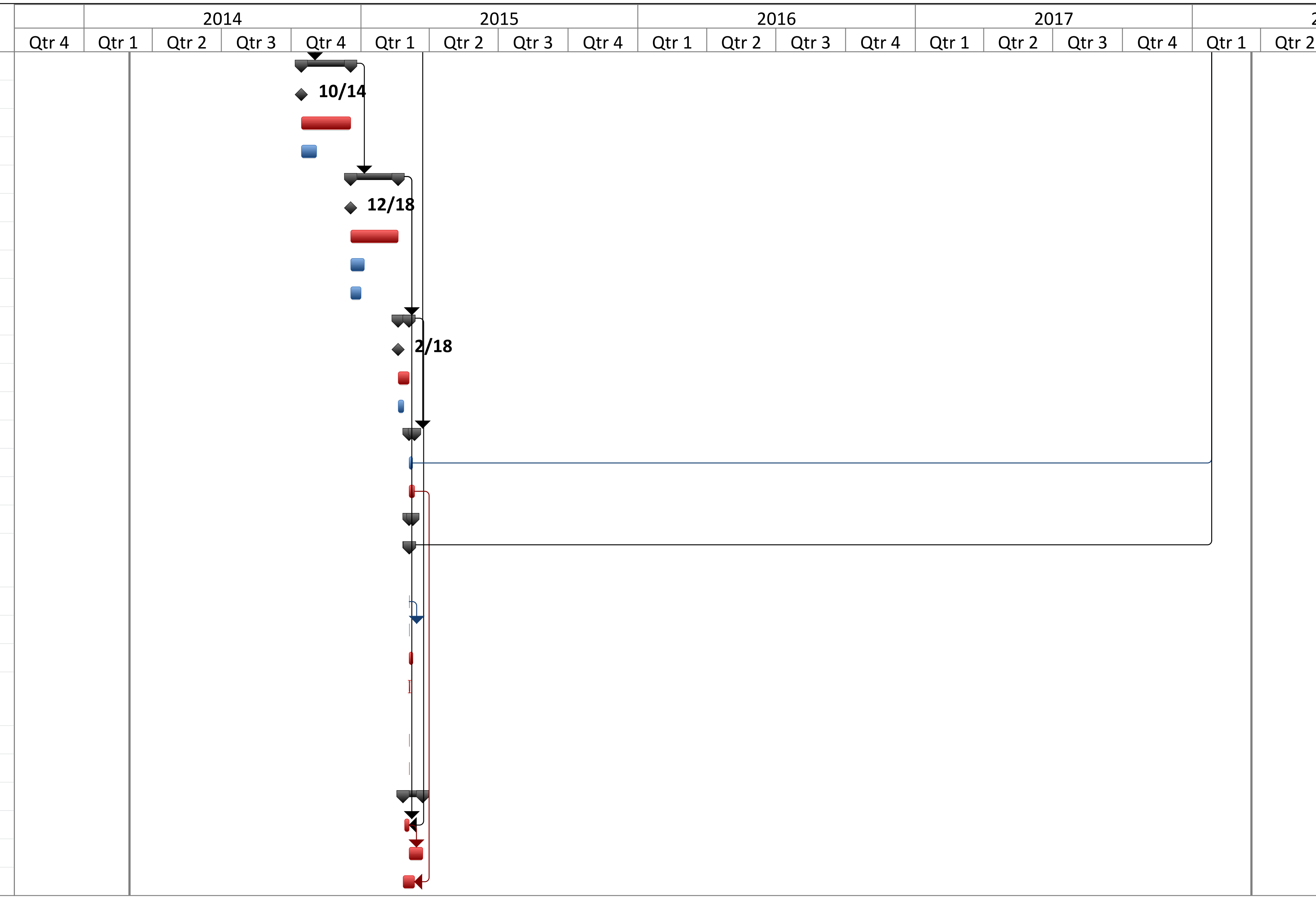
ID	Task Name	Estimated Duration	Start	Finish
72	**Starter Berms**	**39 days**	**Thu 4/14/16**	**Wed 6/8/16**
73	Purchase material	0 days	Thu 4/14/16	Thu 4/14/16
74	Deliver and Stockpile	26 days	Thu 4/14/16	Fri 5/20/16
75	**Load material from stockpile to off road haul trucks**	**5 days**	**Thu 4/14/16**	**Thu 4/21/16**
76	Excavate	4 days	Thu 4/14/16	Wed 4/20/16
77	Load	1 day	Wed 4/20/16	Thu 4/21/16
78	Haul loose lift material for berm	39 days	Thu 4/14/16	Wed 6/8/16
79	Spread loose lift before compaction	7 days	Thu 4/14/16	Mon 4/25/16
80	Compact starter berms	3 days	Thu 4/14/16	Tue 4/19/16
81	**Bio-Intrusion**	**116 days**	**Wed 6/8/16**	**Thu 11/17/16**
82	Purchase of Bio-Intrusion Layer Material	0 days	Wed 6/8/16	Wed 6/8/16
83	Deliver Bio-Intrusion Layer Material	116 days	Wed 6/8/16	Thu 11/17/16
84	Spread Bio-Intrusion Layer Material	35 days	Wed 6/8/16	Wed 7/27/16
85	**Clay**	**75 days**	**Mon 1/2/17**	**Fri 4/14/17**
86	Purchase clay material	0 days	Mon 1/2/17	Mon 1/2/17
87	Deliver clay material to site	75 days	Mon 1/2/17	Fri 4/14/17
88	Spread loose lift before compaction	30 days	Mon 1/2/17	Fri 2/10/17
89	Compact Clay (Final Cover)	24 days	Mon 1/2/17	Fri 2/3/17
90	**Top Soil**	**15 days**	**Mon 1/1/18**	**Fri 1/19/18**
91	Purchase Topsoil	0 days	Mon 1/1/18	Mon 1/1/18
92	Deliver Topsoil	15 days	Mon 1/1/18	Fri 1/19/18
93	Move and place Topsoil (Final Cover)	13 days	Mon 1/1/18	Thu 1/18/18
94	**Post-Construction Stormwater Controls**	**41 days**	**Fri 1/19/18**	**Mon 3/19/18**
95	Install Terraces	5 days	Fri 1/19/18	Fri 1/26/18
96	Construct Ditches	16 days	Fri 1/19/18	Mon 2/12/18
97	**Pond**	**5 days**	**Fri 1/19/18**	**Mon 1/29/18**
98	**Load Overburden Material from stockpile to off road haul truck for pond**	**1 day**	**Fri 1/19/18**	**Tue 1/23/18**
99	Excavate	1 day	Fri 1/19/18	Mon 1/22/18
100	Load	0 days	Mon 1/22/18	Tue 1/23/18
101	Haul loose lift soil for Pond	5 days	Fri 1/19/18	Mon 1/29/18
102	Spread loose lift before compaction (Pond)	2 days	Fri 1/19/18	Tue 1/23/18
103	Compact Berm (Pond)	1 day	Fri 1/19/18	Mon 1/22/18
104	Final Stormwater Controls	2 days	Fri 1/19/18	Tue 1/23/18
105	Install 500 year floodplain barrier	41 days	Fri 1/19/18	Mon 3/19/18
106	**Site Completion**	**36 days**	**Mon 1/8/18**	**Tue 2/27/18**
107	Install temporary irrigation system	9 days	Mon 1/8/18	Fri 1/19/18
108	Apply seeding to cover	27 days	Fri 1/19/18	Tue 2/27/18
109	Apply seeding to soil stockpile	10 days	Fri 1/26/18	Fri 2/9/18
110	Install Fencing	18 days	Wed 1/17/18	Mon 2/12/18



ID	Task Name	Estimated Duration	Start	Finish
111				
112	**Area 1**	**249 days**	**Tue 4/8/14**	**Mon 3/23/15**
113	**Site Preparation**	**7 days**	**Tue 4/8/14**	**Thu 4/17/14**
114	Prepare area with Stormwater BMPS	4 days	Tue 4/8/14	Mon 4/14/14
115	**Decontamination Area**	**0 days**	**Tue 4/8/14**	**Tue 4/8/14**
116	Materials	0 days	Tue 4/8/14	Tue 4/8/14
117	Installation	0 days	Tue 4/8/14	Tue 4/8/14
118	Clear Vegetation (Light)	7 days	Tue 4/8/14	Thu 4/17/14
119	Clear Vegetation (Heavy)	4 days	Tue 4/8/14	Fri 4/11/14
120	**Stormwater Events (Weather Delays)**	**6 days**	**Wed 6/11/14**	**Thu 6/19/14**
121	Dewater construction after rain events	6 days	Wed 6/11/14	Thu 6/19/14
122	**Regrading**	**45 days**	**Thu 6/19/14**	**Thu 8/21/14**
123	Apply daily cover to remaining excavation of Landfilled Material	13 days	Thu 6/19/14	Tue 7/8/14
124	**Relocate Landfilled Material on-site - Excavate**	**5 days**	**Thu 6/19/14**	**Thu 6/26/14**
125	Excavate	5 days	Thu 6/19/14	Wed 6/25/14
126	Load	1 day	Wed 6/25/14	Thu 6/26/14
127	Relocate Landfilled Material on-site - Haul and Dump	45 days	Thu 6/19/14	Thu 8/21/14
128	Apply daily cover to relocated Landfilled Material	13 days	Thu 6/19/14	Tue 7/8/14
129	Spread Landfilled Material	13 days	Thu 6/19/14	Mon 7/7/14
130	Compact Landfilled Material	7 days	Thu 6/19/14	Mon 6/30/14
131	**Backfill and Slope Correction**	**21 days**	**Thu 8/21/14**	**Fri 9/19/14**
132	**Additional Fill**	**21 days**	**Thu 8/21/14**	**Fri 9/19/14**
133	**Excavate additional fill material for grading**	**3 days**	**Thu 8/21/14**	**Tue 8/26/14**
134	Excavate	2 days	Thu 8/21/14	Tue 8/26/14
135	Load	0 days	Tue 8/26/14	Tue 8/26/14
136	Haul additional fill for grading	21 days	Thu 8/21/14	Fri 9/19/14
137	Spread additional fill	4 days	Thu 8/21/14	Wed 8/27/14
138	**Final Cover**	**119 days**	**Fri 9/19/14**	**Thu 3/5/15**
139	**Starter Berms**	**17 days**	**Fri 9/19/14**	**Tue 10/14/14**
140	Purchase material	0 days	Fri 9/19/14	Fri 9/19/14
141	Deliver and Stockpile	11 days	Fri 9/19/14	Mon 10/6/14
142	**Load material from stockpile to off road haul truck**	**2 days**	**Fri 9/19/14**	**Tue 9/23/14**
143	Excavate	2 days	Fri 9/19/14	Tue 9/23/14
144	Load	0 days	Tue 9/23/14	Tue 9/23/14
145	Haul loose lift material for berm	17 days	Fri 9/19/14	Tue 10/14/14
146	Spread loose lift before compaction	3 days	Fri 9/19/14	Wed 9/24/14
147	Compact starter berms	1 day	Fri 9/19/14	Mon 9/22/14



ID	Task Name	Estimated Duration	Start	Finish
148	**Bio-Intrusion**	**47 days**	**Tue 10/14/14**	**Thu 12/18/14**
149	Purchase of Bio-Intrusion Layer Material	0 days	Tue 10/14/14	Tue 10/14/14
150	Deliver Bio-Intrusion Layer Material	47 days	Tue 10/14/14	Thu 12/18/14
151	Spread Bio-Intrusion Layer Material	14 days	Tue 10/14/14	Mon 11/3/14
152	**Clay**	**45 days**	**Thu 12/18/14**	**Wed 2/18/15**
153	Purchase clay material	0 days	Thu 12/18/14	Thu 12/18/14
154	Deliver clay material to site	45 days	Thu 12/18/14	Wed 2/18/15
155	Spread loose lift before compaction	12 days	Thu 12/18/14	Mon 1/5/15
156	Compact Clay (Final Cover)	10 days	Thu 12/18/14	Wed 12/31/14
157	**Top Soil**	**10 days**	**Wed 2/18/15**	**Thu 3/5/15**
158	Purchase Topsoil	0 days	Wed 2/18/15	Wed 2/18/15
159	Deliver Topsoil	10 days	Thu 2/19/15	Thu 3/5/15
160	Move and place Topsoil (Final Cover)	5 days	Thu 2/19/15	Thu 2/26/15
161	**Post-Construction Stormwater Controls**	**6 days**	**Thu 3/5/15**	**Thu 3/12/15**
162	Install Terraces	3 days	Thu 3/5/15	Mon 3/9/15
163	Construct Ditches	6 days	Thu 3/5/15	Thu 3/12/15
164	**Pond**	**3 days**	**Thu 3/5/15**	**Tue 3/10/15**
165	**Load Overburden Material from stockpile to off road haul truck for pond**	**1 day**	**Thu 3/5/15**	**Thu 3/5/15**
166	Excavate	1 day	Thu 3/5/15	Thu 3/5/15
167	Load	0 days	Thu 3/5/15	Thu 3/5/15
168	Haul loose lift soil for Pond	3 days	Thu 3/5/15	Tue 3/10/15
169	Spread loose lift before compaction (Pond)	1 day	Thu 3/5/15	Fri 3/6/15
170	Compact Berm (Pond)	1 day	Thu 3/5/15	Thu 3/5/15
171	Final Stormwater Controls	0 days	Thu 3/5/15	Thu 3/5/15
172	**Site Completion**	**18 days**	**Wed 2/25/15**	**Mon 3/23/15**
173	Install temporary irrigation system	4 days	Fri 2/27/15	Thu 3/5/15
174	Apply seeding to cover	12 days	Thu 3/5/15	Mon 3/23/15
175	Install Fencing	12 days	Wed 2/25/15	Thu 3/12/15



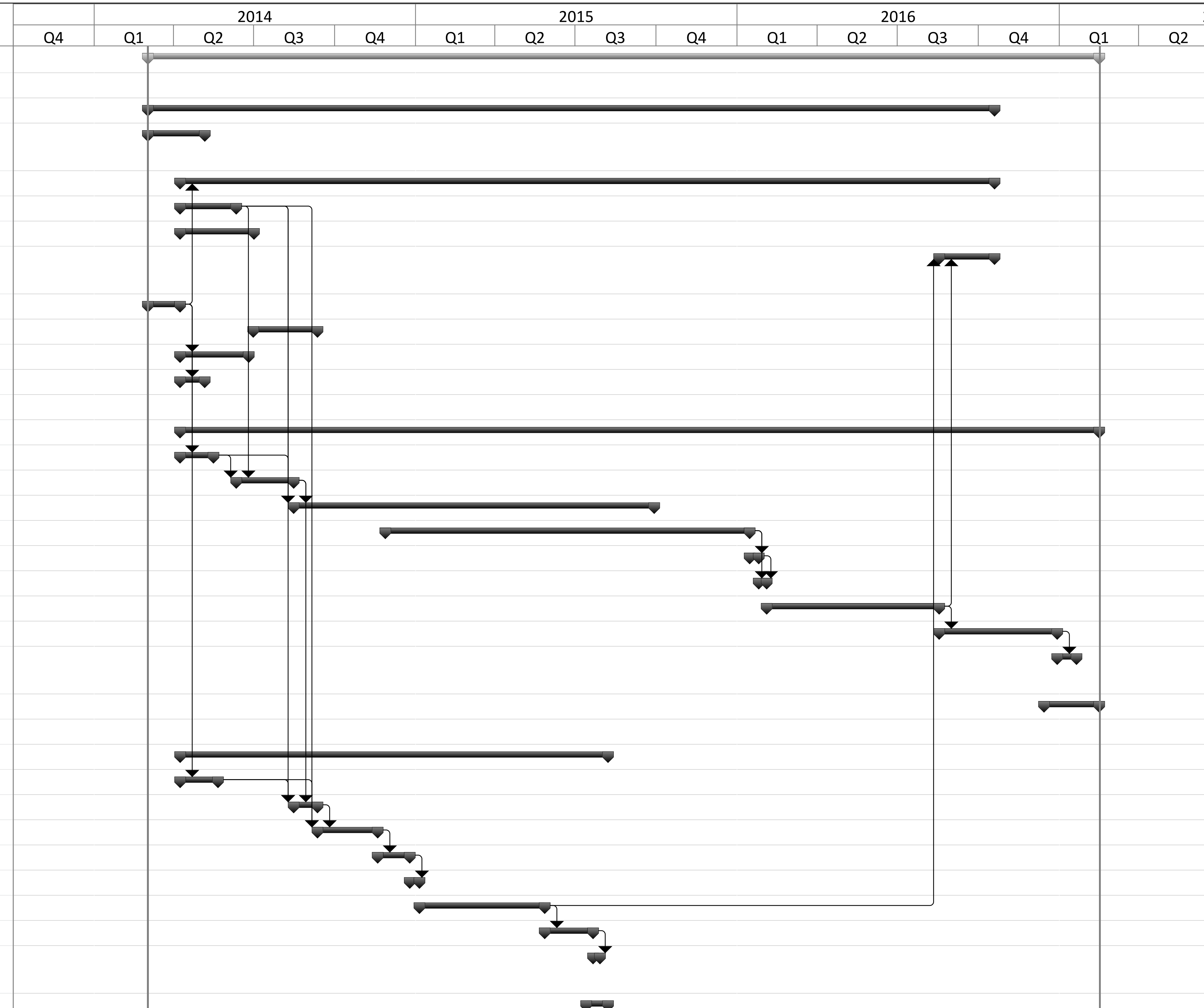
Appendix J-2:

Estimated Project Schedules for the
“Complete Rad Removal” with Off-Site Disposal Alternative

Estimated Schedule

“Complete Rad Removal” with On-Site Disposal Alternative

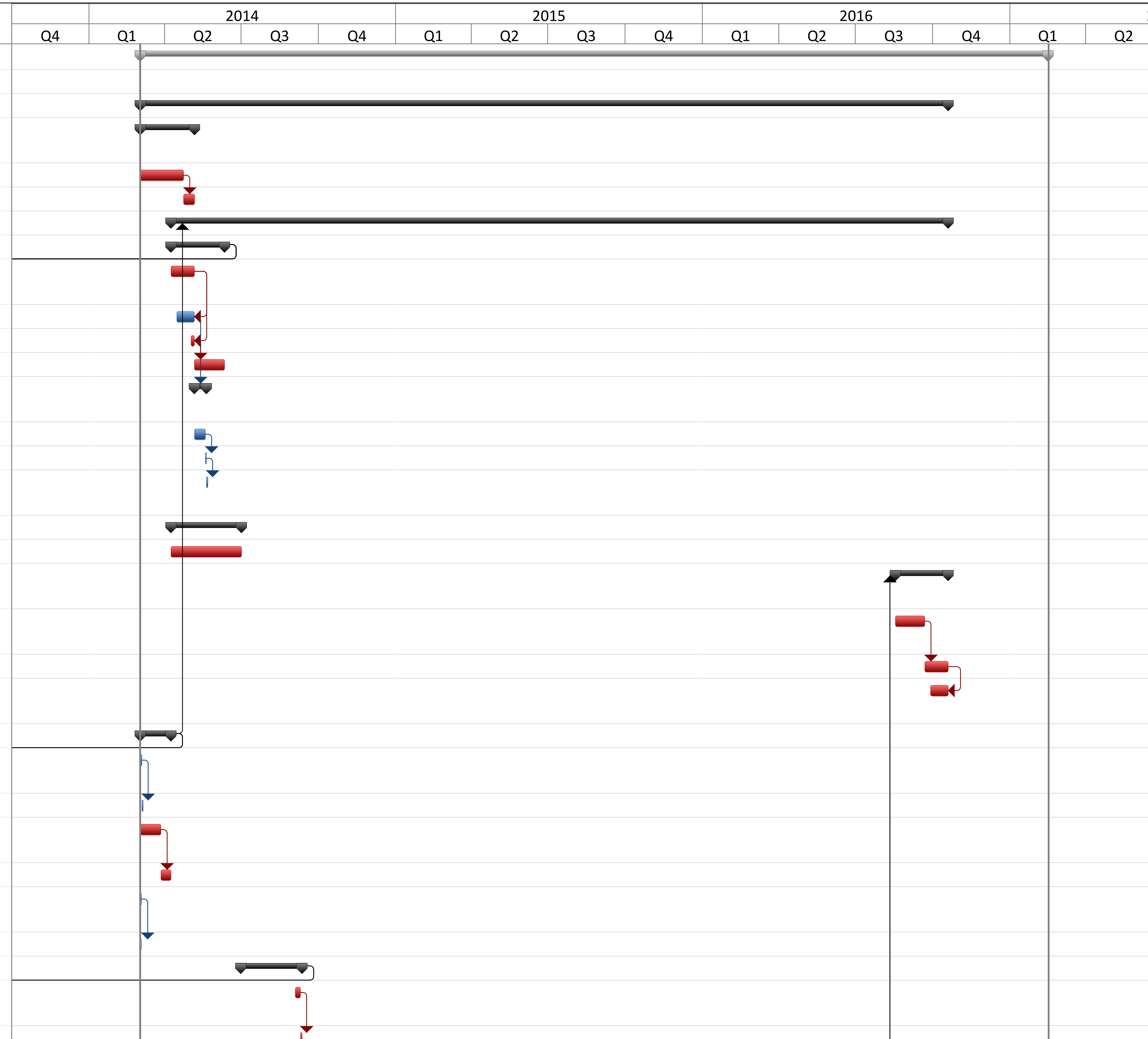
ID	Task Name	Estimated Duration	Start	Finish
0	**Off-Site Disposal Alternative**	**772 days**	**Mon 3/3/14**	**Wed 2/15/17**
1				
2	**Site-wide Preparation**	**687 days**	**Mon 3/3/14**	**Wed 10/19/16**
3	**Temporary Construction Facilities / Utilities / Personnel**	**47 days**	**Mon 3/3/14**	**Tue 5/6/14**
6	**Temporary Stormwater Infrastructure**	**661 days**	**Tue 4/8/14**	**Wed 10/19/16**
7	**Temporary Stormwater Lagoon**	**46 days**	**Tue 4/8/14**	**Wed 6/11/14**
16	**Treatment Facility**	**60 days**	**Tue 4/8/14**	**Tue 7/1/14**
18	**Post-project Stormwater Demolition**	**45 days**	**Wed 8/17/16**	**Wed 10/19/16**
22	**Mobilization**	**27 days**	**Mon 3/3/14**	**Tue 4/8/14**
29	**Supplemental Mobilizations**	**53 days**	**Mon 6/30/14**	**Thu 9/11/14**
36	**Create Temporary Roads**	**56 days**	**Tue 4/8/14**	**Wed 6/25/14**
39	**Install TBD Traffic Improvements**	**20 days**	**Tue 4/8/14**	**Tue 5/6/14**
42				
43	**Area 2**	**746 days**	**Tue 4/8/14**	**Wed 2/15/17**
44	**Site Preparation**	**28 days**	**Tue 4/8/14**	**Fri 5/16/14**
55	**Stormwater Events (Weather Delays)**	**47 days**	**Wed 6/11/14**	**Fri 8/15/14**
57	**Overburden Relocation**	**292 days**	**Fri 8/15/14**	**Mon 9/28/15**
67	**RIM Relocation**	**296 days**	**Thu 11/27/14**	**Fri 1/15/16**
78	**Buffer Zone**	**7 days**	**Fri 1/15/16**	**Mon 1/25/16**
80	**Radiological Survey**	**7 days**	**Mon 1/25/16**	**Wed 2/3/16**
83	**Backfill and Slope Correction**	**140 days**	**Wed 2/3/16**	**Wed 8/17/16**
105	**Final Cover**	**96 days**	**Wed 8/17/16**	**Thu 12/29/16**
115	**Post-Construction Stormwater Controls**	**16 days**	**Thu 12/29/16**	**Fri 1/20/17**
126	**Site Completion**	**44 days**	**Wed 12/14/16**	**Wed 2/15/17**
131				
132	**Area 1**	**348 days**	**Tue 4/8/14**	**Fri 8/7/15**
133	**Site Preparation**	**31 days**	**Tue 4/8/14**	**Wed 5/21/14**
144	**Stormwater Events (Weather Delays)**	**19 days**	**Fri 8/15/14**	**Thu 9/11/14**
146	**Overburden Relocation**	**48 days**	**Thu 9/11/14**	**Tue 11/18/14**
154	**RIM Relocation**	**26 days**	**Wed 11/19/14**	**Thu 12/25/14**
165	**Radiological Survey**	**7 days**	**Thu 12/25/14**	**Mon 1/5/15**
168	**Backfill and Slope Correction**	**103 days**	**Mon 1/5/15**	**Wed 5/27/15**
190	**Final Cover**	**39 days**	**Wed 5/27/15**	**Tue 7/21/15**
200	**Post-Construction Stormwater Controls**	**6 days**	**Tue 7/21/15**	**Wed 7/29/15**
210	**Site Completion**	**19 days**	**Mon 7/13/15**	**Fri 8/7/15**



West Lake OU-1 SFS: "Complete Rad Removal" with Off-site Disposal Alternative

DRAFT - Subject to Revision

ID	Task Name	Estimated Duration	Start	Finish
0	**Off-Site Disposal Alternative**	**772 days**	**Mon 3/3/14**	**Wed 2/15/17**
1				
2	**Site-wide Preparation**	**687 days**	**Mon 3/3/14**	**Wed 10/19/16**
3	**Temporary Construction Facilities / Utilities / Personnel**	**47 days**	**Mon 3/3/14**	**Tue 5/6/14**
4	Construction Trailers	38 days	Mon 3/3/14	Wed 4/23/14
5	Parking Area	9 days	Wed 4/23/14	Tue 5/6/14
6	**Temporary Stormwater Infrastructure**	**661 days**	**Tue 4/8/14**	**Wed 10/19/16**
7	**Temporary Stormwater Lagoon**	**46 days**	**Tue 4/8/14**	**Wed 6/11/14**
8	Excavate soil for 4th berm at former leachate lagoon area	20 days	Tue 4/8/14	Tue 5/6/14
9	Place soil for berm	15 days	Tue 4/15/14	Tue 5/6/14
10	Compact berm	2 days	Fri 5/2/14	Tue 5/6/14
11	Install geomembrane liner	26 days	Tue 5/6/14	Wed 6/11/14
12	**Install force main from Areas 1 and 2 to lagoon**	**11 days**	**Tue 5/6/14**	**Tue 5/20/14**
13	Area 1	9 days	Tue 5/6/14	Mon 5/19/14
14	Area 2	2 days	Mon 5/19/14	Tue 5/20/14
15	Install force main from lagoon to treatment facility	1 day	Tue 5/20/14	Thu 5/22/14
16	**Treatment Facility**	**60 days**	**Tue 4/8/14**	**Tue 7/1/14**
17	Construction	60 days	Tue 4/8/14	Tue 7/1/14
18	**Post-project Stormwater Demolition**	**45 days**	**Wed 8/17/16**	**Wed 10/19/16**
19	Dispose of geomembrane liner in Area 1 or 2	25 days	Wed 8/17/16	Wed 9/21/16
20	Deconstruct 4th berm	20 days	Wed 9/21/16	Wed 10/19/16
21	Grade berm material in lagoon for proper drainage	15 days	Wed 9/28/16	Wed 10/19/16
22	**Mobilization**	**27 days**	**Mon 3/3/14**	**Tue 4/8/14**
23	Mobilize and Demobilize Equipment Under 150HP	2 days	Mon 3/3/14	Tue 3/4/14
24	Extra Mileage for Mobilizations	1 day	Wed 3/5/14	Thu 3/6/14
25	Mobilize and Demobilize Equipment Over 150HP	19 days	Mon 3/3/14	Thu 3/27/14
26	Extra Mileage for Mobilizations	8 days	Thu 3/27/14	Tue 4/8/14
27	Mobilize and Demobilize Equipment, Towed	1 day	Mon 3/3/14	Tue 3/4/14
28	Extra Mileage for Mobilizations	1 day	Tue 3/4/14	Tue 3/4/14
29	**Supplemental Mobilizations**	**53 days**	**Mon 6/30/14**	**Thu 9/11/14**
30	Mobilize and Demobilize Equipment Under 150HP	4 days	Wed 9/3/14	Tue 9/9/14
31	Extra Mileage for Mobilizations	2 days	Tue 9/9/14	Thu 9/11/14

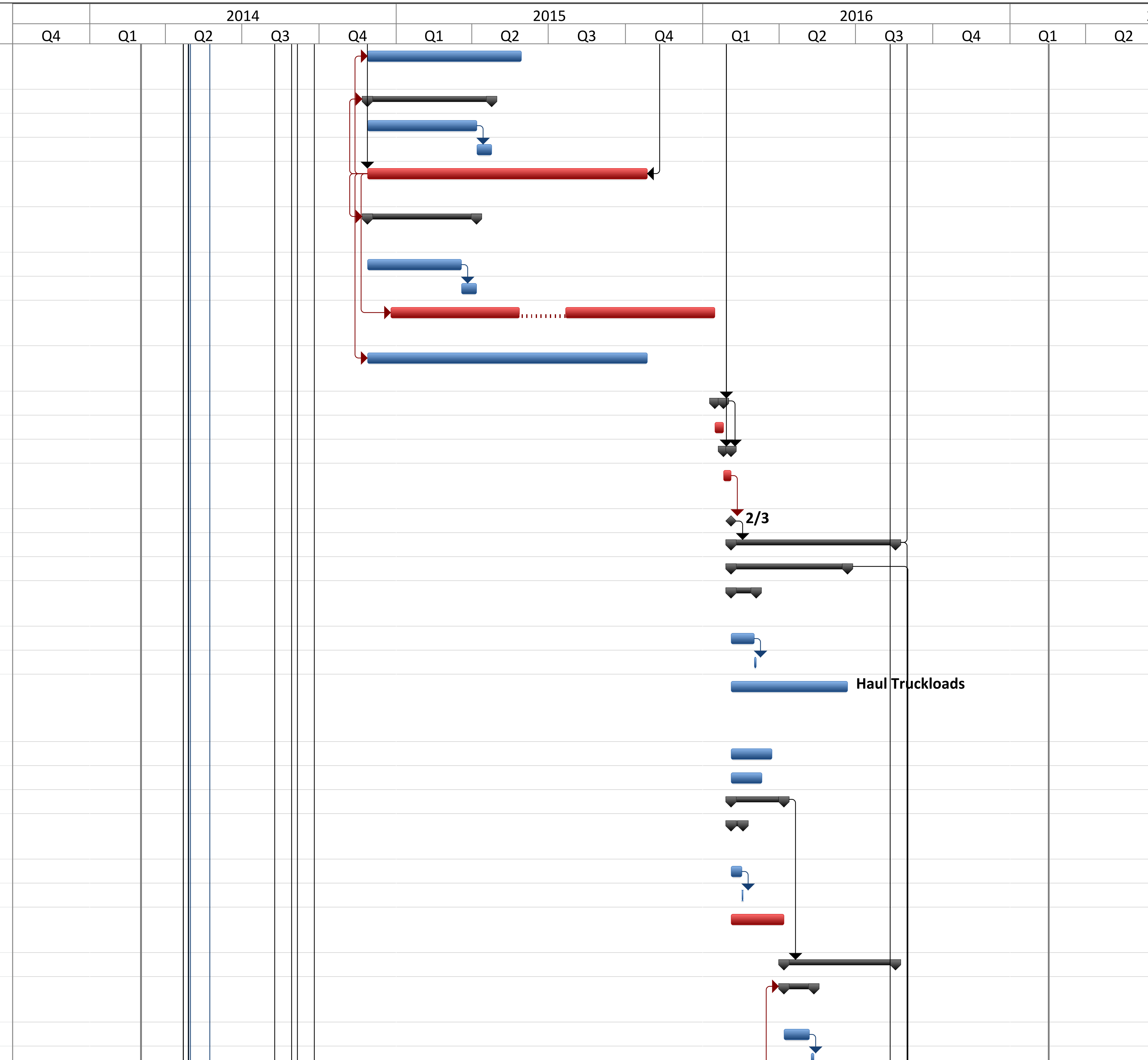


Note: All dates are for planning purposes only - not actual dates.

ID	Task Name	Estimated Duration	Start	Finish
32	Mobilize and Demobilize Equipment Over 150HP	37 days	Mon 6/30/14	Thu 8/21/14
33	Extra Mileage for Mobilizations	16 days	Thu 8/21/14	Thu 9/11/14
34	Mobilize and Demobilize Equipment, Towed	3 days	Mon 9/8/14	Wed 9/10/14
35	Extra Mileage for Mobilizations	1 day	Wed 9/10/14	Thu 9/11/14
36	**Create Temporary Roads**	**56 days**	**Tue 4/8/14**	**Wed 6/25/14**
37	Area 1	19 days	Tue 4/8/14	Mon 5/5/14
38	Area 2	37 days	Mon 5/5/14	Wed 6/25/14
39	**Install TBD Traffic Improvements**	**20 days**	**Tue 4/8/14**	**Tue 5/6/14**
40	Area 1	10 days	Tue 4/8/14	Tue 4/22/14
41	Area 2	10 days	Tue 4/22/14	Tue 5/6/14
42				
43	**Area 2**	**746 days**	**Tue 4/8/14**	**Wed 2/15/17**
44	**Site Preparation**	**28 days**	**Tue 4/8/14**	**Fri 5/16/14**
45	Prepare area with Stormwater BMPS	9 days	Tue 4/8/14	Mon 4/21/14
46	**Decontamination Area**	**0 days**	**Tue 4/8/14**	**Tue 4/8/14**
47	Materials	0 days	Tue 4/8/14	Tue 4/8/14
48	Installation	0 days	Tue 4/8/14	Tue 4/8/14
49	Clear Vegetation (Light)	11 days	Tue 4/8/14	Wed 4/23/14
50	Clear Vegetation (Heavy)	28 days	Tue 4/8/14	Fri 5/16/14
51	**Berms for Overburden**	**4 days**	**Tue 4/8/14**	**Mon 4/14/14**
52	Purchase material	0 days	Tue 4/8/14	Tue 4/8/14
53	Deliver and Stockpile	2 days	Tue 4/8/14	Thu 4/10/14
54	Develop earthen berms to store relocated overburden wastes	2 days	Thu 4/10/14	Mon 4/14/14
55	**Stormwater Events (Weather Delays)**	**47 days**	**Wed 6/11/14**	**Fri 8/15/14**
56	Dewater construction after rain events	47 days	Wed 6/11/14	Fri 8/15/14
57	**Overburden Relocation**	**292 days**	**Fri 8/15/14**	**Mon 9/28/15**
58	**Relocate overburden wastes**	**93 days**	**Fri 8/15/14**	**Wed 12/24/14**
59	Excavate	81 days	Fri 8/15/14	Mon 12/8/14
60	Load	12 days	Mon 12/8/14	Wed 12/24/14
61	**Relocate overburden wastes - Haul and Dump**	**292 days**	**Fri 8/15/14**	**Mon 9/28/15**
62	To bermed area	15 days	Fri 8/15/14	Fri 9/5/14
63	To other areas	277 days	Fri 9/5/14	Mon 9/28/15
64	Apply daily cover to relocated overburden wastes	59 days	Fri 8/15/14	Thu 11/6/14
65	Spread overburden wastes	109 days	Fri 8/15/14	Thu 1/15/15
66	Compact overburden wastes	86 days	Fri 8/15/14	Mon 12/15/14
67	**RIM Relocation**	**296 days**	**Thu 11/27/14**	**Fri 1/15/16**

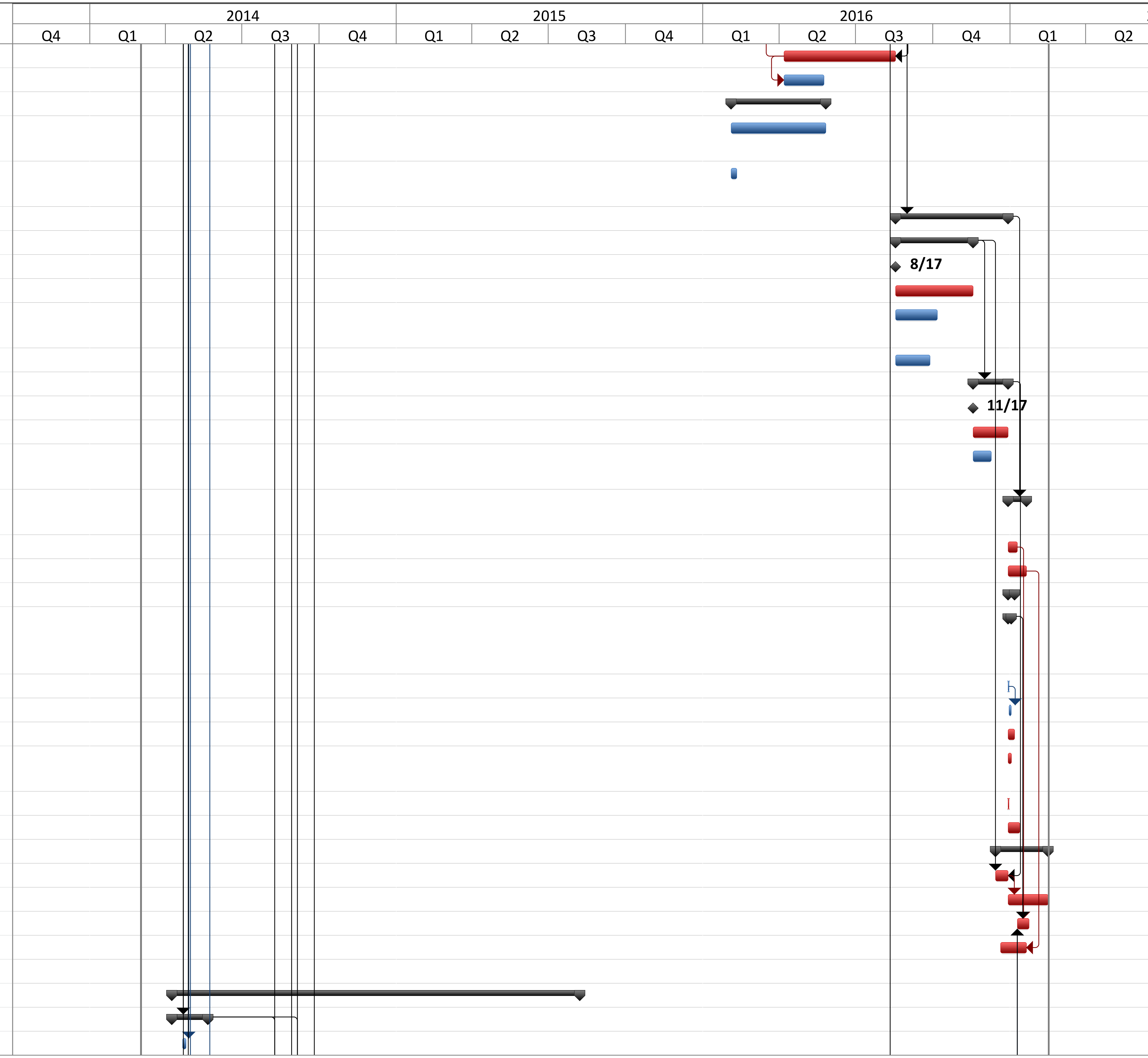
Note: All dates are for planning purposes only - not actual dates.

ID	Task Name	Estimated Duration	Start	Finish
68	Apply daily cover to remaining excavation of RIM Wastes	131 days	Thu 11/27/14	Fri 5/29/15
69	**Relocate RIM Wastes on-site**	**106 days**	**Thu 11/27/14**	**Fri 4/24/15**
70	Excavate	92 days	Thu 11/27/14	Mon 4/6/15
71	Load	14 days	Tue 4/7/15	Fri 4/24/15
72	Relocate RIM Wastes on-site - Haul and Dump	237 days	Thu 11/27/14	Mon 10/26/15
73	**Transfer RIM Wastes into On-Road Trailers**	**92 days**	**Thu 11/27/14**	**Mon 4/6/15**
74	Excavate	80 days	Thu 11/27/14	Thu 3/19/15
75	Load	12 days	Thu 3/19/15	Mon 4/6/15
76	Bag and Transport RIM Wastes to Off-Site Disposal Facility via Rail	237 days	Thu 12/25/14	Fri 1/15/16
77	Off-Site Disposal Facility Disposal Fee	237 days	Thu 11/27/14	Mon 10/26/15
78	**Buffer Zone**	**7 days**	**Fri 1/15/16**	**Mon 1/25/16**
79	Buffer Zone Activity	7 days	Fri 1/15/16	Mon 1/25/16
80	**Radiological Survey**	**7 days**	**Mon 1/25/16**	**Wed 2/3/16**
81	Conduct final radiological survey and wait for approval	7 days	Mon 1/25/16	Wed 2/3/16
82	Area 2 is clean	0 days	Wed 2/3/16	Wed 2/3/16
83	**Backfill and Slope Correction**	**140 days**	**Wed 2/3/16**	**Wed 8/17/16**
84	**Slope Correction Cuts**	**99 days**	**Wed 2/3/16**	**Tue 6/21/16**
85	**Move non-RIM waste to correct slopes in excavation - Excavate**	**22 days**	**Wed 2/3/16**	**Fri 3/4/16**
86	Excavate	19 days	Wed 2/3/16	Wed 3/2/16
87	Load	3 days	Wed 3/2/16	Fri 3/4/16
88	Move non-RIM waste to correct slopes in excavation - Haul and Dump	99 days	Wed 2/3/16	Tue 6/21/16
89	Spread cut material	35 days	Wed 2/3/16	Wed 3/23/16
90	Compact cut material	27 days	Wed 2/3/16	Fri 3/11/16
91	**Backfill Overburden**	**45 days**	**Wed 2/3/16**	**Wed 4/6/16**
92	**Backfill Overburden Materials stored in berms - Excavate**	**10 days**	**Wed 2/3/16**	**Wed 2/17/16**
93	Excavate	9 days	Wed 2/3/16	Tue 2/16/16
94	Load	1 day	Tue 2/16/16	Wed 2/17/16
95	Backfill Overburden Materials stored in berms - Haul and Dump	45 days	Wed 2/3/16	Wed 4/6/16
96	**Additional Fill**	**95 days**	**Wed 4/6/16**	**Wed 8/17/16**
97	**Excavate additional fill material for grading**	**25 days**	**Wed 4/6/16**	**Thu 5/12/16**
98	Excavate	22 days	Wed 4/6/16	Fri 5/6/16
99	Load	3 days	Mon 5/9/16	Thu 5/12/16



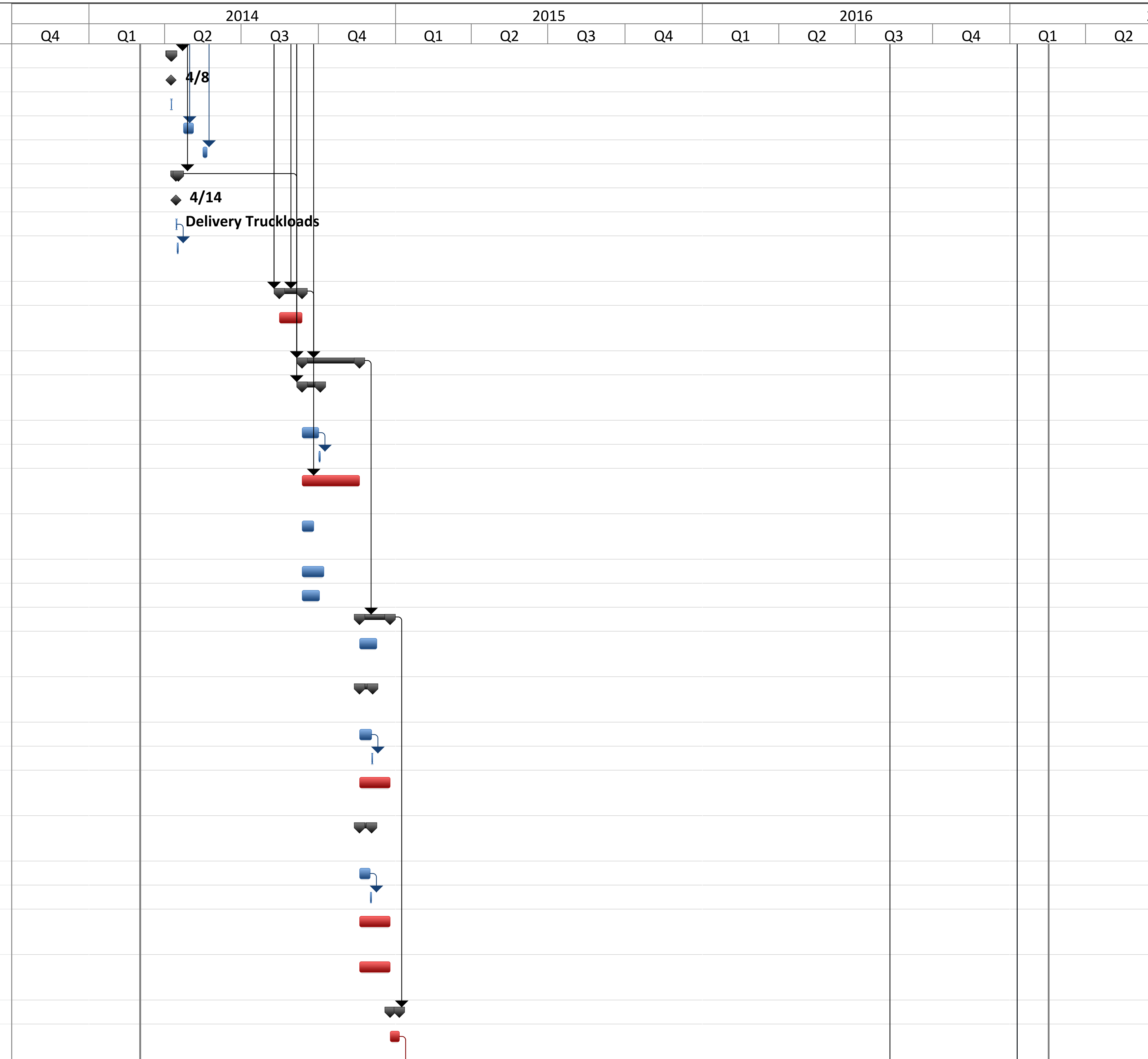
Note: All dates are for planning purposes only - not actual dates.

ID	Task Name	Estimated Duration	Start	Finish
100	Haul additional fill for grading	95 days	Wed 4/6/16	Wed 8/17/16
101	Spread additional fill	33 days	Wed 4/6/16	Tue 5/24/16
102	**Daily Cover**	**81 days**	**Wed 2/3/16**	**Thu 5/26/16**
103	Use geotextile as a daily cover for backfill waste to reclaim slopes	81 days	Wed 2/3/16	Thu 5/26/16
104	Use geotextile as a daily cover on bermed overburden	5 days	Wed 2/3/16	Wed 2/10/16
105	**Final Cover**	**96 days**	**Wed 8/17/16**	**Thu 12/29/16**
106	**Clay**	**66 days**	**Wed 8/17/16**	**Thu 11/17/16**
107	Purchase clay material	0 days	Wed 8/17/16	Wed 8/17/16
108	Deliver clay material to site	66 days	Wed 8/17/16	Thu 11/17/16
109	Spread loose lift before compaction	35 days	Wed 8/17/16	Thu 10/6/16
110	Compact Clay (Final Cover)	29 days	Wed 8/17/16	Tue 9/27/16
111	**Top Soil**	**30 days**	**Thu 11/17/16**	**Thu 12/29/16**
112	Purchase Topsoil	0 days	Thu 11/17/16	Thu 11/17/16
113	Deliver Topsoil	30 days	Fri 11/18/16	Thu 12/29/16
114	Move and place Topsoil (Final Cover)	16 days	Fri 11/18/16	Fri 12/9/16
115	**Post-Construction Stormwater Controls**	**16 days**	**Thu 12/29/16**	**Fri 1/20/17**
116	Install Terraces	7 days	Thu 12/29/16	Mon 1/9/17
117	Construct Ditches	16 days	Thu 12/29/16	Fri 1/20/17
118	**Pond**	**5 days**	**Thu 12/29/16**	**Fri 1/6/17**
119	**Load Overburden Material from stockpile to off road haul truck for pond**	**1 day**	**Thu 12/29/16**	**Mon 1/2/17**
120	Excavate	1 day	Thu 12/29/16	Fri 12/30/16
121	Load	0 days	Fri 12/30/16	Mon 1/2/17
122	Haul loose lift soil for Pond	5 days	Thu 12/29/16	Fri 1/6/17
123	Spread loose lift before compaction (Pond)	2 days	Thu 12/29/16	Mon 1/2/17
124	Compact Berm (Pond)	1 day	Thu 12/29/16	Fri 12/30/16
125	Final Stormwater Controls	10 days	Thu 12/29/16	Thu 1/12/17
126	**Site Completion**	**44 days**	**Wed 12/14/16**	**Wed 2/15/17**
127	Install temporary irrigation system	11 days	Wed 12/14/16	Thu 12/29/16
128	Apply seeding to cover	33 days	Thu 12/29/16	Wed 2/15/17
129	Apply seeding to soil stockpile	10 days	Mon 1/9/17	Mon 1/23/17
130	Install Fencing	23 days	Tue 12/20/16	Fri 1/20/17
131				
132	**Area 1**	**348 days**	**Tue 4/8/14**	**Fri 8/7/15**
133	**Site Preparation**	**31 days**	**Tue 4/8/14**	**Wed 5/21/14**
134	Prepare area with Stormwater BMPS	4 days	Mon 4/21/14	Fri 4/25/14



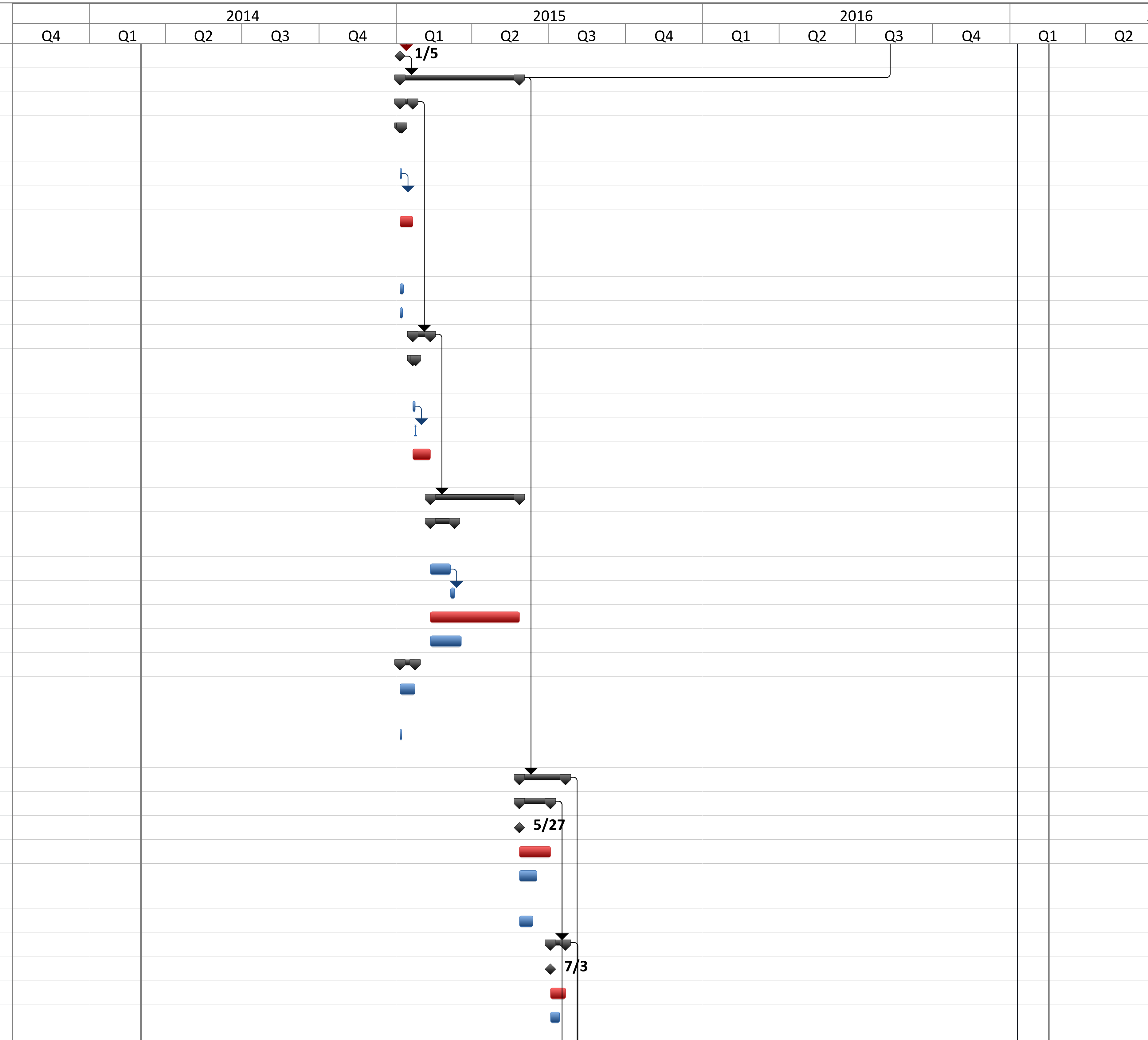
Note: All dates are for planning purposes only - not actual dates.

ID	Task Name	Estimated Duration	Start	Finish
135	**Decontamination Area**	**1 day**	**Tue 4/8/14**	**Wed 4/9/14**
136	Materials	0 days	Tue 4/8/14	Tue 4/8/14
137	Installation	1 day	Tue 4/8/14	Wed 4/9/14
138	Clear Vegetation (Light)	8 days	Wed 4/23/14	Mon 5/5/14
139	Clear Vegetation (Heavy)	4 days	Fri 5/16/14	Wed 5/21/14
140	**Berms for Overburden**	**3 days**	**Mon 4/14/14**	**Thu 4/17/14**
141	Purchase material	0 days	Mon 4/14/14	Mon 4/14/14
142	Deliver and Stockpile	1 day	Mon 4/14/14	Tue 4/15/14
143	Develop earthen berms to store relocated overburden wastes	1 day	Tue 4/15/14	Thu 4/17/14
144	**Stormwater Events (Weather Delays)**	**19 days**	**Fri 8/15/14**	**Thu 9/11/14**
145	Dewater construction after rain events	19 days	Fri 8/15/14	Thu 9/11/14
146	**Overburden Relocation**	**48 days**	**Thu 9/11/14**	**Tue 11/18/14**
147	**Relocate overburden wastes - Excavate**	**15 days**	**Thu 9/11/14**	**Fri 10/3/14**
148	Excavate	13 days	Thu 9/11/14	Wed 10/1/14
149	Load	2 days	Wed 10/1/14	Fri 10/3/14
150	Relocate overburden wastes - Haul and Dump	48 days	Thu 9/11/14	Tue 11/18/14
151	Apply daily cover to relocated overburden wastes	10 days	Thu 9/11/14	Thu 9/25/14
152	Spread overburden wastes	18 days	Thu 9/11/14	Tue 10/7/14
153	Compact overburden wastes	14 days	Thu 9/11/14	Thu 10/2/14
154	**RIM Relocation**	**26 days**	**Wed 11/19/14**	**Thu 12/25/14**
155	Apply daily cover to remaining excavation of RIM Wastes	15 days	Wed 11/19/14	Tue 12/9/14
156	**Relocate RIM Wastes on-site - Excavate**	**12 days**	**Wed 11/19/14**	**Thu 12/4/14**
157	Excavate	10 days	Wed 11/19/14	Wed 12/3/14
158	Load	2 days	Wed 12/3/14	Thu 12/4/14
159	Relocate RIM Wastes on-site - Haul and Dump	26 days	Wed 11/19/14	Thu 12/25/14
160	**Transfer RIM Wastes into On-Road Trailers**	**10 days**	**Wed 11/19/14**	**Wed 12/3/14**
161	Excavate	9 days	Wed 11/19/14	Mon 12/1/14
162	Load	1 day	Mon 12/1/14	Wed 12/3/14
163	Bag and Transport RIM Wastes to Off-Site Disposal Facility via Rail	26 days	Wed 11/19/14	Thu 12/25/14
164	Off-Site Disposal Facility Disposal Fee	26 days	Wed 11/19/14	Thu 12/25/14
165	**Radiological Survey**	**7 days**	**Thu 12/25/14**	**Mon 1/5/15**
166	Conduct final radiological survey and wait for approval	7 days	Thu 12/25/14	Mon 1/5/15



Note: All dates are for planning purposes only - not actual dates.

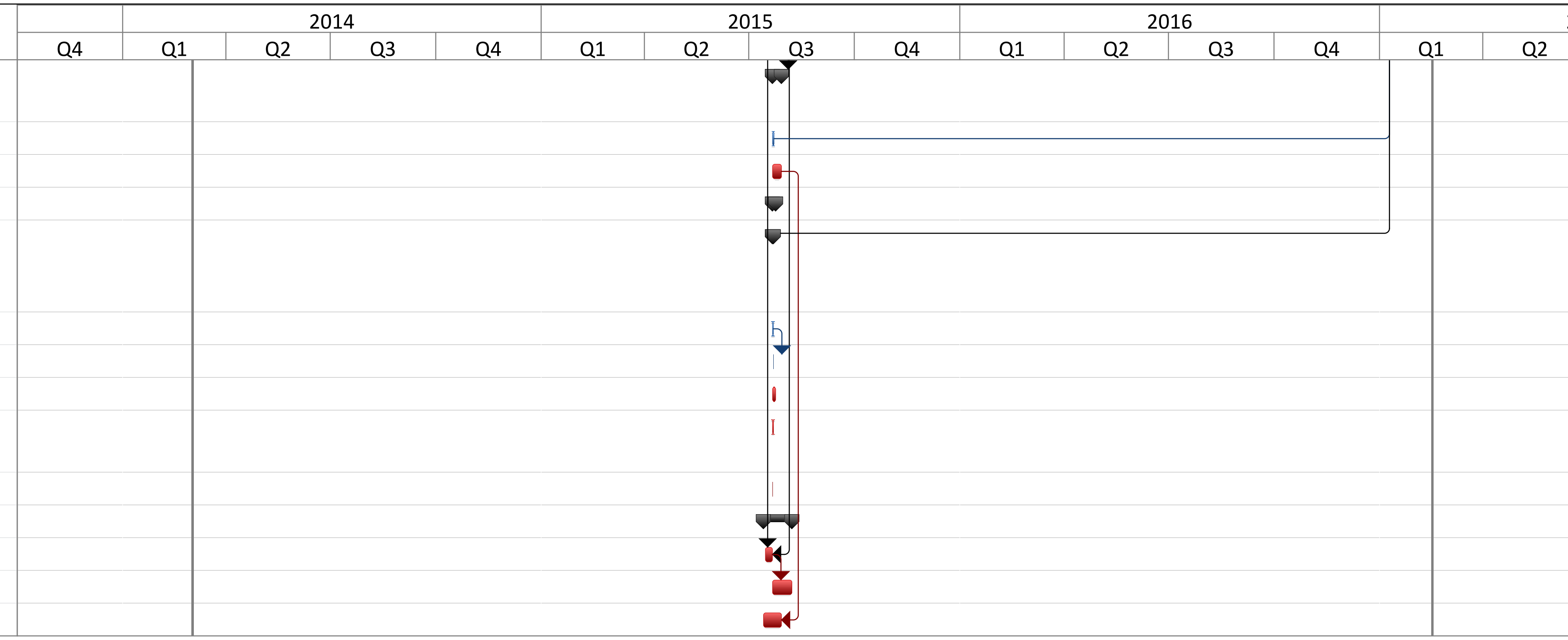
ID	Task Name	Estimated Duration	Start	Finish
167	Area 1 is clean	0 days	Mon 1/5/15	Mon 1/5/15
168	**Backfill and Slope Correction**	**103 days**	**Mon 1/5/15**	**Wed 5/27/15**
169	**Slope Correction Cuts**	**11 days**	**Mon 1/5/15**	**Tue 1/20/15**
170	**Move non-RIM waste to correct slopes in excavation - Excavate**	**3 days**	**Mon 1/5/15**	**Wed 1/7/15**
171	Excavate	2 days	Mon 1/5/15	Wed 1/7/15
172	Load	0 days	Wed 1/7/15	Wed 1/7/15
173	Move non-RIM waste to correct slopes in excavation - Haul and Dump	11 days	Mon 1/5/15	Tue 1/20/15
174	Spread cut material	4 days	Mon 1/5/15	Fri 1/9/15
175	Compact cut material	3 days	Mon 1/5/15	Thu 1/8/15
176	**Backfill Overburden**	**15 days**	**Tue 1/20/15**	**Tue 2/10/15**
177	**Backfill Overburden Materials stored in berms**	**3 days**	**Tue 1/20/15**	**Fri 1/23/15**
178	Excavate	3 days	Tue 1/20/15	Fri 1/23/15
179	Load	0 days	Fri 1/23/15	Fri 1/23/15
180	Backfill Overburden Materials stored in berms - Haul and Dump	15 days	Tue 1/20/15	Tue 2/10/15
181	**Additional Fill**	**76 days**	**Tue 2/10/15**	**Wed 5/27/15**
182	**Excavate additional fill material for grading**	**20 days**	**Tue 2/10/15**	**Wed 3/11/15**
183	Excavate	18 days	Tue 2/10/15	Fri 3/6/15
184	Load	3 days	Fri 3/6/15	Wed 3/11/15
185	Haul additional fill for grading	76 days	Tue 2/10/15	Wed 5/27/15
186	Spread additional fill	27 days	Tue 2/10/15	Thu 3/19/15
187	**Daily Cover**	**14 days**	**Mon 1/5/15**	**Fri 1/23/15**
188	Use geotextile as a daily cover for backfill waste to reclaim slopes	14 days	Mon 1/5/15	Fri 1/23/15
189	Use geotextile as a daily cover on bermed overburden	2 days	Mon 1/5/15	Wed 1/7/15
190	**Final Cover**	**39 days**	**Wed 5/27/15**	**Tue 7/21/15**
191	**Clay**	**27 days**	**Wed 5/27/15**	**Fri 7/3/15**
192	Purchase clay material	0 days	Wed 5/27/15	Wed 5/27/15
193	Deliver clay material to site	27 days	Wed 5/27/15	Fri 7/3/15
194	Spread loose lift before compaction	14 days	Wed 5/27/15	Wed 6/17/15
195	Compact Clay (Final Cover)	12 days	Wed 5/27/15	Fri 6/12/15
196	**Top Soil**	**12 days**	**Fri 7/3/15**	**Tue 7/21/15**
197	Purchase Topsoil	0 days	Fri 7/3/15	Fri 7/3/15
198	Deliver Topsoil	12 days	Fri 7/3/15	Tue 7/21/15
199	Move and place Topsoil (Final Cover)	6 days	Fri 7/3/15	Tue 7/14/15



Note: All dates are for planning purposes only - not actual dates.

Feezor Engineering, Inc.

ID	Task Name	Estimated Duration	Start	Finish
200	**Post-Construction Stormwater Controls**	**6 days**	**Tue 7/21/15**	**Wed 7/29/15**
201	Install Terraces	2 days	Tue 7/21/15	Wed 7/22/15
202	Construct Ditches	6 days	Tue 7/21/15	Wed 7/29/15
203	**Pond**	**3 days**	**Tue 7/21/15**	**Fri 7/24/15**
204	**Load Overburden Material from stockpile to off road haul truck for pond**	**1 day**	**Tue 7/21/15**	**Wed 7/22/15**
205	Excavate	1 day	Tue 7/21/15	Wed 7/22/15
206	Load	0 days	Wed 7/22/15	Wed 7/22/15
207	Haul loose lift soil for Pond	3 days	Tue 7/21/15	Fri 7/24/15
208	Spread loose lift before compaction (Pond)	1 day	Tue 7/21/15	Wed 7/22/15
209	Compact Berm (Pond)	0 days	Tue 7/21/15	Tue 7/21/15
210	**Site Completion**	**19 days**	**Mon 7/13/15**	**Fri 8/7/15**
211	Install temporary irrigation system	4 days	Wed 7/15/15	Tue 7/21/15
212	Apply seeding to cover	13 days	Tue 7/21/15	Fri 8/7/15
213	Install Fencing	11 days	Mon 7/13/15	Wed 7/29/15



Estimated Diesel Fuel Consumption -
"Complete Rad Removal" with Off-site Disposal Alternati

Step #	Category	Sub-Category	Task	Quantity: Off-Site Area 1	Quantity: Off-Site Area 2	Type of Material Handled	Units	Crew Type	Truckloads for Delivery: Off-Site Area 1	Truckloads for Delivery: Off-Site Area 2	Total Miles for Delivery: Off-Site Area 1	Total Miles for Delivery: Off-Site Area 2
Off-Site 71		*Additional Fill*	Excavate additional fill material for grading	127,923	159,363	Overburden Soil	B.C.Y.	B12D				
Off-Site 72		*Additional Fill*	*(additional cost to previous line)*	127,923	159,363	Overburden Soil	B.C.Y.	B12D				
Off-Site 73		*Additional Fill*	Haul additional fill for grading	159,904	199,204	Overburden Soil	L.C.Y.	B34F				
Off-Site 74		*Additional Fill*	Spread additional fill	159,904	199,204	Overburden Soil	L.C.Y.	B10B				
Off-Site 75		*Daily Cover*	Use geotextile as a daily cover for backfill waste to reclaim slopes	33,688	194,117	Geotextile	S.Y.	2 Clab, Import Trans 3	3	17	6,000	34,000
Off-Site 76		*Daily Cover*	Use geotextile as a daily cover on bermed overburden	5,000	11,111	Geotextile	S.Y.	2 Clab, Import Trans 3	1	1	2,000	2,000
Off-Site 77	**Final Cover**	*Clay*	Purchase clay material	61,537	151,279	Clay Material	B.C.Y.					
Off-Site 78	**Final Cover**	*Clay*	Deliver clay material to site	86,152	211,791	Clay Material	L.C.Y.	Import Trans 1	5,385	13,237	376,950	926,590
Off-Site 79	**Final Cover**	*Clay*	Spread loose lift before compaction	86,152	211,791	Clay Material	L.C.Y.	B10B				
Off-Site 80	**Final Cover**	*Clay*	Compact Clay (Final Cover)	61,537	151,279	Clay Material	E.C.Y.	B10G				
Off-Site 81	**Final Cover**	*Top Soil*	Purchase Topsoil	32,008	81,190	Topsoil	B.C.Y.					
Off-Site 82	**Final Cover**	*Top Soil*	Deliver Topsoil	40,009	101,487	Topsoil	L.C.Y.	Import Trans 2	2,354	5,970	47,080	119,400
Off-Site 83	**Final Cover**	*Top Soil*	Move and place Topsoil (Final Cover)	38,461	94,550	Topsoil	L.C.Y.	B10B				
Off-Site 84	**Stormwater Controls (for stormwater after cover is constructed)**		Install Terraces	1,549	6,938	Topsoil	L.C.Y.	B10B				
Off-Site 85	**Stormwater Controls (for stormwater after cover is constructed)**		Construct Ditches	2,630	7,245	Topsoil	B.C.Y.	B10L				
Off-Site 86	**Stormwater Controls (for stormwater after cover is constructed)**	*Pond*	Load Overburden Material from stockpile to off road haul truck for pond	4,023	7,944	Overburden Soil	B.C.Y.	B12D				
Off-Site 87	**Stormwater Controls (for stormwater after cover is constructed)**	*Pond*	*(additional cost to previous line)*	4,023	7,944	Overburden Soil	B.C.Y.	B12D				
Off-Site 88	**Stormwater Controls (for stormwater after cover is constructed)**	*Pond*	Haul loose lift soil for Pond	5,632	11,122	Overburden Soil	L.C.Y.	B34F				
Off-Site 89	**Stormwater Controls (for stormwater after cover is constructed)**	*Pond*	Spread loose lift before compaction (Pond)	5,632	11,122	Overburden Soil	L.C.Y.	B10B				
Off-Site 90	**Stormwater Controls (for stormwater after cover is constructed)**	*Pond*	Compact Berm (Pond)	4,023	7,944	Overburden Soil	E.C.Y.	B10Y				
Off-Site 91	**Stormwater Controls (for stormwater after cover is constructed)**		Final Stormwater Controls	-	2,332	Riprap	S.Y.	B13				
Off-Site 92	**Site Completion**		Apply seeding to cover	1,051	2,653	Seeding	M.S.F.	B81				
Off-Site 93	**Site Completion**		Apply seeding to soil stockpile	790		Seeding	M.S.F.	B81				
Off-Site 94	**Site Completion**		Install temporary irrigation system	87,550	221,114	Irrigation System	S.F.	B20				
Off-Site 95	**Site Completion**		Install Fencing	4,078	8,285	Fencing	L.F.	B80C				
									Totals		***Totals***	
									10,000	34,000	492,000	1,394,000
										44,000		**1,886,000**

$ 82,990,000
$ 47,100,000
$ 36,300,000
$ 166,390,000

NOTE: Please see information presented in Appendix K-3 regarding the costs and schedule for the fiscally-constrained approach ($10 million per year expenditure limitation) to the “Complete Rad Removal” with Off-Site Disposal Alternative.

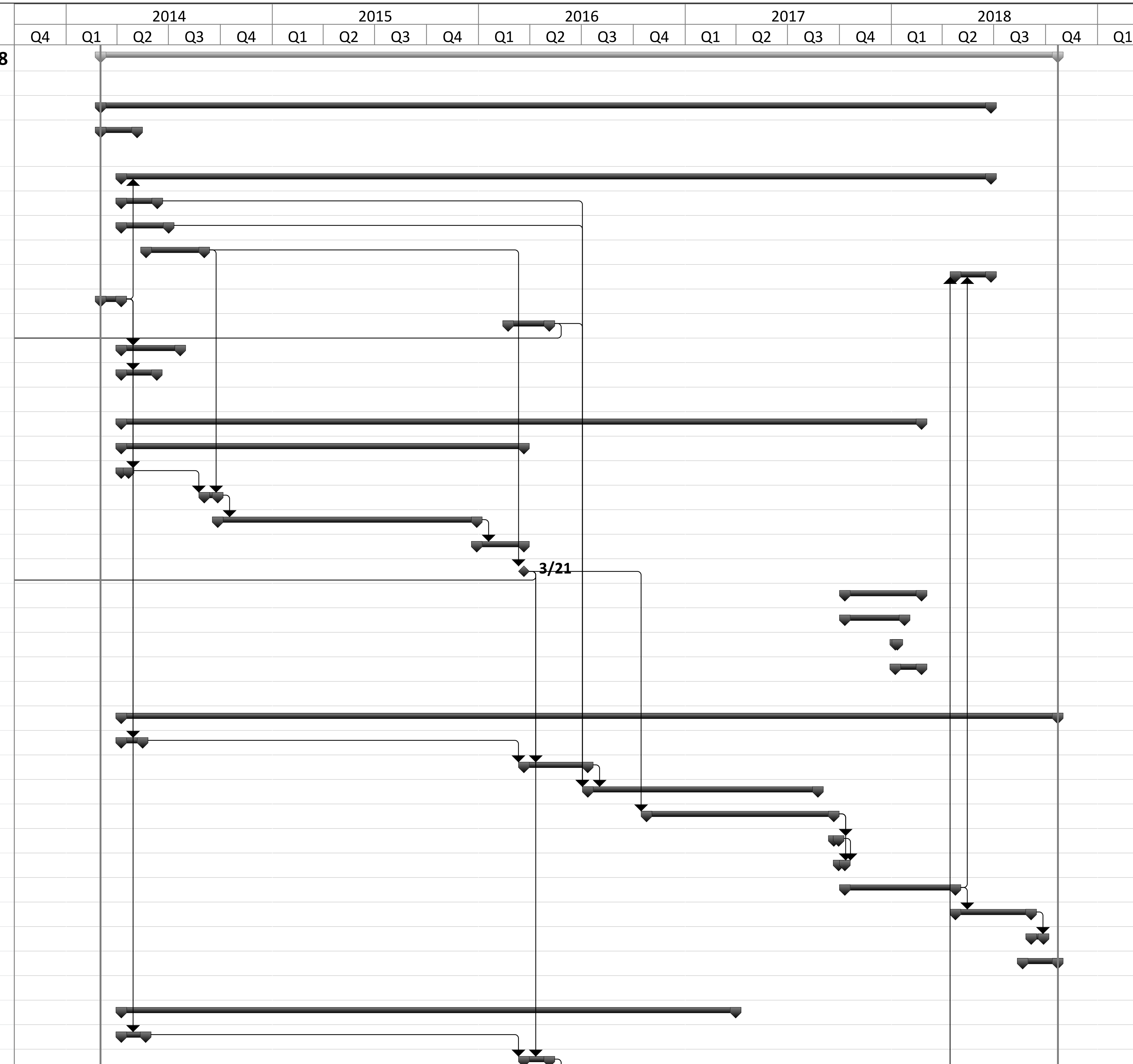
Appendix J-3:

Estimated Project Schedules for the “Complete Rad Removal” with On-Site Disposal in Engineered Cell Alternative

Estimated Schedule

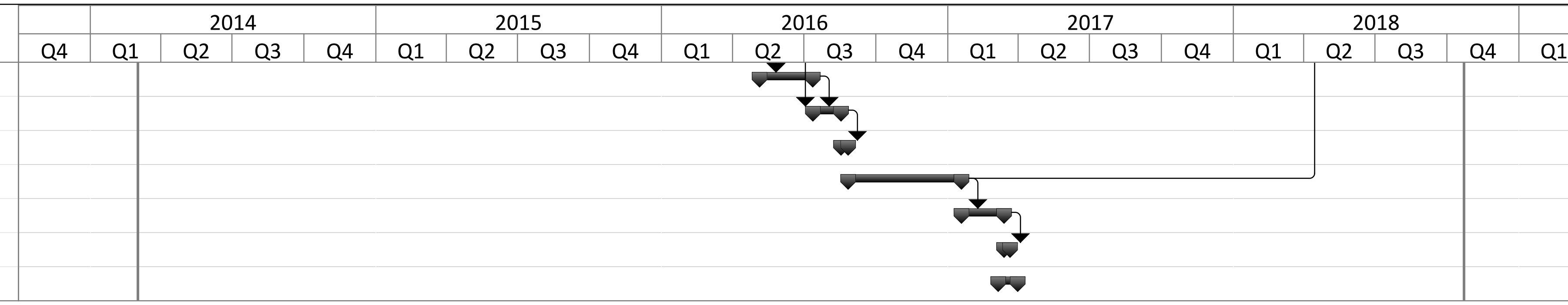
“Complete Rad Removal” with On-Site Disposal Alternative

ID	Task Name	Estimated Duration	Start	Finish
0	**On-Site Disposal Alternative**	**1211 days**	**Mon 3/3/14**	**Mon 10/22/18**
1				
2	**Site-wide Preparation**	**1126 days**	**Mon 3/3/14**	**Tue 6/26/18**
3	**Temporary Construction Facilities / Utilities / Personnel**	**47 days**	**Mon 3/3/14**	**Tue 5/6/14**
6	**Temporary Stormwater Infrastructure**	**1100 days**	**Tue 4/8/14**	**Tue 6/26/18**
7	**Temporary Stormwater Lagoon**	**46 days**	**Tue 4/8/14**	**Wed 6/11/14**
16	**Treatment Facility**	**60 days**	**Tue 4/8/14**	**Tue 7/1/14**
18	**Leachate Treatment Facility**	**73 days**	**Thu 5/22/14**	**Tue 9/2/14**
21	**Post-project Stormwater Demolition**	**45 days**	**Tue 4/24/18**	**Tue 6/26/18**
25	**Mobilization**	**27 days**	**Mon 3/3/14**	**Tue 4/8/14**
34	**Supplemental Mobilizations**	**53 days**	**Mon 2/22/16**	**Thu 5/5/16**
41	**Create Temporary Roads**	**75 days**	**Tue 4/8/14**	**Mon 7/21/14**
45	**Install TBD Traffic Improvements**	**45 days**	**Tue 4/8/14**	**Tue 6/10/14**
49				
50	**On-Site Cell**	**1013 days**	**Tue 4/8/14**	**Fri 2/23/18**
51	**Construction**	**509 days**	**Tue 4/8/14**	**Mon 3/21/16**
52	**Site Preparation**	**9 days**	**Tue 4/8/14**	**Mon 4/21/14**
56	**Stormwater Events (Weather Delays)**	**18 days**	**Tue 9/2/14**	**Fri 9/26/14**
58	**New On-Site Cell Excavation**	**327 days**	**Fri 9/26/14**	**Mon 12/28/15**
60	**Construct Cell Bottom Liner**	**59 days**	**Mon 12/28/15**	**Mon 3/21/16**
79	Cell is Ready for Waste	0 days	Mon 3/21/16	Mon 3/21/16
80	**Closure of On-Site Cell**	**98 days**	**Tue 10/10/17**	**Fri 2/23/18**
81	**Final Cover**	**76 days**	**Tue 10/10/17**	**Wed 1/24/18**
105	**Post-Construction Stormwater Controls**	**4 days**	**Mon 1/8/18**	**Thu 1/11/18**
113	**On-Site Cell Site Completion**	**34 days**	**Mon 1/8/18**	**Fri 2/23/18**
117				
118	**Area 2**	**1184 days**	**Tue 4/8/14**	**Mon 10/22/18**
119	**Site Preparation**	**28 days**	**Tue 4/8/14**	**Fri 5/16/14**
130	**Stormwater Events (Weather Delays)**	**81 days**	**Mon 3/21/16**	**Tue 7/12/16**
132	**Overburden Relocation**	**292 days**	**Tue 7/12/16**	**Wed 8/23/17**
142	**RIM Relocation to On-Site Cell**	**237 days**	**Mon 10/24/16**	**Wed 9/20/17**
151	**Buffer Zone**	**7 days**	**Thu 9/21/17**	**Fri 9/29/17**
153	**Radiological Survey**	**7 days**	**Fri 9/29/17**	**Tue 10/10/17**
156	**Backfill and Slope Correction, Area 2**	**140 days**	**Tue 10/10/17**	**Tue 4/24/18**
178	**Final Cover, Area 2**	**96 days**	**Tue 4/24/18**	**Wed 9/5/18**
188	**Post-Construction Stormwater Controls**	**16 days**	**Wed 9/5/18**	**Thu 9/27/18**
199	**Site Completion, Area 2**	**44 days**	**Tue 8/21/18**	**Mon 10/22/18**
204				
205	**Area 1**	**777 days**	**Tue 4/8/14**	**Fri 3/31/17**
206	**Site Preparation**	**31 days**	**Tue 4/8/14**	**Wed 5/21/14**
217	**Stormwater Events (Weather Delays)**	**33 days**	**Mon 3/21/16**	**Thu 5/5/16**

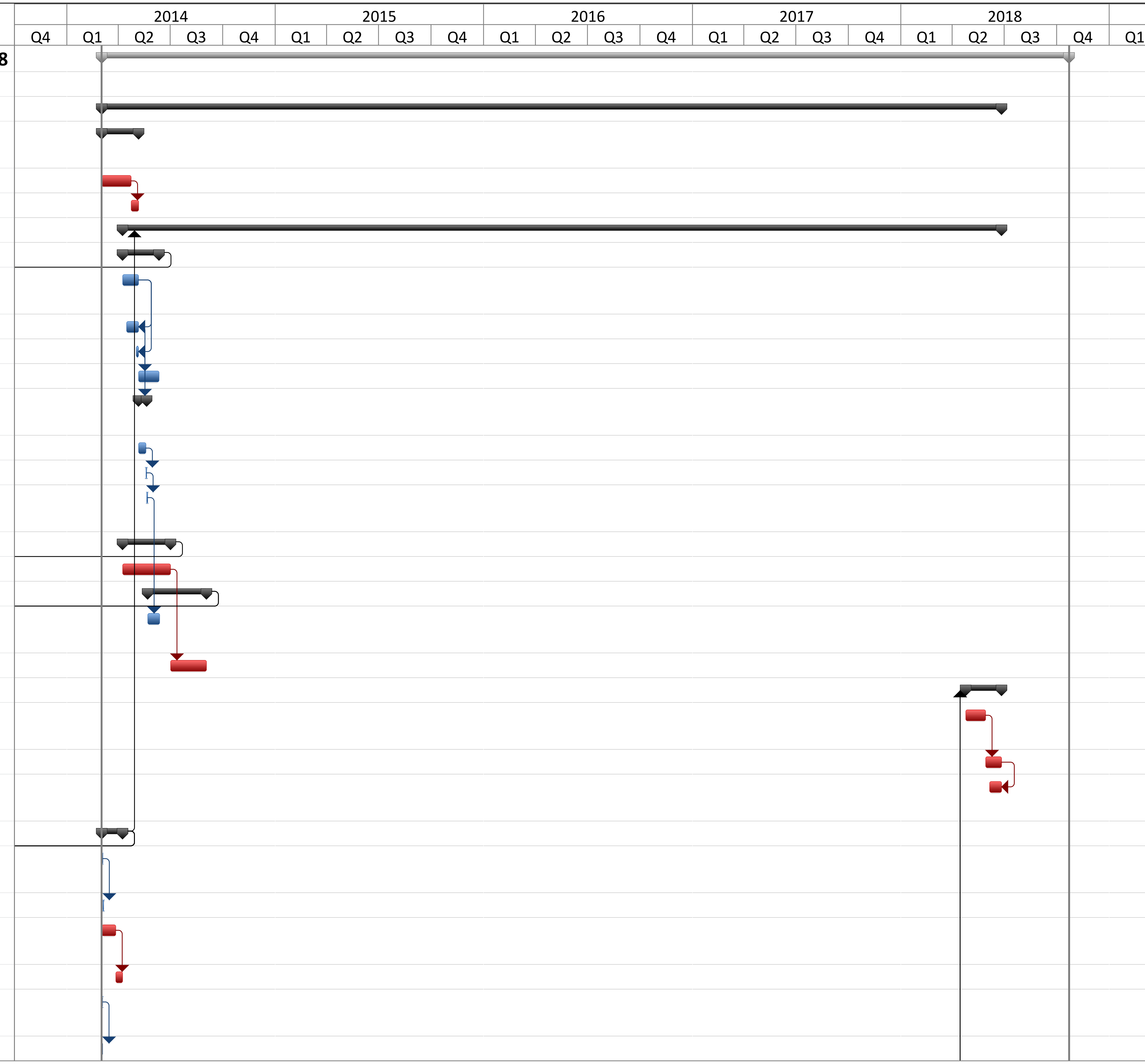


Note: All dates are for planning purposes only - not actual dates.

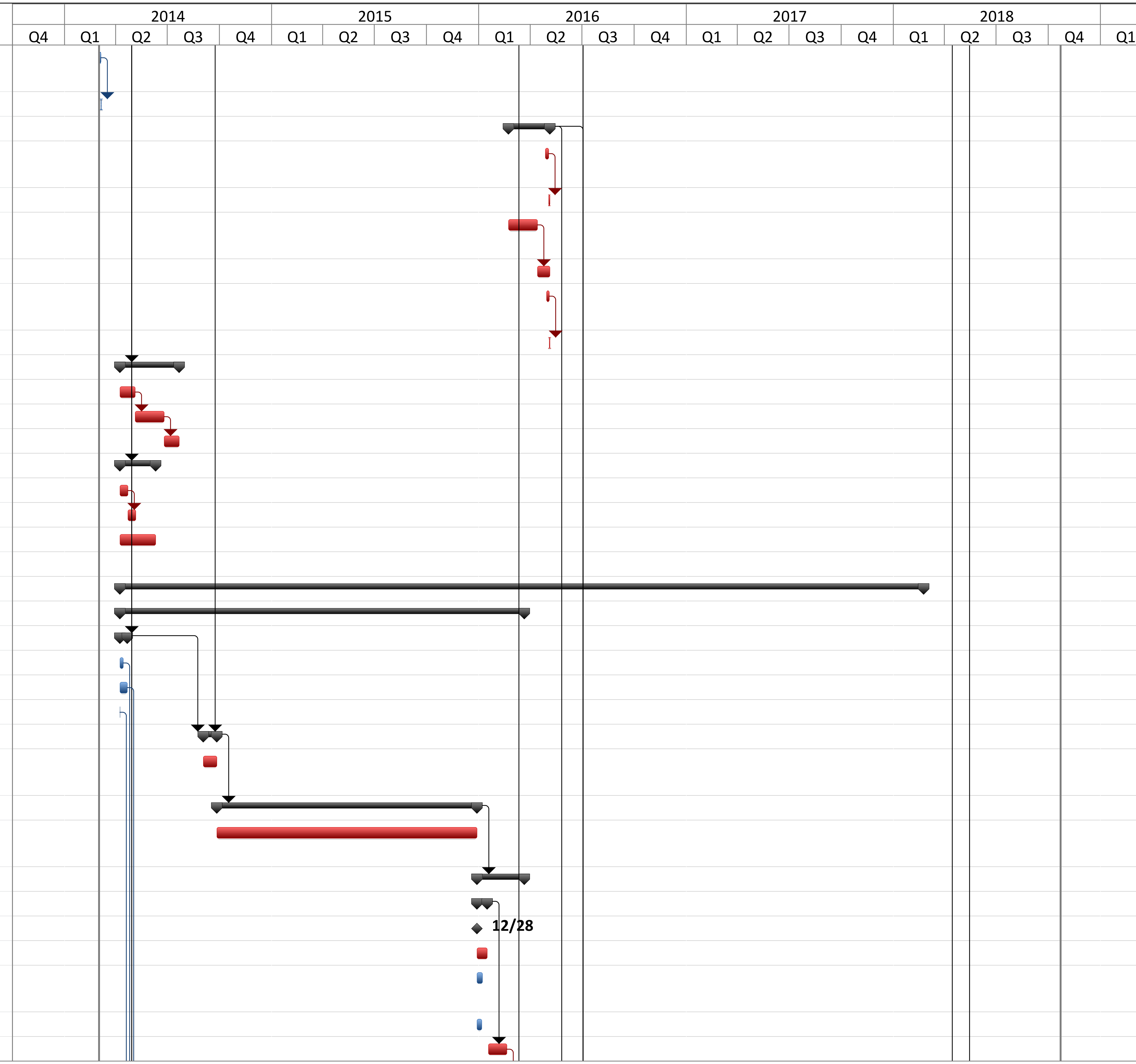
ID	Task Name	Estimated Duration	Start	Finish
219	**Overburden Relocation**	**48 days**	**Thu 5/5/16**	**Tue 7/12/16**
229	**RIM Relocation to On-Site Cell**	**26 days**	**Tue 7/12/16**	**Wed 8/17/16**
238	**Radiological Survey**	**7 days**	**Wed 8/17/16**	**Fri 8/26/16**
241	**Backfill and Slope Correction, Area 1**	**103 days**	**Fri 8/26/16**	**Wed 1/18/17**
263	**Final Cover, Area 1**	**39 days**	**Wed 1/18/17**	**Mon 3/13/17**
273	**Post-Construction Stormwater Controls**	**6 days**	**Tue 3/14/17**	**Tue 3/21/17**
283	**Site Completion, Area 1**	**19 days**	**Mon 3/6/17**	**Fri 3/31/17**



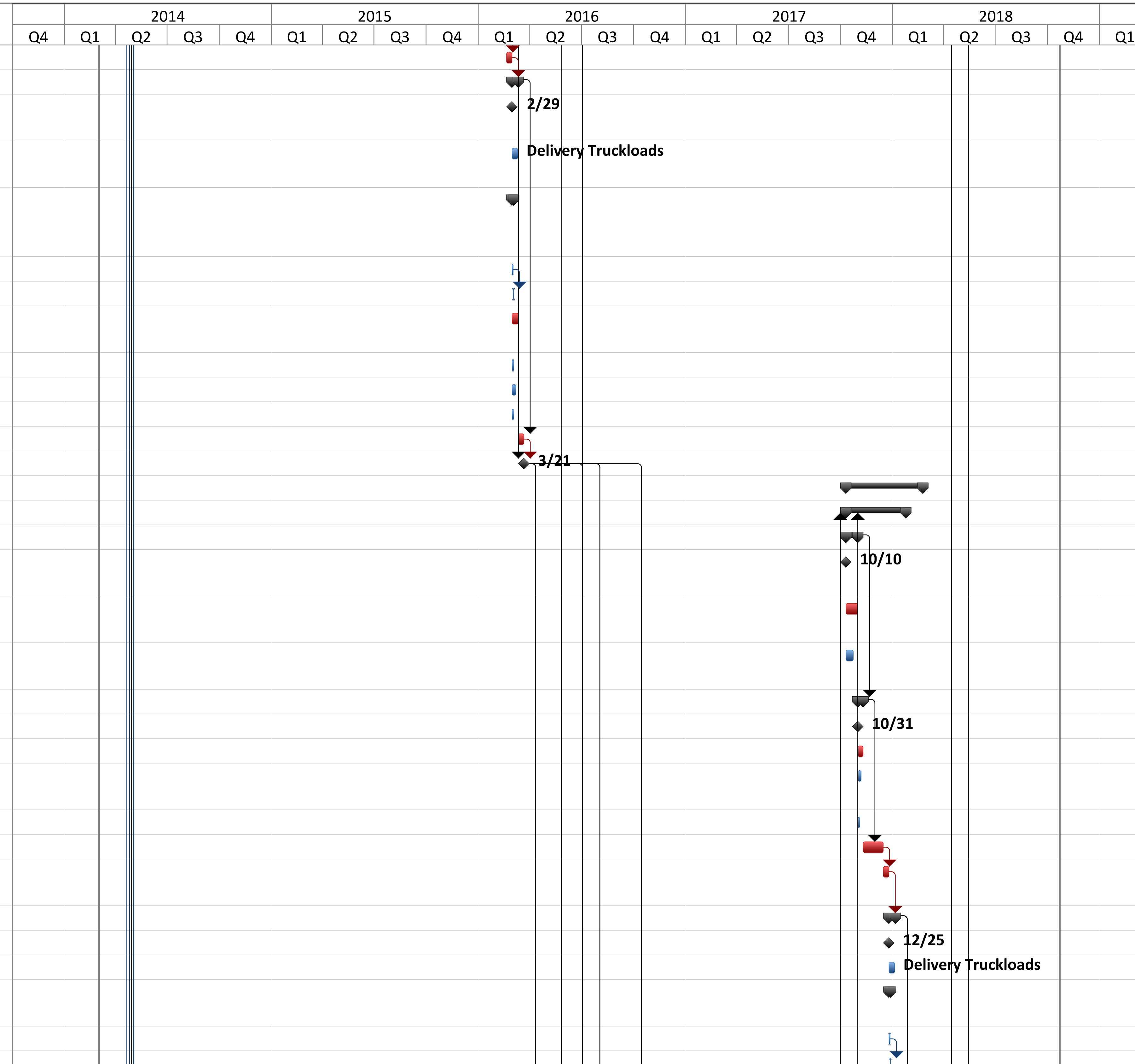
ID	Task Name	Estimated Duration	Start	Finish
0	**On-Site Disposal Alternative**	**1211 days**	**Mon 3/3/14**	**Mon 10/22/18**
1				
2	**Site-wide Preparation**	**1126 days**	**Mon 3/3/14**	**Tue 6/26/18**
3	**Temporary Construction Facilities / Utilities / Personnel**	**47 days**	**Mon 3/3/14**	**Tue 5/6/14**
4	Construction Trailers	38 days	Mon 3/3/14	Wed 4/23/14
5	Parking Area	9 days	Wed 4/23/14	Tue 5/6/14
6	**Temporary Stormwater Infrastructure**	**1100 days**	**Tue 4/8/14**	**Tue 6/26/18**
7	**Temporary Stormwater Lagoon**	**46 days**	**Tue 4/8/14**	**Wed 6/11/14**
8	Excavate soil for 4th berm at former leachate lagoon area	20 days	Tue 4/8/14	Tue 5/6/14
9	Place soil for berm	15 days	Tue 4/15/14	Tue 5/6/14
10	Compact berm	2 days	Fri 5/2/14	Tue 5/6/14
11	Install geomembrane liner	26 days	Tue 5/6/14	Wed 6/11/14
12	**Install force mains from Areas 1 and 2 to lagoon**	**11 days**	**Tue 5/6/14**	**Tue 5/20/14**
13	Area 1	9 days	Tue 5/6/14	Mon 5/19/14
14	Area 2	2 days	Mon 5/19/14	Tue 5/20/14
15	Install force main from lagoon to treatment facility	1 day	Tue 5/20/14	Thu 5/22/14
16	**Treatment Facility**	**60 days**	**Tue 4/8/14**	**Tue 7/1/14**
17	Construction	60 days	Tue 4/8/14	Tue 7/1/14
18	**Leachate Treatment Facility**	**73 days**	**Thu 5/22/14**	**Tue 9/2/14**
19	Force main from cell to Treatment Facility	15 days	Thu 5/22/14	Thu 6/12/14
20	Construct Treatment Facility	45 days	Tue 7/1/14	Tue 9/2/14
21	**Post-project Stormwater Demolition**	**45 days**	**Tue 4/24/18**	**Tue 6/26/18**
22	Dispose of geomembrane liner in On-Site Cell	25 days	Tue 4/24/18	Tue 5/29/18
23	Deconstruct 4th berm	20 days	Tue 5/29/18	Tue 6/26/18
24	Grade berm material in lagoon for proper drainage	15 days	Tue 6/5/18	Tue 6/26/18
25	**Mobilization**	**27 days**	**Mon 3/3/14**	**Tue 4/8/14**
26	Mobilize and Demobilize Equipment Under 150HP	2 days	Mon 3/3/14	Tue 3/4/14
27	Extra Mileage for Mobilizations	1 day	Wed 3/5/14	Thu 3/6/14
28	Mobilize and Demobilize Equipment Over 150HP	19 days	Mon 3/3/14	Thu 3/27/14
29	Extra Mileage for Mobilizations	8 days	Thu 3/27/14	Tue 4/8/14
30	Mobilize and Demobilize Equipment, Towed	1 day	Mon 3/3/14	Tue 3/4/14
31	Extra Mileage for Mobilizations	1 day	Tue 3/4/14	Tue 3/4/14



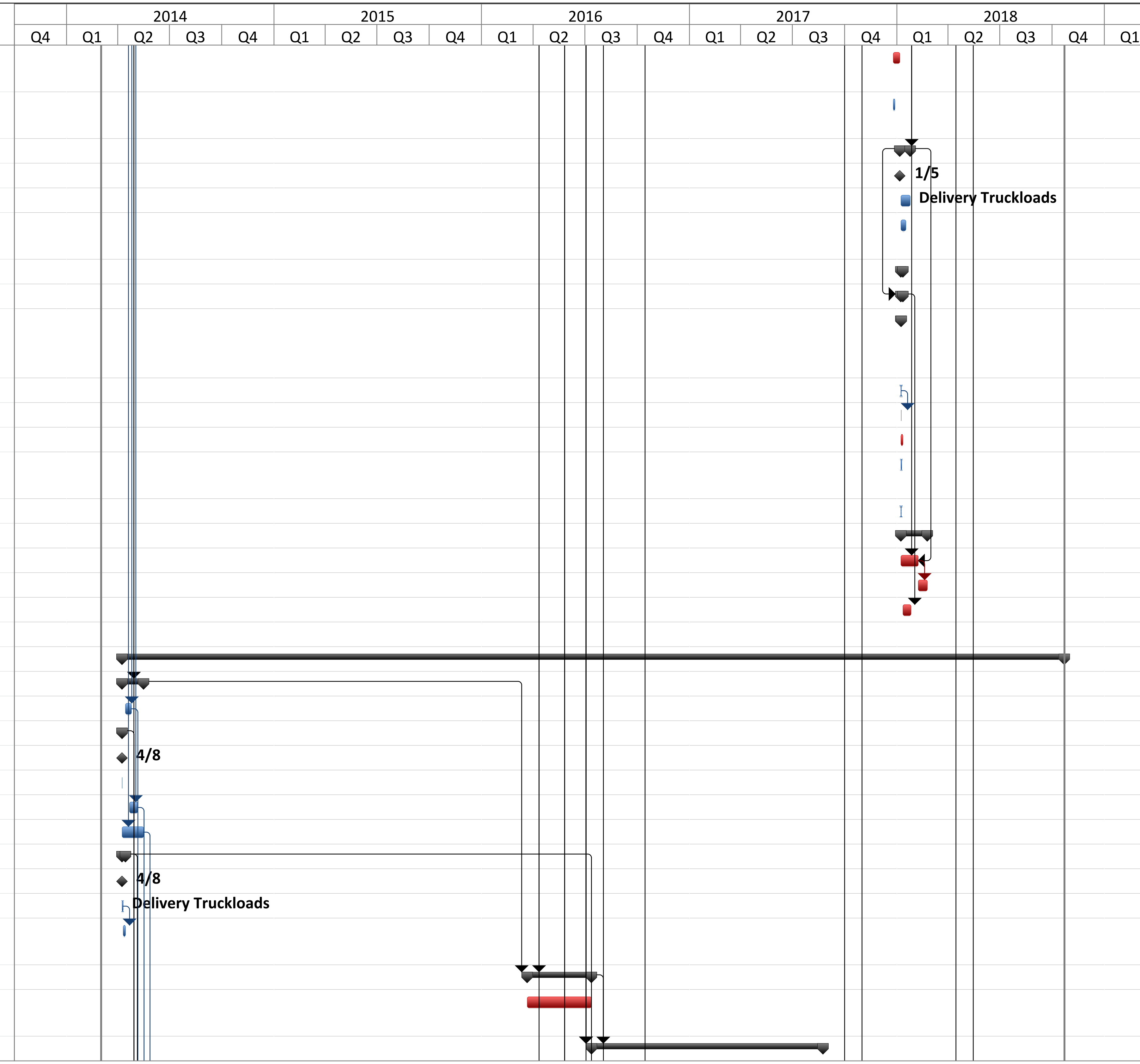
ID	Task Name	Estimated Duration	Start	Finish
32	Mobilize and Demobilize Equipment, Scapers	3 days	Mon 3/3/14	Wed 3/5/14
33	Extra Mileage for Mobilizations	1 day	Thu 3/6/14	Thu 3/6/14
34	**Supplemental Mobilizations**	**53 days**	**Mon 2/22/16**	**Thu 5/5/16**
35	Mobilize and Demobilize Equipment Under 150HP	4 days	Wed 4/27/16	Tue 5/3/16
36	Extra Mileage for Mobilizations	2 days	Tue 5/3/16	Thu 5/5/16
37	Mobilize and Demobilize Equipment Over 150HP	37 days	Mon 2/22/16	Wed 4/13/16
38	Extra Mileage for Mobilizations	16 days	Wed 4/13/16	Thu 5/5/16
39	Mobilize and Demobilize Equipment, Towed	3 days	Fri 4/29/16	Wed 5/4/16
40	Extra Mileage for Mobilizations	1 day	Wed 5/4/16	Thu 5/5/16
41	**Create Temporary Roads**	**75 days**	**Tue 4/8/14**	**Mon 7/21/14**
42	Area 1	19 days	Tue 4/8/14	Mon 5/5/14
43	Area 2	37 days	Mon 5/5/14	Wed 6/25/14
44	On-Site Cell	19 days	Wed 6/25/14	Mon 7/21/14
45	**Install TBD Traffic Improvements**	**45 days**	**Tue 4/8/14**	**Tue 6/10/14**
46	Area 1	10 days	Tue 4/8/14	Tue 4/22/14
47	Area 2	10 days	Tue 4/22/14	Tue 5/6/14
48	On-Site Cell	45 days	Tue 4/8/14	Tue 6/10/14
49				
50	**On-Site Cell**	**1013 days**	**Tue 4/8/14**	**Fri 2/23/18**
51	**Construction**	**509 days**	**Tue 4/8/14**	**Mon 3/21/16**
52	**Site Preparation**	**9 days**	**Tue 4/8/14**	**Mon 4/21/14**
53	Prepare area with Stormwater BMPS	4 days	Tue 4/8/14	Mon 4/14/14
54	Clear Vegetation (Light)	9 days	Tue 4/8/14	Mon 4/21/14
55	Clear Vegetation (Heavy)	0 days	Tue 4/8/14	Tue 4/8/14
56	**Stormwater Events (Weather Delays)**	**18 days**	**Tue 9/2/14**	**Fri 9/26/14**
57	Dewater construction after rain events	18 days	Tue 9/2/14	Fri 9/26/14
58	**New On-Site Cell Excavation**	**327 days**	**Fri 9/26/14**	**Mon 12/28/15**
59	Excavate Excess Overburden to Subgrade Contours	327 days	Fri 9/26/14	Mon 12/28/15
60	**Construct Cell Bottom Liner**	**59 days**	**Mon 12/28/15**	**Mon 3/21/16**
61	**Clay**	**14 days**	**Mon 12/28/15**	**Fri 1/15/16**
62	Purchase clay material	0 days	Mon 12/28/15	Mon 12/28/15
63	Deliver clay material to site	14 days	Tue 12/29/15	Fri 1/15/16
64	Spread loose lift before compaction in Cell Liner	8 days	Tue 12/29/15	Thu 1/7/16
65	Compact Clay in Cell Liner	6 days	Tue 12/29/15	Wed 1/6/16
66	Install Geosynthetic liner	25 days	Mon 1/18/16	Fri 2/19/16



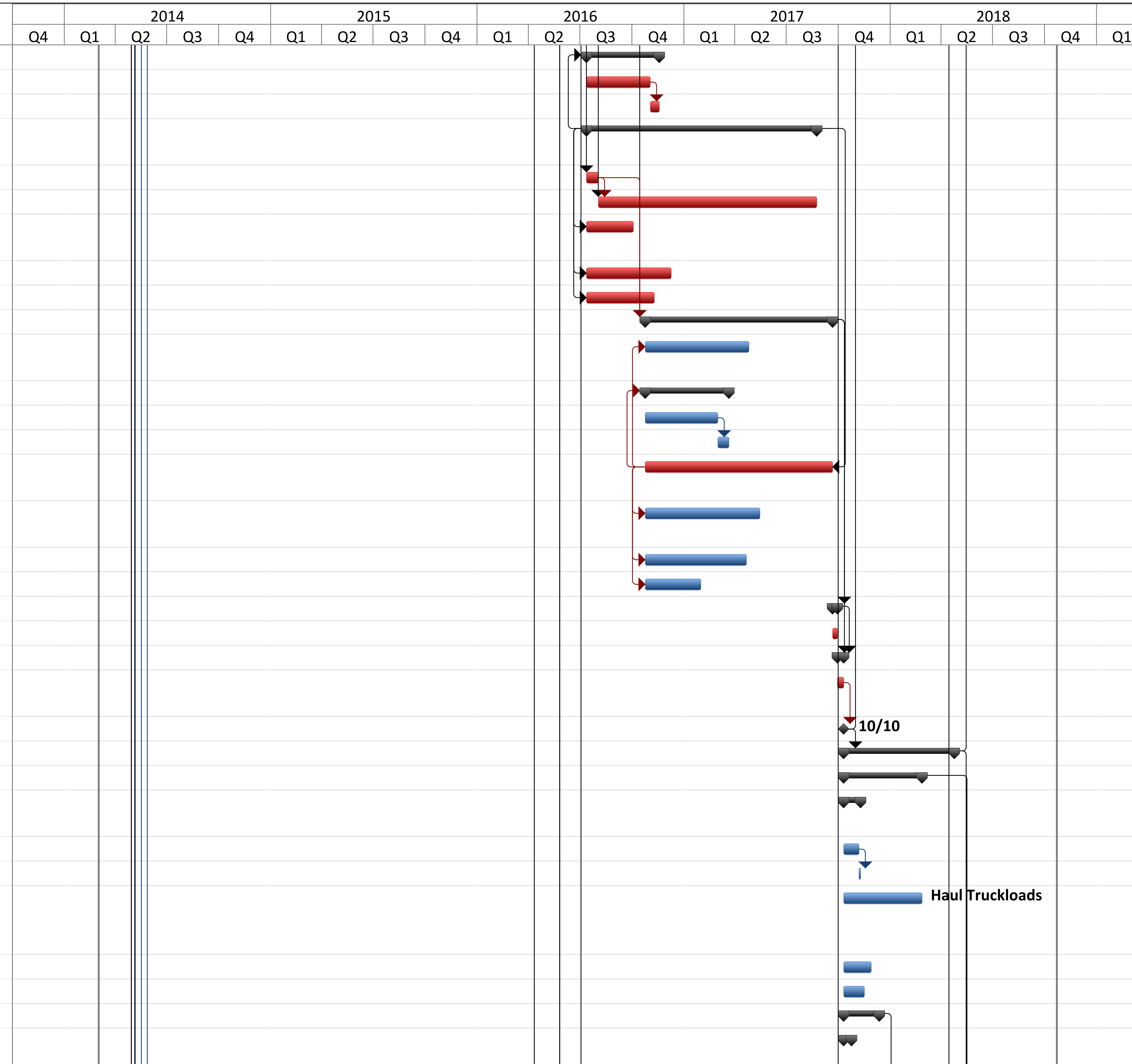
ID	Task Name	Estimated Duration	Start	Finish
67	Install Cushioning geotextile	6 days	Fri 2/19/16	Mon 2/29/16
68	**Leachate Collection**	**9 days**	**Mon 2/29/16**	**Fri 3/11/16**
69	Purchase Leachate Collection Layer Drainage Material	0 days	Mon 2/29/16	Mon 2/29/16
70	Deliver Leachate Collection Layer Drainage Material	8 days	Mon 2/29/16	Thu 3/10/16
71	**Load Leachate Drainage Material from stockpile to off road haul truck**	**3 days**	**Mon 2/29/16**	**Thu 3/3/16**
72	Excavate	3 days	Mon 2/29/16	Wed 3/2/16
73	Load	0 days	Wed 3/2/16	Thu 3/3/16
74	Haul Leachate Drainage Material from stockpile to cell	9 days	Mon 2/29/16	Fri 3/11/16
75	Install Leachate Collection Layer	3 days	Mon 2/29/16	Thu 3/3/16
76	Install Leachate Collection Piping	5 days	Mon 2/29/16	Mon 3/7/16
77	Install Leachate Collection Sump	3 days	Mon 2/29/16	Thu 3/3/16
78	Install Separation Geotextile filter	6 days	Fri 3/11/16	Mon 3/21/16
79	Cell is Ready for Waste	0 days	Mon 3/21/16	Mon 3/21/16
80	**Closure of On-Site Cell**	**98 days**	**Tue 10/10/17**	**Fri 2/23/18**
81	**Final Cover**	**76 days**	**Tue 10/10/17**	**Wed 1/24/18**
82	**Bio-Intrusion Layer**	**15 days**	**Tue 10/10/17**	**Tue 10/31/17**
83	Purchase of Bio-Intrusion Layer Material	0 days	Tue 10/10/17	Tue 10/10/17
84	Deliver Bio-Intrusion Layer Material	15 days	Tue 10/10/17	Tue 10/31/17
85	Spread Bio-Intrusion Layer Material	9 days	Tue 10/10/17	Mon 10/23/17
86	**Clay Layer**	**7 days**	**Tue 10/31/17**	**Thu 11/9/17**
87	Purchase clay material	0 days	Tue 10/31/17	Tue 10/31/17
88	Deliver clay material to site	7 days	Tue 10/31/17	Thu 11/9/17
89	Spread loose lift before compaction	4 days	Tue 10/31/17	Mon 11/6/17
90	Compact Clay (Final Cover)	3 days	Tue 10/31/17	Fri 11/3/17
91	Install Synthetic liner for final cover	26 days	Fri 11/10/17	Fri 12/15/17
92	Install Cushioning geotextile for final cover	6 days	Fri 12/15/17	Mon 12/25/17
93	**Drainage Layer**	**10 days**	**Mon 12/25/17**	**Fri 1/5/18**
94	Purchase Drainage Material	0 days	Mon 12/25/17	Mon 12/25/17
95	Deliver Drainage Material	9 days	Mon 12/25/17	Thu 1/4/18
96	**Load Drainage material from stockpile to off road haul truck**	**3 days**	**Mon 12/25/17**	**Thu 12/28/17**
97	Excavate	3 days	Mon 12/25/17	Wed 12/27/17
98	Load	0 days	Wed 12/27/17	Thu 12/28/17



ID	Task Name	Estimated Duration	Start	Finish
99	Haul material from stockpile to cell	10 days	Mon 12/25/17	Fri 1/5/18
100	Move and Place drainage layer material for final cover	3 days	Mon 12/25/17	Thu 12/28/17
101	**Top Soil**	**12 days**	**Fri 1/5/18**	**Wed 1/24/18**
102	Purchase Topsoil	0 days	Fri 1/5/18	Fri 1/5/18
103	Deliver Topsoil	12 days	Mon 1/8/18	Wed 1/24/18
104	Move and place Topsoil (Final Cover)	7 days	Mon 1/8/18	Tue 1/16/18
105	**Post-Construction Stormwater Controls**	**4 days**	**Mon 1/8/18**	**Thu 1/11/18**
106	**Pond**	**4 days**	**Mon 1/8/18**	**Thu 1/11/18**
107	**Load Overburden Material from stockpile to off road haul truck for pond**	**1 day**	**Mon 1/8/18**	**Mon 1/8/18**
108	Excavate	1 day	Mon 1/8/18	Mon 1/8/18
109	Load	0 days	Mon 1/8/18	Mon 1/8/18
110	Haul loose lift soil for Pond	4 days	Mon 1/8/18	Thu 1/11/18
111	Spread loose lift before compaction (Pond)	1 day	Mon 1/8/18	Tue 1/9/18
112	Compact Berm (Pond)	1 day	Mon 1/8/18	Mon 1/8/18
113	**On-Site Cell Site Completion**	**34 days**	**Mon 1/8/18**	**Fri 2/23/18**
114	Install temporary irrigation system	22 days	Mon 1/8/18	Wed 2/7/18
115	Apply seeding to cover	12 days	Wed 2/7/18	Fri 2/23/18
116	Install Fencing	10 days	Thu 1/11/18	Thu 1/25/18
117				
118	**Area 2**	**1184 days**	**Tue 4/8/14**	**Mon 10/22/18**
119	**Site Preparation**	**28 days**	**Tue 4/8/14**	**Fri 5/16/14**
120	Prepare area with Stormwater BMPS	9 days	Mon 4/14/14	Thu 4/24/14
121	**Decontamination Area**	**0 days**	**Tue 4/8/14**	**Tue 4/8/14**
122	Materials	0 days	Tue 4/8/14	Tue 4/8/14
123	Installation	0 days	Tue 4/8/14	Tue 4/8/14
124	Clear Vegetation (Light)	11 days	Mon 4/21/14	Mon 5/5/14
125	Clear Vegetation (Heavy)	28 days	Tue 4/8/14	Fri 5/16/14
126	**Berms for Overburden**	**4 days**	**Tue 4/8/14**	**Mon 4/14/14**
127	Purchase material	0 days	Tue 4/8/14	Tue 4/8/14
128	Deliver and Stockpile	2 days	Tue 4/8/14	Thu 4/10/14
129	Develop earthen berms to store relocated overburden wastes	2 days	Thu 4/10/14	Mon 4/14/14
130	**Stormwater Events (Weather Delays)**	**81 days**	**Mon 3/21/16**	**Tue 7/12/16**
131	Dewater construction during rain events	81 days	Mon 3/21/16	Tue 7/12/16
132	**Overburden Relocation**	**292 days**	**Tue 7/12/16**	**Wed 8/23/17**

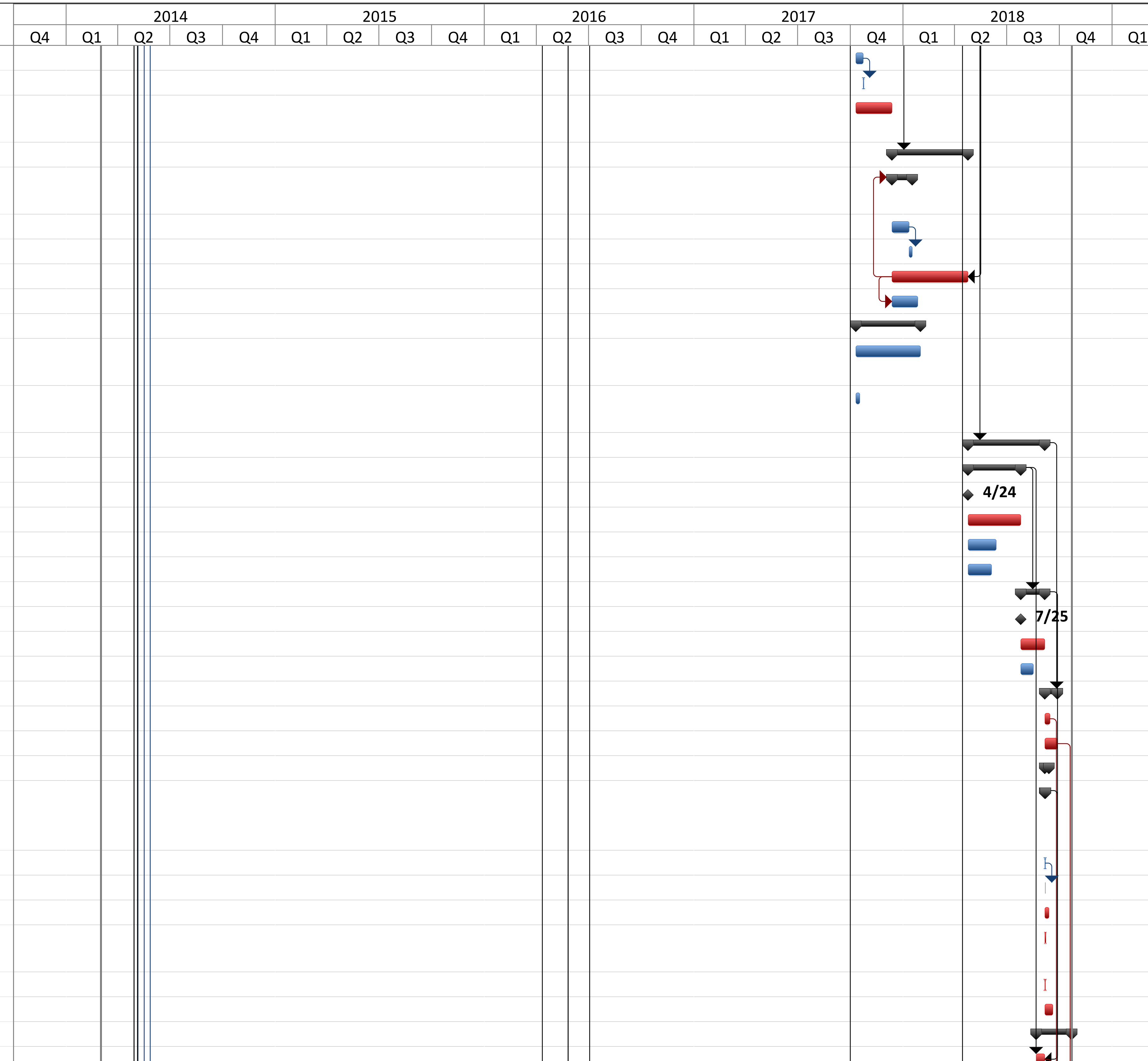


ID	Task Name	Estimated Duration	Start	Finish
133	**Relocate overburden wastes**	**93 days**	**Tue 7/12/16**	**Fri 11/18/16**
134	Excavate	81 days	Tue 7/12/16	Wed 11/2/16
135	Load	12 days	Wed 11/2/16	Fri 11/18/16
136	**Relocate overburden wastes - Haul and Dump**	**292 days**	**Tue 7/12/16**	**Wed 8/23/17**
137	To bermed areas	15 days	Tue 7/12/16	Tue 8/2/16
138	To other areas	277 days	Tue 8/2/16	Wed 8/23/17
139	Apply daily cover to relocated overburden wastes	59 days	Tue 7/12/16	Mon 10/3/16
140	Spread overburden wastes	108 days	Tue 7/12/16	Fri 12/9/16
141	Compact overburden wastes	86 days	Tue 7/12/16	Wed 11/9/16
142	**RIM Relocation to On-Site Cell**	**237 days**	**Mon 10/24/16**	**Wed 9/20/17**
143	Apply daily cover to remaining excavation of RIM Wastes	131 days	Mon 10/24/16	Tue 4/25/17
144	**Relocate RIM Wastes on-site**	**106 days**	**Mon 10/24/16**	**Tue 3/21/17**
145	Excavate	92 days	Mon 10/24/16	Wed 3/1/17
146	Load	14 days	Thu 3/2/17	Tue 3/21/17
147	Relocate RIM Wastes to On-Site Cell - Haul and Dump	237 days	Mon 10/24/16	Wed 9/20/17
148	Apply daily cover to relocated RIM Wastes	144 days	Mon 10/24/16	Mon 5/15/17
149	Spread RIM Wastes at On-Site Cell	129 days	Mon 10/24/16	Fri 4/21/17
150	Compact RIM Wastes at On-Site Cell	70 days	Mon 10/24/16	Mon 1/30/17
151	**Buffer Zone**	**7 days**	**Thu 9/21/17**	**Fri 9/29/17**
152	Buffer Zone Activity	7 days	Thu 9/21/17	Fri 9/29/17
153	**Radiological Survey**	**7 days**	**Fri 9/29/17**	**Tue 10/10/17**
154	Conduct final radiological survey and wait for approval	7 days	Fri 9/29/17	Tue 10/10/17
155	Area 2 is clean	0 days	Tue 10/10/17	Tue 10/10/17
156	**Backfill and Slope Correction, Area 2**	**140 days**	**Tue 10/10/17**	**Tue 4/24/18**
157	**Slope Correction Cuts**	**99 days**	**Tue 10/10/17**	**Mon 2/26/18**
158	**Move non-RIM waste to correct slopes in excavation - Excavate**	**22 days**	**Tue 10/10/17**	**Thu 11/9/17**
159	Excavate	19 days	Tue 10/10/17	Mon 11/6/17
160	Load	3 days	Mon 11/6/17	Thu 11/9/17
161	Move non-RIM waste to correct slopes in excavation - Haul and Dump	99 days	Tue 10/10/17	Mon 2/26/18
162	Spread cut material	35 days	Tue 10/10/17	Tue 11/28/17
163	Compact cut material	27 days	Tue 10/10/17	Thu 11/16/17
164	**Backfill Overburden**	**45 days**	**Tue 10/10/17**	**Tue 12/12/17**
165	**Backfill Overburden Materials stored in berms - Excavate**	**10 days**	**Tue 10/10/17**	**Tue 10/24/17**

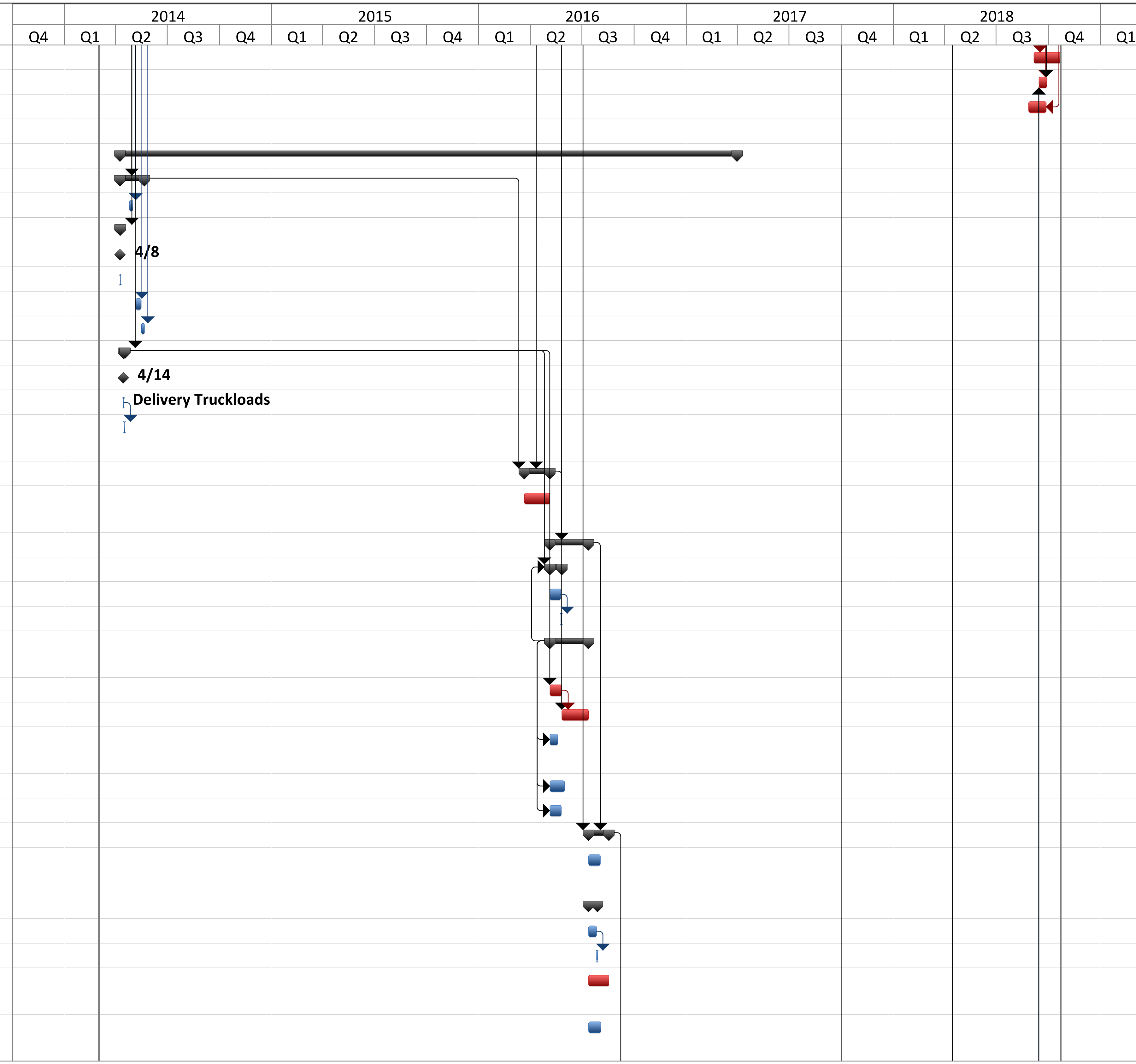


Note: All dates are for planning purposes only - not actual dates.

ID	Task Name	Estimated Duration	Start	Finish
166	Excavate	9 days	Tue 10/10/17	Mon 10/23/17
167	Load	1 day	Mon 10/23/17	Tue 10/24/17
168	Backfill Overburden Materials stored in berms - Haul and Dump	45 days	Tue 10/10/17	Tue 12/12/17
169	**Additional Fill**	**95 days**	**Tue 12/12/17**	**Tue 4/24/18**
170	**Excavate additional fill material for grading**	**25 days**	**Tue 12/12/17**	**Tue 1/16/18**
171	Excavate	22 days	Tue 12/12/17	Thu 1/11/18
172	Load	3 days	Thu 1/11/18	Tue 1/16/18
173	Haul additional fill for grading	95 days	Tue 12/12/17	Tue 4/24/18
174	Spread additional fill	33 days	Tue 12/12/17	Fri 1/26/18
175	**Daily Cover**	**81 days**	**Tue 10/10/17**	**Wed 1/31/18**
176	Use geotextile as a daily cover for backfill waste to reclaim slopes	81 days	Tue 10/10/17	Wed 1/31/18
177	Use geotextile as a daily cover on bermed overburden	5 days	Tue 10/10/17	Tue 10/17/17
178	**Final Cover, Area 2**	**96 days**	**Tue 4/24/18**	**Wed 9/5/18**
179	**Clay**	**66 days**	**Tue 4/24/18**	**Wed 7/25/18**
180	Purchase clay material	0 days	Tue 4/24/18	Tue 4/24/18
181	Deliver clay material to site	66 days	Tue 4/24/18	Wed 7/25/18
182	Spread loose lift before compaction	35 days	Tue 4/24/18	Tue 6/12/18
183	Compact Clay (Final Cover)	29 days	Tue 4/24/18	Mon 6/4/18
184	**Top Soil**	**30 days**	**Wed 7/25/18**	**Wed 9/5/18**
185	Purchase Topsoil	0 days	Wed 7/25/18	Wed 7/25/18
186	Deliver Topsoil	30 days	Wed 7/25/18	Wed 9/5/18
187	Move and place Topsoil (Final Cover)	16 days	Wed 7/25/18	Thu 8/16/18
188	**Post-Construction Stormwater Controls**	**16 days**	**Wed 9/5/18**	**Thu 9/27/18**
189	Install Terraces	7 days	Wed 9/5/18	Fri 9/14/18
190	Construct Ditches	16 days	Wed 9/5/18	Thu 9/27/18
191	**Pond**	**5 days**	**Wed 9/5/18**	**Wed 9/12/18**
192	**Load Overburden Material from stockpile to off road haul truck for pond**	**1 day**	**Wed 9/5/18**	**Thu 9/6/18**
193	Excavate	1 day	Wed 9/5/18	Thu 9/6/18
194	Load	0 days	Thu 9/6/18	Thu 9/6/18
195	Haul loose lift soil for Pond	5 days	Wed 9/5/18	Wed 9/12/18
196	Spread loose lift before compaction (Pond)	2 days	Wed 9/5/18	Fri 9/7/18
197	Compact Berm (Pond)	1 day	Wed 9/5/18	Thu 9/6/18
198	Final Stormwater Controls	10 days	Wed 9/5/18	Wed 9/19/18
199	**Site Completion, Area 2**	**44 days**	**Tue 8/21/18**	**Mon 10/22/18**
200	Install temporary irrigation system	11 days	Tue 8/21/18	Wed 9/5/18



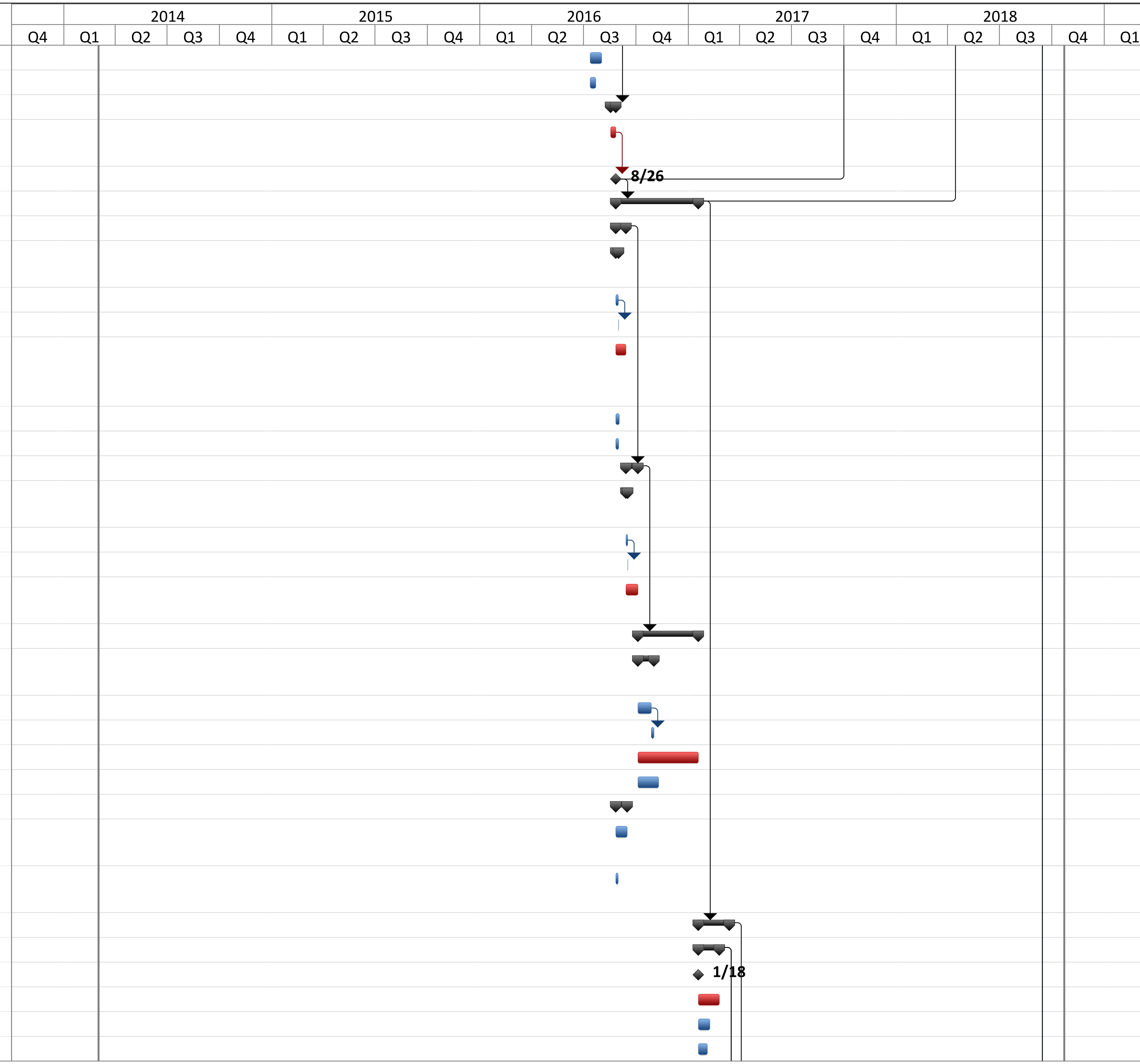
ID	Task Name	Estimated Duration	Start	Finish
201	Apply seeding to cover	33 days	Wed 9/5/18	Mon 10/22/18
202	Apply seeding to soil stockpile	10 days	Fri 9/14/18	Fri 9/28/18
203	Install Fencing	23 days	Mon 8/27/18	Thu 9/27/18
204				
205	**Area 1**	**777 days**	**Tue 4/8/14**	**Fri 3/31/17**
206	**Site Preparation**	**31 days**	**Tue 4/8/14**	**Wed 5/21/14**
207	Prepare area with Stormwater BMPS	4 days	Fri 4/25/14	Thu 5/1/14
208	**Decontamination Area**	**0 days**	**Tue 4/8/14**	**Wed 4/9/14**
209	Materials	0 days	Tue 4/8/14	Tue 4/8/14
210	Installation	0 days	Tue 4/8/14	Wed 4/9/14
211	Clear Vegetation (Light)	8 days	Tue 5/6/14	Thu 5/15/14
212	Clear Vegetation (Heavy)	4 days	Fri 5/16/14	Wed 5/21/14
213	**Berms for Overburden**	**3 days**	**Mon 4/14/14**	**Thu 4/17/14**
214	Purchase material	0 days	Mon 4/14/14	Mon 4/14/14
215	Deliver and Stockpile	1 day	Mon 4/14/14	Tue 4/15/14
216	Develop earthen berms to store relocated overburden wastes	1 day	Tue 4/15/14	Thu 4/17/14
217	**Stormwater Events (Weather Delays)**	**33 days**	**Mon 3/21/16**	**Thu 5/5/16**
218	Dewater construction during rain events	33 days	Mon 3/21/16	Thu 5/5/16
219	**Overburden Relocation**	**48 days**	**Thu 5/5/16**	**Tue 7/12/16**
220	**Relocate overburden wastes**	**15 days**	**Thu 5/5/16**	**Thu 5/26/16**
221	Excavate	13 days	Thu 5/5/16	Tue 5/24/16
222	Load	2 days	Tue 5/24/16	Thu 5/26/16
223	**Relocate overburden wastes - Haul and Dump**	**48 days**	**Thu 5/5/16**	**Tue 7/12/16**
224	To bermed areas	15 days	Thu 5/5/16	Thu 5/26/16
225	To other areas	33 days	Thu 5/26/16	Tue 7/12/16
226	Apply daily cover to relocated overburden wastes	10 days	Thu 5/5/16	Thu 5/19/16
227	Spread overburden wastes	18 days	Thu 5/5/16	Tue 5/31/16
228	Compact overburden wastes	14 days	Thu 5/5/16	Wed 5/25/16
229	**RIM Relocation to On-Site Cell**	**26 days**	**Tue 7/12/16**	**Wed 8/17/16**
230	Apply daily cover to remaining excavation of RIM Wastes	15 days	Tue 7/12/16	Tue 8/2/16
231	**Relocate RIM Wastes on-site - Excavate**	**12 days**	**Tue 7/12/16**	**Thu 7/28/16**
232	Excavate	10 days	Tue 7/12/16	Tue 7/26/16
233	Load	2 days	Tue 7/26/16	Thu 7/28/16
234	Relocate RIM Wastes to On-Site Cell - Haul and Dump	26 days	Tue 7/12/16	Wed 8/17/16
235	Apply daily cover to relocated RIM Wastes	16 days	Tue 7/12/16	Wed 8/3/16



Note: All dates are for planning purposes only - not actual dates.

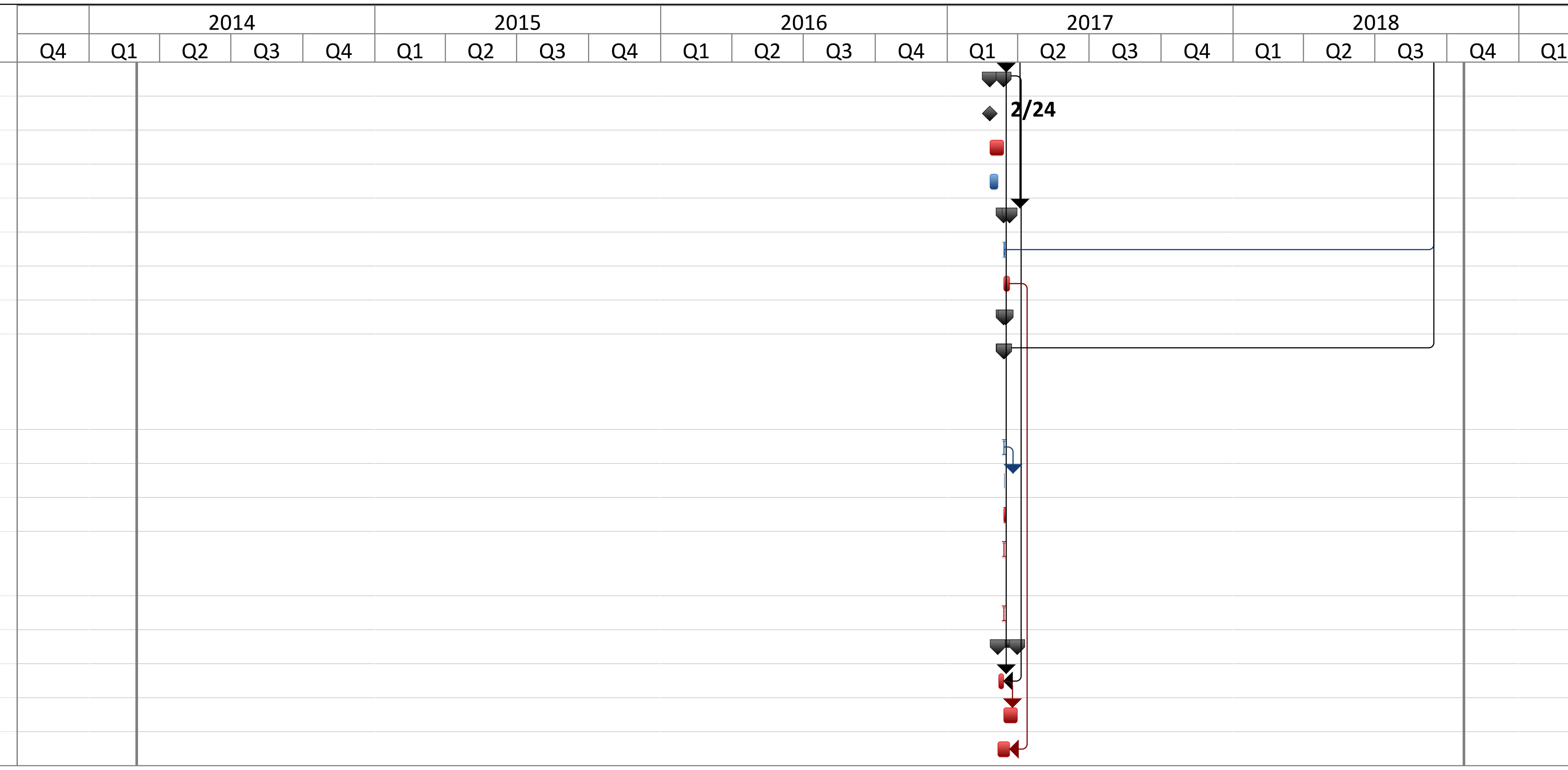
Feezor Engineering, Inc.

ID	Task Name	Estimated Duration	Start	Finish
236	Spread RIM Wastes at On-Site Cell	14 days	Tue 7/12/16	Mon 8/1/16
237	Compact RIM Wastes at On-Site Cell	8 days	Tue 7/12/16	Fri 7/22/16
238	**Radiological Survey**	**7 days**	**Wed 8/17/16**	**Fri 8/26/16**
239	Conduct final radiological survey and wait for approval	7 days	Wed 8/17/16	Fri 8/26/16
240	Area 1 is clean	0 days	Fri 8/26/16	Fri 8/26/16
241	**Backfill and Slope Correction, Area 1**	**103 days**	**Fri 8/26/16**	**Wed 1/18/17**
242	**Slope Correction Cuts**	**11 days**	**Fri 8/26/16**	**Tue 9/13/16**
243	**Move non-RIM waste to correct slopes in excavation**	**3 days**	**Fri 8/26/16**	**Wed 8/31/16**
244	Excavate	2 days	Fri 8/26/16	Tue 8/30/16
245	Load	0 days	Wed 8/31/16	Wed 8/31/16
246	Move non-RIM waste to correct slopes in excavation - Haul and Dump	11 days	Fri 8/26/16	Tue 9/13/16
247	Spread cut material	4 days	Fri 8/26/16	Thu 9/1/16
248	Compact cut material	3 days	Fri 8/26/16	Wed 8/31/16
249	**Backfill Overburden**	**15 days**	**Tue 9/13/16**	**Tue 10/4/16**
250	**Backfill Overburden Materials stored in berms**	**3 days**	**Tue 9/13/16**	**Fri 9/16/16**
251	Excavate	3 days	Tue 9/13/16	Fri 9/16/16
252	Load	0 days	Fri 9/16/16	Fri 9/16/16
253	Backfill Overburden Materials stored in berms - Haul and Dump	15 days	Tue 9/13/16	Tue 10/4/16
254	**Additional Fill**	**76 days**	**Tue 10/4/16**	**Wed 1/18/17**
255	**Excavate additional fill material for grading**	**20 days**	**Tue 10/4/16**	**Tue 11/1/16**
256	Excavate	18 days	Tue 10/4/16	Thu 10/27/16
257	Load	3 days	Fri 10/28/16	Tue 11/1/16
258	Haul additional fill for grading	76 days	Tue 10/4/16	Wed 1/18/17
259	Spread additional fill	27 days	Tue 10/4/16	Wed 11/9/16
260	**Daily Cover**	**14 days**	**Fri 8/26/16**	**Thu 9/15/16**
261	Use geotextile as a daily cover for backfill waste to reclaim slopes	14 days	Fri 8/26/16	Thu 9/15/16
262	Use geotextile as a daily cover on bermed overburden	2 days	Fri 8/26/16	Tue 8/30/16
263	**Final Cover, Area 1**	**39 days**	**Wed 1/18/17**	**Mon 3/13/17**
264	**Clay**	**27 days**	**Wed 1/18/17**	**Fri 2/24/17**
265	Purchase clay material	0 days	Wed 1/18/17	Wed 1/18/17
266	Deliver clay material to site	27 days	Wed 1/18/17	Fri 2/24/17
267	Spread loose lift before compaction	14 days	Wed 1/18/17	Tue 2/7/17
268	Compact Clay (Final Cover)	12 days	Wed 1/18/17	Fri 2/3/17



Note: All dates are for planning purposes only - not actual dates.

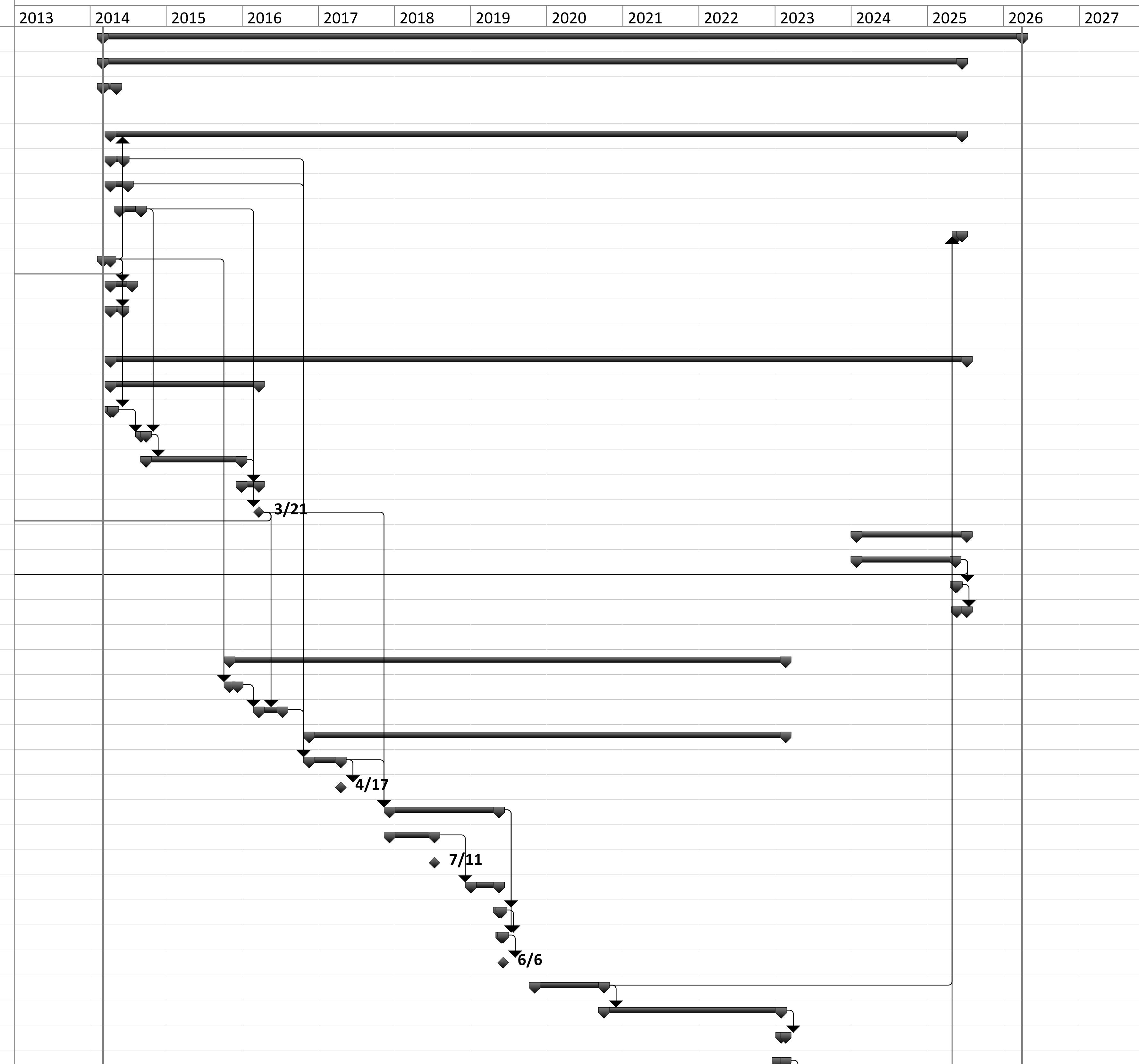
ID	Task Name	Estimated Duration	Start	Finish
269	**Top Soil**	**12 days**	**Fri 2/24/17**	**Mon 3/13/17**
270	Purchase Topsoil	0 days	Fri 2/24/17	Fri 2/24/17
271	Deliver Topsoil	12 days	Fri 2/24/17	Mon 3/13/17
272	Move and place Topsoil (Final Cover)	6 days	Fri 2/24/17	Mon 3/6/17
273	**Post-Construction Stormwater Controls**	**6 days**	**Tue 3/14/17**	**Tue 3/21/17**
274	Install Terraces	2 days	Tue 3/14/17	Wed 3/15/17
275	Construct Ditches	6 days	Tue 3/14/17	Tue 3/21/17
276	**Pond**	**3 days**	**Tue 3/14/17**	**Thu 3/16/17**
277	**Load Overburden Material from stockpile to off road haul truck for pond**	**1 day**	**Tue 3/14/17**	**Tue 3/14/17**
278	Excavate	1 day	Tue 3/14/17	Tue 3/14/17
279	Load	0 days	Tue 3/14/17	Tue 3/14/17
280	Haul loose lift soil for Pond	3 days	Tue 3/14/17	Thu 3/16/17
281	Spread loose lift before compaction (Pond)	1 day	Tue 3/14/17	Tue 3/14/17
282	Compact Berm (Pond)	0 days	Tue 3/14/17	Tue 3/14/17
283	**Site Completion, Area 1**	**19 days**	**Mon 3/6/17**	**Fri 3/31/17**
284	Install temporary irrigation system	4 days	Tue 3/7/17	Mon 3/13/17
285	Apply seeding to cover	13 days	Tue 3/14/17	Fri 3/31/17
286	Install Fencing	11 days	Mon 3/6/17	Tue 3/21/17



Estimated Schedule

“Complete Rad Removal” with On-Site Disposal Alternative
(with $10 million/year limitation)

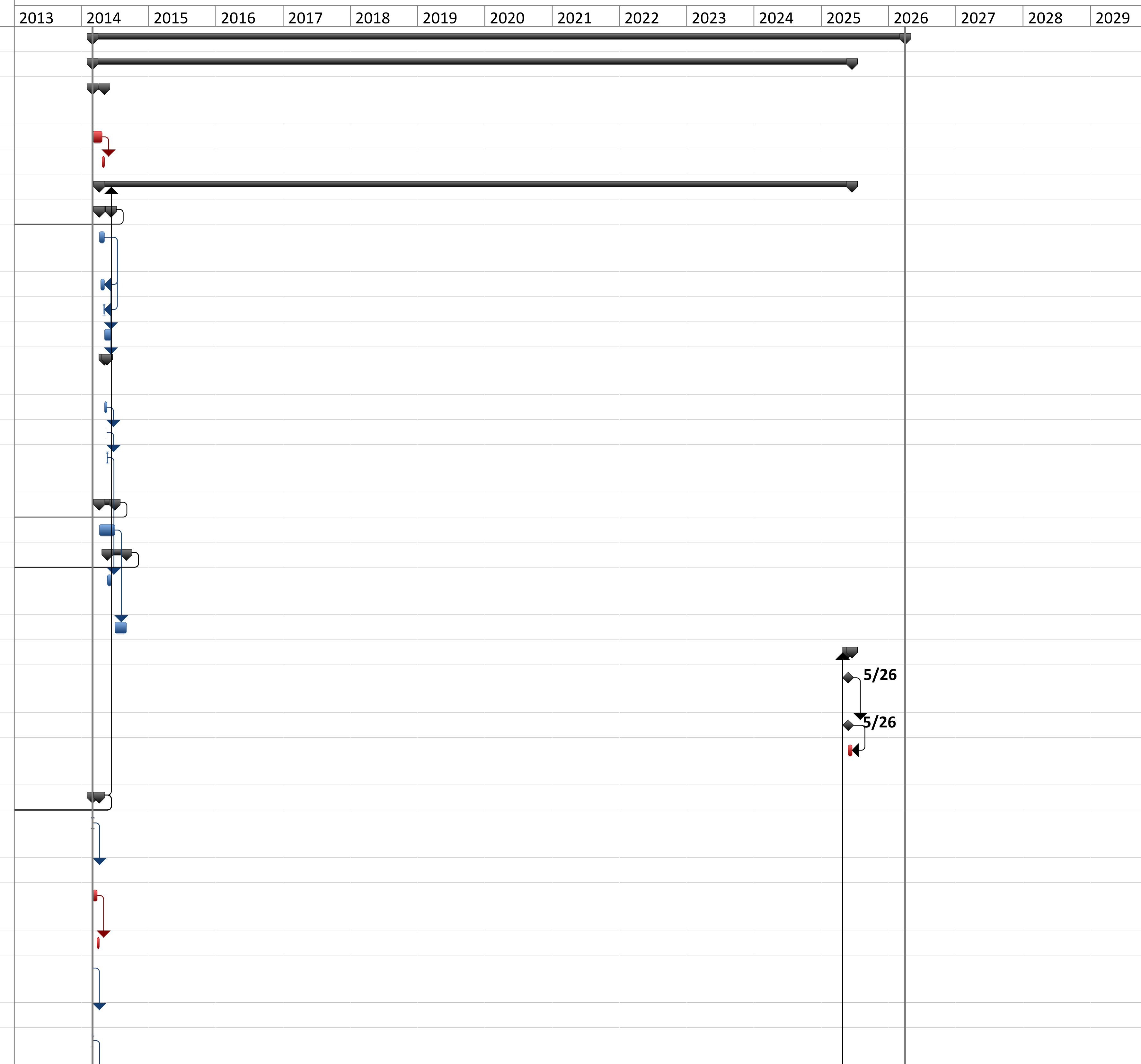
ID	Task Name	Estimated Duration	Start	Finish
1	**On-Site Disposal Alternative**	**3152 days**	**Mon 3/3/14**	**Wed 4/1/26**
2	**Site-wide Preparation**	**2945 days**	**Mon 3/3/14**	**Mon 6/16/25**
3	**Temporary Construction Facilities / Utilities / Personnel**	**47 days**	**Mon 3/3/14**	**Tue 5/6/14**
6	**Temporary Stormwater Infrastructure**	**2919 days**	**Tue 4/8/14**	**Mon 6/16/25**
7	**Temporary Stormwater Lagoon**	**46 days**	**Tue 4/8/14**	**Wed 6/11/14**
16	**Treatment Facility**	**60 days**	**Tue 4/8/14**	**Tue 7/1/14**
18	**Leachate Treatment Facility**	**73 days**	**Thu 5/22/14**	**Tue 9/2/14**
21	**Post-project Stormwater Demolition**	**15 days**	**Mon 5/26/25**	**Mon 6/16/25**
25	**Mobilization**	**27 days**	**Mon 3/3/14**	**Tue 4/8/14**
34	**Create Temporary Roads**	**75 days**	**Tue 4/8/14**	**Mon 7/21/14**
38	**Install TBD Traffic Improvements**	**45 days**	**Tue 4/8/14**	**Tue 6/10/14**
42				
43	**On-Site Cell**	**2936 days**	**Tue 4/8/14**	**Wed 7/9/25**
44	**Construction**	**509 days**	**Tue 4/8/14**	**Mon 3/21/16**
45	**Site Preparation**	**9 days**	**Tue 4/8/14**	**Mon 4/21/14**
49	**Stormwater Events (Weather Delays)**	**18 days**	**Tue 9/2/14**	**Fri 9/26/14**
51	**New On-Site Cell Excavation**	**327 days**	**Fri 9/26/14**	**Mon 12/28/15**
53	**Construct Cell Bottom Liner**	**59 days**	**Mon 12/28/15**	**Mon 3/21/16**
74	Cell is Ready for Waste	0 days	Mon 3/21/16	Mon 3/21/16
75	**Closure of On-Site Cell**	**379 days**	**Fri 1/26/24**	**Wed 7/9/25**
76	**Final Cover**	**340 days**	**Fri 1/26/24**	**Fri 5/16/25**
99	**Post-Construction Stormwater Controls**	**4 days**	**Fri 5/16/25**	**Thu 5/22/25**
107	**On-Site Cell Site Completion**	**34 days**	**Thu 5/22/25**	**Wed 7/9/25**
111				
112	**Area 2**	**1906 days**	**Sun 11/1/15**	**Tue 2/21/23**
113	**Site Preparation**	**28 days**	**Sun 11/1/15**	**Wed 12/9/15**
124	**Stormwater Events (Weather Delays)**	**81 days**	**Mon 3/21/16**	**Tue 7/12/16**
126	**Construction Activities**	**1633 days**	**Thu 11/17/16**	**Tue 2/21/23**
127	**Overburden Relocation**	**108 days**	**Thu 11/17/16**	**Mon 4/17/17**
137	**2017 Job Shutdown Cost Adjustments**	**0 days**	**Mon 4/17/17**	**Mon 4/17/17**
140	**RIM Relocation to On-Site Cell**	**375 days**	**Fri 12/8/17**	**Fri 5/17/19**
141	**2017-2018**	**154 days**	**Fri 12/8/17**	**Wed 7/11/18**
150	**2018 Job Shutdown Cost Adjustments**	**0 days**	**Wed 7/11/18**	**Wed 7/11/18**
153	**2019**	**97 days**	**Wed 1/2/19**	**Fri 5/17/19**
162	**Buffer Zone**	**7 days**	**Fri 5/17/19**	**Tue 5/28/19**
164	**Radiological Survey**	**7 days**	**Tue 5/28/19**	**Thu 6/6/19**
167	**2019 Job Shutdown Cost Adjustments**	**0 days**	**Thu 6/6/19**	**Thu 6/6/19**
170	**Backfill and Slope Correction, Area 2**	**239 days**	**Mon 11/4/19**	**Fri 10/2/20**
192	**Final Cover, Area 2**	**607 days**	**Fri 10/2/20**	**Mon 1/30/23**
204	**Post-Construction Stormwater Controls**	**16 days**	**Mon 1/30/23**	**Tue 2/21/23**
215	**Site Completion, Area 2**	**27 days**	**Fri 1/13/23**	**Tue 2/21/23**



Note: All dates are for planning purposes only - not actual dates.

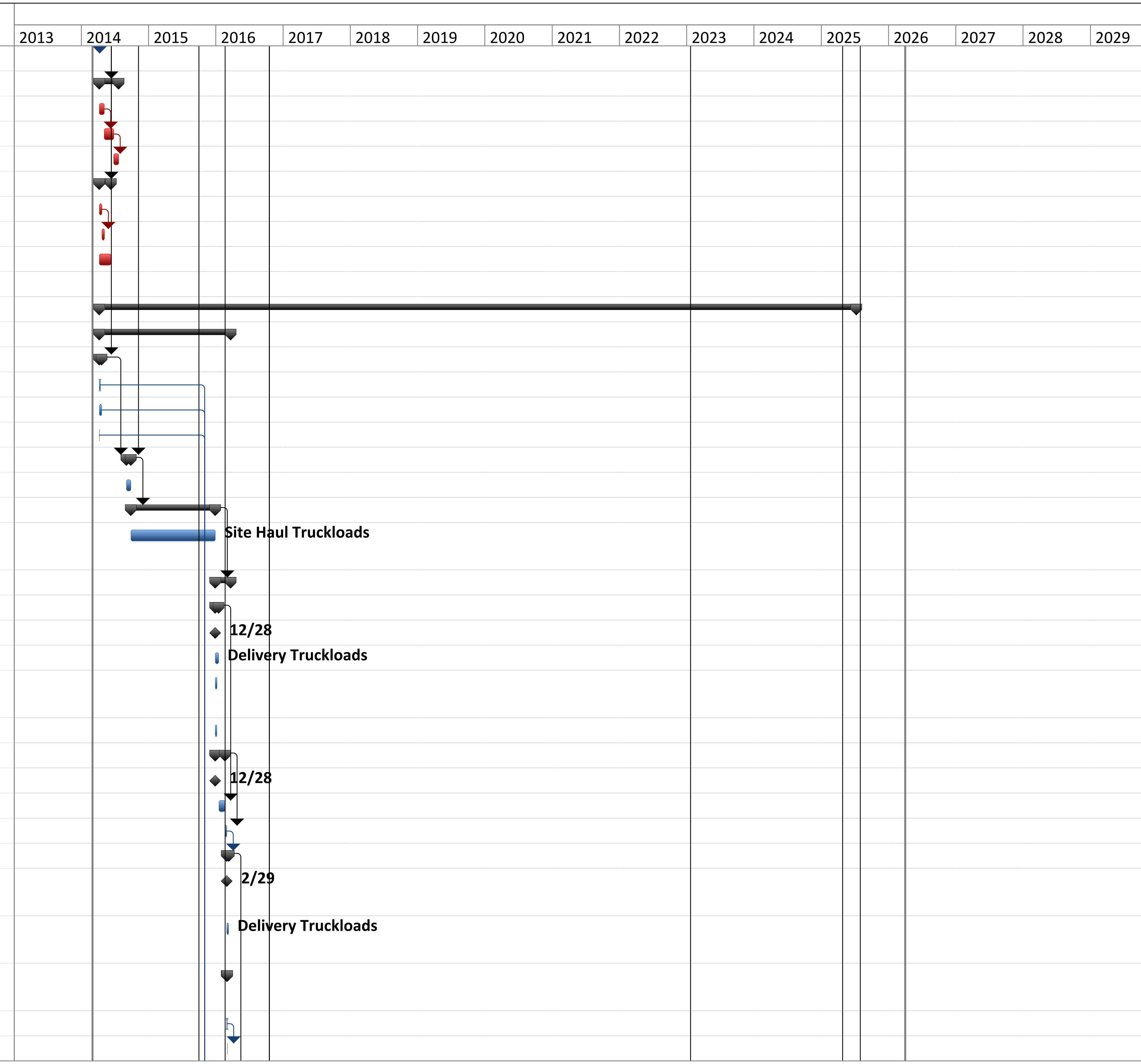
ID	Task Name	Estimated Duration	Start	Finish
220				
221	**Area 1**	**811 days**	**Tue 2/21/23**	**Wed 4/1/26**
222	**Site Preparation**	**8 days**	**Tue 2/21/23**	**Fri 3/3/23**
233	**Stormwater Events (Weather Delays)**	**33 days**	**Fri 3/3/23**	**Wed 4/19/23**
235	**Construction Activities**	**770 days**	**Wed 4/19/23**	**Wed 4/1/26**
236	**Overburden Relocation**	**166 days**	**Wed 4/19/23**	**Wed 12/6/23**
246	**RIM Relocation to On-Site Cell**	**29 days**	**Wed 12/6/23**	**Wed 1/17/24**
247	**2023**	**16 days**	**Wed 12/6/23**	**Thu 12/28/23**
256	**2024**	**11 days**	**Tue 1/2/24**	**Wed 1/17/24**
265	**Radiological Survey**	**7 days**	**Wed 1/17/24**	**Fri 1/26/24**
268	**Backfill and Slope Correction, Area 1**	**102 days**	**Thu 1/2/25**	**Mon 5/26/25**
290	**2025 Job Shutdown Cost Adjustments**	**0 days**	**Mon 5/26/25**	**Mon 5/26/25**
293	**Final Cover, Area 1**	**40 days**	**Fri 1/2/26**	**Thu 2/26/26**
303	**Post-Construction Stormwater Controls**	**6 days**	**Thu 2/26/26**	**Fri 3/6/26**
313	**Site Completion, Area 1**	**17 days**	**Fri 3/6/26**	**Wed 4/1/26**

ID	Task Name	Estimated Duration	Start	Finish
1	**On-Site Disposal Alternative**	**3152 days**	**Mon 3/3/14**	**Wed 4/1/26**
2	**Site-wide Preparation**	**2945 days**	**Mon 3/3/14**	**Mon 6/16/25**
3	**Temporary Construction Facilities / Utilities / Personnel**	**47 days**	**Mon 3/3/14**	**Tue 5/6/14**
4	Construction Trailers	38 days	Mon 3/3/14	Wed 4/23/14
5	Parking Area	9 days	Wed 4/23/14	Tue 5/6/14
6	**Temporary Stormwater Infrastructure**	**2919 days**	**Tue 4/8/14**	**Mon 6/16/25**
7	**Temporary Stormwater Lagoon**	**46 days**	**Tue 4/8/14**	**Wed 6/11/14**
8	Excavate soil for 4th berm at former leachate lagoon area	20 days	Tue 4/8/14	Tue 5/6/14
9	Place soil for berm	15 days	Tue 4/15/14	Tue 5/6/14
10	Compact berm	2 days	Fri 5/2/14	Tue 5/6/14
11	Install geomembrane liner	26 days	Tue 5/6/14	Wed 6/11/14
12	**Install force mains from Areas 1 and 2 to lagoon**	**11 days**	**Tue 5/6/14**	**Tue 5/20/14**
13	Area 1	9 days	Tue 5/6/14	Mon 5/19/14
14	Area 2	2 days	Mon 5/19/14	Tue 5/20/14
15	Install force main from lagoon to treatment facility	1 day	Tue 5/20/14	Thu 5/22/14
16	**Treatment Facility**	**60 days**	**Tue 4/8/14**	**Tue 7/1/14**
17	Construction	60 days	Tue 4/8/14	Tue 7/1/14
18	**Leachate Treatment Facility**	**73 days**	**Thu 5/22/14**	**Tue 9/2/14**
19	Force main from cell to Treatment Facility	15 days	Thu 5/22/14	Thu 6/12/14
20	Construct Treatment Facility	45 days	Tue 7/1/14	Tue 9/2/14
21	**Post-project Stormwater Demolition**	**15 days**	**Mon 5/26/25**	**Mon 6/16/25**
22	Dispose of geomembrane liner in On-Site Cell	0 days	Mon 5/26/25	Mon 5/26/25
23	Deconstruct 4th berm	0 days	Mon 5/26/25	Mon 5/26/25
24	Grade berm material in lagoon for proper drainage	15 days	Mon 5/26/25	Mon 6/16/25
25	**Mobilization**	**27 days**	**Mon 3/3/14**	**Tue 4/8/14**
26	Mobilize and Demobilize Equipment Under 150HP	2 days	Mon 3/3/14	Tue 3/4/14
27	Extra Mileage for Mobilizations	1 day	Wed 3/5/14	Thu 3/6/14
28	Mobilize and Demobilize Equipment Over 150HP	19 days	Mon 3/3/14	Thu 3/27/14
29	Extra Mileage for Mobilizations	8 days	Thu 3/27/14	Tue 4/8/14
30	Mobilize and Demobilize Equipment, Towed	1 day	Mon 3/3/14	Tue 3/4/14
31	Extra Mileage for Mobilizations	1 day	Tue 3/4/14	Tue 3/4/14
32	Mobilize and Demobilize Equipment, Scapers	3 days	Mon 3/3/14	Wed 3/5/14

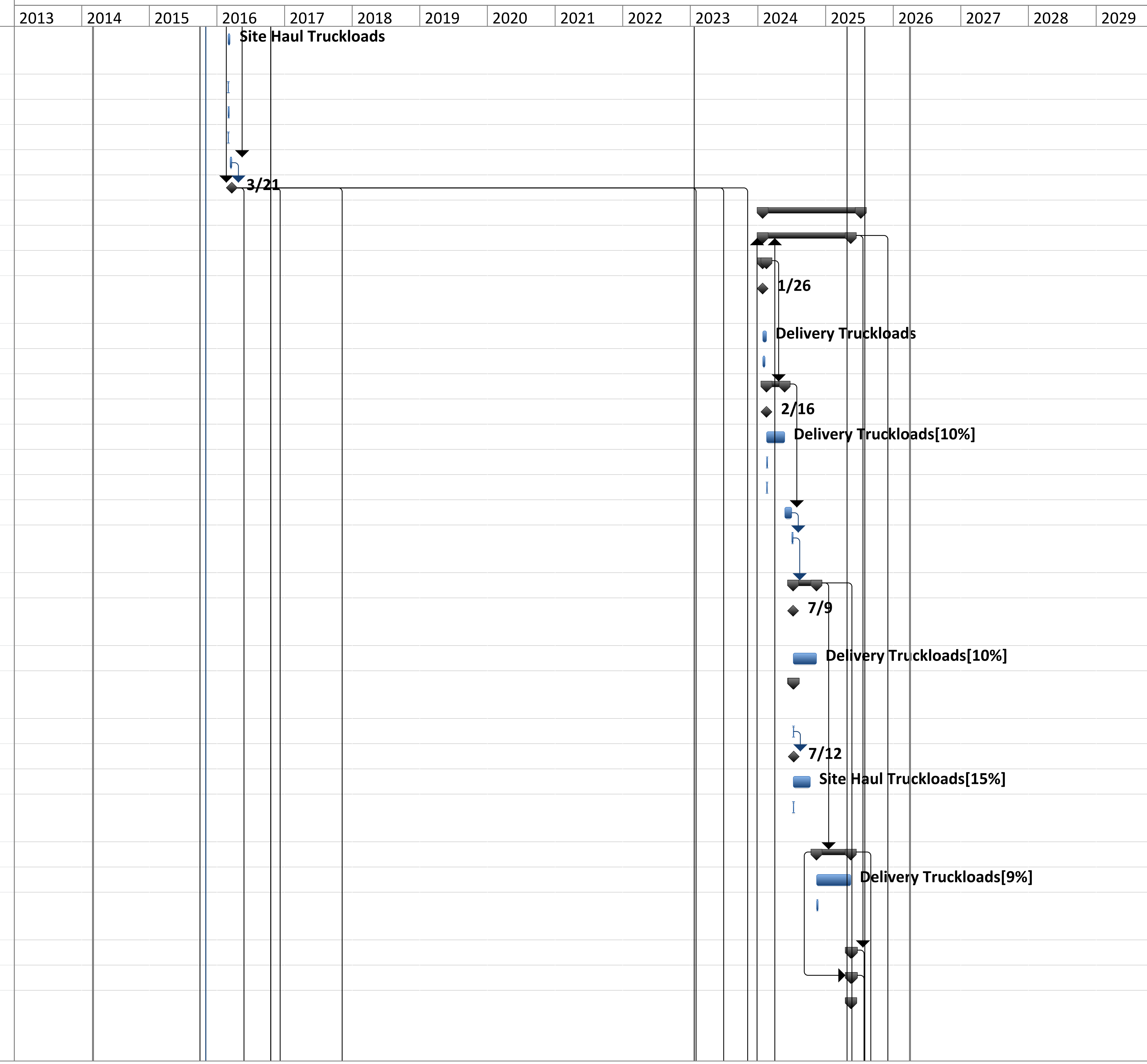


Note: All dates are for planning purposes only - not actual dates.

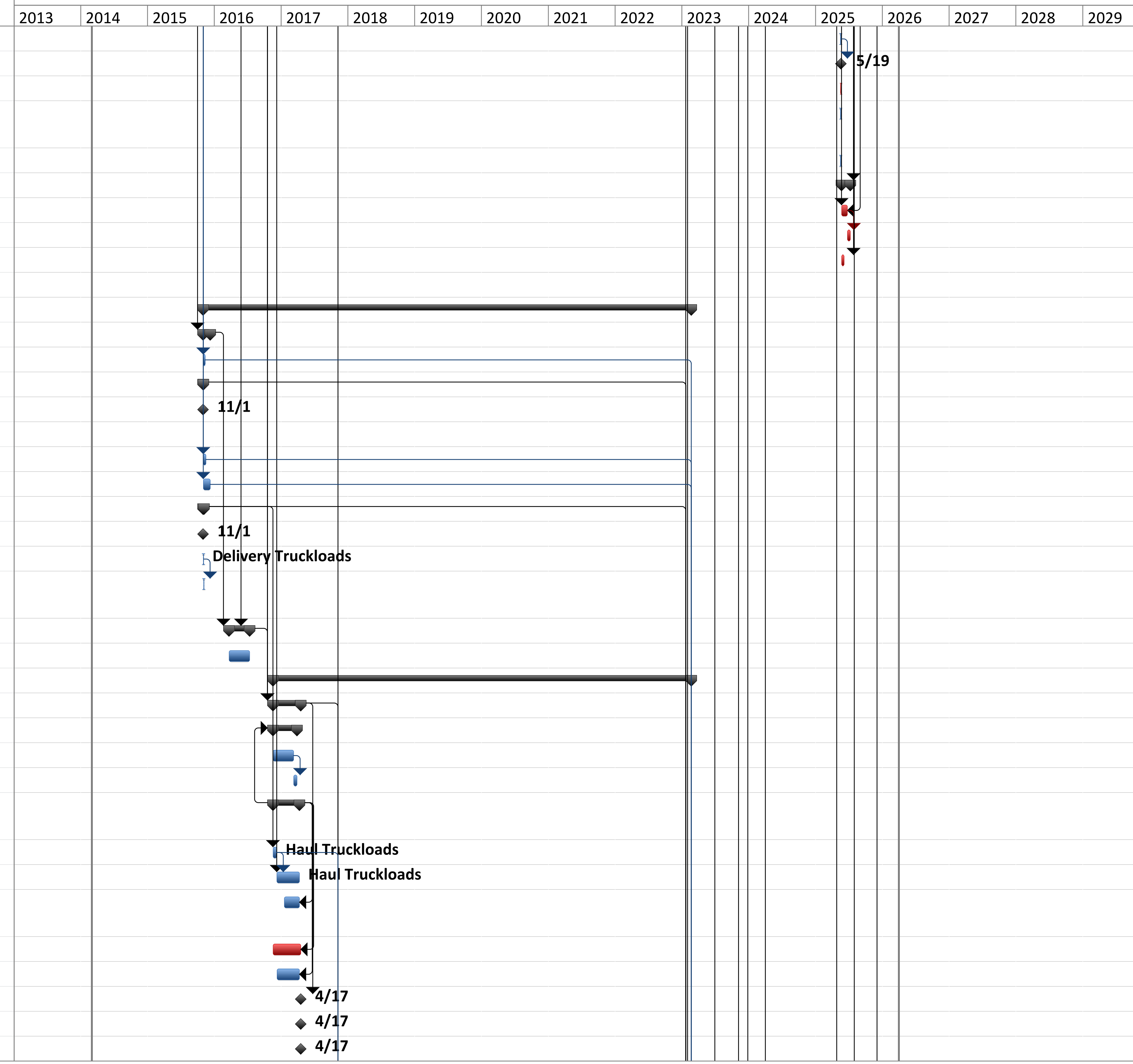
ID	Task Name	Estimated Duration	Start	Finish
33	Extra Mileage for Mobilizations	1 day	Thu 3/6/14	Thu 3/6/14
34	**Create Temporary Roads**	**75 days**	**Tue 4/8/14**	**Mon 7/21/14**
35	Area 1	19 days	Tue 4/8/14	Mon 5/5/14
36	Area 2	37 days	Mon 5/5/14	Wed 6/25/14
37	On-Site Cell	19 days	Wed 6/25/14	Mon 7/21/14
38	**Install TBD Traffic Improvements**	**45 days**	**Tue 4/8/14**	**Tue 6/10/14**
39	Area 1	10 days	Tue 4/8/14	Tue 4/22/14
40	Area 2	10 days	Tue 4/22/14	Tue 5/6/14
41	On-Site Cell	45 days	Tue 4/8/14	Tue 6/10/14
42				
43	**On-Site Cell**	**2936 days**	**Tue 4/8/14**	**Wed 7/9/25**
44	**Construction**	**509 days**	**Tue 4/8/14**	**Mon 3/21/16**
45	**Site Preparation**	**9 days**	**Tue 4/8/14**	**Mon 4/21/14**
46	Prepare area with Stormwater BMPS	4 days	Tue 4/8/14	Mon 4/14/14
47	Clear Vegetation (Light)	9 days	Tue 4/8/14	Mon 4/21/14
48	Clear Vegetation (Heavy)	0 days	Tue 4/8/14	Tue 4/8/14
49	**Stormwater Events (Weather Delays)**	**18 days**	**Tue 9/2/14**	**Fri 9/26/14**
50	Dewater construction after rain events	18 days	Tue 9/2/14	Fri 9/26/14
51	**New On-Site Cell Excavation**	**327 days**	**Fri 9/26/14**	**Mon 12/28/15**
52	Excavate Excess Overburden to Subgrade Contours	327 days	Fri 9/26/14	Mon 12/28/15
53	**Construct Cell Bottom Liner**	**59 days**	**Mon 12/28/15**	**Mon 3/21/16**
54	**Clay**	**14 days**	**Mon 12/28/15**	**Fri 1/15/16**
55	Purchase clay material	0 days	Mon 12/28/15	Mon 12/28/15
56	Deliver clay material to site	14 days	Tue 12/29/15	Fri 1/15/16
57	Spread loose lift before compaction in Cell Liner	8 days	Tue 12/29/15	Thu 1/7/16
58	Compact Clay in Cell Liner	6 days	Tue 12/29/15	Wed 1/6/16
59	**Install Geosynthetic liner**	**39 days**	**Mon 12/28/15**	**Fri 2/19/16**
60	Purchase Material	0 days	Mon 12/28/15	Mon 12/28/15
61	Install Liner	25 days	Mon 1/18/16	Fri 2/19/16
62	Install Cushioning geotextile	6 days	Fri 2/19/16	Mon 2/29/16
63	**Leachate Collection**	**9 days**	**Mon 2/29/16**	**Fri 3/11/16**
64	Purchase Leachate Collection Layer Drainage Material	0 days	Mon 2/29/16	Mon 2/29/16
65	Deliver Leachate Collection Layer Drainage Material	8 days	Mon 2/29/16	Thu 3/10/16
66	**Load Leachate Drainage Material from stockpile to off road haul truck**	**3 days**	**Mon 2/29/16**	**Thu 3/3/16**
67	Excavate	3 days	Mon 2/29/16	Wed 3/2/16
68	Load	0 days	Wed 3/2/16	Thu 3/3/16



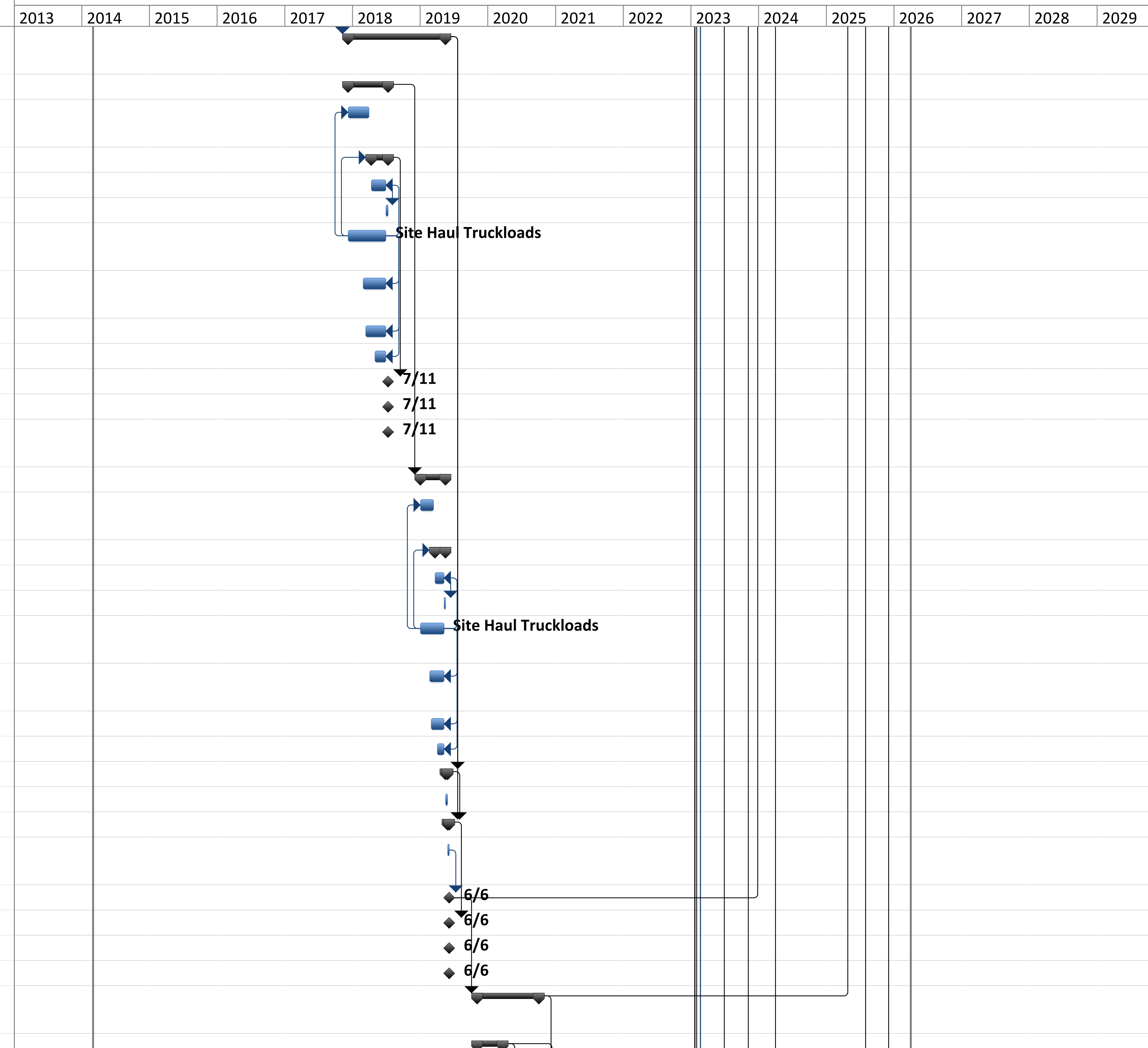
ID	Task Name	Estimated Duration	Start	Finish
69	Haul Leachate Drainage Material from stockpile to cell	9 days	Mon 2/29/16	Fri 3/11/16
70	Install Leachate Collection Layer	3 days	Mon 2/29/16	Thu 3/3/16
71	Install Leachate Collection Piping	5 days	Mon 2/29/16	Mon 3/7/16
72	Install Leachate Collection Sump	3 days	Mon 2/29/16	Thu 3/3/16
73	Install Separation Geotextile filter	6 days	Fri 3/11/16	Mon 3/21/16
74	Cell is Ready for Waste	0 days	Mon 3/21/16	Mon 3/21/16
75	**Closure of On-Site Cell**	**379 days**	**Fri 1/26/24**	**Wed 7/9/25**
76	**Final Cover**	**340 days**	**Fri 1/26/24**	**Fri 5/16/25**
77	**Bio-Intrusion Layer**	**15 days**	**Fri 1/26/24**	**Fri 2/16/24**
78	Purchase of Bio-Intrusion Layer Material	0 days	Fri 1/26/24	Fri 1/26/24
79	Deliver Bio-Intrusion Layer Material	15 days	Fri 1/26/24	Fri 2/16/24
80	Spread Bio-Intrusion Layer Material	9 days	Fri 1/26/24	Thu 2/8/24
81	**Clay Layer**	**70 days**	**Fri 2/16/24**	**Fri 5/24/24**
82	Purchase clay material	0 days	Fri 2/16/24	Fri 2/16/24
83	Delivery	70 days	Fri 2/16/24	Fri 5/24/24
84	Spread loose lift before compaction	4 days	Fri 2/16/24	Thu 2/22/24
85	Compact Clay (Final Cover)	3 days	Fri 2/16/24	Wed 2/21/24
86	Install Synthetic liner for final cover	26 days	Fri 5/24/24	Mon 7/1/24
87	Install Cushioning geotextile for final cover	6 days	Mon 7/1/24	Tue 7/9/24
88	**Drainage Layer**	**90 days**	**Tue 7/9/24**	**Tue 11/12/24**
89	Purchase Drainage Material	0 days	Tue 7/9/24	Tue 7/9/24
90	Delivery	90 days	Tue 7/9/24	Tue 11/12/24
91	**Load Drainage material from stockpile to off road haul truck**	**3 days**	**Tue 7/9/24**	**Fri 7/12/24**
92	Excavate	3 days	Tue 7/9/24	Fri 7/12/24
93	Load	0 days	Fri 7/12/24	Fri 7/12/24
94	Haul material from stockpile to cell	67 days	Tue 7/9/24	Wed 10/9/24
95	Move and Place drainage layer material for final cover	3 days	Tue 7/9/24	Fri 7/12/24
96	**Top Soil**	**133 days**	**Tue 11/12/24**	**Fri 5/16/25**
97	Purchase and Deliver Topsoil	133 days	Tue 11/12/24	Fri 5/16/25
98	Move and place Topsoil (Final Cover)	7 days	Tue 11/12/24	Thu 11/21/24
99	**Post-Construction Stormwater Controls**	**4 days**	**Fri 5/16/25**	**Thu 5/22/25**
100	**Pond**	**4 days**	**Fri 5/16/25**	**Thu 5/22/25**
101	**Load Overburden Material from stockpile to off road haul truck for pond**	**1 day**	**Fri 5/16/25**	**Mon 5/19/25**



ID	Task Name	Estimated Duration	Start	Finish
102	Excavate	1 day	Fri 5/16/25	Mon 5/19/25
103	Load	0 days	Mon 5/19/25	Mon 5/19/25
104	Haul loose lift soil for Pond	4 days	Fri 5/16/25	Thu 5/22/25
105	Spread loose lift before compaction (Pond)	1 day	Fri 5/16/25	Mon 5/19/25
106	Compact Berm (Pond)	1 day	Fri 5/16/25	Mon 5/19/25
107	**On-Site Cell Site Completion**	**34 days**	**Thu 5/22/25**	**Wed 7/9/25**
108	Install temporary irrigation system	22 days	Thu 5/22/25	Mon 6/23/25
109	Apply seeding to cover	12 days	Mon 6/23/25	Wed 7/9/25
110	Install Fencing	10 days	Thu 5/22/25	Thu 6/5/25
111				
112	**Area 2**	**1906 days**	**Sun 11/1/15**	**Tue 2/21/23**
113	**Site Preparation**	**28 days**	**Sun 11/1/15**	**Wed 12/9/15**
114	Prepare area with Stormwater BMPS	9 days	Mon 11/2/15	Thu 11/12/15
115	**Decontamination Area**	**0 days**	**Sun 11/1/15**	**Mon 11/2/15**
116	Materials	0 days	Sun 11/1/15	Sun 11/1/15
117	Installation	0 days	Mon 11/2/15	Mon 11/2/15
118	Clear Vegetation (Light)	11 days	Mon 11/2/15	Mon 11/16/15
119	Clear Vegetation (Heavy)	28 days	Mon 11/2/15	Wed 12/9/15
120	**Berms for Overburden**	**4 days**	**Sun 11/1/15**	**Thu 11/5/15**
121	Purchase material	0 days	Sun 11/1/15	Sun 11/1/15
122	Deliver and Stockpile	2 days	Mon 11/2/15	Tue 11/3/15
123	Develop earthen berms to store relocated overburden wastes	2 days	Tue 11/3/15	Thu 11/5/15
124	**Stormwater Events (Weather Delays)**	**81 days**	**Mon 3/21/16**	**Tue 7/12/16**
125	Dewater construction during rain events	81 days	Mon 3/21/16	Tue 7/12/16
126	**Construction Activities**	**1633 days**	**Thu 11/17/16**	**Tue 2/21/23**
127	**Overburden Relocation**	**108 days**	**Thu 11/17/16**	**Mon 4/17/17**
128	**Relocate overburden wastes**	**93 days**	**Thu 11/17/16**	**Mon 3/27/17**
129	Excavate	81 days	Thu 11/17/16	Thu 3/9/17
130	Load	12 days	Fri 3/10/17	Mon 3/27/17
131	**Relocate overburden wastes - Haul and Dump**	**102 days**	**Thu 11/17/16**	**Mon 4/10/17**
132	To bermed areas	15 days	Thu 11/17/16	Wed 12/7/16
133	To other areas	87 days	Thu 12/8/16	Mon 4/10/17
134	Apply daily cover to relocated overburden wastes	59 days	Tue 1/17/17	Mon 4/10/17
135	Spread overburden wastes	108 days	Thu 11/17/16	Mon 4/17/17
136	Compact overburden wastes	86 days	Thu 12/8/16	Mon 4/10/17
137	**2017 Job Shutdown Cost Adjustments**	**0 days**	**Mon 4/17/17**	**Mon 4/17/17**
138	Additions (mob/demob)	0 days	Mon 4/17/17	Mon 4/17/17
139	Reductions (staffing, dust control, etc)	0 days	Mon 4/17/17	Mon 4/17/17

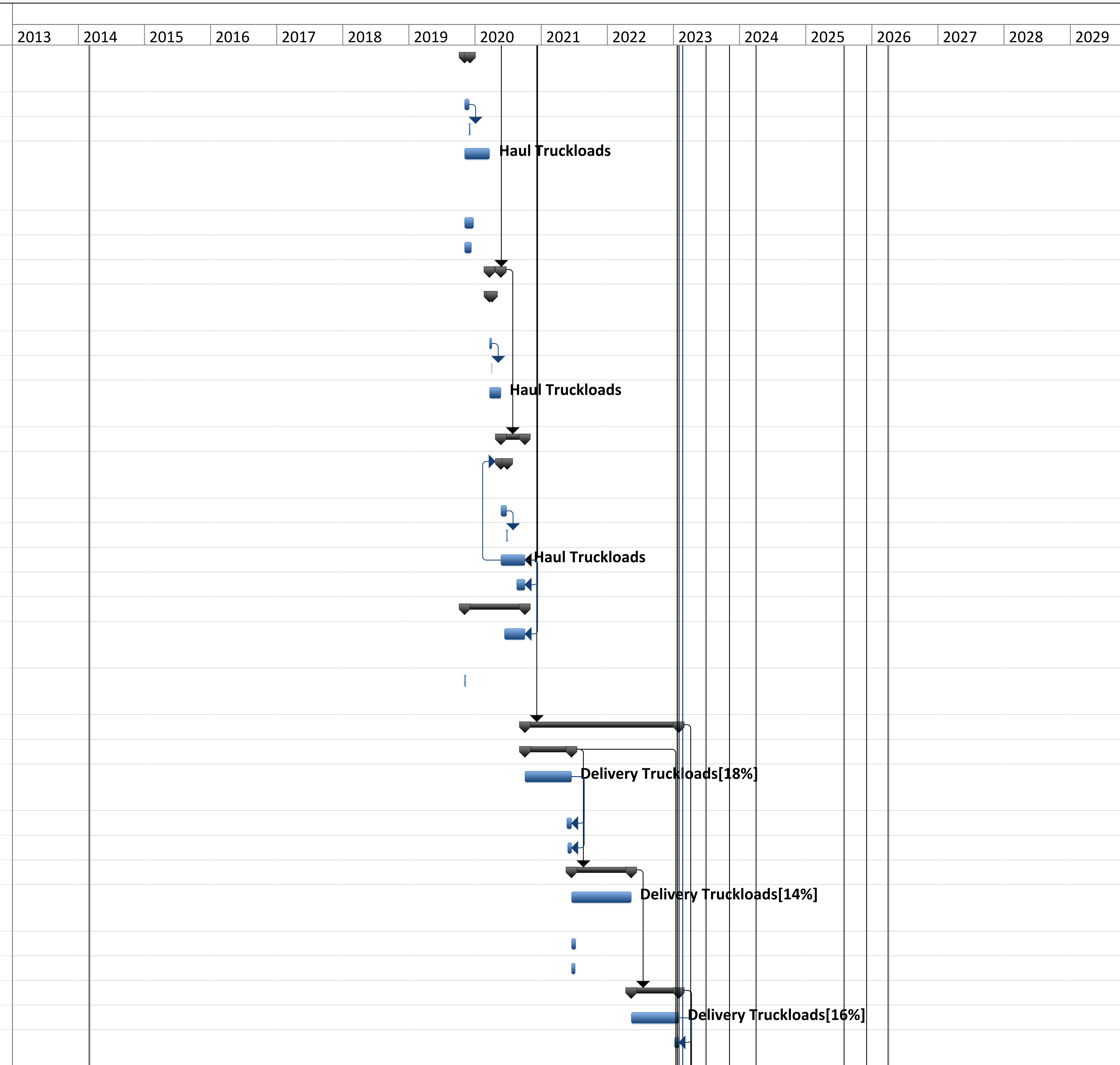


ID	Task Name	Estimated Duration	Start	Finish
140	**RIM Relocation to On-Site Cell**	**375 days**	**Fri 12/8/17**	**Fri 5/17/19**
141	**2017-2018**	**154 days**	**Fri 12/8/17**	**Wed 7/11/18**
142	Apply daily cover to remaining excavation of RIM Wastes	80 days	Fri 12/8/17	Fri 3/30/18
143	**Relocate RIM Wastes on-site**	**65 days**	**Wed 4/11/18**	**Wed 7/11/18**
144	Excavate	57 days	Wed 4/11/18	Fri 6/29/18
145	Load	8 days	Fri 6/29/18	Wed 7/11/18
146	Relocate RIM Wastes to On-Site Cell - Haul and Dump	145 days	Fri 12/8/17	Fri 6/29/18
147	Apply daily cover to relocated RIM Wastes	89 days	Mon 2/26/18	Fri 6/29/18
148	Spread RIM Wastes at On-Site Cell	79 days	Mon 3/12/18	Fri 6/29/18
149	Compact RIM Wastes at On-Site Cell	43 days	Tue 5/1/18	Fri 6/29/18
150	**2018 Job Shutdown Cost Adjustments**	**0 days**	**Wed 7/11/18**	**Wed 7/11/18**
151	Additions (mob/demob)	0 days	Wed 7/11/18	Wed 7/11/18
152	Reductions (staffing, dust control, etc)	0 days	Wed 7/11/18	Wed 7/11/18
153	**2019**	**97 days**	**Wed 1/2/19**	**Fri 5/17/19**
154	Apply daily cover to remaining excavation of RIM Wastes	51 days	Wed 1/2/19	Wed 3/13/19
155	**Relocate RIM Wastes on-site**	**41 days**	**Thu 3/21/19**	**Fri 5/17/19**
156	Excavate	36 days	Thu 3/21/19	Thu 5/9/19
157	Load	5 days	Thu 5/9/19	Fri 5/17/19
158	Relocate RIM Wastes to On-Site Cell - Haul and Dump	92 days	Wed 1/2/19	Thu 5/9/19
159	Apply daily cover to relocated RIM Wastes	56 days	Wed 2/20/19	Thu 5/9/19
160	Spread RIM Wastes at On-Site Cell	50 days	Thu 2/28/19	Thu 5/9/19
161	Compact RIM Wastes at On-Site Cell	27 days	Tue 4/2/19	Thu 5/9/19
162	**Buffer Zone**	**7 days**	**Fri 5/17/19**	**Tue 5/28/19**
163	Buffer Zone Activity	7 days	Fri 5/17/19	Tue 5/28/19
164	**Radiological Survey**	**7 days**	**Tue 5/28/19**	**Thu 6/6/19**
165	Conduct final radiological survey and wait for approval	7 days	Tue 5/28/19	Thu 6/6/19
166	Area 2 is clean	0 days	Thu 6/6/19	Thu 6/6/19
167	**2019 Job Shutdown Cost Adjustments**	**0 days**	**Thu 6/6/19**	**Thu 6/6/19**
168	Additions (mob/demob)	0 days	Thu 6/6/19	Thu 6/6/19
169	Reductions (staffing, dust control, etc)	0 days	Thu 6/6/19	Thu 6/6/19
170	**Backfill and Slope Correction, Area 2**	**239 days**	**Mon 11/4/19**	**Fri 10/2/20**
171	**Slope Correction Cuts**	**99 days**	**Mon 11/4/19**	**Fri 3/20/20**

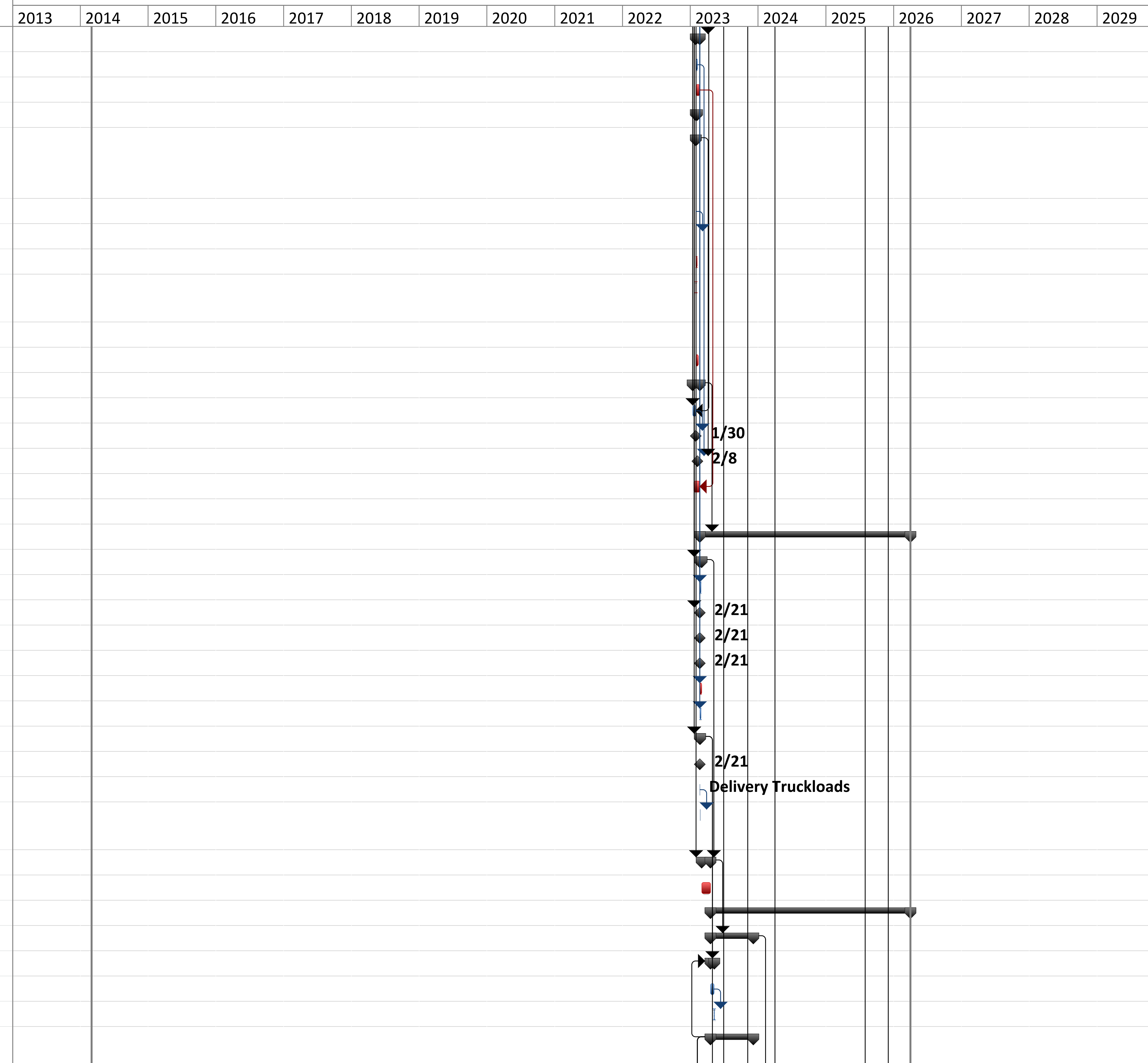


Note: All dates are for planning purposes only - not actual dates.

ID	Task Name	Estimated Duration	Start	Finish
172	**Move non-RIM waste to correct slopes in excavation - Excavate**	**22 days**	**Mon 11/4/19**	**Wed 12/4/19**
173	Excavate	19 days	Mon 11/4/19	Fri 11/29/19
174	Load	3 days	Fri 11/29/19	Wed 12/4/19
175	Move non-RIM waste to correct slopes in excavation - Haul and Dump	99 days	Mon 11/4/19	Fri 3/20/20
176	Spread cut material	35 days	Mon 11/4/19	Mon 12/23/19
177	Compact cut material	27 days	Mon 11/4/19	Wed 12/11/19
178	**Backfill Overburden**	**45 days**	**Fri 3/20/20**	**Fri 5/22/20**
179	**Backfill Overburden Materials stored in berms - Excavate**	**10 days**	**Fri 3/20/20**	**Fri 4/3/20**
180	Excavate	9 days	Fri 3/20/20	Thu 4/2/20
181	Load	1 day	Thu 4/2/20	Fri 4/3/20
182	Backfill Overburden Materials stored in berms - Haul and Dump	45 days	Fri 3/20/20	Fri 5/22/20
183	**Additional Fill**	**95 days**	**Fri 5/22/20**	**Fri 10/2/20**
184	**Excavate additional fill material for grading**	**25 days**	**Fri 5/22/20**	**Fri 6/26/20**
185	Excavate	22 days	Fri 5/22/20	Tue 6/23/20
186	Load	3 days	Tue 6/23/20	Fri 6/26/20
187	Haul additional fill for grading	95 days	Fri 5/22/20	Fri 10/2/20
188	Spread additional fill	33 days	Mon 8/17/20	Fri 10/2/20
189	**Daily Cover**	**239 days**	**Mon 11/4/19**	**Fri 10/2/20**
190	Use geotextile as a daily cover for backfill waste to reclaim slopes	81 days	Thu 6/11/20	Fri 10/2/20
191	Use geotextile as a daily cover on bermed overburden	5 days	Mon 11/4/19	Fri 11/8/19
192	**Final Cover, Area 2**	**607 days**	**Fri 10/2/20**	**Mon 1/30/23**
193	**Clay, Part 1**	**183 days**	**Fri 10/2/20**	**Wed 6/16/21**
194	Purchase and Deliver clay material to site	183 days	Fri 10/2/20	Wed 6/16/21
195	Spread loose lift before compaction	18 days	Fri 5/21/21	Wed 6/16/21
196	Compact Clay (Final Cover)	15 days	Wed 5/26/21	Wed 6/16/21
197	**Clay, Part 2**	**236 days**	**Wed 6/16/21**	**Thu 5/12/22**
198	Purchase and Deliver clay material to site	236 days	Wed 6/16/21	Thu 5/12/22
199	Spread loose lift before compaction	18 days	Wed 6/16/21	Fri 7/9/21
200	Compact Clay (Final Cover)	15 days	Wed 6/16/21	Tue 7/6/21
201	**Top Soil**	**188 days**	**Thu 5/12/22**	**Mon 1/30/23**
202	Purchase and Deliver Topsoil	188 days	Thu 5/12/22	Mon 1/30/23
203	Move and place Topsoil (Final Cover)	16 days	Fri 1/6/23	Mon 1/30/23



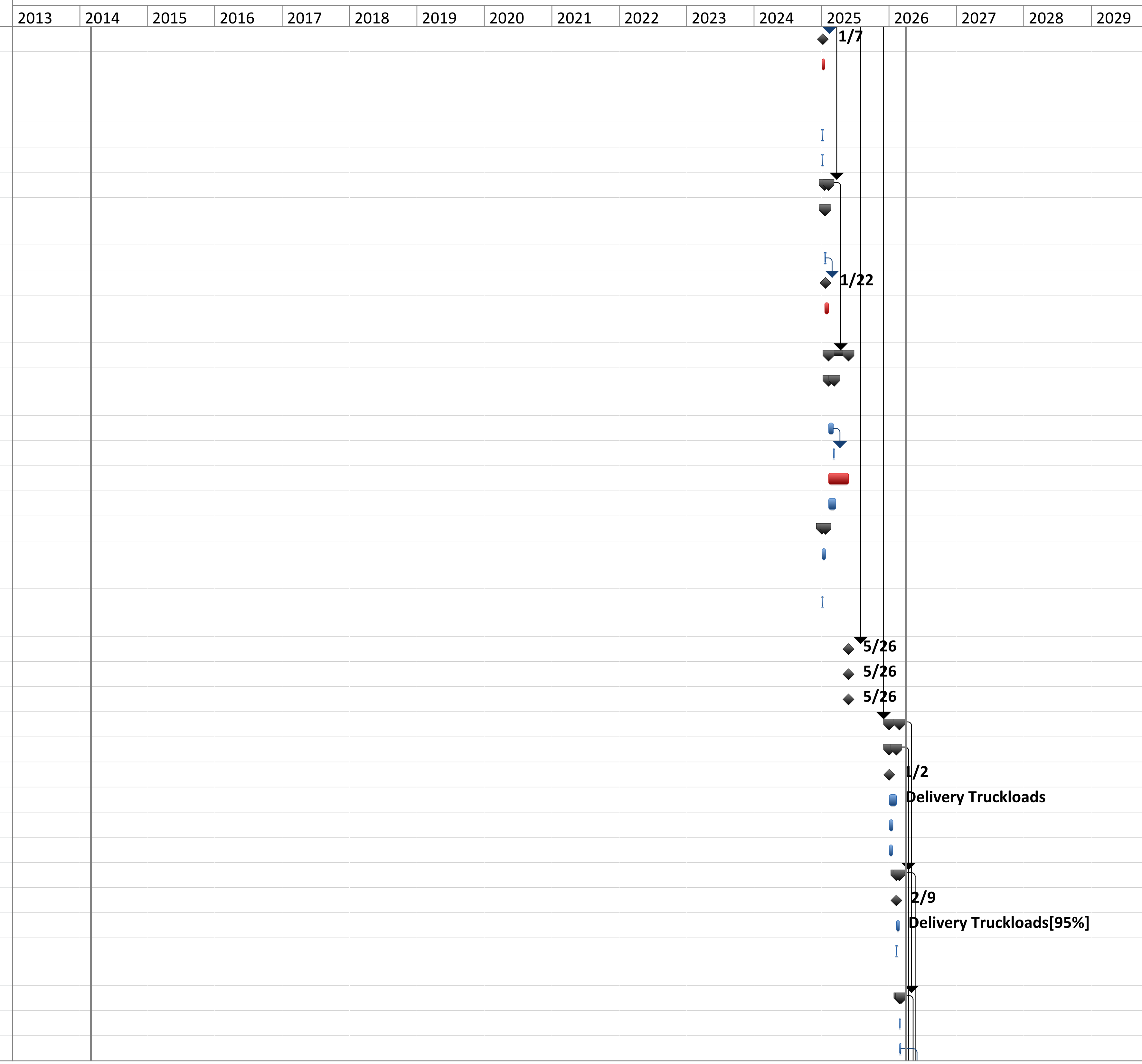
ID	Task Name	Estimated Duration	Start	Finish
204	**Post-Construction Stormwater Controls**	**16 days**	**Mon 1/30/23**	**Tue 2/21/23**
205	Install Terraces	7 days	Mon 1/30/23	Wed 2/8/23
206	Construct Ditches	16 days	Mon 1/30/23	Tue 2/21/23
207	**Pond**	**5 days**	**Mon 1/30/23**	**Mon 2/6/23**
208	**Load Overburden Material from stockpile to off road haul truck for pond**	**1 day**	**Mon 1/30/23**	**Tue 1/31/23**
209	Excavate	1 day	Mon 1/30/23	Tue 1/31/23
210	Load	0 days	Tue 1/31/23	Tue 1/31/23
211	Haul loose lift soil for Pond	5 days	Mon 1/30/23	Mon 2/6/23
212	Spread loose lift before compaction (Pond)	2 days	Mon 1/30/23	Wed 2/1/23
213	Compact Berm (Pond)	1 day	Mon 1/30/23	Tue 1/31/23
214	Final Stormwater Controls	10 days	Mon 1/30/23	Mon 2/13/23
215	**Site Completion, Area 2**	**27 days**	**Fri 1/13/23**	**Tue 2/21/23**
216	Install temporary irrigation system	11 days	Fri 1/13/23	Mon 1/30/23
217	Apply seeding to cover	0 days	Mon 1/30/23	Mon 1/30/23
218	Apply seeding to soil stockpile	0 days	Wed 2/8/23	Wed 2/8/23
219	Install Fencing	23 days	Thu 1/19/23	Tue 2/21/23
220				
221	**Area 1**	**811 days**	**Tue 2/21/23**	**Wed 4/1/26**
222	**Site Preparation**	**8 days**	**Tue 2/21/23**	**Fri 3/3/23**
223	Prepare area with Stormwater BMPS	4 days	Tue 2/21/23	Mon 2/27/23
224	**Decontamination Area**	**0 days**	**Tue 2/21/23**	**Tue 2/21/23**
225	Materials	0 days	Tue 2/21/23	Tue 2/21/23
226	Installation	0 days	Tue 2/21/23	Tue 2/21/23
227	Clear Vegetation (Light)	8 days	Tue 2/21/23	Fri 3/3/23
228	Clear Vegetation (Heavy)	4 days	Tue 2/21/23	Mon 2/27/23
229	**Berms for Overburden**	**2 days**	**Tue 2/21/23**	**Thu 2/23/23**
230	Purchase material	0 days	Tue 2/21/23	Tue 2/21/23
231	Deliver and Stockpile	1 day	Tue 2/21/23	Wed 2/22/23
232	Develop earthen berms to store relocated overburden wastes	1 day	Wed 2/22/23	Thu 2/23/23
233	**Stormwater Events (Weather Delays)**	**33 days**	**Fri 3/3/23**	**Wed 4/19/23**
234	Dewater construction during rain events	33 days	Fri 3/3/23	Wed 4/19/23
235	**Construction Activities**	**770 days**	**Wed 4/19/23**	**Wed 4/1/26**
236	**Overburden Relocation**	**166 days**	**Wed 4/19/23**	**Wed 12/6/23**
237	**Relocate overburden wastes**	**15 days**	**Wed 4/19/23**	**Wed 5/10/23**
238	Excavate	13 days	Wed 4/19/23	Mon 5/8/23
239	Load	2 days	Mon 5/8/23	Wed 5/10/23
240	**Relocate overburden wastes - Haul and Dump**	**166 days**	**Wed 4/19/23**	**Wed 12/6/23**



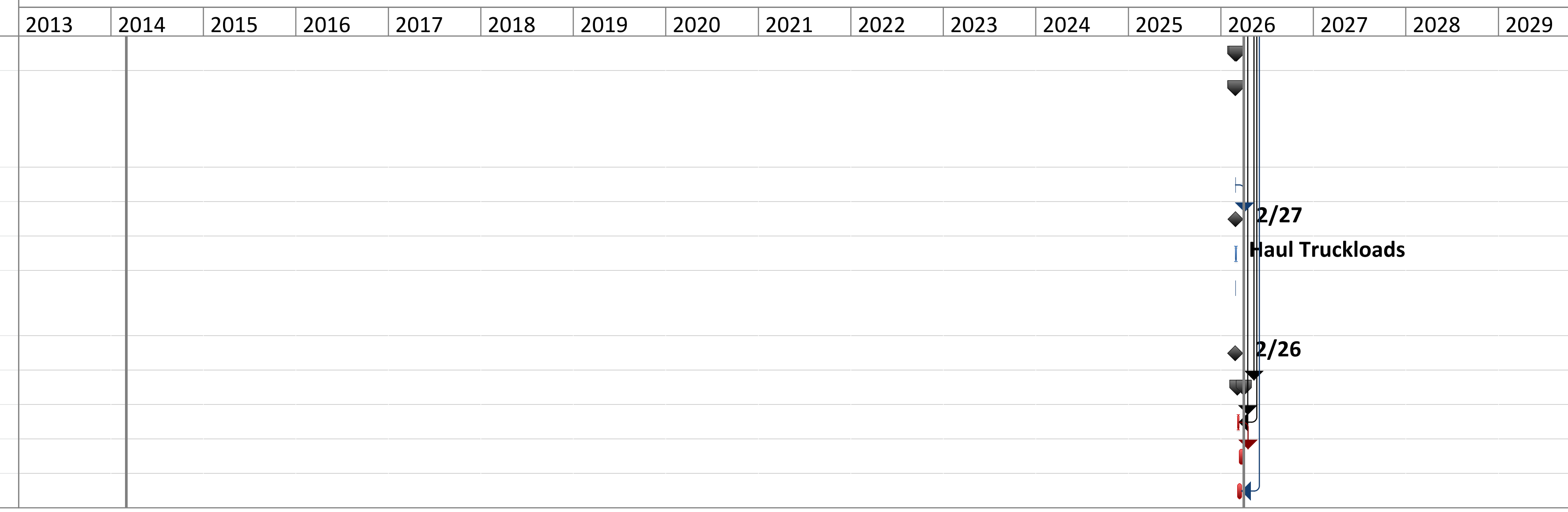
ID	Task Name	Estimated Duration	Start	Finish
241	To bermed areas	52 days	Wed 4/19/23	Fri 6/30/23
242	To other areas	114 days	Fri 6/30/23	Wed 12/6/23
243	Apply daily cover to relocated overburden wastes	10 days	Wed 4/19/23	Wed 5/3/23
244	Spread overburden wastes	18 days	Wed 4/19/23	Mon 5/15/23
245	Compact overburden wastes	14 days	Wed 4/19/23	Tue 5/9/23
246	**RIM Relocation to On-Site Cell**	**29 days**	**Wed 12/6/23**	**Wed 1/17/24**
247	**2023**	**16 days**	**Wed 12/6/23**	**Thu 12/28/23**
248	Apply daily cover to remaining excavation of RIM Wastes	9 days	Wed 12/6/23	Tue 12/19/23
249	**Relocate RIM Wastes on-site - Excavate**	**7 days**	**Wed 12/6/23**	**Fri 12/15/23**
250	Excavate	6 days	Wed 12/6/23	Fri 12/15/23
251	Load	1 day	Fri 12/15/23	Fri 12/15/23
252	Relocate RIM Wastes to On-Site Cell - Haul and Dump	16 days	Wed 12/6/23	Thu 12/28/23
253	Apply daily cover to relocated RIM Wastes	10 days	Wed 12/6/23	Wed 12/20/23
254	Spread RIM Wastes at On-Site Cell	9 days	Wed 12/6/23	Tue 12/19/23
255	Compact RIM Wastes at On-Site Cell	5 days	Wed 12/6/23	Wed 12/13/23
256	**2024**	**11 days**	**Tue 1/2/24**	**Wed 1/17/24**
257	Apply daily cover to remaining excavation of RIM Wastes	6 days	Tue 1/2/24	Wed 1/10/24
258	**Relocate RIM Wastes on-site - Excavate**	**5 days**	**Tue 1/2/24**	**Tue 1/9/24**
259	Excavate	4 days	Tue 1/2/24	Mon 1/8/24
260	Load	1 day	Mon 1/8/24	Tue 1/9/24
261	Relocate RIM Wastes to On-Site Cell - Haul and Dump	11 days	Tue 1/2/24	Wed 1/17/24
262	Apply daily cover to relocated RIM Wastes	7 days	Tue 1/2/24	Thu 1/11/24
263	Spread RIM Wastes at On-Site Cell	6 days	Tue 1/2/24	Wed 1/10/24
264	Compact RIM Wastes at On-Site Cell	3 days	Tue 1/2/24	Fri 1/5/24
265	**Radiological Survey**	**7 days**	**Wed 1/17/24**	**Fri 1/26/24**
266	Conduct final radiological survey and wait for approval	7 days	Wed 1/17/24	Fri 1/26/24
267	Area 1 is clean	0 days	Fri 1/26/24	Fri 1/26/24
268	**Backfill and Slope Correction, Area 1**	**102 days**	**Thu 1/2/25**	**Mon 5/26/25**
269	**Slope Correction Cuts**	**11 days**	**Thu 1/2/25**	**Fri 1/17/25**
270	**Move non-RIM waste to correct slopes in excavation**	**3 days**	**Thu 1/2/25**	**Tue 1/7/25**
271	Excavate	3 days	Thu 1/2/25	Tue 1/7/25

Note: All dates are for planning purposes only - not actual dates.

ID	Task Name	Estimated Duration	Start	Finish
272	Load	0 days	Tue 1/7/25	Tue 1/7/25
273	Move non-RIM waste to correct slopes in excavation - Haul and Dump	11 days	Thu 1/2/25	Fri 1/17/25
274	Spread cut material	4 days	Thu 1/2/25	Wed 1/8/25
275	Compact cut material	3 days	Thu 1/2/25	Tue 1/7/25
276	**Backfill Overburden**	**15 days**	**Fri 1/17/25**	**Fri 2/7/25**
277	**Backfill Overburden Materials stored in berms**	**3 days**	**Fri 1/17/25**	**Wed 1/22/25**
278	Excavate	3 days	Fri 1/17/25	Wed 1/22/25
279	Load	0 days	Wed 1/22/25	Wed 1/22/25
280	Backfill Overburden Materials stored in berms - Haul and Dump	15 days	Fri 1/17/25	Fri 2/7/25
281	**Additional Fill**	**76 days**	**Fri 2/7/25**	**Mon 5/26/25**
282	**Excavate additional fill material for grading**	**21 days**	**Fri 2/7/25**	**Mon 3/10/25**
283	Excavate	18 days	Fri 2/7/25	Wed 3/5/25
284	Load	3 days	Wed 3/5/25	Mon 3/10/25
285	Haul additional fill for grading	76 days	Fri 2/7/25	Mon 5/26/25
286	Spread additional fill	27 days	Fri 2/7/25	Tue 3/18/25
287	**Daily Cover**	**14 days**	**Thu 1/2/25**	**Wed 1/22/25**
288	Use geotextile as a daily cover for backfill waste to reclaim slopes	14 days	Thu 1/2/25	Wed 1/22/25
289	Use geotextile as a daily cover on bermed overburden	2 days	Thu 1/2/25	Mon 1/6/25
290	**2025 Job Shutdown Cost Adjustments**	**0 days**	**Mon 5/26/25**	**Mon 5/26/25**
291	Additions (mob/demob)	0 days	Mon 5/26/25	Mon 5/26/25
292	Reductions (staffing, dust control, etc)	0 days	Mon 5/26/25	Mon 5/26/25
293	**Final Cover, Area 1**	**40 days**	**Fri 1/2/26**	**Thu 2/26/26**
294	**Clay**	**27 days**	**Fri 1/2/26**	**Mon 2/9/26**
295	Purchase clay material	0 days	Fri 1/2/26	Fri 1/2/26
296	Deliver clay material to site	27 days	Fri 1/2/26	Mon 2/9/26
297	Spread loose lift before compaction	14 days	Fri 1/2/26	Wed 1/21/26
298	Compact Clay (Final Cover)	12 days	Fri 1/2/26	Mon 1/19/26
299	**Top Soil**	**13 days**	**Mon 2/9/26**	**Thu 2/26/26**
300	Purchase Topsoil	0 days	Mon 2/9/26	Mon 2/9/26
301	Deliver Topsoil	13 days	Tue 2/10/26	Thu 2/26/26
302	Move and place Topsoil (Final Cover)	3 days	Tue 2/10/26	Thu 2/12/26
303	**Post-Construction Stormwater Controls**	**6 days**	**Thu 2/26/26**	**Fri 3/6/26**
304	Install Terraces	2 days	Thu 2/26/26	Mon 3/2/26
305	Construct Ditches	6 days	Thu 2/26/26	Fri 3/6/26



ID	Task Name	Estimated Duration	Start	Finish
306	**Pond**	**3 days**	**Thu 2/26/26**	**Tue 3/3/26**
307	**Load Overburden Material from stockpile to off road haul truck for pond**	**1 day**	**Thu 2/26/26**	**Fri 2/27/26**
308	Excavate	1 day	Thu 2/26/26	Fri 2/27/26
309	Load	0 days	Fri 2/27/26	Fri 2/27/26
310	Haul loose lift soil for Pond	3 days	Thu 2/26/26	Tue 3/3/26
311	Spread loose lift before compaction (Pond)	1 day	Thu 2/26/26	Fri 2/27/26
312	Compact Berm (Pond)	0 days	Thu 2/26/26	Thu 2/26/26
313	**Site Completion, Area 1**	**17 days**	**Fri 3/6/26**	**Wed 4/1/26**
314	Install temporary irrigation system	4 days	Fri 3/6/26	Fri 3/13/26
315	Apply seeding to cover	13 days	Fri 3/13/26	Wed 4/1/26
316	Install Fencing	11 days	Fri 3/6/26	Mon 3/23/26



APPENDIX K:

Estimated Costs for the Remedial Alternatives

Appendix K-1:

Costing Assumptions and RS Means Data

General Construction Assumptions, Site- and Remedy-Specific

		Area 1			Area 2			
		ROD	Off-Site	On-Site	ROD	Off-Site	On-Site	On-Site Cell
Initial Infrastructure Work and Best Management Practices								
Area to Clear and Grub Heavy Trees	acres	3.5	3.5	3.5	27.8	27.8	27.8	0.1
Area to Clear and Grub Light or No Trees	acres	14.5	16.0	16.0	12.1	21.4	21.4	17.5
Clearing Perimeter	ft	4,166	4,078	4,078	6,448	8,285	8,285	3,614
Silt Fence Length	ft	*4,166*	*4,078*	*4,078*	*6,448*	*8,285*	*8,285*	*3,614*
Temporary Road Length	feet	2,500	5,000	5,000	5,000	10,000	10,000	5,000
Temporary Road Width	feet	24	24	24	24	24	24	24
Site Traffic Improvements Cost		$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 500,000
Site Traffic Improvements Duration	days	10	10	10	10	10	10	45
Contact Stormwater Treatment Systems	each	1	1	1	-	-	-	-
Contact Stormwater Generated During Construction	gallons	560,000	1,500,000	2,500,000	560,000	1,500,000	2,500,000	
Contact Stormwater Force Main Distance	ft	3,671	3,641	3,641	832	607	607	
Leachate Treatment Systems	each	-	-	-	-	-	-	1
Leachate Generated During Construction	gal/ac/yr	-	-	-	-	-	-	3,500,000
Leachate Force Main Distance	ft	-	-	-	-	-	-	3,000
Decontamination Pad								
Length of Pad	ft	50	50	50	50	50	50	
Width of Pad	ft	20	20	20	20	20	20	
Area of Pad	sq ft	*1,000*	*1,000*	*1,000*	*1,000*	*1,000*	*1,000*	
Volume of 18 inch Pad	cy	*56*	*56*	*56*	*56*	*56*	*56*	
Number of Decontamination Pads *	each	1	2	1	1	1	1	
Containment Berm								
Length of berm surround stored overburden waste	ft	-	800	800	-	1,200	1,200	
Height of berm	ft	-	5	5	-	5	5	
Top width of berm	ft	-	5	5	-	5	5	
Slopes on berm	ft/ft	-	3	3	-	3	3	
Cross Sectional area of berm to surround stored overburden waste	sq ft	-	*100*	*100*	-	*100*	*100*	
Volume of bermed stockpile	cy		21,000	21,000		63,000	63,000	
Plan view area of soil stockpile SF	sq ft		45,000	45,000		100,000	100,000	

General Construction Assumptions, Site- and Remedy-Specific

		Area 1			Area 2			
		ROD	**Off-Site**	**On-Site**	**ROD**	**Off-Site**	**On-Site**	**On-Site Cell**
Waste Relocation and RIM Removal								
Waste Relocation Volume	bcy	29,744			66,493			
Total Excavation	bcy		100,975	100,975		710,031	710,031	
RIM Volume	bcy		33,500	33,500		302,000	302,000	
Overburden Non Rad Waste Excavation	bcy		*67,475*	*67,475*		*408,031*	*408,031*	
Volume for Daily Cover During Excavation	%	10%	10%	10%	10%	10%	10%	
Volume for Daily Non-RAD Waste Stockpiles	%		10%	10%		10%	10%	
Volume Daily Cover Waste Relocated	%	10%	10%	10%	10%	10%	10%	
Geotextile Daily Cover Area	sq ft		303,191	303,191		1,747,054	1,747,054	
Geotextile Daily Cover Multiple Factor			1.0	1.0		1.0	1.0	
On-Site Cell Liner Information								
Volume to Excavate to subgrade contours	bcy							490,107
Cell Volume	bcy							464,279
Area of Liner	sq ft							433,240
Thickness of Clay Liner	ft							2.0
Geomembrane Plan View Buffer	%							10%
Geotextile Plan View Buffer	%							10%
Thickness of Leachate Drainage Layer	ft							1.0
Length of leachate pipe	lf							1,362
Leachate Sumps	each							2
Leachate Sump Piping	lf							41
Backfill and Final Cover Information								
Volume to Backfill to Top of Waste Design grades	bcy	44,269	203,732	203,732	230,251	655,677	655,677	
Extra Waste Relocation to reduce slope steepness	bcy		15,915	15,915		137,914	137,914	
How many yards will fit into a replaced yard	bcy/bcy	1.10	1.10	1.10	1.10	1.10	1.10	
Backfill Yards Needed of soil	bcy	*17,229*	*127,923*	*127,923*	*169,803*	*159,363*	*159,363*	
Starter Berm Length	ft	1,900			4,400			
Starter Berm Cross-sectional Area	sf	180			180			
Area of Final Cover	sq ft	670,277	805,948	805,948	1,653,957	1,981,293	1,981,293	433,240
Area of Final Cover, Slope-Corrected	sq ft	*690,906*	*830,752*	*830,752*	*1,704,860*	*2,042,270*	*2,042,270*	*446,574*
Thickness of Bio-Intrusion Layer	ft	2.0			2.0			2.0
Thickness of Clay Layer	ft	2.0	2.0	2.0	2.0	2.0	2.0	1.0
Thickness of Final Cover drainage layer	ft							1.0
Thickness of Topsoil Layer	ft	1.0	1.0	1.0	1.0	1.0	1.0	2.0

General Construction Assumptions, Site- and Remedy-Specific

		Area 1			Area 2			
		ROD	Off-Site	On-Site	ROD	Off-Site	On-Site	On-Site Cell
Post-Construction Stormwater Controls								
Terrace length	lf	2,235	1,239	1,239	3,801	5,550	5,550	
Terrace height	ft	3	3	3	3	3	3	3
Slopes on terrace	ft/ft	3	3	3	3	3	3	3
Cross Sectional area of terrace	sq ft	*27*	*27*	*27*	*27*	*27*	*27*	*27*
Area of Riprap	sq ft	755	-	-	4,337	20,985	20,985	
Length of Perimeter Ditch	lf	2,219	2,219	2,219	6,113	6,113	6,113	
Depth of Perimeter Ditch	ft	2	2	2	2	2	2	2
Bottom Width of Perimeter Ditch	ft	10	10	10	10	10	10	10
Cross Sectional area of Perimeter Ditch	sq ft	*32*	*32*	*32*	*32*	*32*	*32*	*32*
Length of Stormwater Pond Berm	lf	1,014	869	869	1,716	1,716	1,716	1,153
Cross Sectional Area of Pond Berm	sq ft	125	125	125	125	125	125	125
Area of 500 Year Floodplain Protection	sq yd				9,743			
Vegetation and Fencing Information								
Vegetation Area	sq ft	785,686	849,357	849,357	1,739,932	2,145,117	2,145,117	766,062
Additional Disturbed Area Factor	%	20%	20%	20%	20%	20%	20%	20%
Seeding Area	sq ft	*942,823*	*1,019,228*	*1,019,228*	*2,087,918*	*2,574,140*	*2,574,140*	*919,274*
Fencing Length	lf	4,166	4,078	4,078	6,448	8,285	8,285	3,614
Irrigation Area Reduction Factor	%	90%	90%	90%	90%	90%	90%	
Irrigation Areas	sq ft	*78,569*	*84,936*	*84,936*	*173,993*	*214,512*	*214,512*	433,240
Other								
Radiological Surveys Quantity	each		1	1		1	1	
Supplemental Mobilizations EA	each	1	2	2				

** Additional decontamination pad assumed for off-site disposal alternative, for trucks with RIM leaving site.*

Calculated values are shown with background shading

Schedule Assumptions

		ROD		Off-Site		On-Site		
		Area 1	Area 2	Area 1	Area 2	Area 1	Area 2	On-Site Cell
Project Duration	months	7	19	13	34	14	32	28
Project Duration for Construction Personnel	months	23		64		92		
Project Duration for Construction Trailers	months	23		64		92		
Duration of Construction Stormwater	months	11		28		49		
Duration of On-Site Cell Construction Leachate	months							20
Duration of Water Truck Dust Control	months	6	16	12	33	12	31	46

General Construction Assumptions, Common

	Value	Units	Source	Source Details
General Assumptions				
Stockpile Compensation Factor	100%			
Stockpile Compensation Factor Pea Gravel	110%			
Tax Rate Materials Bridgeton	7.925%			
Radiological Survey Duration	7	days		
On-site Transportation Rate (per each Contractor's Operation)	2,100	lcy/day	*NOTE: At some points multiple operations may be reasonably activated by the contractor*	
Cap Slope (for Slope Correction Factor)	4	ft/ft		
Cap Slope Correction Factor	103.1%	sf/sf		
Swell Factors (Load Factor =1/[1+Swell])				
Swell Factor Clay	140%	lcy/bcy	Standard Handbook for Civil Engineers, 4th ed.	Table 13.10 (1/ Load Factor)
Swell Factor Top Soil	125%	lcy/bcy	Standard Handbook for Civil Engineers, 4th ed.	Table 13.10 (1/ Load Factor), approx. as loam
Swell Factor Pea Gravel	112%	lcy/bcy	Standard Handbook for Civil Engineers, 4th ed.	Table 13.10 (1/ Load Factor), approx. as gravel
Swell Factor Bio-Intrusion Rock	165%	lcy/bcy	Standard Handbook for Civil Engineers, 4th ed.	Table 13.10 (1/ Load Factor), approx. as rock, well-blasted
Swell Factor Refuse	150%	lcy/bcy	150% is based on Mound site	
Material Densities (Placed)				
Density Clay	125	pcf	"Design of Small Dams", Bureau of Reclamation, 1987	Table 5.1, type CL (range of values)
Density Top Soil	105	pcf	"Design of Small Dams", Bureau of Reclamation, 1987	Table 5.1, range of values
Density Pea Gravel	130	pcf	"Design of Small Dams", Bureau of Reclamation, 1987	Table 5.1, type GP (range of values)
Density Bio-Intrusion Rock	135	pcf	"Caterpillar Performance Handbook", January 2008	p.27-4, Gravel - Pitrun
Material Cost Estimates				
Cost Clay	$ 10.00	per ton	Local Republic landfill with surplus material	
Cost Top Soil	$ 17.59	per ton	RS Means, Year 2011 Quarter 1 - Ext. Material O&P	Soils for earthwork, topsoil borrow,weed free, spread with 200 H.P. dozer, includes load at pit and haul, 2 miles round trip, excludes compaction
Cost Pea Gravel	$ 11.00	per ton	Central Stone estimate, 4/4/2011	
Cost Bio-Intrusion Rock	$ 5.25	per ton	Fred Weber estimate, 3/23/2011	
Material Delivery Costs				
Delivery Clay	*$ 8.65*	per ton	Based on Central Stone estimate	Central Stone estimate for pea gravel, with density compensation.
Delivery Top Soil	*$ 7.27*	per ton	Based on Central Stone estimate	Central Stone estimate for pea gravel, with density compensation.
Delivery Pea Gravel	$ 9.00	per ton	Central Stone estimate, 4/4/2011	
Delivery Bio-Intrusion Rock	$ 4.25	per ton	Fred Weber estimate, 3/23/2011	
Efficiency Rates relative to Normal Construction				
Efficiency Full Excavation Rate	100%			
Efficiency RIM Overburden Excavation Phase Rate	70%		Auxier & Associates excavation project experience	
Efficiency RIM Excavation Phase Rate	50%		Auxier & Associates excavation project experience	

General Construction Assumptions, Common

	Value	Units	Source	Source Details
Stormwater and Construction Leachate				
Stormwater				
Rainfall	50	in/yr		
Pump Volume per Day	25,668	cf/day	(400 gpm/7.48 gal/cf) * 60 min/hr * 8 hr/day	
Pump Crews	4	each		
Temporary Stormwater Lagoon				
Temporary Stormwater Lagoon Liner Area	450,000	sf		
Temporary Stormwater Lagoon Berm Cross-section	868	sf		
Temporary Stormwater Lagoon Berm Length	665	ft		
Force Main from Lagoon to Treatment Facility	551	ft		
Temporary Stormwater Lagoon Liner Demo Cost	$ 400	per MSF	Estimating $.40/sf	
Temporary Stormwater Lagoon Liner Demo Rate	20	MSF/day	Estimate	
Temporary Stormwater Lagoon Liner Demo Crew Size	3	people	Estimate	
Temporary Stormwater Lagoon Geomembrane Plan View Buffer	10%			
Stormwater Treatment Facility				
Stormwater Treatment Facility Cost	$ 264,000		EMSI Estimate	
Stormwater Treatment Facility Installation Time	60	days	Estimate	
Stormwater Treatment Facility Installation Crew Size	7	people	Estimate	
Stormwater Treatment Facility Monthly Operational Cost	$ 9,000	per month	EMSI Estimate	
Stormwater Treatment Facility Monthly Operational Labor	20	hours/month	Estimate	
Stormwater Treatment Facility Operational Crew Size	1	person		
On-Site Cell Leachate Treatment Facility				
Leachate Treatment Facility Cost	$ 107,000		EMSI Estimate	
Leachate Treatment Facility Installation Time	45	days	Estimate	
Leachate Treatment Facility Installation Crew Size	7	people	Estimate	
Leachate Treatment Facility Monthly Operational Cost	$ 5,000	per month	EMSI Estimate	
Leachate Treatment Facility Monthly Operational Labor	20	hours/month	Estimate	
Leachate Treatment Facility Operational Crew Size	1	person		
Other Costs				
MSD Disposal Cost	$ 0.0028	per gallon	Metropolitan St. Louis Sewer District, May 2011	$2.11 per 100 cf
Force Main Trenching - Trenching	$ 3.45	per lf	RS Means, Year 2010, Section G10 - Ext. Total	Trenching common earth, no slope, 2' wide, 3' deep, 3/8 C.Y. bucket.
Force Main Trenching - Bedding	$ 3.12	per lf	RS Means, Year 2010, Section G10 - Ext. Total	Pipe bedding, side slope 0 to 1, 2' wide, pipe size 8" diameter

General Construction Assumptions, Common

	Value	Units	Source	Source Details
Material Delivery / Off-Site Trucking Information				
Capacities				
Geomembrane Delivery	100	MSF/truckload		
Geotextile Delivery	12,000	sy/ truckload		
Material Delivery Truck Capacity Weight	20	tons		
Material Delivery Truck Capacity Volume	20	lcy		
Clay Delivery	*16*	lcy/truckload		
Pea Gravel Delivery	*12*	lcy/truckload		
Topsoil Delivery	*17*	lcy/truckload		
Shot Rock Delivery	*18*	lcy/truckload		
Traffic				
On-Road Truck Traffic Maximum	200	truckloads/day		
Mileage Information				
Clay Delivery Round Trip	70	miles	Roxana, IL	
Geomembrane Round Trip	2,000	miles		
Geotextile Round Trip	2,000	miles		
Pea Gravel Round Trip	40	miles	Central Stone is 15.5 miles one-way	
Topsoil Round Trip	20	miles		
Shot Rock Round Trip	16	miles	Fred Weber is 4 miles one-way. Central Stone is 15.5 miles one-way.	
Delivery Trips per Truck	4	trips/day		
Round Trip Miles to Rail Spur	20	miles	"Complete Rad Removal" with off-site disposal alternative only	

Calculated values are shown with background shading

Off-Site Disposal Assumptions and Calculations

	Value	Units	Source	Source Details
RIM Density (bank)	1,000	lb/cy		
RIM Density (loose)	*0.33*	tons/lcy		
Gondola Car Capacity (volume)	140	lcy/car		
Gondola Car Capacity (weight)	106	tons/car		
Gondola Car RIM Capacity	*46.67*	tons		
So, gondola car is	*volume limited*			
Gondola cars available	15	per day		
Railroad "switches"	5	days/week		
Daily Capacity for Set of Gondola Cars	*700*	tons		
which is	*2,100*	lcy		
or	*1,400*	bcy		
This would be a weekly rate of	*7,000*	bcy		

Aluminum Semi-trailer Trucks				
Semi capacity (volume)	35	lcy/truckload		
Semi capacity (weight)	22	tons/truckload		
Semi RIM capacity	*11.67*	tons		
So, aluminum semi is	*volume limited*			
Semi capacity controlled for RIM (weight)	*11.67*	tons		
Semi capacity controlled for RIM (volume)	*35.00*	lcy		
Semi loads to Match Gondola Rate	*60*	truckloads/day		
Round Trips per Truck	4	per day		
Road Trucks Required	*15*	each		

Gondola Transport Crew Composition				
Gondola Crew - Laborers Placing DOT Bags in Trailer	2	each		
Gondola Crew - Truck Drivers	*15*	each		
Gondola Crew - Excavators Loading	2	each		
Gondola Crew - Spotter/Pup Engine Operator at Gondola car	1	each		
Gondola Crew - Spotter at Truck Loading	1	each		
Gondola Crew Total	*21*	each		
Gondola Transport Crew	1	each		

Disposal Costs				
Off-site Disposal Facility transportation cost	$ 150	per lcy	Off-site Disposal Facility estimate	
Off-site Disposal Facility disposal fee	$ 85	per lcy	Off-site Disposal Facility estimate	

Calculated values are shown with background shading

General Construction Assumptions, Equipment

Heavy Equipment List	**70-150 HP**	**150+ HP**	**Towed**	**Scrapers**	**Total**
Equipment Dozers Qty EA		6			**6**
Equipment Excavators Qty EA		3			**3**
Equipment Front-end Loaders Qty EA		4			**4**
Equipment Motor Graders Qty EA		1			**1**
Equipment Haul Trucks Qty EA		12			**12**
Equipment All-Terrain Forklifts Qty EA	1				**1**
Equipment Scrapers Qty EA				3	**3**
Equipment Water Trucks Qty EA	3				**3**
Equipment Water Wagons/Towers Qty EA			2		**2**
Totals	**4**	**28**	**2**	**3**	**37**
Contractor Mobilization Distance	100	miles			
Mobilization Extra Mileage Daily Output EA	72	units	Based on 45 mph average for 8 hours, divided by the 5 mile RS Means increment = 72 units		

Geosynthetics					
Geomembrane Crews EA	12	RS Means uses a crew of 3 skilled workers, output = 1600 sf/day. Reasonable output is 22,000 sf/day, thus nearly 14 crews.			
Geotextile Crews EA	4				

Dust Control			**Source**	**Details**
Water Truck Purchase Price	$ 50,000	each	Estimate	
Average Days per Month Requiring Dust Control	20	days/month	Estimate	
Water Truck Operation	$ 8,000	per month	Estimate of operator, fuel, maintenance	$50/hr x 8 hrs/day
Water Cost	$ 0.00319	per gallon	Missouri American Water Company, 4/20/2011	Current rate to site
Water Use (per water truck)	$ 200,000	gallons/month	Estimate	10,000 gal/day
Water Truck Crew Size	1			

Assumptions for Construction Trailers

Capital Costs	Description	Cost	Source	RS Means Reference #	Crew Type	Crew Size	Daily Rate	Days	Man-days
Trailer Purchase	Office Trailer, furnished, buy, 32' x 8', excl. hookups	$ 15,346	RS Means, Year 2011 Quarter 1	015213200300	2 Skwk	2.0	0.7	1.4	2.9
Trailer Delivery, per mile	Office Trailer, delivery, add per mile	$ 5.12	RS Means, Year 2011 Quarter 1	015213200800					
Delivery Distance	Delivery Distance (miles)	20	Estimate						
Trailer Delivery		*$ 102*							
Electrical Connection	Temporary electrical power equipment (pro-rated per job), connections, office trailer, 200 amp	$ 947	RS Means, Year 2011 Quarter 1	015113500890	1 Elec	1.0	2.0	0.5	0.5
Total per Trailer		*$ 16,396*						*1.9*	*3.4*
Number of Site Trailers	Contractor, Engineering, Reg. Oversight, Decon building, Lab	5							
Electrical Feed to Trailer Area	Temporary electrical power equipment (pro-rated per job), underground feed, 3 uses, 1000 amp	$ 5,062	RS Means, Year 2011 Quarter 1	015113500160	1 Elec	1.0	0.4	2.9	2.9
Grand Total		*$ 87,000*						*12.5*	*19.6*

					Applicable Costs per Trailer				
Operating Costs	Description	Cost per Trailer	Source	RS Means Reference #	Contractor	Engineering	Reg. Oversight	Lab	Decon
Office Equipment Rental	Field Office Expense, office equipment rental, average	$ 223	RS Means, Year 2011 Quarter 1	015213400100	$ 223	$ 223			
Office Supplies	Field Office Expense, office supplies, average	$ 96	RS Means, Year 2011 Quarter 1	015213400120	$ 96	$ 96			
Telephone	Field Office Expense, telephone bill; avg. bill/month, incl. long distance	$ 90	RS Means, Year 2011 Quarter 1	015213400140	$ 90	$ 90	$ 90	$ 90	
Electrical Usage	Field Office Expense, field office lights & HVAC	$ 169	RS Means, Year 2011 Quarter 1	015213400160	$ 169	$ 169	$ 169	$ 169	$ 169
Air Conditioning	Office Trailer, excl. hookups, air conditioning, rent per month, add	$ 46	RS Means, Year 2011 Quarter 1	015213200700	$ 46	$ 46	$ 46	$ 46	$ 46
Portable Toilets for Trailer Areas	Rent portable toilet chemical, recycle, flush type, Incl. Hourly Oper. Cost.	$ 281	RS Means, Year 2011 Quarter 1	015433406420	$ 281			$ 281	
Total Monthly, each Trailer					*$ 905*	*$ 625*	*$ 306*	*$ 587*	*$ 215*
Grand Total (Monthly)					***$***				***2,600***

Parking Area		
Parking Area Length	100	ft
Parking Area Width	200	ft
Parking Area Total	*2,222*	sy

Calculated values are shown with background shading

Assumptions and Calculations for Buffer Zone / Crossroad Property

Assumptions	Value	Units	Source
Length of Access Fence	850	lf	
Length of Silt Fence	850	lf	
Area to address	1.78	ac	ROD, Section 5.2
Depth of soil to replace	1.0	ft	

Construction Costs	RS Means Reference #	RS Means Description	Quantity	Units	Unit Cost	Extended Cost	Source	Crew Type	Daily Rate	Crew Size	Number of Crews	Efficiency Factor	Days	Man-days
1) Surveying	022113090020	Topographical survey, conventional, minimum	1.78	Acre	$ 601	$ 1,070	RS Means, Year 2011 Quarter 1	A7	3.3	3	1	100%	0.5	1.6
2) Silt Fence	312514161100	Synthetic erosion control, silt fence, polypropylene, adverse conditions, 3' high	850	L.F.	$ 1.31	$ 1,110	RS Means, Year 2011 Quarter 1	2 Clab	950	2	1	100%	0.9	1.8
3) Clearing and grubbing (light)	311313101020	Selective tree and shrub removal, selective clearing brush mowing, light density, tractor with rotary mower, excludes removal offsite	1.78	Acre	$ 441	$ 785	RS Means, Year 2011 Quarter 1	B84	2	1	1	100%	0.9	0.9
4) Excavate top layer of soil and haul to Area 2													*1.9*	
Excavate top layer of soil	312316420305	Excavating, bulk bank measure, 3-1/2 C.Y. capacity = 160 C.Y./hour, backhoe, hydraulic, crawler mounted, excluding truck loading	2,872	B.C.Y.	$ 1.49	$ 4,280	RS Means, Year 2011 Quarter 1	B12D	2,400	2	2	50%	1.2	4.8
Load soil onto haul trucks	312316420305A	Excavating, bulk bank measure, for loading onto trucks, add	2,872	B.C.Y.	$ 0.22	$ 632	RS Means, Year 2011 Quarter 1	B12D	16,255	2	2	50%	0.2	0.7
Haul soil to Area 2	312323205060	Cycle hauling(wait, load,travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 22 C.Y. truck, cycle 2000 ft, 10 MPH, excludes loading equipment	4,020	L.C.Y.	$ 2.96	$ 11,900	RS Means, Year 2011 Quarter 1	B34F	594	1	3.535354	100%	1.9	6.8
Spread soil in Area 2	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	4,020	L.C.Y.	$ 1.99	$ 8,000	RS Means, Year 2011 Quarter 1	B10B	1,000	1.5	3	100%	1.3	6.0
Compact soil in Area 2	312323235720	Compaction, 4 passes, 12" lifts, riding, sheepsfoot or wobbly wheel roller	2,872	E.C.Y.	$ 0.78	$ 2,240	RS Means, Year 2011 Quarter 1	B10G	2,600	1.5	1	100%	1.1	1.7
Apply daily cover to relocated soil	312316462200	Excavating, bulk, dozer, open site, bank measure, sand and gravel, 80 H.P. dozer, 150' haul	287	B.C.Y.	$ 5.32	$ 1,530	RS Means, Year 2011 Quarter 1	B10L	230	1.5	1	100%	1.2	1.9
5) Chain Link Fence for Access Restriction	323113200920	Fence, chain link industrial, galvanized steel, 6 ga. wire, 2-1/2" posts @ 10' OC, 8' high, includes excavation, in concrete, excludes barbed wire	850	L.F.	$ 37.36	$ 31,800	RS Means, Year 2011 Quarter 1	B80C	180	3	2	100%	2.4	14.2
Total						**$ 63,300**							**6.6**	**40.3**

Note that summary durations are the maximum duration of simultaneous component steps

Calculated values are shown with background shading

Appendix K-2:

Cost Estimates for the ROD-Selected Remedy

Present Worth Cost Estimate (30 years)
ROD Remedy Alternative

Year	n	P/F(i=2.3%)	Capital Costs ($) ROD Remedy	Capital Costs ($) Subtotal Capital Costs	Operation, Maintenance, and Monitoring Costs ($/yr) Environmental Monitoring	Landfill Gas and Radon Monitoring	Groundwater/ Surface Water Monitoring	Annual Site Inspection/Cover Maintenance	5 year Review	Subtotal O&M Costs	Total Costs ($)	Cumulative Total Costs ($)	Present Worth of Annual Costs ($)	Cumulative Present Worth ($)	
2013	0	1.00000	2,625,000	2,625,000	91,000		93,000			184,000	2,809,000	2,809,000	2,809,000	2,809,000	Construction Costs
2014	1	0.97752	17,300,000	17,300,000	109,000		93,000			202,000	17,502,000	20,311,000	17,109,000	19,918,000	
2015	2	0.95554	20,900,000	20,900,000	100,000		93,000			193,000	21,093,000	41,404,000	20,155,000	40,073,000	
2016	3	0.93406				15,000	372,000	27,000		414,000	414,000	41,818,000	387,000	40,460,000	OM&M Costs
2017	4	0.91306				15,000	372,000	27,000		414,000	414,000	42,232,000	378,000	40,838,000	
2018	5	0.89253				15,000	372,000	27,000		414,000	414,000	42,646,000	370,000	41,208,000	
2019	6	0.87246				15,000	186,000	27,000		228,000	228,000	42,874,000	199,000	41,407,000	
2020	7	0.85285				15,000	186,000	27,000	30,000	258,000	258,000	43,132,000	220,000	41,627,000	
2021	8	0.83367				15,000		27,000		42,000	42,000	43,174,000	35,000	41,662,000	
2022	9	0.81493				15,000	93,000	27,000		135,000	135,000	43,309,000	110,000	41,772,000	
2023	10	0.79661				15,000		27,000		42,000	42,000	43,351,000	33,000	41,805,000	
2024	11	0.77870				15,000	93,000	27,000		135,000	135,000	43,486,000	105,000	41,910,000	
2025	12	0.76119				15,000		27,000	30,000	72,000	72,000	43,558,000	55,000	41,965,000	
2026	13	0.74408				15,000	93,000	27,000		135,000	135,000	43,693,000	100,000	42,065,000	
2027	14	0.72735				15,000		27,000		42,000	42,000	43,735,000	31,000	42,096,000	
2028	15	0.71099				15,000	93,000	27,000		135,000	135,000	43,870,000	96,000	42,192,000	
2029	16	0.69501				15,000		27,000		42,000	42,000	43,912,000	29,000	42,221,000	
2030	17	0.67938				15,000	93,000	27,000	30,000	165,000	165,000	44,077,000	112,000	42,333,000	
2031	18	0.66411				15,000		27,000		42,000	42,000	44,119,000	28,000	42,361,000	
2032	19	0.64918				15,000	93,000	27,000		135,000	135,000	44,254,000	88,000	42,449,000	
2033	20	0.63458				15,000		27,000		42,000	42,000	44,296,000	27,000	42,476,000	
2034	21	0.62031				15,000	93,000	27,000		135,000	135,000	44,431,000	84,000	42,560,000	
2035	22	0.60637				15,000		27,000	30,000	72,000	72,000	44,503,000	44,000	42,604,000	
2036	23	0.59273				15,000	93,000	27,000		135,000	135,000	44,638,000	80,000	42,684,000	
2037	24	0.57941				15,000		27,000		42,000	42,000	44,680,000	24,000	42,708,000	
2038	25	0.56638				15,000	93,000	27,000		135,000	135,000	44,815,000	76,000	42,784,000	
2039	26	0.55365				15,000		27,000		42,000	42,000	44,857,000	23,000	42,807,000	
2040	27	0.54120				15,000	93,000	27,000	30,000	165,000	165,000	45,022,000	89,000	42,896,000	
2041	28	0.52903				15,000		27,000		42,000	42,000	45,064,000	22,000	42,918,000	
2042	29	0.51714				15,000	93,000	27,000		135,000	135,000	45,199,000	70,000	42,988,000	

Estimated Non-discounted Total Costs: 45,000,000

Estimated 30-year Present Worth Costs: 43,000,000

The information in this cost estimate summary is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. In accordance with USEPA Guidance, this is an order-of-magnitude engineering estimate that is expected to be within -30 to +50 percent of the actual project cost.

Present Worth Cost Estimate (1,000 years)
ROD Remedy Alternative

Year	*n*	P/F(*i*=2.3%)	Capital Costs ($): ROD Remedy	Capital Costs ($): Subtotal Capital Costs	Operation, Maintenance, and Monitoring Costs ($/yr): Environmental Monitoring	Landfill Gas and Radon Monitoring	Groundwater/ Surface Water Monitoring	Annual Site Inspection/Cover Maintenance	5 year Review	Subtotal O&M Costs	Total Costs ($)	Cumulative Total Costs ($)	Present Worth of Annual Costs ($)	Cumulative Present Worth ($)	
2013	0	1.00000	2,625,000	2,625,000	91,000		93,000			184,000	2,809,000	2,809,000	2,809,000	2,809,000	Construction Costs
2014	1	0.97752	17,300,000	17,300,000	109,000		93,000			202,000	17,502,000	20,311,000	17,109,000	19,918,000	
2015	2	0.95554	20,900,000	20,900,000	100,000		93,000			193,000	21,093,000	41,404,000	20,155,000	40,073,000	
2016	3	0.93406				15,000	372,000	27,000		414,000	414,000	41,818,000	387,000	40,460,000	OM&M Costs
2017	4	0.91306				15,000	372,000	27,000		414,000	414,000	42,232,000	378,000	40,838,000	
2018	5	0.89253				15,000	372,000	27,000		414,000	414,000	42,646,000	370,000	41,208,000	
2019	6	0.87246				15,000	186,000	27,000		228,000	228,000	42,874,000	199,000	41,407,000	
2020	7	0.85285				15,000	186,000	27,000	30,000	258,000	258,000	43,132,000	220,000	41,627,000	
2021	8	0.83367				15,000		27,000		42,000	42,000	43,174,000	35,000	41,662,000	
2022	9	0.81493				15,000	93,000	27,000		135,000	135,000	43,309,000	110,000	41,772,000	
2023	10	0.79661				15,000		27,000		42,000	42,000	43,351,000	33,000	41,805,000	
2024	11	0.77870				15,000	93,000	27,000		135,000	135,000	43,486,000	105,000	41,910,000	
2025	12	0.76119				15,000		27,000	30,000	72,000	72,000	43,558,000	55,000	41,965,000	
2026	13	0.74408				15,000	93,000	27,000		135,000	135,000	43,693,000	100,000	42,065,000	
2027	14	0.72735				15,000		27,000		42,000	42,000	43,735,000	31,000	42,096,000	
2028	15	0.71099				15,000	93,000	27,000		135,000	135,000	43,870,000	96,000	42,192,000	
2029	16	0.69501				15,000		27,000		42,000	42,000	43,912,000	29,000	42,221,000	
2030	17	0.67938				15,000	93,000	27,000	30,000	165,000	165,000	44,077,000	112,000	42,333,000	
2031	18	0.66411				15,000		27,000		42,000	42,000	44,119,000	28,000	42,361,000	
2032	19	0.64918				15,000	93,000	27,000		135,000	135,000	44,254,000	88,000	42,449,000	
2033	20	0.63458				15,000		27,000		42,000	42,000	44,296,000	27,000	42,476,000	
2034	21	0.62031				15,000	93,000	27,000		135,000	135,000	44,431,000	84,000	42,560,000	
2035	22	0.60637				15,000		27,000	30,000	72,000	72,000	44,503,000	44,000	42,604,000	
2036	23	0.59273				15,000	93,000	27,000		135,000	135,000	44,638,000	80,000	42,684,000	
2037	24	0.57941				15,000		27,000		42,000	42,000	44,680,000	24,000	42,708,000	
2038	25	0.56638				15,000	93,000	27,000		135,000	135,000	44,815,000	76,000	42,784,000	
2039	26	0.55365				15,000		27,000		42,000	42,000	44,857,000	23,000	42,807,000	
2040	27	0.54120				15,000	93,000	27,000	30,000	165,000	165,000	45,022,000	89,000	42,896,000	
2041	28	0.52903				15,000		27,000		42,000	42,000	45,064,000	22,000	42,918,000	
2042	29	0.51714				15,000	93,000	27,000		135,000	135,000	45,199,000	70,000	42,988,000	
2212	199	0.01083				15,000	93,000	27,000		135,000	135,000	61,264,000	1,000	45,061,000	
3012	999	0.00000				15,000	93,000	27,000		135,000	135,000	136,864,000	0	45,087,000	

Estimated Non-discounted Total Costs: 137,000,000

Estimated 1,000-year Present Worth Costs: 45,000,000

The information in this cost estimate summary is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. In accordance with USEPA Guidance, this is an order-of-magnitude engineering estimate that is expected to be within -30 to +50 percent of the actual project cost.

Total Capital Costs
ROD Remedy Alternative

Cost Item			Estimated Capital Costs
Construction Costs		$	25,600,000
Radiological Survey Costs		$	711,000
Environmental Monitoring Costs		$	369,000
Long-Term Monitoring Facilities		$	98,000
Baseline Monitoring		$	7,000
Institutional Controls		$	50,000
Subtotal		$	26,835,000
Project Management	5%	$	1,342,000
Engineering Design	6%	$	1,610,000
Construction Management	6%	$	1,610,000
Subtotal Construction On-Site		$	31,400,000
Scope Contingency	10%	$	3,140,000
Bid Contingency	20%	$	6,280,000
Subtotal Contingency		$	9,420,000
Total: ROD Remedy		$	40,800,000

Estimated Length Construction 1.7 years

Construction Cost Estimate - ROD Remedy

Step #	Category	Sub-Category	Task	Quantity ROD Area 1	Quantity ROD Area 2	Type of Material Handled	Units	Source of Costing Estimate	RS Means Reference #	RS Means Description	Crew Type	Daily Unit Rate of Constr-uction	Crew Size (Men)	Number of Crews	Effic-iency Factor	Construction (Days) ROD Area 1	Construction (Days) ROD Area 2	Crew Man-days ROD Area 1	Crew Man-days ROD Area 2	Unit Costs: Extended Material Overhead and Profit	Unit Costs: Extended Labor Overhead and Profit	Unit Costs: Extended Labor Overhead and Profit - Ineffeciency	Unit Costs: Extended Equipment Overhead and Profit	Unit Costs: Extended Equipment Overhead and Profit - Ineffeciency	Unit Costs: Extended Total Overhead and Profit	Material Taxes at Bridgeton (7.925%) ROD Area 1	Material Taxes at Bridgeton (7.925%) ROD Area 2	Total Cost for Line Item ROD Area 1	Total Cost for Line Item ROD Area 2	Truckloads for Delivery ROD Area 1	Truckloads for Delivery ROD Area 2	Total Miles for Delivery ROD Area 1	Total Miles for Delivery ROD Area 2
ROD 1	Temporary Construction Facilities / Utilities / Personnel	*Construction Trailers*	Capital Expenses	2		Group of Trailers		See separate Assumptions sheet								25.0	-	39.3	-						$ 87,040	$ -	$ -	$ 174,000	$ -	10	-	200	-
ROD 2			Operating Expenses	23		Group of Trailers	Months	See separate Assumptions sheet																	$ 2,638	$ -	$ -	$ 60,400	$ -				
ROD 3			Parking Area	4,444		Gravel Area	S.Y.	RS Means, Year 2011 Quarter 1	015523500050	Temporary, roads, gravel fill, 4" gravel depth, excl surfacing	B14	715	6	1	100%	6.2	-	37.3	-	$ 4.46	$ 3.97	$ -	$ 0.53	$ -	$ 8.96	$ 1,570	$ -	$ 41,400	$ -				
ROD 4			Portable Toilets in Construction areas	7	19	Portable Toilets	Month	RS Means, Year 2011 Quarter 1	015433406420	Rent portable toilet chemical, recycle, flush type, Incl. Hourly Oper. Cost.					100%					$ -	$ -	$ -	$ 281	$ -	$ 281	$ -	$ -	$ 1,910	$ 5,210				
ROD 5		*Contractor's Construction Management Personnel*	Project Manager	89		Personnel	Week	RS Means, Year 2011 Quarter 1	013113200220	Field personnel, project manager, maximum		0.2	1	1	100%	445	-	445	-	$ -	$ 3,650	$ -	$ -	$ -	$ 3,650	$ -	$ -	$ 326,000	$ -				
ROD 6			Construction Superintendent(s)	99		Personnel	Week	RS Means, Year 2011 Quarter 1	013113200260	Field personnel, superintendent, average		0.2	1	1	100%	496	-	496	-	$ -	$ 2,950	$ -	$ -	$ -	$ 2,950	$ -	$ -	$ 294,000	$ -				
ROD 7			Clerk(s)	99		Personnel	Week	RS Means, Year 2011 Quarter 1	013113200020	Field Personnel, clerk, average		0.2	1	1	100%	496	-	496	-	$ -	$ 630	$ -	$ -	$ -	$ 630	$ -	$ -	$ 62,700	$ -				
ROD 8			Field Engineer(s) / Safety Officer(s)	99		Personnel	Week	RS Means, Year 2011 Quarter 1	013113200120	Field personnel, field engineer, average		0.2	1	1	100%	496	-	496	-	$ -	$ 1,950	$ -	$ -	$ -	$ 1,950	$ -	$ -	$ 194,000	$ -				
ROD 9	Temporary Stormwater Infrastructure (for stormwater during construction)	*Temporary Stormwater Lagoon*	Excavate soil for 4th berm at former leachate lagoon area	21,379		Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316464420	Excavating, bulk, dozer, open site, bank measure, common earth, 200 H.P. dozer, 300' push	B10B	270	1.5	4	100%	19.8	-	118.8	-	$ -	$ 2.72	$ -	$ 4.65	$ -	$ 7.37	$ -	$ -	$ 158,000	$ -				
ROD 10			Place soil for berm	29,930		Soil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	1.5	2	100%	15.0	-	44.9	-	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ 59,600	$ -				
ROD 11			Compact berm	21,379		Soil	E.C.Y.	RS Means, Year 2011 Quarter 1	312323235060	Compaction, riding, vibrating roller, 2 passes, 12" lifts	B10Y	5,200	1.5	2	100%	2.1	-	6.2	-	$ -	$ 0.14	$ -	$ 0.12	$ -	$ 0.26	$ -	$ -	$ 5,560	$ -				
ROD 12			Install geomembrane liner	495		60 mil HDPE	M.S.F.	RS Means, Year 2011 Quarter 1	334713531220	Pond and Reservoir Liners, membrane lining systems HDPE, 100,000 S.F. or more, 60 mil thick	3 Skwk	2	3	12	100%	25.8	-	928.1	-	$ 271.46	$ 1,113.15	$ -	$ -	$ -	$ 1,384.61	$ 10,600	$ -	$ 696,000	$ -	5	-	10,000	-
ROD 13			Install force main from Areas 1 and 2 to lagoon	3,671	832	HDPE Pipe	L.F.	RS Means, Year 2011 Quarter 1	331113350100	Water supply distribution piping, piping HDPE, butt fusion joints, 40' lengths, 4" diameter, SDR 21	B22A	400	5	1	100%	9.2	2.1	45.9	10.4	$ 3.66	$ 6.46	$ -	$ 1.89	$ -	$ 12.01	$ 1,060	$ 241	$ 45,200	$ 10,200				
ROD 14			Install force main from lagoon to treatment facility	551		HDPE Pipe	L.F.	RS Means, Year 2011 Quarter 1	331113350100	Water supply distribution piping, piping HDPE, butt fusion joints, 40' lengths, 4" diameter, SDR 21	B22A	400	5	1	100%	1.4	-	6.9	-	$ 3.66	$ 6.46	$ -	$ 1.89	$ -	$ 12.01	$ 160	$ -	$ 6,780	$ -				
ROD 15		*Treatment Facility*	Construct Treatment Facility	1		Treatment Facility	Each	EMSI Estimate				0.017	7	1	100%	60.0	-	420.0	-						$ 264,000	$ -	$ -	$ 264,000	$ -				
ROD 16			Monthly Operation during construction	11		Treatment Facility Operation	Months	EMSI Estimate				0.4	1	1	100%	27.8	-	27.8	-						$ 9,000	$ -	$ -	$ 100,000	$ -				
ROD 17		*Stormwater events during construction*	Dewater construction after rain events	101	249	Construction stormwater	Days of Pumping	RS Means, Year 2011 Quarter 1	312319200650	Dewatering, pumping, 8 hr., attended 2 hours per day, 4" discharge pump used for 8 hours, includes 20 L.F. of suction hose and 100 L.F. of discharge hose	B10I	4	1.5	4	100%	6.3	15.5	37.8	93.2	$ -	$ 183.11	$ -	$ 35.30	$ -	$ 218.41	$ -	$ -	$ 22,000	$ 54,300				
ROD 18			Dispose of contact stormwater to MSD	560,000	560,000	Contact stormwater	Gallons	Metropolitan St. Louis Sewer District, May 2011							100%										$ 0.0028	$ -	$ -	$ 1,580	$ 1,580				
ROD 19		*Post-project Stormwater Demolition*	Dispose of geomembrane liner	495		60 mil HDPE	M.S.F.	Estimating $.40/sf				20	3	1	100%	24.8	-	74.3	-						$ 400	$ -	$ -	$ 198,000	$ -				
ROD 20			Deconstruct 4th berm	21,379		Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316464420	Excavating, bulk, dozer, open site, bank measure, common earth, 200 H.P. dozer, 300' push	B10B	270	1.5	4	100%	19.8	-	118.8	-	$ -	$ 2.72	$ -	$ 4.65	$ -	$ 7.37	$ -	$ -	$ 158,000	$ -				
ROD 21			Grade berm material in lagoon for proper drainage	29,930		Soil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	1.5	2	100%	15.0	-	44.9	-	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ 59,600	$ -				
ROD 22	Site-wide Preparation	*Mobilization*	Mobilize and Demobilize Equipment Under 150HP	8		Units of Equipment up to 150HP (up to 50 miles)	Ea.	RS Means, Year 2011 Quarter 1	015436500020	Mobilization or demobilization, dozer, loader, backhoe or excavator, 70 H.P. to 150 H.P., up to 50 miles	B34N	4	1	1	100%	2.0	-	2.0	-	$ -	$ 112.25	$ -	$ 139.01	$ -	$ 251.26	$ -	$ -	$ 2,010	$ -				
ROD 23			*Extra Mileage for Mobilizations*	80		Per 5 additional miles		RS Means, Year 2011 Quarter 1	015436500020A	Mobilization or demobilization, each additional 5 miles haul distance, add	B34N	72	1	1	100%	1.1	-	1.1	-	$ -	$ 11.23	$ -	$ 13.90	$ -	$ 25.12	$ -	$ -	$ 2,010	$ -				
ROD 24			Mobilize and Demobilize Equipment Over 150HP	56		Units of Equipment over 150HP (up to 50 miles)	Ea.	RS Means, Year 2011 Quarter 1	015436500100	Mobilization or demobilization, dozer, loader, backhoe or excavator, above 150 H.P., up to 50 miles	B34K	3	1	1	100%	18.7	-	18.7	-	$ -	$ 148.59	$ -	$ 309.51	$ -	$ 458.10	$ -	$ -	$ 25,700	$ -				
ROD 25			*Extra Mileage for Mobilizations*	560		Per 5 additional miles		RS Means, Year 2011 Quarter 1	015436500100A	Mobilization or demobilization, each additional 5 miles haul distance, add	B34K	72	1	1	100%	7.8	-	7.8	-	$ -	$ 14.86	$ -	$ 30.95	$ -	$ 45.81	$ -	$ -	$ 25,700	$ -				
ROD 26			Mobilize and Demobilize Equipment, Towed	4		Units of Towed Equipment (up to 50 miles)	Ea.	RS Means, Year 2011 Quarter 1	015436500300	Mobilization or demobilization, scraper, towed type (including tractor), 6 C.Y. capacity, up to 50 miles	B34K	3	1	1	100%	1.3	-	1.3	-	$ -	$ 148.59	$ -	$ 309.51	$ -	$ 458.10	$ -	$ -	$ 1,830	$ -				
ROD 27			*Extra Mileage for Mobilizations*	40		Per 5 additional miles		RS Means, Year 2011 Quarter 1	015436500300A	Mobilization or demobilization, each additional 5 miles haul distance, add	B34K	72	1	1	100%	0.6	-	0.6	-	$ -	$ 14.86	$ -	$ 30.95	$ -	$ 45.81	$ -	$ -	$ 1,830	$ -				
ROD 28		*Supplemental Mobilizations*	Mobilize and Demobilize Equipment Under 150HP	8		Units of Equipment up to 150HP (up to 50 miles)	Ea.	RS Means, Year 2011 Quarter 1	015436500020	Mobilization or demobilization, dozer, loader, backhoe or excavator, 70 H.P. to 150 H.P., up to 50 miles	B34N	4	1	1	100%	2.0	-	2.0	-	$ -	$ 112.25	$ -	$ 139.01	$ -	$ 251.26	$ -	$ -	$ 2,010	$ -				
ROD 29			*Extra Mileage for Mobilizations*	80		Per 5 additional miles		RS Means, Year 2011 Quarter 1	015436500020A	Mobilization or demobilization, each additional 5 miles haul distance, add	B34N	72	1	1	100%	1.1	-	1.1	-	$ -	$ 11.23	$ -	$ 13.90	$ -	$ 25.12	$ -	$ -	$ 2,010	$ -				
ROD 30			Mobilize and Demobilize Equipment Over 150HP	56		Units of Equipment over 150HP (up to 50 miles)	Ea.	RS Means, Year 2011 Quarter 1	015436500100	Mobilization or demobilization, dozer, loader, backhoe or excavator, above 150 H.P., up to 50 miles	B34K	3	1	1	100%	18.7	-	18.7	-	$ -	$ 148.59	$ -	$ 309.51	$ -	$ 458.10	$ -	$ -	$ 25,700	$ -				
ROD 31		*Supplemental Mobilizations (cont.)*	*Extra Mileage for Mobilizations*	560		Per 5 additional miles		RS Means, Year 2011 Quarter 1	015436500100A	Mobilization or demobilization, each additional 5 miles haul distance, add	B34K	72	1	1	100%	7.8	-	7.8	-	$ -	$ 14.86	$ -	$ 30.95	$ -	$ 45.81	$ -	$ -	$ 25,700	$ -				
ROD 32			Mobilize and Demobilize Equipment, Towed	4		Units of Towed Equipment (up to 50 miles)	Ea.	RS Means, Year 2011 Quarter 1	015436500300	Mobilization or demobilization, scraper, towed type (including tractor), 6 C.Y. capacity, up to 50 miles	B34K	3	1	1	100%	1.3	-	1.3	-	$ -	$ 148.59	$ -	$ 309.51	$ -	$ 458.10	$ -	$ -	$ 1,830	$ -				

Construction Cost Estimate - ROD Remedy

				Quantity												Construction (Days)		Crew Man-days		Unit Costs						Material Taxes at Bridgeton (7.925%)		Total Cost for Line Item		Truckloads for Delivery		Total Miles for Delivery	
Step #	Category	Sub-Category	Task	ROD Area 1	ROD Area 2	Type of Material Handled	Units	Source of Costing Estimate	RS Means Reference #	RS Means Description	Crew Type	Daily Unit Rate of Constr-uction	Crew Size (Men)	Number of Crews	Effic-iency Factor	ROD Area 1	ROD Area 2	ROD Area 1	ROD Area 2	Extended Material Overhead and Profit	Extended Labor Overhead and Profit	Extended Labor Overhead and Profit - Ineffeciency	Extended Equipment Overhead and Profit	Extended Equipment Overhead and Profit - Ineffeciency	Extended Total Overhead and Profit	ROD Area 1	ROD Area 2	ROD Area 1	ROD Area 2	ROD Area 1	ROD Area 2	ROD Area 1	ROD Area 2
ROD 33			*Extra Mileage for Mobilizations*	40		Per 5 additional miles		RS Means, Year 2011 Quarter 1	015436500300A	Mobilization or demobilization, each additional 5 miles haul distance, add	B34K	72	1	1	100%	0.6	-	0.6	-	$ -	$ 14.86	$ -	$ 30.95	$ -	$ 45.81	$ -	$ -	$ 1,830	$ -				
ROD 34	Site-wide Preparation (cont.)		Create Temporary Roads	6,667	13,333	Gravel Roads	S.Y.	RS Means, Year 2011 Quarter 1	015523500050	Temporary, roads, gravel fill, 4" gravel depth, excl surfacing	B14	715	6	1	100%	9.3	18.6	55.9	111.9	$ 4.46	$ 3.97	$ -	$ 0.53	$ -	$ 8.96	$ 2,360	$ 4,710	$ 62,100	$ 124,000				
ROD 35			Install TBD Traffic Improvements	$ 100,000	$ 100,000	TBD (shown as budget estimate)	$						6	1	100%	10.0	10.0	60.0	60.0	$ 1.00					$ 1.00	$ 7,930	$ 7,930	$ 108,000	$ 108,000				
ROD 36			Water Truck Depreciation	1	1	Water Trucks	Trucks	Estimate																	$ 50,000	$ -	$ -	$ 50,000	$ 50,000				
ROD 37			Water Truck Operation	6	16	Water Trucks	Months	Estimate				0.050	1	1	100%	127	330	127	330						$ 8,000	$ -	$ -	$ 50,700	$ 132,000				
ROD 38		*Dust Control*	Use Water to Control Dust	1,270,000	3,300,000	Water	Gal	Missouri American Water Company, 4/20/2011							100%										$ 0.0032	$ -	$ -	$ 4,040	$ 10,500				
ROD 39			Prepare area with Stormwater BMPs	4,166	6,448	Silt Fence	L.F.	RS Means, Year 2011 Quarter 1	312514161100	Synthetic erosion control, silt fence, polypropylene, adverse conditions, 3' high	2 Clab	950	2	1	100%	4.4	6.8	8.8	13.6	$ 0.44	$ 0.87	$ -	$ -	$ -	$ 1.31	$ 145	$ 225	$ 5,600	$ 8,670				
ROD 40		*Decontamination Area*	Materials	56	56	Concrete	C.Y.	RS Means, Year 2011 Quarter 1	033105350300	Structural concrete, ready mix, normal weight, 4000 PSI, includes local aggregate, sand, Portland cement and water, delivered, excludes all additives and treatments					100%					$ 105.20					$ 105.20	$ 463	$ 463	$ 6,310	$ 6,310				
ROD 41	Site Preparation		Installation	56	56	Concrete	C.Y.	RS Means, Year 2011 Quarter 1	33105704650	Structural concrete, placing, slab on grade, pumped, over 6" thick, includes strike off & consolidation, excludes material	C20	185	8	1	100%	0.3	0.3	2.4	2.4	$ -	$ 20.96	$ -	$ 5.08	$ -	$ 26.04	$ -	$ -	$ 1,450	$ 1,450				
ROD 42			Clear Vegetation (Light)	14.5	12.1	Vegetation	Acre	RS Means, Year 2011 Quarter 1	311313101020	Selective tree and shrub removal, selective clearing brush mowing, light density, tractor with rotary mower, excludes removal offsite	B84	2	1	1	100%	7.3	6.1	7.3	6.1	$ -	$ 265.31	$ -	$ 175.93	$ -	$ 441.24	$ -	$ -	$ 6,400	$ 5,340				
ROD 43			Clear Vegetation (Heavy)	3.5	27.8	Vegetation	Acre	RS Means, Year 2011 Quarter 1	311110100020	Clearing & grubbing, cut & chip light trees, to 6" diameter	B7	1	6	1	100%	3.5	27.8	21.0	166.8	$ -	$ 2,618.83	$ -	$ 1,574.70	$ -	$ 4,193.53	$ -	$ -	$ 14,700	$ 117,000				
ROD 44			Apply daily cover to remaining excavation of Landfilled Material	2,974	6,649	Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316462200	Excavating, bulk, dozer, open site, bank measure, sand and gravel, 80 H.P. dozer, 150' haul	B10L	230	1.5	1	100%	12.9	28.9	19.4	43.4	$ -	$ 3.18	$ -	$ 2.14	$ -	$ 5.32	$ -	$ -	$ 15,800	$ 35,400				
ROD 45			Relocate Landfilled Material on-site - Excavate	32,718	73,142	Landfilled Material	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305	Excavating, bulk bank measure, 3-1/2 C.Y. capacity = 160 C.Y./hour, backhoe, hydraulic, crawler mounted, excluding truck loading	B12D	2,400	2	3	100%	4.5	10.2	27.3	61.0	$ -	$ 0.40	$ -	$ 1.09	$ -	$ 1.49	$ -	$ -	$ 48,800	$ 109,000				
ROD 46			*(additional cost to previous line)*	32,718	73,142	Landfilled Material	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305A	Excavating, bulk bank measure, for loading onto trucks, add	B12D	16,255	2	3	100%	0.7	1.5	4.0	9.0	$ -	$ 0.02	$ -	$ 0.03	$ -	$ 0.22	$ -	$ -	$ 7,200	$ 16,100				
ROD 47	Regrading		Relocate Landfilled Material on-site - Haul and Dump	47,590	106,389	Landfilled Material	L.C.Y.	RS Means, Year 2011 Quarter 1	312323205110	Cycle hauling(wait, load,travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 22 C.Y. truck, cycle 2 mile, 10 MPH, excludes loading equipment	B34F	374	1	5.6	100%	22.7	50.7	127	284	$ -	$ 1.09	$ -	$ 3.63	$ -	$ 4.72	$ -	$ -	$ 225,000	$ 502,000				
ROD 48			Apply daily cover to relocated Landfilled Material	2,974	6,649	Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316462200	Excavating, bulk, dozer, open site, bank measure, sand and gravel, 80 H.P. dozer, 150' haul	B10L	230	1.5	1	100%	12.9	28.9	19.4	43.4	$ -	$ 3.18	$ -	$ 2.14	$ -	$ 5.32	$ -	$ -	$ 15,800	$ 35,400				
ROD 49			Spread Landfilled Material	50,565	113,038	Landfilled Material	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	1.5	4	100%	12.6	28.3	75.8	169.6	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ 101,000	$ 225,000				
ROD 50			Compact Landfilled Material	35,693	79,792	Landfilled Material	E.C.Y.	RS Means, Year 2011 Quarter 1	312323235720	Compaction, 4 passes, 12" lifts, riding, sheepsfoot or wobbly wheel roller	B10G	2,600	1.5	2	100%	6.9	15.3	20.6	46.0	$ -	$ 0.28	$ -	$ 0.50	$ -	$ 0.78	$ -	$ -	$ 27,800	$ 62,200				
ROD 51	Buffer Zone		Buffer Zone Activity	-	1	See separate Assumptions sheet		See separate Assumptions sheet						1	100%	-	6.6	-	40.3						$ 63,304	$ -	$ -	$ -	$ 63,300				
ROD 52			Excavate additional fill material for grading	17,229	169,803	Overburden Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305	Excavating, bulk bank measure, 3-1/2 C.Y. capacity = 160 C.Y./hour, backhoe, hydraulic, crawler mounted, excluding truck loading	B12D	2,400	2	3	100%	2.4	23.6	14.4	141.5	$ -	$ 0.40	$ -	$ 1.09	$ -	$ 1.49	$ -	$ -	$ 25,700	$ 253,000				
ROD 53	Backfill and Slope Correction	*Additional Fill*	*(additional cost to previous line)*	17,229	169,803	Overburden Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305A	Excavating, bulk bank measure, for loading onto trucks, add	B12D	16,255	2	3	100%	0.4	3.5	2.1	20.9	$ -	$ 0.02	$ -	$ 0.03	$ -	$ 0.22	$ -	$ -	$ 3,790	$ 37,400				
ROD 54			Haul additional fill for grading	21,536	212,254	Overburden Soil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323205110	Cycle hauling(wait, load,travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 22 C.Y. truck, cycle 2 mile, 10 MPH, excludes loading equipment	B34F	374	1	5.6	100%	10.3	101.1	57.6	567.5	$ -	$ 1.09	$ -	$ 3.63	$ -	$ 4.72	$ -	$ -	$ 102,000	$ 1,000,000				
ROD 55			Spread additional fill	21,536	212,254	Overburden Soil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	2	6	100%	3.6	35.4	32.3	318.4	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ 42,900	$ 422,000				
ROD 56			Purchase material	12,667	29,333	Soil	B.C.Y.	Local Republic landfill with surplus material												$ 16.88					$ 16.88	$ 16,900	$ 39,200	$ 231,000	$ 534,000				
ROD 57			Deliver and Stockpile	17,733	41,067	Soil	L.C.Y.	Based on Central Stone estimate				64	1	50	100%	5.5	12.8	277.1	641.7		$ 5.22	$ -	$ 5.22	$ -	$ 10.43	$ -	$ -	$ 185,000	$ 428,000	1,109	2,567	77,630	179,690
ROD 58			Load material from stockpile to off road haul trucks	12,667	29,333	Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305	Excavating, bulk bank measure, 3-1/2 C.Y. capacity = 160 C.Y./hour, backhoe, hydraulic, crawler mounted, excluding truck loading	B12D	2,400	2	3	100%	1.8	4.1	10.6	24.4	$ -	$ 0.40	$ -	$ 1.09	$ -	$ 1.49	$ -	$ -	$ 18,900	$ 43,700				
ROD 59		*Starter Berms*	*(additional cost to previous line)*	12,667	29,333	Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305A	Excavating, bulk bank measure, for loading onto trucks, add	B12D	16,255	2	3	100%	0.3	0.6	1.6	3.6	$ -	$ 0.02	$ -	$ 0.03	$ -	$ 0.22	$ -	$ -	$ 2,790	$ 6,450				
ROD 60			Haul loose lift material for berm	17,733	41,067	Soil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323205060	Cycle hauling(wait, load,travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 22 C.Y. truck, cycle 2000 ft, 10 MPH, excludes loading equipment	B34F	594	1	4	100%	8.4	19.6	29.9	69.1	$ -	$ 0.68	$ -	$ 2.28	$ -	$ 2.96	$ -	$ -	$ 52,500	$ 122,000				
ROD 61			Spread loose lift before compaction	17,733	41,067	Soil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	2	6	100%	3.0	6.8	26.6	61.6	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ 35,300	$ 81,700				

Construction Cost Estimate - ROD Remedy

Step #	Category	Sub-Category	Task	Quantity ROD Area 1	Quantity ROD Area 2	Type of Material Handled	Units	Source of Costing Estimate	RS Means Reference #	RS Means Description	Crew Type	Daily Unit Rate of Constr-uction	Crew Size (Men)	Number of Crews	Effic-iency Factor
ROD 62	Final Cover		Compact starter berms	12,667	29,333	Soil	E.C.Y.	RS Means, Year 2011 Quarter 1	312323235060	Compaction, riding, vibrating roller, 2 passes, 12" lifts	B10Y	5,200	2	2	100%
ROD 63		Bio-Intrusion	Purchase of Bio-Intrusion Layer Material	84,444	208,372	8 inch Shot Rock	L.C.Y.	Fred Weber estimate, 3/23/2011							
ROD 64			Deliver Bio-Intrusion Layer Material	84,444	208,372	8 inch Shot Rock	L.C.Y.	Fred Weber estimate, 3/23/2011				72	1	50	100%
ROD 65			Spread Bio-Intrusion Layer Material	84,444	208,372	8 inch Shot Rock	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	2	6	100%
ROD 66		Clay	Purchase clay material	51,178	126,286	Clay Material	B.C.Y.	Local Republic landfill with surplus material							
ROD 67			Deliver clay material to site	71,649	176,800	Clay Material	L.C.Y.	Based on Central Stone estimate				64	1	50	100%
ROD 68			Spread loose lift before compaction	71,649	176,800	Clay Material	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	2	6	100%
ROD 69			Compact Clay (Final Cover)	51,178	126,286	Clay Material	E.C.Y.	RS Means, Year 2011 Quarter 1	312323235720	Compaction, 4 passes, 12" lifts, riding, sheepsfoot or wobbly wheel roller	B10G	2,600	1.5	2	100%
ROD 70		Top Soil	Purchase Topsoil	27,824	66,944	Topsoil	B.C.Y.	RS Means, Year 2011 Quarter 1 - Ext. Material O&P							
ROD 71			Deliver Topsoil	34,780	83,680	Topsoil	L.C.Y.	Based on Central Stone estimate				68	1	50	100%
ROD 72			Move and place Topsoil (Final Cover)	31,986	78,929	Topsoil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	2	6	100%
ROD 73	Stormwater Controls (for stormwater after cover is constructed)		Install Terraces	2,794	4,751	Topsoil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	2	1	100%
ROD 74			Construct Ditches	2,630	7,245	Topsoil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316462200	Excavating, bulk, dozer, open site, bank measure, sand and gravel, 80 H.P. dozer, 150' haul	B10L	230	2	2	100%
ROD 75		Pond	Load Overburden Material from stockpile to off road haul truck for pond	4,694	7,944	Overburden Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305	Excavating, bulk bank measure, 3-1/2 C.Y. capacity = 160 C.Y./hour, backhoe, hydraulic, crawler mounted, excluding truck loading	B12D	2,400	2	3	100%
ROD 76			*(additional cost to previous line)*	4,694	7,944	Overburden Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305A	Excavating, bulk bank measure, for loading onto trucks, add	B12D	16,255	2	3	100%
ROD 77			Haul loose lift soil for Pond	6,572	11,122	Overburden Soil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323205060	Cycle hauling(wait, load,travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 22 C.Y. truck, cycle 2000 ft, 10 MPH, excludes loading equipment	B34F	594	1	3.5	100%
ROD 78			Spread loose lift before compaction (Pond)	6,572	11,122	Overburden Soil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	2	6	100%
ROD 79			Compact Berm (Pond)	4,694	7,944	Overburden Soil	E.C.Y.	RS Means, Year 2011 Quarter 1	312323235060	Compaction, riding, vibrating roller, 2 passes, 12" lifts	B10Y	5,200	2	2	100%
ROD 80			Final Stormwater Controls	84	482	Riprap	S.Y.	RS Means, Year 2011 Quarter 1	313713100110	Rip-rap and rock lining, random, broken stone, 3/8 to 1/4 C.Y. pieces, machine placed for slope protection, grouted	B13	80	7	3	100%
ROD 81			Install 500 year floodplain barrier		9,743	Riprap	S.Y.	RS Means, Year 2011 Quarter 1	313713100110	Rip-rap and rock lining, random, broken stone, 3/8 to 1/4 C.Y. pieces, machine placed for slope protection, grouted	B13	80	7	3	100%
ROD 82	Site Completion		Apply seeding to cover	972	2,152	Seeding	M.S.F.	RS Means, Year 2011 Quarter 1	329219142400	Seeding athletic fields, seeding fescue, fall with mulch and fertilizer, 5.5 lb. per M.S.F., hydro/air seeding	B81	80	3	1	100%
ROD 83			Apply seeding to soil stockpile	790		Seeding	M.S.F.	RS Means, Year 2011 Quarter 1	329219142400	Seeding athletic fields, seeding fescue, fall with mulch and fertilizer, 5.5 lb. per M.S.F., hydro/air seeding	B81	80	3	1	100%
ROD 84			Install temporary irrigation system	80,987	179,348	Irrigation System	S.F.	RS Means, Year 2011 Quarter 1	328423100800	Underground sprinklers irrigation system, for lawns, residential system, custom, 1" supply	B20	2,000	3	10	100%
ROD 85			Install Fencing	4,166	6,448	Fencing	L.F.	RS Means, Year 2011 Quarter 1	323113200920	Fence, chain link industrial, galvanized steel, 6 ga. wire, 2-1/2" posts @ 10' OC, 8' high, includes excavation, in concrete, excludes barbed wire	B80C	180	3	2	100%

Step #	Construction (Days) ROD Area 1	Construction (Days) ROD Area 2	Crew Man-days ROD Area 1	Crew Man-days ROD Area 2	Unit Costs: Extended Material Overhead and Profit	Extended Labor Overhead and Profit	Extended Labor Overhead and Profit - Ineffeciency	Extended Equipment Overhead and Profit	Extended Equipment Overhead and Profit - Ineffeciency	Extended Total Overhead and Profit	Material Taxes at Bridgeton (7.925%) ROD Area 1	Material Taxes ROD Area 2	Total Cost for Line Item ROD Area 1	Total Cost for Line Item ROD Area 2	Truckloads for Delivery ROD Area 1	Truckloads ROD Area 2	Total Miles for Delivery ROD Area 1	Total Miles ROD Area 2
ROD 62	1.2	2.8	3.7	8.5	$ -	$ 0.14	$ -	$ 0.12	$ -	$ 0.26	$ -	$ -	$ 3,290	$ 7,630				
ROD 63					$ 5.80					$ 5.80	$ 38,800	$ 95,800	$ 528,000	$ 1,300,000				
ROD 64	23.5	57.9	1,173	2,894		$ 2.35	$ -	$ 2.35	$ -	$ 4.69	$ -	$ -	$ 396,000	$ 978,000	4,692	11,577	75,072	185,232
ROD 65	14.1	34.7	126.7	312.6	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ 168,000	$ 415,000				
ROD 66					$ 16.88					$ 16.88	$ 68,400	$ 169,000	$ 932,000	$ 2,300,000				
ROD 67	22.4	55.3	1,120	2,763		$ 5.22	$ -	$ 5.22	$ -	$ 10.43	$ -	$ -	$ 747,000	$ 1,840,000	4,479	11,051	313,530	773,570
ROD 68	11.9	29.5	107.5	265.2	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ 143,000	$ 352,000				
ROD 69	9.8	24.3	29.5	72.9	$ -	$ 0.28	$ -	$ 0.50	$ -	$ 0.78	$ -	$ -	$ 39,900	$ 98,500				
ROD 70					$ 24.94					$ 24.94	$ 55,000	$ 132,000	$ 749,000	$ 1,800,000				
ROD 71	10.2	24.6	511	1,231		$ 4.12	$ -	$ 4.12	$ -	$ 8.24	$ -	$ -	$ 287,000	$ 690,000	2,046	4,923	40,920	98,460
ROD 72	5.3	13.2	48.0	118.4	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ 63,700	$ 157,000				
ROD 73	2.8	4.8	4.2	7.1	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ 5,560	$ 9,450				
ROD 74	5.7	15.8	17.2	47.3	$ -	$ 3.18	$ -	$ 2.14	$ -	$ 5.32	$ -	$ -	$ 14,000	$ 38,500				
ROD 75	0.7	1.1	3.9	6.6	$ -	$ 0.40	$ -	$ 1.09	$ -	$ 1.49	$ -	$ -	$ 6,990	$ 11,800				
ROD 76	0.1	0.2	0.6	1.0	$ -	$ 0.02	$ -	$ 0.03	$ -	$ 0.22	$ -	$ -	$ 1,030	$ 1,750				
ROD 77	3.1	5.3	11.1	18.7	$ -	$ 0.68	$ -	$ 2.28	$ -	$ 2.96	$ -	$ -	$ 19,500	$ 32,900				
ROD 78	1.1	1.9	9.9	16.7	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ 13,100	$ 22,100				
ROD 79	0.5	0.8	1.4	2.3	$ -	$ 0.14	$ -	$ 0.12	$ -	$ 0.26	$ -	$ -	$ 1,220	$ 2,070				
ROD 80	0.3	2.0	7.3	42.2	$ 71.05	$ 38.47	$ -	$ 11.19	$ -	$ 120.71	$ 472	$ 2,710	$ 10,600	$ 60,900				
ROD 81	-	40.6	-	852.5	$ 71.05	$ 38.47	$ -	$ 11.19	$ -	$ 120.71	$ -	$ 54,900	$ -	$ 1,230,000				
ROD 82	12.1	26.9	36.4	80.7	$ 40.82	$ 16.91	$ -	$ 8.31	$ -	$ 66.04	$ 3,140	$ 6,960	$ 67,300	$ 149,000				
ROD 83	9.9	-	29.6	-	$ 40.82	$ 16.91	$ -	$ 8.31	$ -	$ 66.04	$ 2,550	$ -	$ 54,700	$ -				
ROD 84	4.0	9.0	121.5	269.0	$ 0.33	$ 0.70	$ -	$ -	$ -	$ 1.03	$ 2,120	$ 4,690	$ 85,500	$ 189,000				
ROD 85	11.6	17.9	69.4	107.5	$ 29.40	$ 6.78	$ -	$ 1.18	$ -	$ 37.36	$ 9,710	$ 15,000	$ 165,000	$ 256,000				
											Totals		Totals		Totals		Totals	
											$ 222,000	$ 534,000	$ 9,000,000	$ 16,600,000	12,000	30,000	517,000	1,237,000
											$	756,000		$ 25,600,000		42,000		1,754,000

Radiological Survey Costs
ROD Remedy Alternative

Indirect Labor Ratio	1.6
Number of Years	1.7
Number of Radiological Survey Days (RS3 days)	35

Total Estimated Costs for Radiological Survey and Health & Safety Support

Total Labor Cost	$650,000
Total Capital Cost	$28,000
Total Expendable Cost	$33,000
Total	**$711,000**

3/3/2014	Estimated Start Date
11/18/2015	Estimated End Date
625	No. of calendar days
1.7	No. years
446	No. of working days

Estimated Labor Costs	Teams	# Days	Personnel Description	Cost/day*	Notes:
	RS1	Note 1	Safety Mgr	Hire these	Will supervise the Environmental and Toxicological Monitoring Programs; Conduct Rad Worker Orientation for non-Rad workers
$598,100			Sr Rad Tech	three for	Run Dosimetry Program; Environmental Monitoring - Collect samples and deliver to outside lab; Maintain records
			Rad Tech	~$ 250,000/yr	Run personal air sampling program; Available for decon, distributing protective clothing, assist with survey vehicle moving on-site
$1,360	RS1A	Note 2	Rad Tech	$680	Preliminary survey, run control points when moving RIM from Buffer Zone/Crossroad property and excavating north slope of Area 2
$20,400			Rad Tech	$680	Preliminary survey, run control points when moving RIM from Buffer Zone/Crossroad property and excavating north slope of Area 2
$1,480	RS2	Note 3	Sr Rad Tech	$800	Final Survey for Buffer/Crossroads property after RIM relocated
$7,400			Rad Tech	$680	Final Survey for Buffer/Crossroads property after RIM relocated
$23,800	RS3	Note 4	Rad Tech	$680	Control movement to and from top of areas until grading complete

$649,700 Total Estimated Labor Costs during Construction

Note 1 From beginning to end of Environmental Monitoring Program
Note 2 From beginning of clearing on Areas 1 and 2 until RIM from Buffer Zone/Crossroad Property is relocated on-site (15 days)
Note 3 From time after all RIM has been removed from Buffer Zone/Crossroad Property until Final Survey is complete; estimate 5 days
If right people available, team RS1A may become Team RS2
Note 4 And additional Rad Tech to monitor entry and exit while grading top of Areas 1 and 2

* Includes per diem at $150/day (except salaried)

Estimate of Non-Labor Costs

Item		Capital/set-up Costs ($)	Expendable Costs: Recurring Rate ($)	Units	Number	Expendable Costs ($)
Rad survey inst (7)	Different types needed	$17,500	$200	month	22	$4,400
Check sources		$1,000				
Rent special survey equipment (30 days @ $200/day)		$6,000				
Toxic Gas monitor		$2,500				
Dosimetry Program: All long term workers need (25 people @$20/badge)		$500	$40	month	22	$880
Disposable clothing	Need until RIM covered (20 sets/day?)		$60	day	260	$15,600
Other PPE (e.g., safety glasses @ $5)		$250				
Misc cost			$50	day	250	$12,500
	Total Estimated Non-Labor Costs:	**$27,800**				**$33,400**

Environmental Monitoring Costs
ROD Remedy Alternative

Item	Number	Cost	Shipping	Total Capital	Annual Cost
HI-Q's Polyurethane Foam (PUF) air sampling system Model 3300	15	$3,205	$100	$49,575	
Calibrator for PUP Sampler	1	$560	$15	$575	
Adapter Plate	1	$85	$10	$95	
Diversified Research ALPHA II® Continuous Radon Monitor	15	$1,775	$25	$27,000	
Install AC electrical service to all stations (lineal ft)	10,473	$25		$261,800	
Monitoring Station Foundation / Supports (assume will not be moved)	15	$2,000		$30,000	
Items requiring periodic replacement					
Environmental dosimeters 1/qtr/station	60	$30			$1,800
Kidde 442020 Radon Gas Detection Test Kit (1 kit/month/station)	180	$25			$4,500
Expendables					
Particulate air sample media Boxes of 100	10	$89	$5		$940
Toxic organic sample media Boxes of 10	75	$32	$5		$2,775
Lab services					
Analyze organic vapor filters (once per week per station)	780	$120			$93,600
Calibration Cost					
Air Samplers 1/yr	15	$100	$50		$2,250
Radon monitors 1/yr	15	$100	$25		$1,875
Labor					
Assume 2 man days/wk	16	$90			$1,440
	Subtotal - Capital			**$369,000**	
	Subtotal - Annual Expendables/Labor				**$109,000**

Capital Cost Estimate - Long-Term Monitoring
ROD Remedy Alternative

Description	Quantity	Units	Unit Rate	Estimated Cost ($)
Secure easements	1	LS	2,000	2,000
Landfill Gas:				
Driller: Install radon/landfill gas monitoring probes, MDNR "Code Wells"; 10' dee	31	each	1,850	57,400
Misc. wellhead sampling fittings and locks	31	each	40	1,200
Field technician observation during drilling and construction of probe	140	hour	90	12,600
Mileage for field technician during probe constructio	1,600	mile	0.51	800
Multi-gas detector (e.g., Industrial Scientific iBri™ MX6), incl regulator, tubing, calbrtn ga	1	LS	4,400	4,400
Portable radon gas monitor and detector (e.g., Pylon AB6 monitor w/ 300A detect	1	LS	8,250	8,300
Groundwater:				
Recondition and purge existing groundwater monitoring wel	16	each	500	8,000
Flat-bottom polyethylene tank to store purge water prior to dispos	1,500	gallon	2	3,000
Estimated Long-term Monitoring Capital Costs - Total				**98,000**

Post-Construction Baseline Monitoring Cost Estimate
ROD Remedy Alternative

(Radon Flux and Radon in Subsurface Landfill Gas)

Description	Quantity	Units	Unit Rate	Estimated Cost ($)
Radon Flux:				
Number of Large Area Activated Charcoal Canisters	*50*			
Labor to place and pickup LAACCs - field technicia	22	hour	90	1,980
Field vehicle	2	day	120	260
Shipping of LAACCs to site (20 per box) - ground	3	each	25	80
Overnight shipping of activated charcoal to laborato	1	each	50	50
Return shipping of LAACCs to lab (20 per box) - groun	3	each	25	80
Analysis of samples for radon flux (Tellco Environmental - Grand Junction, CO	50	each	22	1,100
Rental of LAACCs (assume 1 week per event	350	day	1.00	350
Data managemen	1	hour	100	100
Reporting	4	hour	130	520
Estimated Radon Flux Monitoring Costs - Total				**4,500**
Subsurface Gas (Radon):				
Number of Subsurface Gas Monitoring Wells	*31*			
Labor - field techniciar	9	hour	90	810
Field vehicle	1	day	120	120
Replacement radon detector (Pylon 300A	1	each	550	550
Data managemen	1	hour	100	100
Reporting	4	hour	130	520
Estimated Subsurface Gas (Radon) Monitoring Costs - Total				**2,100**

Capital Cost Estimate - Amend Existing/Additional Institutional Controls
ROD Remedy Alternative

Description	Quantity	Units	Unit Rate	Estimated Cost
Prepare Institutional Controls planning documents	1	LS	10,000	10,000
Attorney labor: prepare draft amended existing and additional ICs	1	LS	20,000	20,000
Review of draft documents	1	LS	5,000	5,000
Revise amended and additional Institutional Controls documents	1	LS	10,000	10,000
Filings and registrations	1	LS	5,000	5,000
Estimated Institutional Controls Capital Costs - Total				**50,000**

Long-Term Post-Construction Monitoring (per event) Cost Estimate
ROD Remedy Alternative

(Landfill Gas, Groundwater, and Surface Water Monitoring and Annual Post-Construction Site Inspections)

Description	Analytical Method	Quantity	Units	Unit Rate ($)	Estimated Cost ($)
Landfill Gas/Radon:					
Number of Landfill Gas/Radon Monitoring Wells		*31*			
Labor - field technician		9	hour	90	810
Field vehicle		1	day	120	120
Replacement radon detector (Pylon 300A)		1	each	550	550
Calibration gas for multi-gas detector		1	each	330	330
Data management		2	hour	100	200
Reporting		8	hour	130	1,040
Estimated Landfill Gas/Radon Monitoring Costs - Subtotal					3,100
Contingency			*%*	*20*	*600*
Estimated Landfill Gas/Radon Monitoring Costs - Total (per Event)					**3,700**
Groundwater and Surface Water:					
Number of Samples:			*For VOCs*		
Investigative Groundwater		*16*	*16*		
Investigative Surface Water		*2*	*2*		
Field Duplicates (one per every 10 investigative samples)		*2*	*2*		
Trip blank (one per day per cooler)			*5*		
Matrix Spike			*1*		
Matrix Spike Duplicate			*1*		
Sub-total number of unfiltered samples:		*20*	*27*		
Sub-total number of filtered samples for radionuclide and metals analyses:		*20*			
Total number of samples:		*40*	*27*		
Labor:					
Labor - field technicians (2 people, 4 sample locations/day)		81	hour	90	7,290
Materials and equipment:					
Sample kits, incl. filters		18	each	50	900
Field instrumentation and flowcell rental - groundwater		5	day	100	500
Field Vehicle		5	day	120	600
Overnight shipping of sample coolers (assume 1 per day to rad lab)		5	coolers	100	500
Delivery of sample coolers to local lab (2 to 3 coolers per day)		5	hour	90	450
Disposal of purge water (assumes PE tank previously purchased is onsite):					
Vacuum truck		4	hour	200	800
Transportation and disposal (assumes approx 25 gal per well per event)		400	gallon	2.00	800
Laboratory Sample Analysis:	*Analytical Method:*				
Gross alpha and beta	EPA 900.0	40	each	50	2,000
Uranium-234, 235, 238	EML U-02 Mod	40	each	100	4,000
Thorium-228, 230, 232	EML Th-01 Mod	40	each	100	4,000
Radium 228	EPA 904.0	40	each	85	3,400
Radium 226	EPA 903.0 Mod	40	each	85	3,400
Radon 222 - 72 hr hold time	SM 20th ED 7500-Rn B	40	each	85	3,400
Volatile Organic Compounds [VOCs] (GC/MS)	8260B	27	each	110	2,970
Semivolatile Organic Compounds [SVOCs] (GC/MS)	8270C	40	each	220	8,800
22 Metals Target Analyte List (ICP/AES)	6010B	40	each	115	4,600
Mercury (CVAA)	7470A	40	each	35	1,400
4 Anions (IC) - Bromide, Chloride, Fluoride, Sulfate	300.0	40	each	72	2,880
2 Anions (IC) - Nitrate, Nitrite - 48 hr hold time	300.0	40	each	36	1,440
Sulfide, Total	SM 4500 S2 D	40	each	35	1,400
Phosphorus, Total	365.1	40	each	40	1,600
Organic carbon, Total (TOC)	SM 5310B	40	each	40	1,600
Total Alkalinity, Carbonate, Bicarbonate	SM 2320B	40	each	20	800
Nitrogen, Ammonia	350.1	40	each	25	1,000
Level IV data deliverable		$ 48,690	%	10%	4,870
Data validation (assumes validation of 100% of Level IV data will be required)		66	DVR	100	6,600
Data management		6	SDG	100	600
Reporting		40	hour	130	5,200
Estimated Groundwater and Surface Water Monitoring Costs - Subtotal					77,800
Contingency			*%*	*20*	*15,600*
Estimated Groundwater and Surface Water Monitoring Costs - Total (per Event)					**93,000**

DVR = data validation report
SDG = sample delivery group

Description	Analytical Method	Quantity	Units	Unit Rate ($)	Estimated Cost ($)
Annual Post-Construction Site Inspections					
Labor - Engineer		9	hour	130	1,170
Field vehicle		1	day	120	120
Site Inspection Report		8	hour	130	1,040
Estimated Annual Post-Construction Site Inspections Costs - Subtotal					2,300
Contingency			*%*	*20*	*500*
Estimated Annual Post-Construction Site Inspections Costs - Total					**2,800**

Operation and Maintenance Cost Estimate - Cover System Maintenance
ROD Remedy Alternative

Description	Quantity	Units	Unit Rate	Estimated Cost
Mowing; tractor w/ rotary mower (once/year)	55.3	acre	40.00	2,200
Fill depressions in cover w/ topsoil, assume 1% of area; 6 inches dee	446	bcy	37.53	16,700
Seeding of filled area	24.1	M.S.F.	66.04	1,600
Estimated Cover System O&M Costs - Subtotal				20,500
Contingency		*%*	*20*	*4,100*
Estimated Annual Cover Maintenance O&M Costs - Total				**24,600**

M.S.F. = 1,000 square feet

Operation and Maintenance Cost Estimate - 5 year Review
ROD Remedy Alternative

Description	Quantity	Units	Unit Rate	Estimated Cost ($)
Access Restrictions (inspect/repair fencing and signage	16	hours	130	2,100
Institutional Controls verificatioı	8	hours	130	1,000
Document that landfill cover is effectiv	8	hours	130	1,000
Assemble Monitoring Data (landfill gas/radon, groundwater, surface wate	40	hours	130	5,200
Summarize Annual Post-Construction Site Inspection	8	hours	130	1,000
Summarize Annual Cover Maintenance Documentatic	8	hours	130	1,000
Water supply well inventory reviev	8	hours	130	1,000
Document any changes in Land Use at and around West Lake Landf	16	hours	130	2,100
Prepare Summary Repor	80	hours	130	10,400
Estimated 5-year Maint/Review O&M Costs - Subtotal				**25,000**
Contingency		*%*	*20*	*5,000*
Estimated 5-year Maintenance O&M Costs - Total				**30,000**

Cost Estimates for the
ROD-Selected Remedy
(with $10 million/year limitation)

Present Worth Cost Estimate (30 years)
ROD Remedy Alternative Constrained to $10M per Year

			Capital Costs ($)		Operation, Maintenance, and Monitoring Costs ($/yr)										
Year	*n*	P/F(*i* =2.3%)	ROD Remedy	Subtotal Capital Costs	Environmental Monitoring	Landfill Gas and Radon Monitoring	Groundwater/ Surface Water Monitoring	Annual Site Inspection/Cover Maintenance	5 year Review	Subtotal O&M Costs	Total Costs ($)	Cumulative Total Costs ($)	Present Worth of Annual Costs ($)	Cumulative Present Worth ($)	
2013	0	1.00000	2,800,000	2,800,000	90,000		93,000			183,000	2,983,000	2,983,000	2,983,000	2,983,000	Construction Costs
2014	1	0.97752	8,900,000	8,900,000	109,000		93,000			202,000	9,102,000	12,085,000	8,897,000	11,880,000	
2015	2	0.95554	9,200,000	9,200,000	109,000		93,000			202,000	9,402,000	21,487,000	8,984,000	20,864,000	
2016	3	0.93406	8,400,000	8,400,000	109,000		93,000			202,000	8,602,000	30,089,000	8,035,000	28,899,000	
2017	4	0.91306	8,200,000	8,200,000	109,000		93,000			202,000	8,402,000	38,491,000	7,671,000	36,570,000	
2018	5	0.89253	7,300,000	7,300,000	19,000	15,000	372,000	27,000		433,000	7,733,000	46,224,000	6,902,000	43,472,000	OM&M Costs
2019	6	0.87246				15,000	372,000	27,000		414,000	414,000	46,638,000	361,000	43,833,000	
2020	7	0.85285				15,000	372,000	27,000		414,000	414,000	47,052,000	353,000	44,186,000	
2021	8	0.83367				15,000	186,000	27,000		228,000	228,000	47,280,000	190,000	44,376,000	
2022	9	0.81493				15,000	186,000	27,000		228,000	228,000	47,508,000	186,000	44,562,000	
2023	10	0.79661				15,000		27,000	30,000	72,000	72,000	47,580,000	57,000	44,619,000	
2024	11	0.77870				15,000	93,000	27,000		135,000	135,000	47,715,000	105,000	44,724,000	
2025	12	0.76119				15,000		27,000		42,000	42,000	47,757,000	32,000	44,756,000	
2026	13	0.74408				15,000	93,000	27,000		135,000	135,000	47,892,000	100,000	44,856,000	
2027	14	0.72735				15,000		27,000		42,000	42,000	47,934,000	31,000	44,887,000	
2028	15	0.71099				15,000	93,000	27,000	30,000	165,000	165,000	48,099,000	117,000	45,004,000	
2029	16	0.69501				15,000		27,000		42,000	42,000	48,141,000	29,000	45,033,000	
2030	17	0.67938				15,000	93,000	27,000		135,000	135,000	48,276,000	92,000	45,125,000	
2031	18	0.66411				15,000		27,000		42,000	42,000	48,318,000	28,000	45,153,000	
2032	19	0.64918				15,000	93,000	27,000		135,000	135,000	48,453,000	88,000	45,241,000	
2033	20	0.63458				15,000		27,000	30,000	72,000	72,000	48,525,000	46,000	45,287,000	
2034	21	0.62031				15,000	93,000	27,000		135,000	135,000	48,660,000	84,000	45,371,000	
2035	22	0.60637				15,000		27,000		42,000	42,000	48,702,000	25,000	45,396,000	
2036	23	0.59273				15,000	93,000	27,000		135,000	135,000	48,837,000	80,000	45,476,000	
2037	24	0.57941				15,000		27,000		42,000	42,000	48,879,000	24,000	45,500,000	
2038	25	0.56638				15,000	93,000	27,000	30,000	165,000	165,000	49,044,000	93,000	45,593,000	
2039	26	0.55365				15,000		27,000		42,000	42,000	49,086,000	23,000	45,616,000	
2040	27	0.54120				15,000	93,000	27,000		135,000	135,000	49,221,000	73,000	45,689,000	
2041	28	0.52903				15,000		27,000		42,000	42,000	49,263,000	22,000	45,711,000	
2042	29	0.51714				15,000	93,000	27,000		135,000	135,000	49,398,000	70,000	45,781,000	

Estimated Non-discounted Total Costs: 49,000,000

Estimated 30-year Present Worth Costs: 46,000,000

The information in this cost estimate summary is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. In accordance with USEPA Guidance, this is an order-of-magnitude engineering estimate that is expected to be within -30 to +50 percent of the actual project cost.

Present Worth Cost Estimate (1,000 years)
ROD Remedy Alternative Constrained to $10M per Year

			Capital Costs ($)		Operation, Maintenance, and Monitoring Costs ($/yr)										
Year	*n*	P/F(*i* =2.3%)	ROD Remedy	Subtotal Capital Costs	Environmental Monitoring	Landfill Gas and Radon Monitoring	Groundwater/ Surface Water Monitoring	Annual Site Inspection/Cover Maintenance	5 year Review	Subtotal O&M Costs	Total Costs ($)	Cumulative Total Costs ($)	Present Worth of Annual Costs ($)	Cumulative Present Worth ($)	
2013	0	1.00000	2,800,000	2,800,000	90,000		93,000			183,000	2,983,000	2,983,000	2,983,000	2,983,000	Construction Costs
2014	1	0.97752	8,900,000	8,900,000	109,000		93,000			202,000	9,102,000	12,085,000	8,897,000	11,880,000	
2015	2	0.95554	9,200,000	9,200,000	109,000		93,000			202,000	9,402,000	21,487,000	8,984,000	20,864,000	
2016	3	0.93406	8,400,000	8,400,000	109,000		93,000			202,000	8,602,000	30,089,000	8,035,000	28,899,000	
2017	4	0.91306	8,200,000	8,200,000	109,000		93,000			202,000	8,402,000	38,491,000	7,671,000	36,570,000	
2018	5	0.89253	7,300,000	7,300,000	19,000	15,000	372,000	27,000		433,000	7,733,000	46,224,000	6,902,000	43,472,000	OM&M Costs
2019	6	0.87246				15,000	372,000	27,000		414,000	414,000	46,638,000	361,000	43,833,000	
2020	7	0.85285				15,000	372,000	27,000		414,000	414,000	47,052,000	353,000	44,186,000	
2021	8	0.83367				15,000	186,000	27,000		228,000	228,000	47,280,000	190,000	44,376,000	
2022	9	0.81493				15,000	186,000	27,000		228,000	228,000	47,508,000	186,000	44,562,000	
2023	10	0.79661				15,000		27,000	30,000	72,000	72,000	47,580,000	57,000	44,619,000	
2024	11	0.77870				15,000	93,000	27,000		135,000	135,000	47,715,000	105,000	44,724,000	
2025	12	0.76119				15,000		27,000		42,000	42,000	47,757,000	32,000	44,756,000	
2026	13	0.74408				15,000	93,000	27,000		135,000	135,000	47,892,000	100,000	44,856,000	
2027	14	0.72735				15,000		27,000		42,000	42,000	47,934,000	31,000	44,887,000	
2028	15	0.71099				15,000	93,000	27,000	30,000	165,000	165,000	48,099,000	117,000	45,004,000	
2029	16	0.69501				15,000		27,000		42,000	42,000	48,141,000	29,000	45,033,000	
2030	17	0.67938				15,000	93,000	27,000		135,000	135,000	48,276,000	92,000	45,125,000	
2031	18	0.66411				15,000		27,000		42,000	42,000	48,318,000	28,000	45,153,000	
2032	19	0.64918				15,000	93,000	27,000		135,000	135,000	48,453,000	88,000	45,241,000	
2033	20	0.63458				15,000		27,000	30,000	72,000	72,000	48,525,000	46,000	45,287,000	
2034	21	0.62031				15,000	93,000	27,000		135,000	135,000	48,660,000	84,000	45,371,000	
2035	22	0.60637				15,000		27,000		42,000	42,000	48,702,000	25,000	45,396,000	
2036	23	0.59273				15,000	93,000	27,000		135,000	135,000	48,837,000	80,000	45,476,000	
2037	24	0.57941				15,000		27,000		42,000	42,000	48,879,000	24,000	45,500,000	
2038	25	0.56638				15,000	93,000	27,000	30,000	165,000	165,000	49,044,000	93,000	45,593,000	
2039	26	0.55365				15,000		27,000		42,000	42,000	49,086,000	23,000	45,616,000	
2040	27	0.54120				15,000	93,000	27,000		135,000	135,000	49,221,000	73,000	45,689,000	
2041	28	0.52903				15,000		27,000		42,000	42,000	49,263,000	22,000	45,711,000	
2042	29	0.51714				15,000	93,000	27,000		135,000	135,000	49,398,000	70,000	45,781,000	
2212	199	0.01083				15,000	93,000	27,000		135,000	135,000	65,463,000	1,000	47,856,000	
3012	999	0.00000				15,000	93,000	27,000		135,000	135,000	141,063,000	0	47,883,000	

Estimated Non-discounted Total Costs: 141,000,000

Estimated 1,000-year Present Worth Costs: 48,000,000

The information in this cost estimate summary is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. In accordance with USEPA Guidance, this is an order-of-magnitude engineering estimate that is expected to be within -30 to +50 percent of the actual project cost.

Total Capital Costs
ROD Remedy Alternative Constrained to $10M per Year

Cost Item		Estimated Capital Costs 2013	2014	2015	2016	2017	2018	Subtotal
Construction Costs			$ 5,784,000	$ 5,967,000	$ 5,423,000	$ 5,310,000	$ 4,858,000	$ 27,342,000
Radiological Survey Costs			$ 357,000	$ 434,000	$ 388,000	$ 388,000	$ 66,000	$ 1,633,000
Environmental Monitoring Costs		$ 369,000						$ 369,000
Long-Term Monitoring Facilities							$ 98,000	$ 98,000
Baseline Monitoring							$ 7,000	$ 7,000
Institutional Controls							$ 50,000	$ 50,000
Subtotal		$ 369,000	$ 6,141,000	$ 6,401,000	$ 5,811,000	$ 5,700,000	$ 5,079,000	$ 29,501,000
Project Management	5%	$ 18,000	$ 307,000	$ 320,000	$ 291,000	$ 285,000	$ 254,000	$ 1,475,000
Engineering Design	6%	$ 1,770,000						$ 1,770,000
Construction Management	6%	$ 22,000	$ 368,000	$ 384,000	$ 349,000	$ 342,000	$ 305,000	$ 1,770,000
Subtotal Construction On-Site		$ 2,180,000	$ 6,820,000	$ 7,110,000	$ 6,450,000	$ 6,330,000	$ 5,640,000	$ 34,530,000
Scope Contingency	10%	$ 218,000	$ 682,000	$ 711,000	$ 645,000	$ 633,000	$ 564,000	$ 3,453,000
Bid Contingency	20%	$ 436,000	$ 1,364,000	$ 1,422,000	$ 1,290,000	$ 1,266,000	$ 1,128,000	$ 6,906,000
Subtotal Contingency		$ 650,000	$ 2,050,000	$ 2,130,000	$ 1,940,000	$ 1,900,000	$ 1,690,000	$ 10,360,000
Total: ROD Remedy		$ 2,800,000	$ 8,900,000	$ 9,200,000	$ 8,400,000	$ 8,200,000	$ 7,300,000	$ 44,800,000

Estimated Length Construction 4.05 years

Radiological Survey Costs
ROD Remedy Alternative Constrained to $10M per Year

Indirect Labor Ratio	1.6
Number of Years	4.05
Number of Radiological Survey Days (RS3 days)	35

Total Estimated Costs for Radiological Survey and Health & Safety Support

Total Labor Cost	$1,583,000
Total Capital Cost	$28,000
Total Expendable Cost	$40,000
Total	**$1,651,000**

3/3/2014	Estimated Start Date
3/19/2018	Estimated End Date
1477	No. of calendar days
4.05	No. years
1055	No. of working days

Estimated Labor Costs	Teams	# Days	Personnel Description	Cost/day*	Notes:
	RS1	Note 1	Safety Mgr	Hire these	Will supervise the Environmental and Toxicological Monitoring Programs; Conduct Rad Worker Orientation for non-Rad workers
$1,531,800			Sr Rad Tech	three for	Run Dosimetry Program; Environmental Monitoring - Collect samples and deliver to outside lab; Maintain records
			Rad Tech	~$ 250,000/yr	Run personal air sampling program; Available for decon, distributing protective clothing, assist with survey vehicle moving on-site
$1,360	RS1A	Note 2	Rad Tech	$680	Preliminary survey, run control points when moving RIM from Buffer Zone/Crossroad property and excavating north slope of Area 2
$20,400			Rad Tech	$680	Preliminary survey, run control points when moving RIM from Buffer Zone/Crossroad property and excavating north slope of Area 2
$1,480	RS2	Note 3	Sr Rad Tech	$800	Final Survey for Buffer/Crossroads property after RIM relocated
$7,400			Rad Tech	$680	Final Survey for Buffer/Crossroads property after RIM relocated
$23,800	RS3	Note 4	Rad Tech	$680	Control movement to and from top of areas until grading complete

$1,583,400 Total Estimated Labor Costs during Construction

Note 1 From beginning to end of Environmental Monitoring Program
Note 2 From beginning of clearing on Areas 1 and 2 until RIM from Buffer Zone/Crossroad Property is relocated on-site (15 days)
Note 3 From time after all RIM has been removed from Buffer Zone/Crossroad Property until Final Survey is complete; estimate 5 days
If right people available, team RS1A may become Team RS2
Note 4 And additional Rad Tech to monitor entry and exit while grading top of Areas 1 and 2

* Includes per diem at $150/day (except salaried)

Estimate of Non-Labor Costs

Item		Capital/set-up Costs ($)	Expendable Costs: Recurring Rate ($)	Units	Number	Expendable Costs ($)
Rad survey inst (7)	Different types needed	$17,500	$200	month	49	$9,712
Check sources		$1,000				
Rent special survey equipment (30 days @ $200/day)		$6,000				
Toxic Gas monitor		$2,500				
Dosimetry Program: All long term workers need (25 people @$20/badge)		$500	$40	month	49	$1,942
Disposable clothing	Need until RIM covered (20 sets/day?)		$60	day	260	$15,600
Other PPE (e.g., safety glasses @ $5)		$250				
Misc cost			$50	day	250	$12,500
	Total Estimated Non-Labor Costs:	**$27,800**				**$39,800**

Environmental Monitoring Costs
ROD Remedy Alternative Constrained to $10M per Year

Item	Number	Cost	Shipping	Total Capital	Annual Cost
HI-Q's Polyurethane Foam (PUF) air sampling system Model 3300	15	$3,205	$100	$49,575	
Calibrator for PUP Sampler	1	$560	$15	$575	
Adapter Plate	1	$85	$10	$95	
Diversified Research ALPHA II® Continuous Radon Monitor	15	$1,775	$25	$27,000	
Install AC electrical service to all stations (lineal ft)	10,473	$25		$261,800	
Monitoring Station Foundation / Supports (assume will not be moved)	15	$2,000		$30,000	
Items requiring periodic replacement					
Environmental dosimeters 1/qtr/station	60	$30			$1,800
Kidde 442020 Radon Gas Detection Test Kit (1 kit/month/station)	180	$25			$4,500
Expendables					
Particulate air sample media Boxes of 100	10	$89	$5		$940
Toxic organic sample media Boxes of 10	75	$32	$5		$2,775
Lab services					
Analyze organic vapor filters (once per week per station)	780	$120			$93,600
Calibration Cost					
Air Samplers 1/yr	15	$100	$50		$2,250
Radon monitors 1/yr	15	$100	$25		$1,875
Labor					
Assume 2 man days/wk	16	$90			$1,440
	Subtotal - Capital			**$369,000**	
	Subtotal - Annual Expendables/Labor				**$109,000**

Capital Cost Estimate - Long-Term Monitoring
ROD Remedy Alternative Constrained to $10M per Year

Description	Quantity	Units	Unit Rate	Estimated Cost ($)
Secure easements	1	LS	2,000	2,000
Landfill Gas:				
Driller: Install radon/landfill gas monitoring probes, MDNR "Code Wells"; 10' dee	31	each	1,850	57,400
Misc. wellhead sampling fittings and lock:	31	each	40	1,200
Field technician observation during drilling and construction of probe	140	hour	90	12,600
Mileage for field technician during probe constructio	1,600	mile	0.51	800
Multi-gas detector (e.g., Industrial Scientific iBri™ MX6), incl regulator, tubing, calbrtn ga:	1	LS	4,400	4,400
Portable radon gas monitor and detector (e.g., Pylon AB6 monitor w/ 300A detect	1	LS	8,250	8,300
Groundwater:				
Recondition and purge existing groundwater monitoring wel	16	each	500	8,000
Flat-bottom polyethylene tank to store purge water prior to dispo:	1,500	gallon	2	3,000
Estimated Long-term Monitoring Capital Costs - Total				**98,000**

Post-Construction Baseline Monitoring Cost Estimate
ROD Remedy Alternative Constrained to $10M per Year

(Radon Flux and Radon in Subsurface Landfill Gas)

Description	Quantity	Units	Unit Rate	Estimated Cost ($)
Radon Flux:				
Number of Large Area Activated Charcoal Canisters	*50*			
Labor to place and pickup LAACCs - field technicia	22	hour	90	1,980
Field vehicle	2	day	120	260
Shipping of LAACCs to site (20 per box) - groun	3	each	25	80
Overnight shipping of activated charcoal to laborato	1	each	50	50
Return shipping of LAACCs to lab (20 per box) - groun	3	each	25	80
Analysis of samples for radon flux (Tellco Environmental - Grand Junction, CC	50	each	22	1,100
Rental of LAACCs (assume 1 week per even	350	day	1.00	350
Data managemen	1	hour	100	100
Reporting	4	hour	130	520
Estimated Radon Flux Monitoring Costs - Total				**4,500**
Subsurface Gas (Radon):				
Number of Subsurface Gas Monitoring Wells	*31*			
Labor - field techniciar	9	hour	90	810
Field vehicle	1	day	120	120
Replacement radon detector (Pylon 300A	1	each	550	550
Data managemen	1	hour	100	100
Reporting	4	hour	130	520
Estimated Subsurface Gas (Radon) Monitoring Costs - Total				**2,100**

Capital Cost Estimate - Amend Existing/Additional Institutional Controls
ROD Remedy Alternative Constrained to $10M per Year

Description	Quantity	Units	Unit Rate	Estimated Cost
Prepare Institutional Controls planning documents	1	LS	10,000	10,000
Attorney labor: prepare draft amended existing and additional ICs	1	LS	20,000	20,000
Review of draft documents	1	LS	5,000	5,000
Revise amended and additional Institutional Controls documents	1	LS	10,000	10,000
Filings and registrations	1	LS	5,000	5,000
Estimated Institutional Controls Capital Costs - Total				**50,000**

Long-Term Post-Construction Monitoring (per event) Cost Estimate
ROD Remedy Alternative Constrained to $10M per Year

(Landfill Gas, Groundwater, and Surface Water Monitoring and Annual Post-Construction Site Inspections)

Description	Analytical Method	Quantity	Units	Unit Rate ($)	Estimated Cost ($)
Landfill Gas/Radon:					
Number of Landfill Gas/Radon Monitoring Wells		*31*			
Labor - field technician		9	hour	90	810
Field vehicle		1	day	120	120
Replacement radon detector (Pylon 300A)		1	each	550	550
Calibration gas for multi-gas detector		1	each	330	330
Data management		2	hour	100	200
Reporting		8	hour	130	1,040
Estimated Landfill Gas/Radon Monitoring Costs - Subtotal					3,100
Contingency			*%*	*20*	*600*
Estimated Landfill Gas/Radon Monitoring Costs - Total (per Event)					**3,700**

Description	Analytical Method	Quantity	Units	Unit Rate ($)	Estimated Cost ($)
Groundwater and Surface Water:					
Number of Samples:			*For VOCs*		
Investigative Groundwater		*16*	*16*		
Investigative Surface Water		*2*	*2*		
Field Duplicates (one per every 10 investigative samples)		*2*	*2*		
Trip blank (one per day per cooler)			*5*		
Matrix Spike			*1*		
Matrix Spike Duplicate			*1*		
Sub-total number of unfiltered samples:		*20*	*27*		
Sub-total number of filtered samples for radionuclide and metals analyses:		*20*			
Total number of samples:		*40*	*27*		
Labor:					
Labor - field technicians (2 people, 4 sample locations/day)		81	hour	90	7,290
Materials and equipment:					
Sample kits, incl. filters		18	each	50	900
Field instrumentation and flowcell rental - groundwater		5	day	100	500
Field Vehicle		5	day	120	600
Overnight shipping of sample coolers (assume 1 per day to rad lab)		5	coolers	100	500
Delivery of sample coolers to local lab (2 to 3 coolers per day)		5	hour	90	450
Disposal of purge water (assumes PE tank previously purchased is onsite):					
Vacuum truck		4	hour	200	800
Transportation and disposal (assumes approx 25 gal per well per event)		400	gallon	2.00	800
Laboratory Sample Analysis:					
Gross alpha and beta	EPA 900.0	40	each	50	2,000
Uranium-234, 235, 238	EML U-02 Mod	40	each	100	4,000
Thorium-228, 230, 232	EML Th-01 Mod	40	each	100	4,000
Radium 228	EPA 904.0	40	each	85	3,400
Radium 226	EPA 903.0 Mod	40	each	85	3,400
Radon 222 - 72 hr hold time	SM 20th ED 7500-Rn B	40	each	85	3,400
Volatile Organic Compounds [VOCs] (GC/MS)	8260B	27	each	110	2,970
Semivolatile Organic Compounds [SVOCs] (GC/MS)	8270C	40	each	220	8,800
22 Metals Target Analyte List (ICP/AES)	6010B	40	each	115	4,600
Mercury (CVAA)	7470A	40	each	35	1,400
4 Anions (IC) - Bromide, Chloride, Fluoride, Sulfate	300.0	40	each	72	2,880
2 Anions (IC) - Nitrate, Nitrite - 48 hr hold time	300.0	40	each	36	1,440
Sulfide, Total	SM 4500 S2 D	40	each	35	1,400
Phosphorus, Total	365.1	40	each	40	1,600
Organic carbon, Total (TOC)	SM 5310B	40	each	40	1,600
Total Alkalinity, Carbonate, Bicarbonate	SM 2320B	40	each	20	800
Nitrogen, Ammonia	350.1	40	each	25	1,000
Level IV data deliverable		$ 48,690	%	10%	4,870
Data validation (assumes validation of 100% of Level IV data will be required)		66	DVR	100	6,600
Data management		6	SDG	100	600
Reporting		40	hour	130	5,200
Estimated Groundwater and Surface Water Monitoring Costs - Subtotal					77,800
Contingency			*%*	*20*	*15,600*
Estimated Groundwater and Surface Water Monitoring Costs - Total (per Event)					**93,000**

DVR = data validation report
SDG = sample delivery group

Description	Analytical Method	Quantity	Units	Unit Rate ($)	Estimated Cost ($)
Annual Post-Construction Site Inspections					
Labor - Engineer		9	hour	130	1,170
Field vehicle		1	day	120	120
Site Inspection Report		8	hour	130	1,040
Estimated Annual Post-Construction Site Inspections Costs - Subtotal					2,300
Contingency			*%*	*20*	*500*
Estimated Annual Post-Construction Site Inspections Costs - Total					**2,800**

Operation and Maintenance Cost Estimate - Cover System Maintenance
ROD Remedy Alternative Constrained to $10M per Year

Description	Quantity	Units	Unit Rate	Estimated Cost
Mowing; tractor w/ rotary mower (once/year)	55.3	acre	40.00	2,200
Fill depressions in cover w/ topsoil, assume 1% of area; 6 inches dee	446	bcy	37.53	16,700
Seeding of filled area	24.1	M.S.F.	66.04	1,600
Estimated Cover System O&M Costs - Subtotal				20,500
Contingency		*%*	*20*	*4,100*
Estimated Annual Cover Maintenance O&M Costs - Total				**24,600**

M.S.F. = 1,000 square feet

Operation and Maintenance Cost Estimate - 5 year Review
ROD Remedy Alternative Constrained to $10M per Year

Description	Quantity	Units	Unit Rate	Estimated Cost ($)
Access Restrictions (inspect/repair fencing and signage	16	hours	130	2,100
Institutional Controls verificatio	8	hours	130	1,000
Document that landfill cover is effectiv	8	hours	130	1,000
Assemble Monitoring Data (landfill gas/radon, groundwater, surface wate	40	hours	130	5,200
Summarize Annual Post-Construction Site Inspection	8	hours	130	1,000
Summarize Annual Cover Maintenance Documentatic	8	hours	130	1,000
Water supply well inventory reviev	8	hours	130	1,000
Document any changes in Land Use at and around West Lake Landf	16	hours	130	2,100
Prepare Summary Repor	80	hours	130	10,400
Estimated 5-year Maint/Review O&M Costs - Subtotal				**25,000**
Contingency		*%*	*20*	*5,000*
Estimated 5-year Maintenance O&M Costs - Total				**30,000**

Construction Cost Estimate - ROD Remedy

Step #	Category	Sub-Category	Task	Quantity ROD Area 1	Quantity ROD Area 2	Type of Material Handled	Units	Source of Costing Estimate	RS Means Reference #	RS Means Description	Crew Type	Daily Unit Rate of Constr-uction	Crew Size (Men)	Number of Crews	Effic-iency Factor	Construction (Days) ROD Area 1	Construction (Days) ROD Area 2	Crew Man-days ROD Area 1	Crew Man-days ROD Area 2	Unit Costs: Extended Material Overhead and Profit	Unit Costs: Extended Labor Overhead and Profit	Unit Costs: Extended Labor Overhead and Profit - Ineffeciency	Unit Costs: Extended Equipment Overhead and Profit	Unit Costs: Extended Equipment Overhead and Profit - Ineffeciency	Unit Costs: Extended Total Overhead and Profit	Material Taxes at Bridgeton (7.925%) ROD Area 1	Material Taxes at Bridgeton (7.925%) ROD Area 2	Total Cost for Line Item ROD Area 1	Total Cost for Line Item ROD Area 2	Truckloads for Delivery ROD Area 1	Truckloads for Delivery ROD Area 2	Total Miles for Delivery ROD Area 1	Total Miles for Delivery ROD Area 2
ROD 1	Temporary Construction Facilities / Utilities / Personnel	Construction Trailers	Capital Expenses	2		Group of Trailers		See separate Assumptions sheet								25.0	-	39.3	-						$ 87,040	$ -	$ -	$ 174,000	$ -	10	-	200	-
ROD 2			Operating Expenses	23		Group of Trailers	Months	See separate Assumptions sheet																	$ 2,638	$ -	$ -	$ 60,400	$ -				
ROD 3			Parking Area	4,444		Gravel Area	S.Y.	RS Means, Year 2011 Quarter 1	015523500050	Temporary, roads, gravel fill, 4" gravel depth, excl surfacing	B14	715	6	1	100%	6.2	-	37.3	-	$ 4.46	$ 3.97	$ -	$ 0.53	$ -	$ 8.96	$ 1,570	$ -	$ 41,400	$ -				
ROD 4			Portable Toilets in Construction areas	7	19	Portable Toilets	Month	RS Means, Year 2011 Quarter 1	015433406420	Rent portable toilet chemical, recycle, flush type, Incl. Hourly Oper. Cost.					100%					$ -	$ -	$ -	$ 281	$ -	$ 281	$ -	$ -	$ 1,910	$ 5,210				
ROD 5		Contractor's Construction Management Personnel	Project Manager	89		Personnel	Week	RS Means, Year 2011 Quarter 1	013113200220	Field personnel, project manager, maximum		0.2	1	1	100%	445	-	445	-	$ -	$ 3,650	$ -	$ -	$ -	$ 3,650	$ -	$ -	$ 326,000	$ -				
ROD 6			Construction Superintendent(s)	99		Personnel	Week	RS Means, Year 2011 Quarter 1	013113200260	Field personnel, superintendent, average		0.2	1	1	100%	496	-	496	-	$ -	$ 2,950	$ -	$ -	$ -	$ 2,950	$ -	$ -	$ 294,000	$ -				
ROD 7			Clerk(s)	99		Personnel	Week	RS Means, Year 2011 Quarter 1	013113200020	Field Personnel, clerk, average		0.2	1	1	100%	496	-	496	-	$ -	$ 630	$ -	$ -	$ -	$ 630	$ -	$ -	$ 62,700	$ -				
ROD 8			Field Engineer(s) / Safety Officer(s)	99		Personnel	Week	RS Means, Year 2011 Quarter 1	013113200120	Field personnel, field engineer, average		0.2	1	1	100%	496	-	496	-	$ -	$ 1,950	$ -	$ -	$ -	$ 1,950	$ -	$ -	$ 194,000	$ -				
ROD 9	Temporary Stormwater Infrastructure (for stormwater during construction)	Temporary Stormwater Lagoon	Excavate soil for 4th berm at former leachate lagoon area	21,379		Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316464420	Excavating, bulk, dozer, open site, bank measure, common earth, 200 H.P. dozer, 300' push	B10B	270	1.5	4	100%	19.8	-	118.8	-	$ -	$ 2.72	$ -	$ 4.65	$ -	$ 7.37	$ -	$ -	$ 158,000	$ -				
ROD 10			Place soil for berm	29,930		Soil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	1.5	2	100%	15.0	-	44.9	-	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ 59,600	$ -				
ROD 11			Compact berm	21,379		Soil	E.C.Y.	RS Means, Year 2011 Quarter 1	312323235060	Compaction, riding, vibrating roller, 2 passes, 12" lifts	B10Y	5,200	1.5	2	100%	2.1	-	6.2	-	$ -	$ 0.14	$ -	$ 0.12	$ -	$ 0.26	$ -	$ -	$ 5,560	$ -				
ROD 12			Install geomembrane liner	495		60 mil HDPE	M.S.F.	RS Means, Year 2011 Quarter 1	334713531220	Pond and Reservoir Liners, membrane lining systems HDPE, 100,000 S.F. or more, 60 mil thick	3 Skwk	2	3	12	100%	25.8	-	928.1	-	$ 271.46	$ 1,113.15	$ -	$ -	$ -	$ 1,384.61	$ 10,600	$ -	$ 696,000	$ -	5	-	10,000	-
ROD 13			Install force main from Areas 1 and 2 to lagoon	3,671	832	HDPE Pipe	L.F.	RS Means, Year 2011 Quarter 1	331113350100	Water supply distribution piping, piping HDPE, butt fusion joints, 40' lengths, 4" diameter, SDR 21	B22A	400	5	1	100%	9.2	2.1	45.9	10.4	$ 3.66	$ 6.46	$ -	$ 1.89	$ -	$ 12.01	$ 1,060	$ 241	$ 45,200	$ 10,200				
ROD 14			Install force main from lagoon to treatment facility	551		HDPE Pipe	L.F.	RS Means, Year 2011 Quarter 1	331113350100	Water supply distribution piping, piping HDPE, butt fusion joints, 40' lengths, 4" diameter, SDR 21	B22A	400	5	1	100%	1.4	-	6.9	-	$ 3.66	$ 6.46	$ -	$ 1.89	$ -	$ 12.01	$ 160	$ -	$ 6,780	$ -				
ROD 15		Treatment Facility	Construct Treatment Facility	1		Treatment Facility	Each	EMSI Estimate				0.017	7	1	100%	60.0	-	420.0	-						$ 264,000	$ -	$ -	$ 264,000	$ -				
ROD 16			Monthly Operation during construction	11		Treatment Facility Operation	Months	EMSI Estimate				0.4	1	1	100%	27.8	-	27.8	-						$ 9,000	$ -	$ -	$ 100,000	$ -				
ROD 17		Stormwater events during construction	Dewater construction after rain events	101	249	Construction stormwater	Days of Pumping	RS Means, Year 2011 Quarter 1	312319200650	Dewatering, pumping, 8 hr., attended 2 hours per day, 4" discharge pump used for 8 hours, includes 20 L.F. of suction hose and 100 L.F. of discharge hose	B10I	4	1.5	4	100%	6.3	15.5	37.8	93.2	$ -	$ 183.11	$ -	$ 35.30	$ -	$ 218.41	$ -	$ -	$ 22,000	$ 54,300				
ROD 18			Dispose of contact stormwater to MSD	560,000	560,000	Contact stormwater	Gallons	Metropolitan St. Louis Sewer District, May 2011							100%										$ 0.0028	$ -	$ -	$ 1,580	$ 1,580				
ROD 19		Post-project Stormwater Demolition	Dispose of geomembrane liner	495		60 mil HDPE	M.S.F.	Estimating $.40/sf				20	3	1	100%	24.8	-	74.3	-						$ 400	$ -	$ -	$ 198,000	$ -				
ROD 20			Deconstruct 4th berm	21,379		Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316464420	Excavating, bulk, dozer, open site, bank measure, common earth, 200 H.P. dozer, 300' push	B10B	270	1.5	4	100%	19.8	-	118.8	-	$ -	$ 2.72	$ -	$ 4.65	$ -	$ 7.37	$ -	$ -	$ 158,000	$ -				
ROD 21			Grade berm material in lagoon for proper drainage	29,930		Soil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	1.5	2	100%	15.0	-	44.9	-	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ 59,600	$ -				
ROD 22	Site-wide Preparation	Mobilization	Mobilize and Demobilize Equipment Under 150HP	8		Units of Equipment up to 150HP (up to 50 miles)	Ea.	RS Means, Year 2011 Quarter 1	015436500020	Mobilization or demobilization, dozer, loader, backhoe or excavator, 70 H.P. to 150 H.P., up to 50 miles	B34N	4	1	1	100%	2.0	-	2.0	-	$ -	$ 112.25	$ -	$ 139.01	$ -	$ 251.26	$ -	$ -	$ 2,010	$ -				
ROD 23			*Extra Mileage for Mobilizations*	80		Per 5 additional miles		RS Means, Year 2011 Quarter 1	015436500020A	Mobilization or demobilization, each additional 5 miles haul distance, add	B34N	72	1	1	100%	1.1	-	1.1	-	$ -	$ 11.23	$ -	$ 13.90	$ -	$ 25.12	$ -	$ -	$ 2,010	$ -				
ROD 24			Mobilize and Demobilize Equipment Over 150HP	56		Units of Equipment over 150HP (up to 50 miles)	Ea.	RS Means, Year 2011 Quarter 1	015436500100	Mobilization or demobilization, dozer, loader, backhoe or excavator, above 150 H.P., up to 50 miles	B34K	3	1	1	100%	18.7	-	18.7	-	$ -	$ 148.59	$ -	$ 309.51	$ -	$ 458.10	$ -	$ -	$ 25,700	$ -				
ROD 25			*Extra Mileage for Mobilizations*	560		Per 5 additional miles		RS Means, Year 2011 Quarter 1	015436500100A	Mobilization or demobilization, each additional 5 miles haul distance, add	B34K	72	1	1	100%	7.8	-	7.8	-	$ -	$ 14.86	$ -	$ 30.95	$ -	$ 45.81	$ -	$ -	$ 25,700	$ -				
ROD 26			Mobilize and Demobilize Equipment, Towed	4		Units of Towed Equipment (up to 50 miles)	Ea.	RS Means, Year 2011 Quarter 1	015436500300	Mobilization or demobilization, scraper, towed type (including tractor), 6 C.Y. capacity, up to 50 miles	B34K	3	1	1	100%	1.3	-	1.3	-	$ -	$ 148.59	$ -	$ 309.51	$ -	$ 458.10	$ -	$ -	$ 1,830	$ -				
ROD 27			*Extra Mileage for Mobilizations*	40		Per 5 additional miles		RS Means, Year 2011 Quarter 1	015436500300A	Mobilization or demobilization, each additional 5 miles haul distance, add	B34K	72	1	1	100%	0.6	-	0.6	-	$ -	$ 14.86	$ -	$ 30.95	$ -	$ 45.81	$ -	$ -	$ 1,830	$ -				
ROD 28		Supplemental Mobilizations	Mobilize and Demobilize Equipment Under 150HP	8		Units of Equipment up to 150HP (up to 50 miles)	Ea.	RS Means, Year 2011 Quarter 1	015436500020	Mobilization or demobilization, dozer, loader, backhoe or excavator, 70 H.P. to 150 H.P., up to 50 miles	B34N	4	1	1	100%	2.0	-	2.0	-	$ -	$ 112.25	$ -	$ 139.01	$ -	$ 251.26	$ -	$ -	$ 2,010	$ -				
ROD 29			*Extra Mileage for Mobilizations*	80		Per 5 additional miles		RS Means, Year 2011 Quarter 1	015436500020A	Mobilization or demobilization, each additional 5 miles haul distance, add	B34N	72	1	1	100%	1.1	-	1.1	-	$ -	$ 11.23	$ -	$ 13.90	$ -	$ 25.12	$ -	$ -	$ 2,010	$ -				
ROD 30			Mobilize and Demobilize Equipment Over 150HP	56		Units of Equipment over 150HP (up to 50 miles)	Ea.	RS Means, Year 2011 Quarter 1	015436500100	Mobilization or demobilization, dozer, loader, backhoe or excavator, above 150 H.P., up to 50 miles	B34K	3	1	1	100%	18.7	-	18.7	-	$ -	$ 148.59	$ -	$ 309.51	$ -	$ 458.10	$ -	$ -	$ 25,700	$ -				
ROD 31		Supplemental Mobilizations (cont.)	*Extra Mileage for Mobilizations*	560		Per 5 additional miles		RS Means, Year 2011 Quarter 1	015436500100A	Mobilization or demobilization, each additional 5 miles haul distance, add	B34K	72	1	1	100%	7.8	-	7.8	-	$ -	$ 14.86	$ -	$ 30.95	$ -	$ 45.81	$ -	$ -	$ 25,700	$ -				
ROD 32			Mobilize and Demobilize Equipment, Towed	4		Units of Towed Equipment (up to 50 miles)	Ea.	RS Means, Year 2011 Quarter 1	015436500300	Mobilization or demobilization, scraper, towed type (including tractor), 6 C.Y. capacity, up to 50 miles	B34K	3	1	1	100%	1.3	-	1.3	-	$ -	$ 148.59	$ -	$ 309.51	$ -	$ 458.10	$ -	$ -	$ 1,830	$ -				

Construction Cost Estimate - ROD Remedy

Step #	Category	Sub-Category	Task	Quantity ROD Area 1	Quantity ROD Area 2	Type of Material Handled	Units	Source of Costing Estimate	RS Means Reference #	RS Means Description	Crew Type	Daily Unit Rate of Construction	Crew Size (Men)	Number of Crews	Efficiency Factor	Construction (Days) ROD Area 1	Construction (Days) ROD Area 2	Crew Man-days ROD Area 1	Crew Man-days ROD Area 2	Unit Costs: Extended Material Overhead and Profit	Extended Labor Overhead and Profit	Extended Labor Overhead and Profit - Ineffeciency	Extended Equipment Overhead and Profit	Extended Equipment Overhead and Profit - Ineffeciency	Extended Total Overhead and Profit	Material Taxes at Bridgeton (7.925%) ROD Area 1	Material Taxes at Bridgeton (7.925%) ROD Area 2	Total Cost for Line Item ROD Area 1	Total Cost for Line Item ROD Area 2	Truckloads for Delivery ROD Area 1	Truckloads for Delivery ROD Area 2	Total Miles for Delivery ROD Area 1	Total Miles for Delivery ROD Area 2
ROD 33	Site-wide Preparation (cont.)		*Extra Mileage for Mobilizations*	40		Per 5 additional miles		RS Means, Year 2011 Quarter 1	015436500300A	Mobilization or demobilization, each additional 5 miles haul distance, add	B34K	72	1	1	100%	0.6	-	0.6	-	$ -	$ 14.86	$ -	$ 30.95	$ -	$ 45.81	$ -	$ -	$ 1,830	$ -				
ROD 34			Create Temporary Roads	6,667	13,333	Gravel Roads	S.Y.	RS Means, Year 2011 Quarter 1	015523500050	Temporary roads, gravel fill, 4" gravel depth, excl surfacing	B14	715	6	1	100%	9.3	18.6	55.9	111.9	$ 4.46	$ 3.97	$ -	$ 0.53	$ -	$ 8.96	$ 2,360	$ 4,710	$ 62,100	$ 124,000				
ROD 35			Install TBD Traffic Improvements	$ 100,000	$ 100,000	TBD (shown as budget estimate)	$						6	1	100%	10.0	10.0	60.0	60.0	$ 1.00					$ 1.00	$ 7,930	$ 7,930	$ 108,000	$ 108,000				
ROD 36		*Dust Control*	Water Truck Depreciation	1	1	Water Trucks	Trucks	Estimate																	$ 50,000	$ -	$ -	$ 50,000	$ 50,000				
ROD 37			Water Truck Operation	6	16	Water Trucks	Months	Estimate				0.050	1	1	100%	127	330	127	330						$ 8,000	$ -	$ -	$ 50,700	$ 132,000				
ROD 38			Use Water to Control Dust	1,270,000	3,300,000	Water	Gal	Missouri American Water Company, 4/20/2011							100%										$ 0.0032	$ -	$ -	$ 4,040	$ 10,500				
ROD 39	Site Preparation		Prepare area with Stormwater BMPs	4,166	6,448	Silt Fence	L.F.	RS Means, Year 2011 Quarter 1	312514161100	Synthetic erosion control, silt fence, polypropylene, adverse conditions, 3' high	2 Clab	950	2	1	100%	4.4	6.8	8.8	13.6	$ 0.44	$ 0.87	$ -	$ -	$ -	$ 1.31	$ 145	$ 225	$ 5,600	$ 8,670				
ROD 40		*Decontamination Area*	Materials	56	56	Concrete	C.Y.	RS Means, Year 2011 Quarter 1	033105350300	Structural concrete, ready mix, normal weight, 4000 PSI, includes local aggregate, sand, Portland cement and water, delivered, excludes all additives and treatments					100%					$ 105.20					$ 105.20	$ 463	$ 463	$ 6,310	$ 6,310				
ROD 41			Installation	56	56	Concrete	C.Y.	RS Means, Year 2011 Quarter 1	33105704650	Structural concrete, placing, slab on grade, pumped, over 6" thick, includes strike off & consolidation, excludes material	C20	185	8	1	100%	0.3	0.3	2.4	2.4	$ -	$ 20.96	$ -	$ 5.08	$ -	$ 26.04	$ -	$ -	$ 1,450	$ 1,450				
ROD 42			Clear Vegetation (Light)	14.5	12.1	Vegetation	Acre	RS Means, Year 2011 Quarter 1	311313101020	Selective tree and shrub removal, selective clearing brush mowing, light density, tractor with rotary mower, excludes removal offsite	B84	2	1	1	100%	7.3	6.1	7.3	6.1	$ -	$ 265.31	$ -	$ 175.93	$ -	$ 441.24	$ -	$ -	$ 6,400	$ 5,340				
ROD 43			Clear Vegetation (Heavy)	3.5	27.8	Vegetation	Acre	RS Means, Year 2011 Quarter 1	311110100020	Clearing & grubbing, cut & chip light trees, to 6" diameter	B7	1	6	1	100%	3.5	27.8	21.0	166.8	$ -	$ 2,618.83	$ -	$ 1,574.70	$ -	$ 4,193.53	$ -	$ -	$ 14,700	$ 117,000				
ROD 44	Regrading		Apply daily cover to remaining excavation of Landfilled Material	2,974	6,649	Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316462200	Excavating, bulk, dozer, open site, bank measure, sand and gravel, 80 H.P. dozer, 150' haul	B10L	230	1.5	1	100%	12.9	28.9	19.4	43.4	$ -	$ 3.18	$ -	$ 2.14	$ -	$ 5.32	$ -	$ -	$ 15,800	$ 35,400				
ROD 45			Relocate Landfilled Material on-site - Excavate	32,718	73,142	Landfilled Material	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305	Excavating, bulk bank measure, 3-1/2 C.Y. capacity = 160 C.Y./hour, backhoe, hydraulic, crawler mounted, excluding truck loading	B12D	2,400	2	3	100%	4.5	10.2	27.3	61.0	$ -	$ 0.40	$ -	$ 1.09	$ -	$ 1.49	$ -	$ -	$ 48,800	$ 109,000				
ROD 46			*(additional cost to previous line)*	32,718	73,142	Landfilled Material	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305A	Excavating, bulk bank measure, for loading onto trucks, add	B12D	16,255	2	3	100%	0.7	1.5	4.0	9.0	$ -	$ 0.02	$ -	$ 0.03	$ -	$ 0.22	$ -	$ -	$ 7,200	$ 16,100				
ROD 47			Relocate Landfilled Material on-site - Haul and Dump	47,590	106,389	Landfilled Material	L.C.Y.	RS Means, Year 2011 Quarter 1	312323205110	Cycle hauling(wait, load,travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 22 C.Y. truck, cycle 2 mile, 10 MPH, excludes loading equipment	B34F	374	1	5.6	100%	22.7	50.7	127	284	$ -	$ 1.09	$ -	$ 3.63	$ -	$ 4.72	$ -	$ -	$ 225,000	$ 502,000				
ROD 48			Apply daily cover to relocated Landfilled Material	2,974	6,649	Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316462200	Excavating, bulk, dozer, open site, bank measure, sand and gravel, 80 H.P. dozer, 150' haul	B10L	230	1.5	1	100%	12.9	28.9	19.4	43.4	$ -	$ 3.18	$ -	$ 2.14	$ -	$ 5.32	$ -	$ -	$ 15,800	$ 35,400				
ROD 49			Spread Landfilled Material	50,565	113,038	Landfilled Material	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	1.5	4	100%	12.6	28.3	75.8	169.6	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ 101,000	$ 225,000				
ROD 50			Compact Landfilled Material	35,693	79,792	Landfilled Material	E.C.Y.	RS Means, Year 2011 Quarter 1	312323235720	Compaction, 4 passes, 12" lifts, riding, sheepsfoot or wobbly wheel roller	B10G	2,600	1.5	2	100%	6.9	15.3	20.6	46.0	$ -	$ 0.28	$ -	$ 0.50	$ -	$ 0.78	$ -	$ -	$ 27,800	$ 62,200				
ROD 51	Buffer Zone		Buffer Zone Activity	-	1	See separate Assumptions sheet		See separate Assumptions sheet						1	100%	-	6.6	-	40.3						$ 63,304	$ -	$ -	$ -	$ 63,300				
ROD 52	Backfill and Slope Correction	*Additional Fill*	Excavate additional fill material for grading	17,229	169,803	Overburden Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305	Excavating, bulk bank measure, 3-1/2 C.Y. capacity = 160 C.Y./hour, backhoe, hydraulic, crawler mounted, excluding truck loading	B12D	2,400	2	3	100%	2.4	23.6	14.4	141.5	$ -	$ 0.40	$ -	$ 1.09	$ -	$ 1.49	$ -	$ -	$ 25,700	$ 253,000				
ROD 53			*(additional cost to previous line)*	17,229	169,803	Overburden Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305A	Excavating, bulk bank measure, for loading onto trucks, add	B12D	16,255	2	3	100%	0.4	3.5	2.1	20.9	$ -	$ 0.02	$ -	$ 0.03	$ -	$ 0.22	$ -	$ -	$ 3,790	$ 37,400				
ROD 54			Haul additional fill for grading	21,536	212,254	Overburden Soil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323205110	Cycle hauling(wait, load,travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 22 C.Y. truck, cycle 2 mile, 10 MPH, excludes loading equipment	B34F	374	1	5.6	100%	10.3	101.1	57.6	567.5	$ -	$ 1.09	$ -	$ 3.63	$ -	$ 4.72	$ -	$ -	$ 102,000	$ 1,000,000				
ROD 55			Spread additional fill	21,536	212,254	Overburden Soil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	2	6	100%	3.6	35.4	32.3	318.4	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ 42,900	$ 422,000				
ROD 56		*Starter Berms*	Purchase material	12,667	29,333	Soil	B.C.Y.	Local Republic landfill with surplus material												$ 16.88					$ 16.88	$ 16,900	$ 39,200	$ 231,000	$ 534,000				
ROD 57			Deliver and Stockpile	17,733	41,067	Soil	L.C.Y.	Based on Central Stone estimate				64	1	50	100%	5.5	12.8	277.1	641.7		$ 5.22	$ -	$ 5.22	$ -	$ 10.43	$ -	$ -	$ 185,000	$ 428,000	1,109	2,567	77,630	179,690
ROD 58			Load material from stockpile to off road haul trucks	12,667	29,333	Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305	Excavating, bulk bank measure, 3-1/2 C.Y. capacity = 160 C.Y./hour, backhoe, hydraulic, crawler mounted, excluding truck loading	B12D	2,400	2	3	100%	1.8	4.1	10.6	24.4	$ -	$ 0.40	$ -	$ 1.09	$ -	$ 1.49	$ -	$ -	$ 18,900	$ 43,700				
ROD 59			*(additional cost to previous line)*	12,667	29,333	Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305A	Excavating, bulk bank measure, for loading onto trucks, add	B12D	16,255	2	3	100%	0.3	0.6	1.6	3.6	$ -	$ 0.02	$ -	$ 0.03	$ -	$ 0.22	$ -	$ -	$ 2,790	$ 6,450				
ROD 60			Haul loose lift material for berm	17,733	41,067	Soil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323205060	Cycle hauling(wait, load,travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 22 C.Y. truck, cycle 2000 ft, 10 MPH, excludes loading equipment	B34F	594	1	4	100%	8.4	19.6	29.9	69.1	$ -	$ 0.68	$ -	$ 2.28	$ -	$ 2.96	$ -	$ -	$ 52,500	$ 122,000				
ROD 61			Spread loose lift before compaction	17,733	41,067	Soil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	2	6	100%	3.0	6.8	26.6	61.6	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ 35,300	$ 81,700				

Construction Cost Estimate - ROD Remedy

				Quantity												Construction (Days)		Crew Man-days		Unit Costs						Material Taxes at Bridgeton (7.925%)		Total Cost for Line Item		Truckloads for Delivery		Total Miles for Delivery	
Step #	Category	Sub-Category	Task	ROD Area 1	ROD Area 2	Type of Material Handled	Units	Source of Costing Estimate	RS Means Reference #	RS Means Description	Crew Type	Daily Unit Rate of Constr-uction	Crew Size (Men)	Number of Crews	Effic-iency Factor	ROD Area 1	ROD Area 2	ROD Area 1	ROD Area 2	Extended Material Overhead and Profit	Extended Labor Overhead and Profit	Extended Labor Overhead and Profit - Ineffeciency	Extended Equipment Overhead and Profit	Extended Equipment Overhead and Profit - Ineffeciency	Extended Total Overhead and Profit	ROD Area 1	ROD Area 2	ROD Area 1	ROD Area 2	ROD Area 1	ROD Area 2	ROD Area 1	ROD Area 2
ROD 62	Final Cover		Compact starter berms	12,667	29,333	Soil	E.C.Y.	RS Means, Year 2011 Quarter 1	312323235060	Compaction, riding, vibrating roller, 2 passes, 12" lifts	B10Y	5,200	2	2	100%	1.2	2.8	3.7	8.5	$ -	$ 0.14	$ -	$ 0.12	$ -	$ 0.26	$ -	$ -	$ 3,290	$ 7,630				
ROD 63		Bio-Intrusion	Purchase of Bio-Intrusion Layer Material	84,444	208,372	8 inch Shot Rock	L.C.Y.	Fred Weber estimate, 3/23/2011												$ 5.80					$ 5.80	$ 38,800	$ 95,800	$ 528,000	$ 1,300,000				
ROD 64			Deliver Bio-Intrusion Layer Material	84,444	208,372	8 inch Shot Rock	L.C.Y.	Fred Weber estimate, 3/23/2011				72	1	50	100%	23.5	57.9	1,173	2,894		$ 2.35	$ -	$ 2.35	$ -	$ 4.69	$ -	$ -	$ 396,000	$ 978,000	4,692	11,577	75,072	185,232
ROD 65			Spread Bio-Intrusion Layer Material	84,444	208,372	8 inch Shot Rock	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	2	6	100%	14.1	34.7	126.7	312.6	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ 168,000	$ 415,000				
ROD 66		Clay	Purchase clay material	51,178	126,286	Clay Material	B.C.Y.	Local Republic landfill with surplus material												$ 16.88					$ 16.88	$ 68,400	$ 169,000	$ 932,000	$ 2,300,000				
ROD 67			Deliver clay material to site	71,649	176,800	Clay Material	L.C.Y.	Based on Central Stone estimate				64	1	50	100%	22.4	55.3	1,120	2,763		$ 5.22	$ -	$ 5.22	$ -	$ 10.43	$ -	$ -	$ 747,000	$ 1,840,000	4,479	11,051	313,530	773,570
ROD 68			Spread loose lift before compaction	71,649	176,800	Clay Material	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	2	6	100%	11.9	29.5	107.5	265.2	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ 143,000	$ 352,000				
ROD 69			Compact Clay (Final Cover)	51,178	126,286	Clay Material	E.C.Y.	RS Means, Year 2011 Quarter 1	312323235720	Compaction, 4 passes, 12" lifts, riding, sheepsfoot or wobbly wheel roller	B10G	2,600	1.5	2	100%	9.8	24.3	29.5	72.9	$ -	$ 0.28	$ -	$ 0.50	$ -	$ 0.78	$ -	$ -	$ 39,900	$ 98,500				
ROD 70		Top Soil	Purchase Topsoil	27,824	66,944	Topsoil	B.C.Y.	RS Means, Year 2011 Quarter 1 - Ext. Material O&P												$ 24.94					$ 24.94	$ 55,000	$ 132,000	$ 749,000	$ 1,800,000				
ROD 71			Deliver Topsoil	34,780	83,680	Topsoil	L.C.Y.	Based on Central Stone estimate				68	1	50	100%	10.2	24.6	511	1,231		$ 4.12	$ -	$ 4.12	$ -	$ 8.24	$ -	$ -	$ 287,000	$ 690,000	2,046	4,923	40,920	98,460
ROD 72			Move and place Topsoil (Final Cover)	31,986	78,929	Topsoil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	2	6	100%	5.3	13.2	48.0	118.4	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ 63,700	$ 157,000				
ROD 73	Stormwater Controls (for stormwater after cover is constructed)		Install Terraces	2,794	4,751	Topsoil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	2	1	100%	2.8	4.8	4.2	7.1	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ 5,560	$ 9,450				
ROD 74			Construct Ditches	2,630	7,245	Topsoil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316462200	Excavating, bulk, dozer, open site, bank measure, sand and gravel, 80 H.P. dozer, 150' haul	B10L	230	2	2	100%	5.7	15.8	17.2	47.3	$ -	$ 3.18	$ -	$ 2.14	$ -	$ 5.32	$ -	$ -	$ 14,000	$ 38,500				
ROD 75		Pond	Load Overburden Material from stockpile to off road haul truck for pond	4,694	7,944	Overburden Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305	Excavating, bulk bank measure, 3-1/2 C.Y. capacity = 160 C.Y./hour, backhoe, hydraulic, crawler mounted, excluding truck loading	B12D	2,400	2	3	100%	0.7	1.1	3.9	6.6	$ -	$ 0.40	$ -	$ 1.09	$ -	$ 1.49	$ -	$ -	$ 6,990	$ 11,800				
ROD 76			*(additional cost to previous line)*	4,694	7,944	Overburden Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305A	Excavating, bulk bank measure, for loading onto trucks, add	B12D	16,255	2	3	100%	0.1	0.2	0.6	1.0	$ -	$ 0.02	$ -	$ 0.03	$ -	$ 0.22	$ -	$ -	$ 1,030	$ 1,750				
ROD 77			Haul loose lift soil for Pond	6,572	11,122	Overburden Soil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323205060	Cycle hauling(wait, load,travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 22 C.Y. truck, cycle 2000 ft, 10 MPH, excludes loading equipment	B34F	594	1	3.5	100%	3.1	5.3	11.1	18.7	$ -	$ 0.68	$ -	$ 2.28	$ -	$ 2.96	$ -	$ -	$ 19,500	$ 32,900				
ROD 78			Spread loose lift before compaction (Pond)	6,572	11,122	Overburden Soil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	2	6	100%	1.1	1.9	9.9	16.7	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ 13,100	$ 22,100				
ROD 79			Compact Berm (Pond)	4,694	7,944	Overburden Soil	E.C.Y.	RS Means, Year 2011 Quarter 1	312323235060	Compaction, riding, vibrating roller, 2 passes, 12" lifts	B10Y	5,200	2	2	100%	0.5	0.8	1.4	2.3	$ -	$ 0.14	$ -	$ 0.12	$ -	$ 0.26	$ -	$ -	$ 1,220	$ 2,070				
ROD 80			Final Stormwater Controls	84	482	Riprap	S.Y.	RS Means, Year 2011 Quarter 1	313713100110	Rip-rap and rock lining, random, broken stone, 3/8 to 1/4 C.Y. pieces, machine placed for slope protection, grouted	B13	80	7	3	100%	0.3	2.0	7.3	42.2	$ 71.05	$ 38.47	$ -	$ 11.19	$ -	$ 120.71	$ 472	$ 2,710	$ 10,600	$ 60,900				
ROD 81			Install 500 year floodplain barrier		9,743	Riprap	S.Y.	RS Means, Year 2011 Quarter 1	313713100110	Rip-rap and rock lining, random, broken stone, 3/8 to 1/4 C.Y. pieces, machine placed for slope protection, grouted	B13	80	7	3	100%	-	40.6	-	852.5	$ 71.05	$ 38.47	$ -	$ 11.19	$ -	$ 120.71	$ -	$ 54,900	$ -	$ 1,230,000				
ROD 82	Site Completion		Apply seeding to cover	972	2,152	Seeding	M.S.F.	RS Means, Year 2011 Quarter 1	329219142400	Seeding athletic fields, seeding fescue, tall with mulch and fertilizer, 5.5 lb. per M.S.F., hydro/air seeding	B81	80	3	1	100%	12.1	26.9	36.4	80.7	$ 40.82	$ 16.91	$ -	$ 8.31	$ -	$ 66.04	$ 3,140	$ 6,960	$ 67,300	$ 149,000				
ROD 83			Apply seeding to soil stockpile	790		Seeding	M.S.F.	RS Means, Year 2011 Quarter 1	329219142400	Seeding athletic fields, seeding fescue, tall with mulch and fertilizer, 5.5 lb. per M.S.F., hydro/air seeding	B81	80	3	1	100%	9.9	-	29.6	-	$ 40.82	$ 16.91	$ -	$ 8.31	$ -	$ 66.04	$ 2,550	$ -	$ 54,700	$ -				
ROD 84			Install temporary irrigation system	80,987	179,348	Irrigation System	S.F.	RS Means, Year 2011 Quarter 1	328423100800	Underground sprinklers irrigation system, for lawns, residential system, custom, 1" supply	B20	2,000	3	10	100%	4.0	9.0	121.5	269.0	$ 0.33	$ 0.70	$ -	$ -	$ -	$ 1.03	$ 2,120	$ 4,690	$ 85,500	$ 189,000				
ROD 85			Install Fencing	4,166	6,448	Fencing	L.F.	RS Means, Year 2011 Quarter 1	323113200920	Fence, chain link industrial, galvanized steel, 6 ga. wire, 2-1/2" posts @ 10' OC, 8' high, includes excavation, in concrete, excludes barbed wire	B80C	180	3	2	100%	11.6	17.9	69.4	107.5	$ 29.40	$ 6.78	$ -	$ 1.18	$ -	$ 37.36	$ 9,710	$ 15,000	$ 165,000	$ 256,000				
																										Totals		*Totals*		*Totals*		*Totals*	
																										$ 222,000	$ 534,000	$ 9,000,000	$ 16,600,000	12,000	30,000	517,000	1,237,000
																										$	**756,000**		**$ 25,600,000**		**42,000**		**1,754,000**

ID	Task Name	Duration	Start	Finish	Details	2014	2015	2016	2017	2018	2019	2020
						'14	'15	'16	'17	'18	'19	
1	**ROD Remedy**	**1055.36 days**	**Mon 3/3/14**	**Mon 3/19/18**	Cost	$5,784,290.83	$5,966,780.08	$5,423,442.25	$5,310,399.05	$4,858,453.12		
	Trailers Operation		*Mon 3/3/14*	*Mon 3/19/18*	Cost	$31,392.10	$34,425.90	$34,425.90	$34,294.00	$7,301.98		
	Project Manager		*Mon 3/3/14*	*Mon 3/19/18*	Cost	$142,080.00	$165,735.00	$165,735.00	$165,100.00	$35,153.60		
	Construction Superintendent		*Mon 3/3/14*	*Mon 3/19/18*	Cost	$131,570.00	$153,990.00	$153,990.00	$153,400.00	$32,662.40		
	Clerk		*Mon 3/3/14*	*Mon 3/19/18*	Cost	$28,098.00	$32,886.00	$32,886.00	$32,760.00	$6,975.36		
	Field/Safety Engineer		*Mon 3/3/14*	*Mon 3/19/18*	Cost	$86,970.00	$101,790.00	$101,790.00	$101,400.00	$21,590.40		
	Treatment Facility		*Mon 3/3/14*	*Mon 3/19/18*	Cost	$98,100.00	$117,450.00	$117,450.00	$117,000.00	$24,912.00		
2	**Site-wide Preparation**	**637.35 days**	**Mon 3/3/14**	**Wed 8/10/16**	Cost	$1,981,073.23		$415,600.00				
3	**Temporary Construction Facilities / Utilities / Personnel**	**31.2 days**	**Mon 3/3/14**	**Tue 4/15/14**	Cost	$215,473.23						
6	**Temporary Stormwater Infrastructure**	**610.85 days**	**Tue 4/8/14**	**Wed 8/10/16**	Cost	$1,245,340.00		$415,600.00				
22	**Mobilization**	**26.5 days**	**Mon 3/3/14**	**Tue 4/8/14**	Cost	$59,080.00						
29	**Supplemental Mobilization**	**26.5 days**	**Tue 11/25/14**	**Wed 12/31/14**	Cost	$59,080.00						
36	**Create Temporary Roads**	**27.9 days**	**Tue 4/8/14**	**Fri 5/16/14**	Cost	$186,100.00						
39	**Install TBD Traffic Improvements**	**20 days**	**Tue 4/8/14**	**Tue 5/6/14**	Cost	$216,000.00						
42					Cost							
43	**Area 2**	**1028.86 days**	**Tue 4/8/14**	**Mon 3/19/18**	Cost	$330,048.42	$2,508,496.63	$4,401,565.35	$4,706,445.05	$4,729,857.38		
	Water Truck Operation		*Tue 4/8/14*	*Mon 3/19/18*	Cost	$76,600.00	$104,400.00	$104,400.00	$104,000.00	$22,144.00		
	Water (10kgal/day)		*Tue 4/8/14*	*Mon 3/19/18*	Cost	$6,108.85	$8,325.90	$8,325.90	$8,294.00	$1,765.98		
	Portable Toilet - Area 2		*Tue 4/8/14*	*Mon 3/19/18*	Cost	$2,689.14	$3,665.09	$3,665.09	$3,651.05	$777.39		
	Water Truck Depreciation		*Tue 4/8/14*	*Mon 3/19/18*	Cost	$50,000.00	$0.00	$0.00	$0.00	$0.00		
44	**Site Preparation**	**27.8 days**	**Tue 4/8/14**	**Fri 5/16/14**	Cost	$138,770.00						
51	**Stormwater Events (Weather Delays)**	**15.5 days**	**Wed 6/11/14**	**Wed 7/2/14**	Cost	$55,880.43						
53	**Regrading**	**126.75 days**	**Thu 1/1/15**	**Fri 6/26/15**	Cost		$985,100.00					
62	**Buffer Zone**	**6.6 days**	**Fri 6/26/15**	**Tue 7/7/15**	Cost		$63,300.00					
64	**Backfill and Slope Correction**	**202.2 days**	**Tue 7/7/15**	**Thu 4/14/16**	Cost		$1,343,705.64	$368,694.36				
71	**Final Cover**	**461.21 days**	**Thu 4/14/16**	**Fri 1/19/18**	Cost			$3,916,480.00	$4,590,500.00	$2,647,000.00		
72	**Starter Berms**	**39.2 days**	**Thu 4/14/16**	**Wed 6/8/16**	Cost			$1,223,480.00				
81	**Bio-Intrusion**	**115.8 days**	**Wed 6/8/16**	**Thu 11/17/16**	Cost			$2,693,000.00				
85	**Clay**	**74.6 days**	**Mon 1/2/17**	**Fri 4/14/17**	Cost				$4,590,500.00			
90	**Top Soil**	**14.76 days**	**Mon 1/1/18**	**Fri 1/19/18**	Cost					$2,647,000.00		
94	**Post-Construction Stormwater Controls**	**40.6 days**	**Fri 1/19/18**	**Mon 3/19/18**	Cost					$1,409,470.00		
106	**Site Completion**	**35.9 days**	**Mon 1/8/18**	**Tue 2/27/18**	Cost					$648,700.00		
111					Cost							
112	**Area 1**	**248.8 days**	**Tue 4/8/14**	**Mon 3/23/15**	Cost	$2,954,959.08	$2,852,006.55					
	Water Truck Operation		*Tue 4/8/14*	*Mon 3/23/15*	Cost	$76,600.00	$22,920.00					
	Water (10kgal/day)		*Tue 4/8/14*	*Mon 3/23/15*	Cost	$6,108.85	$1,827.87					
	Portable Toilet - Area 1		*Tue 4/8/14*	*Mon 3/23/15*	Cost	$2,689.14	$804.64					
	Water Truck Depreciation		*Tue 4/8/14*	*Mon 3/23/15*	Cost	$50,000.00	$0.00					
113	**Site Preparation**	**7.3 days**	**Tue 4/8/14**	**Thu 4/17/14**	Cost	$34,460.00						
120	**Stormwater Events (Weather Delays)**	**6.3 days**	**Wed 6/11/14**	**Thu 6/19/14**	Cost	$23,585.13						
	Contact Stormwater Disposal (1000 gal)		*Wed 6/11/14*	*Thu 6/19/14*	Cost	$1,579.20						
122	**Regrading**	**45.4 days**	**Thu 6/19/14**	**Thu 8/21/14**	Cost	$441,400.00						
131	**Backfill and Slope Correction**	**20.6 days**	**Thu 8/21/14**	**Fri 9/19/14**	Cost	$174,390.00						
138	**Final Cover**	**118.8 days**	**Fri 9/19/14**	**Thu 3/5/15**	Cost	$2,145,725.96	$2,436,654.04					
161	**Post-Construction Stormwater Controls**	**5.7 days**	**Thu 3/5/15**	**Thu 3/12/15**	Cost		$72,000.00					
172	**Site Completion**	**18 days**	**Wed 2/25/15**	**Mon 3/23/15**	Cost		$317,800.00					

Appendix K-3:

Cost Estimates for the "Complete Rad Removal" with Off-Site Disposal Alternative

Present Worth Cost Estimate (30 years)
"Complete Rad Removal" with Off-site Disposal Alternative

Year	*n*	P/F(*i* =2.3%)	Capital Costs ($): "Complete Rad Removal" with Off-site Disposal	Capital Costs ($): Subtotal Capital Costs	Operation, Maintenance, and Monitoring Costs ($/yr): Environmental Monitoring	Operation, Maintenance, and Monitoring Costs ($/yr): Landfill Gas Monitoring	Operation, Maintenance, and Monitoring Costs ($/yr): Groundwater/ Surface Water Monitoring	Operation, Maintenance, and Monitoring Costs ($/yr): Annual Site Inspection/Cover Maintenance	Operation, Maintenance, and Monitoring Costs ($/yr): 5 year Review	Operation, Maintenance, and Monitoring Costs ($/yr): Subtotal O&M Costs	Total Costs ($)	Cumulative Total Costs ($)	Present Worth of Annual Costs ($)	Cumulative Present Worth ($)	
2013	0	1.00000	4,964,000	4,964,000	91,000		93,000			184,000	5,148,000	5,148,000	5,148,000	5,148,000	Construction Costs
2014	1	0.97752	44,470,000	44,470,000	109,000		93,000			202,000	44,672,000	49,820,000	43,668,000	48,816,000	
2015	2	0.95554	171,509,000	171,509,000	109,000		93,000			202,000	171,711,000	221,531,000	164,077,000	212,893,000	
2016	3	0.93406	34,606,000	34,606,000	109,000		93,000			202,000	34,808,000	256,339,000	32,513,000	245,406,000	
2017	4	0.91306	2,199,000	2,199,000	18,000	9,000	279,000	28,000		334,000	2,533,000	258,872,000	2,313,000	247,719,000	
2018	5	0.89253				12,000	372,000	28,000		412,000	412,000	259,284,000	368,000	248,087,000	OM&M Costs
2019	6	0.87246				12,000	372,000	28,000		412,000	412,000	259,696,000	359,000	248,446,000	
2020	7	0.85285				12,000	279,000	28,000		319,000	319,000	260,015,000	272,000	248,718,000	
2021	8	0.83367				12,000	186,000	28,000	30,000	256,000	256,000	260,271,000	213,000	248,931,000	
2022	9	0.81493				12,000		28,000		40,000	40,000	260,311,000	33,000	248,964,000	
2023	10	0.79661				12,000	186,000	28,000		226,000	226,000	260,537,000	180,000	249,144,000	
2024	11	0.77870				12,000		28,000		40,000	40,000	260,577,000	31,000	249,175,000	
2025	12	0.76119				12,000	93,000	28,000		133,000	133,000	260,710,000	101,000	249,276,000	
2026	13	0.74408				12,000		28,000	30,000	70,000	70,000	260,780,000	52,000	249,328,000	
2027	14	0.72735				12,000	93,000	28,000		133,000	133,000	260,913,000	97,000	249,425,000	
2028	15	0.71099				12,000		28,000		40,000	40,000	260,953,000	28,000	249,453,000	
2029	16	0.69501				12,000	93,000	28,000		133,000	133,000	261,086,000	92,000	249,545,000	
2030	17	0.67938				12,000		28,000		40,000	40,000	261,126,000	27,000	249,572,000	
2031	18	0.66411				12,000	93,000	28,000	30,000	163,000	163,000	261,289,000	108,000	249,680,000	
2032	19	0.64918				12,000		28,000		40,000	40,000	261,329,000	26,000	249,706,000	
2033	20	0.63458				12,000	93,000	28,000		133,000	133,000	261,462,000	84,000	249,790,000	
2034	21	0.62031				12,000		28,000		40,000	40,000	261,502,000	25,000	249,815,000	
2035	22	0.60637				12,000	93,000	28,000		133,000	133,000	261,635,000	81,000	249,896,000	
2036	23	0.59273				12,000		28,000	30,000	70,000	70,000	261,705,000	41,000	249,937,000	
2037	24	0.57941				12,000	93,000	28,000		133,000	133,000	261,838,000	77,000	250,014,000	
2038	25	0.56638				12,000		28,000		40,000	40,000	261,878,000	23,000	250,037,000	
2039	26	0.55365				12,000	93,000	28,000		133,000	133,000	262,011,000	74,000	250,111,000	
2040	27	0.54120				12,000		28,000		40,000	40,000	262,051,000	22,000	250,133,000	
2041	28	0.52903				12,000	93,000	28,000	30,000	163,000	163,000	262,214,000	86,000	250,219,000	
2042	29	0.51714				12,000		28,000		40,000	40,000	262,254,000	21,000	250,240,000	

Estimated Non-discounted Total Costs: 262,000,000

Estimated 30-year Present Worth Costs: 250,000,000

The information in this cost estimate summary is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. In accordance with USEPA Guidance, this is an order-of-magnitude engineering estimate that is expected to be within -30 to +50 percent of the actual project cost.

Present Worth Cost Estimate (1,000 years)
"Complete Rad Removal" with Off-site Disposal Alternative

			Capital Costs ($)		Operation, Maintenance, and Monitoring Costs ($/yr)										
Year	*n*	P/F(*i* =2.3%)	"Complete Rad Removal" with Off-site Disposal	Subtotal Capital Costs	Environmental Monitoring	Landfill Gas Monitoring	Groundwater/ Surface Water Monitoring	Annual Site Inspection/Cover Maintenance	5 year Review	Subtotal O&M Costs	Total Costs ($)	Cumulative Total Costs ($)	Present Worth of Annual Costs ($)	Cumulative Present Worth ($)	
2013	0	1.00000	4,964,000	4,964,000	91,000		93,000			184,000	5,148,000	5,148,000	5,148,000	5,148,000	Construction Costs
2014	1	0.97752	44,470,000	44,470,000	109,000		93,000			202,000	44,672,000	49,820,000	43,668,000	48,816,000	
2015	2	0.95554	171,509,000	171,509,000	109,000		93,000			202,000	171,711,000	221,531,000	164,077,000	212,893,000	
2016	3	0.93406	34,606,000	34,606,000	109,000		93,000			202,000	34,808,000	256,339,000	32,513,000	245,406,000	
2017	4	0.91306	2,199,000	2,199,000	18,000	9,000	279,000	28,000		334,000	2,533,000	258,872,000	2,313,000	247,719,000	
2018	5	0.89253				12,000	372,000	28,000		412,000	412,000	259,284,000	368,000	248,087,000	
2019	6	0.87246				12,000	372,000	28,000		412,000	412,000	259,696,000	359,000	248,446,000	
2020	7	0.85285				12,000	279,000	28,000		319,000	319,000	260,015,000	272,000	248,718,000	
2021	8	0.83367				12,000	186,000	28,000	30,000	256,000	256,000	260,271,000	213,000	248,931,000	
2022	9	0.81493				12,000		28,000		40,000	40,000	260,311,000	33,000	248,964,000	
2023	10	0.79661				12,000	186,000	28,000		226,000	226,000	260,537,000	180,000	249,144,000	
2024	11	0.77870				12,000		28,000		40,000	40,000	260,577,000	31,000	249,175,000	
2025	12	0.76119				12,000	93,000	28,000		133,000	133,000	260,710,000	101,000	249,276,000	
2026	13	0.74408				12,000		28,000	30,000	70,000	70,000	260,780,000	52,000	249,328,000	
2027	14	0.72735				12,000	93,000	28,000		133,000	133,000	260,913,000	97,000	249,425,000	
2028	15	0.71099				12,000		28,000		40,000	40,000	260,953,000	28,000	249,453,000	
2029	16	0.69501				12,000	93,000	28,000		133,000	133,000	261,086,000	92,000	249,545,000	
2030	17	0.67938				12,000		28,000		40,000	40,000	261,126,000	27,000	249,572,000	
2031	18	0.66411				12,000	93,000	28,000	30,000	163,000	163,000	261,289,000	108,000	249,680,000	
2032	19	0.64918				12,000		28,000		40,000	40,000	261,329,000	26,000	249,706,000	
2033	20	0.63458				12,000	93,000	28,000		133,000	133,000	261,462,000	84,000	249,790,000	
2034	21	0.62031				12,000		28,000		40,000	40,000	261,502,000	25,000	249,815,000	
2035	22	0.60637				12,000	93,000	28,000		133,000	133,000	261,635,000	81,000	249,896,000	
2036	23	0.59273				12,000		28,000	30,000	70,000	70,000	261,705,000	41,000	249,937,000	
2037	24	0.57941				12,000	93,000	28,000		133,000	133,000	261,838,000	77,000	250,014,000	
2038	25	0.56638				12,000		28,000		40,000	40,000	261,878,000	23,000	250,037,000	
2039	26	0.55365				12,000	93,000	28,000		133,000	133,000	262,011,000	74,000	250,111,000	
2040	27	0.54120				12,000		28,000		40,000	40,000	262,051,000	22,000	250,133,000	
2041	28	0.52903				12,000	93,000	28,000	30,000	163,000	163,000	262,214,000	86,000	250,219,000	
2042	29	0.51714				12,000		28,000		40,000	40,000	262,254,000	21,000	250,240,000	
2212	199	0.01083				12,000		28,000		40,000	40,000	277,979,000	0	252,290,000	OM&M Costs
3012	999	0.00000				12,000		28,000		40,000	40,000	351,979,000	0	252,316,000	

Estimated Non-discounted Total Costs: 352,000,000

Estimated 1,000-year Present Worth Costs: 252,000,000

The information in this cost estimate summary is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. In accordance with USEPA Guidance, this is an order-of-magnitude engineering estimate that is expected to be within -30 to +50 percent of the actual project cost.

Total Capital Costs
"Complete Rad Removal" with Off-site Disposal Alternative

Cost Item		Estimated Capital Costs	2013	2014	2015	2016	2017	Total
			Allocation to Years (includes indirects and contingencies)					
On Site Construction Costs		$ 36,300,000		18,686,000	25,301,000	30,976,000	1,603,000	
Radiological Survey Costs		$ 3,270,000						
Environmental Monitoring Costs		$ 379,000	753,260					753,260
Long-Term Monitoring Facilities		$ 98,000					195,120	195,120
Baseline Monitoring		$ 2,000					3,880	3,880
Institutional Controls		$ 50,000					99,000	99,000
Subtotal		$ 40,100,000						
Project Management	5%	$ 2,005,000						
Engineering Design	6%	$ 2,406,000	4,210,500					4,210,500
Construction Management	6%	$ 2,406,000						
Subtotal Construction Onsite		$ 46,920,000		18,686,000	25,301,000	30,976,000	1,901,000	76,864,000
Offsite Transporation		$ 82,990,000						
Offsite Disposal (@$85/cy)		$ 47,100,000						
Subtotal - Transport/Disposal Offsite		$ 130,090,000		25,784,000	146,208,000	3,630,000		175,622,000
Contingencies:								
Scope (construction onsite)	55%	$ 25,806,000						
Scope (transport/disposal offsite)	15%	$ 19,514,000						
Bid (all activities)	20%	$ 35,402,000						
Subtotal - Contingencies		$ 80,720,000						
Total: "Complete Rad Removal" with Off-site Disposal		$ 257,700,000	4,964,000	44,470,000	171,509,000	34,606,000	2,199,000	257,700,000

Estimated Length Construction 3.0 years

Construction Cost Estimate -
"Complete Rad Removal" with Off-site Disposal Alternative

Step #	Category	Sub-Category	Task	Quantity Off-Site Area 1	Quantity Off-Site Area 2	Type of Material Handled	Units	Source of Costing Estimate	RS Means Reference #	RS Means Description	Crew Type	Daily Unit Rate of Constr-uction	Crew Size (Men)	Number of Crews	Effic-iency Factor	Construction (Days) Off-Site Area 1	Construction (Days) Off-Site Area 2	Crew Man-days Off-Site Area 1	Crew Man-days Off-Site Area 2	Unit Costs Extended Material Overhead and Profit	Extended Labor Overhead and Profit	Extended Labor Overhead and Profit - Ineffeciency	Extended Equipment Overhead and Profit	Extended Equipment Overhead and Profit - Ineffeciency	Extended Total Overhead and Profit	Material Taxes at Bridgeton (7.925%) Off-Site Area 1	Material Taxes at Bridgeton (7.925%) Off-Site Area 2	Total Cost for Line Item Off-Site Area 1	Total Cost for Line Item Off-Site Area 2	Truckloads for Delivery Off-Site Area 1	Truckloads for Delivery Off-Site Area 2	Total Miles for Delivery Off-Site Area 1	Total Miles for Delivery Off-Site Area 2
Off-Site 1	Temporary Construction Facilities / Utilities / Personnel	*Construction Trailers*	Capital Expenses	3		Group of Trailers		See separate Assumptions sheet								37.5	-	58.9	-						$ 87,040	$ -	$ -	$ 261,000	$ -	15	-	300	-
Off-Site 2			Operating Expenses	64		Group of Trailers	Months	See separate Assumptions sheet																	$ 2,638	$ -	$ -	$ 168,000	$ -				
Off-Site 3			Parking Area	6,667		Gravel Area	S.Y.	RS Means, Year 2011 Quarter 1	015523500050	Temporary, roads, gravel fill, 4" gravel depth, excl surfacing	B14	715	6	1	100%	9.3	-	55.9	-	$ 4.46	$ 3.97	$ -	$ 0.53	$ -	$ 8.96	$ 2,360	$ -	$ 62,100	$ -				
Off-Site 4			Portable Toilets in Construction areas	13	69	Portable Toilets	Month	RS Means, Year 2011 Quarter 1	015433406420	Rent portable toilet chemical, recycle, flush type, Incl. Hourly Oper. Cost.					100%					$ -	$ -	$ -	$ 281	$ -	$ 281	$ -	$ -	$ 3,720	$ 19,300				
Off-Site 5		*Contractor's Construction Management Personnel*	Project Manager	154		Personnel	Week	RS Means, Year 2011 Quarter 1	013113200220	Field personnel, project manager, maximum		0.2	1	1	100%	769	-	769	-	$ -	$ 3,650	$ -	$ -	$ -	$ 3,650	$ -	$ -	$ 563,000	$ -				
Off-Site 6			Construction Superintendent(s)	276		Personnel	Week	RS Means, Year 2011 Quarter 1	013113200260	Field personnel, superintendent, average		0.2	1	1	100%	1,377	-	1,377	-	$ -	$ 2,950	$ -	$ -	$ -	$ 2,950	$ -	$ -	$ 815,000	$ -				
Off-Site 7			Clerk(s)	276		Personnel	Week	RS Means, Year 2011 Quarter 1	013113200020	Field Personnel, clerk, average		0.2	1	1	100%	1,377	-	1,377	-	$ -	$ 630	$ -	$ -	$ -	$ 630	$ -	$ -	$ 174,000	$ -				
Off-Site 8			Field Engineer(s) / Safety Officer(s)	276		Personnel	Week	RS Means, Year 2011 Quarter 1	013113200120	Field personnel, field engineer, average		0.2	1	1	100%	1,377	-	1,377	-	$ -	$ 1,950	$ -	$ -	$ -	$ 1,950	$ -	$ -	$ 539,000	$ -				
Off-Site 9	Temporary Stormwater Infrastructure (for stormwater during construction)	*Temporary Stormwater Lagoon*	Excavate soil for 4th berm at former leachate lagoon area	21,379		Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316464420	Excavating, bulk, dozer, open site, bank measure, common earth, 200 H.P. dozer, 300' push	B10B	270	1.5	4	100%	19.8	-	118.8	-	$ -	$ 2.72	$ -	$ 4.65	$ -	$ 7.37	$ -	$ -	$ 158,000	$ -				
Off-Site 10			Place soil for berm	29,930		Soil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	1.5	2	100%	15.0	-	44.9	-	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ 59,600	$ -				
Off-Site 11			Compact berm	21,379		Soil	E.C.Y.	RS Means, Year 2011 Quarter 1	312323235060	Compaction, riding, vibrating roller, 2 passes, 12" lifts	B10Y	5,200	1.5	2	100%	2.1	-	6.2	-	$ -	$ 0.14	$ -	$ 0.12	$ -	$ 0.26	$ -	$ -	$ 5,560	$ -				
Off-Site 12			Install geomembrane liner	495		60 mil HDPE	M.S.F.	RS Means, Year 2011 Quarter 1	334713531220	Pond and Reservoir Liners, membrane lining systems HDPE, 100,000 S.F. or more, 60 mil thick	3 Skwk	2	3	12	100%	25.8	-	928.1	-	$ 271.46	$ 1,113.15	$ -	$ -	$ -	$ 1,384.61	$ 10,600	$ -	$ 696,000	$ -	5	-	10,000	-
Off-Site 13			Install force main from Areas 1 and 2 to lagoon	3,641	607	HDPE Pipe	L.F.	RS Means, Year 2011 Quarter 1	331113350100	Water supply distribution piping, piping HDPE, butt fusion joints, 40' lengths, 4" diameter, SDR 21	B22A	400	5	1	100%	9.1	1.5	45.5	7.6	$ 3.66	$ 6.46	$ -	$ 1.89	$ -	$ 12.01	$ 1,060	$ 176	$ 44,800	$ 7,470				
Off-Site 14			Install force main from lagoon to treatment facility	551		HDPE Pipe	L.F.	RS Means, Year 2011 Quarter 1	331113350100	Water supply distribution piping, piping HDPE, butt fusion joints, 40' lengths, 4" diameter, SDR 21	B22A	400	5	1	100%	1.4	-	6.9	-	$ 3.66	$ 6.46	$ -	$ 1.89	$ -	$ 12.01	$ 160	$ -	$ 6,780	$ -				
Off-Site 15		*Treatment Facility*	Construct Treatment Facility	1		Treatment Facility	Each	EMSI Estimate				0.017	7	1	100%	60.0	-	420.0	-						$ 264,000	$ -	$ -	$ 264,000	$ -				
Off-Site 16			Monthly Operation during construction	28		Treatment Facility Operation	Months	EMSI Estimate				0.4	1	1	100%	70.8	-	70.8	-						$ 9,000	$ -	$ -	$ 255,000	$ -				
Off-Site 17		*Stormwater events during construction*	Dewater construction after rain events	309	759	Construction stormwater	Days of Pumping	RS Means, Year 2011 Quarter 1	312319200650	Dewatering, pumping, 8 hr., attended 2 hours per day, 4" discharge pump used for 8 hours, includes 20 L.F. of suction hose and 100 L.F. of discharge hose	B10I	4	1.5	4	100%	19.3	47.4	115.8	284.6	$ -	$ 183.11	$ -	$ 35.30	$ -	$ 218.41	$ -	$ -	$ 67,400	$ 166,000				
Off-Site 18			Dispose of contact stormwater to MSD	1,500,000	3,000,000	Contact stormwater	Gallons	Metropolitan St. Louis Sewer District, May 2011							100%										$ 0.0028	$ -	$ -	$ 4,230	$ 8,460				
Off-Site 19		*Post-project Stormwater Demolition*	Dispose of geomembrane liner in Area 1 or 2	495		60 mil HDPE	M.S.F.	Estimating $.40/sf				20	3	1	100%	24.8	-	74.3	-						$ 400	$ -	$ -	$ 198,000	$ -				
Off-Site 20			Deconstruct 4th berm	21,379		Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316464420	Excavating, bulk, dozer, open site, bank measure, common earth, 200 H.P. dozer, 300' push	B10B	270	1.5	4	100%	19.8	-	118.8	-	$ -	$ 2.72	$ -	$ 4.65	$ -	$ 7.37	$ -	$ -	$ 158,000	$ -				
Off-Site 21			Grade berm material in lagoon for proper drainage	29,930		Soil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	1.5	2	100%	15.0	-	44.9	-	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ 59,600	$ -				
Off-Site 22	Site-wide Preparation	*Mobilization*	Mobilize and Demobilize Equipment Under 150HP	8		Units of Equipment up to 150HP (up to 50 miles)	Ea.	RS Means, Year 2011 Quarter 1	015436500020	Mobilization or demobilization, dozer, loader, backhoe or excavator, 70 H.P. to 150 H.P., up to 50 miles	B34N	4	1	1	100%	2.0	-	2.0	-	$ -	$ 112.25	$ -	$ 139.01	$ -	$ 251.26	$ -	$ -	$ 2,010	$ -				
Off-Site 23			*Extra Mileage for Mobilizations*	80		Per 5 additional miles		RS Means, Year 2011 Quarter 1	015436500020A	Mobilization or demobilization, each additional 5 miles haul distance, add	B34N	72	1	1	100%	1.1	-	1.1	-	$ -	$ 11.23	$ -	$ 13.90	$ -	$ 25.12	$ -	$ -	$ 2,010	$ -				
Off-Site 24			Mobilize and Demobilize Equipment Over 150HP	56		Units of Equipment over 150HP (up to 50 miles)	Ea.	RS Means, Year 2011 Quarter 1	015436500100	Mobilization or demobilization, dozer, loader, backhoe or excavator, above 150 H.P., up to 50 miles	B34K	3	1	1	100%	18.7	-	18.7	-	$ -	$ 148.59	$ -	$ 309.51	$ -	$ 458.10	$ -	$ -	$ 25,700	$ -				
Off-Site 25			*Extra Mileage for Mobilizations*	560		Per 5 additional miles		RS Means, Year 2011 Quarter 1	015436500100A	Mobilization or demobilization, each additional 5 miles haul distance, add	B34K	72	1	1	100%	7.8	-	7.8	-	$ -	$ 14.86	$ -	$ 30.95	$ -	$ 45.81	$ -	$ -	$ 25,700	$ -				
Off-Site 26			Mobilize and Demobilize Equipment, Towed	4		Units of Towed Equipment (up to 50 miles)	Ea.	RS Means, Year 2011 Quarter 1	015436500300	Mobilization or demobilization, scraper, towed type (including tractor), 6 C.Y. capacity, up to 50 miles	B34K	3	1	1	100%	1.3	-	1.3	-	$ -	$ 148.59	$ -	$ 309.51	$ -	$ 458.10	$ -	$ -	$ 1,830	$ -				
Off-Site 27			*Extra Mileage for Mobilizations*	40		Per 5 additional miles		RS Means, Year 2011 Quarter 1	015436500300A	Mobilization or demobilization, each additional 5 miles haul distance, add	B34K	72	1	1	100%	0.6	-	0.6	-	$ -	$ 14.86	$ -	$ 30.95	$ -	$ 45.81	$ -	$ -	$ 1,830	$ -				
Off-Site 28		*Supplemental Mobilizations*	Mobilize and Demobilize Equipment Under 150HP	16		Units of Equipment up to 150HP (up to 50 miles)	Ea.	RS Means, Year 2011 Quarter 1	015436500020	Mobilization or demobilization, dozer, loader, backhoe or excavator, 70 H.P. to 150 H.P., up to 50 miles	B34N	4	1	1	100%	4.0	-	4.0	-	$ -	$ 112.25	$ -	$ 139.01	$ -	$ 251.26	$ -	$ -	$ 4,020	$ -				
Off-Site 29			*Extra Mileage for Mobilizations*	160		Per 5 additional miles		RS Means, Year 2011 Quarter 1	015436500020A	Mobilization or demobilization, each additional 5 miles haul distance, add	B34N	72	1	1	100%	2.2	-	2.2	-	$ -	$ 11.23	$ -	$ 13.90	$ -	$ 25.12	$ -	$ -	$ 4,020	$ -				
Off-Site 30			Mobilize and Demobilize Equipment Over 150HP	112		Units of Equipment over 150HP (up to 50 miles)	Ea.	RS Means, Year 2011 Quarter 1	015436500100	Mobilization or demobilization, dozer, loader, backhoe or excavator, above 150 H.P., up to 50 miles	B34K	3	1	1	100%	37.3	-	37.3	-	$ -	$ 148.59	$ -	$ 309.51	$ -	$ 458.10	$ -	$ -	$ 51,300	$ -				

Construction Cost Estimate -
"Complete Rad Removal" with Off-site Disposal Alternative

				Quantity												Construction (Days)		Crew Man-days		Unit Costs						Material Taxes at Bridgeton (7.925%)		Total Cost for Line Item		Truckloads for Delivery		Total Miles for Delivery	
Step #	Category	Sub-Category	Task	Off-Site Area 1	Off-Site Area 2	Type of Material Handled	Units	Source of Costing Estimate	RS Means Reference #	RS Means Description	Crew Type	Daily Unit Rate of Constr-uction	Crew Size (Men)	Number of Crews	Effic-iency Factor	Off-Site Area 1	Off-Site Area 2	Off-Site Area 1	Off-Site Area 2	Extended Material Overhead and Profit	Extended Labor Overhead and Profit	Extended Labor Overhead and Profit - Ineffeciency	Extended Equipment Overhead and Profit	Extended Equipment Overhead and Profit - Ineffeciency	Extended Total Overhead and Profit	Off-Site Area 1	Off-Site Area 2	Off-Site Area 1	Off-Site Area 2	Off-Site Area 1	Off-Site Area 2	Off-Site Area 1	Off-Site Area 2
Off-Site 31			*Extra Mileage for Mobilizations*	1,120		Per 5 additional miles		RS Means, Year 2011 Quarter 1	015436500100A	Mobilization or demobilization, each additional 5 miles haul distance, add	B34K	72	1	1	100%	15.6	-	15.6	-	$ -	$ 14.86	$ -	$ 30.95	$ -	$ 45.81	$ -	$ -	$ 51,300	$ -				
Off-Site 32	Site-wide Preparation (cont.)		Mobilize and Demobilize Equipment, Towed	8		Units of Towed Equipment (up to 50 miles)	Ea.	RS Means, Year 2011 Quarter 1	015436500300	Mobilization or demobilization, scraper, towed type (including tractor), 6 C.Y. capacity, up to 50 miles	B34K	3	1	1	100%	2.7	-	2.7	-	$ -	$ 148.59	$ -	$ 309.51	$ -	$ 458.10	$ -	$ -	$ 3,660	$ -				
Off-Site 33			*Extra Mileage for Mobilizations*	80		Per 5 additional miles		RS Means, Year 2011 Quarter 1	015436500300A	Mobilization or demobilization, each additional 5 miles haul distance, add	B34K	72	1	1	100%	1.1	-	1.1	-	$ -	$ 14.86	$ -	$ 30.95	$ -	$ 45.81	$ -	$ -	$ 3,660	$ -				
Off-Site 34			Create Temporary Roads	13,333	26,667	Gravel Roads	S.Y.	RS Means, Year 2011 Quarter 1	015523500050	Temporary, roads, gravel fill, 4" gravel depth, excl surfacing	B14	715	6	1	100%	18.6	37.3	111.9	223.8	$ 4.46	$ 3.97	$ -	$ 0.53	$ -	$ 8.96	$ 4,710	$ 9,430	$ 124,000	$ 248,000				
Off-Site 35			Install TBD Traffic Improvements	$ 100,000	$ 100,000	TBD (shown as budget estimate)	$						6	1	100%	10.0	10.0	60.0	60.0	$ 1.00					$ 1.00	$ 7,930	$ 7,930	$ 108,000	$ 108,000				
Off-Site 36			Water Truck Depreciation	1	2	Water Trucks	Trucks	Estimate																	$ 50,000	$ -	$ -	$ 50,000	$ 100,000				
Off-Site 37			Water Truck Operation	12	65	Water Trucks	Months	Estimate				0.050	1	1	100%	239	1,309	239	1,309						$ 8,000	$ -	$ -	$ 95,400	$ 523,000				
Off-Site 38		*Dust Control*	Use Water to Control Dust	2,390,000	13,100,000	Water	Gal	Missouri American Water Company, 4/20/2011							100%										$ 0.0032	$ -	$ -	$ 7,610	$ 41,700				
Off-Site 39			Prepare area with Stormwater BMPs	4,078	8,285	Silt Fence	L.F.	RS Means, Year 2011 Quarter 1	312514161100	Synthetic erosion control, silt fence, polypropylene, adverse conditions, 3' high	2 Clab	950	2	1	100%	4.3	8.7	8.6	17.4	$ 0.44	$ 0.87	$ -	$ -	$ -	$ 1.31	$ 142	$ 289	$ 5,480	$ 11,100				
Off-Site 40		*Decontamination Areas*	Materials	111	56	Concrete	C.Y.	RS Means, Year 2011 Quarter 1	033105350300	Structural concrete, ready mix, normal weight, 4000 PSI, includes local aggregate, sand, Portland cement and water, delivered, excludes all additives and treatments					100%					$ 105.20					$ 105.20	$ 926	$ 463	$ 12,600	$ 6,310				
Off-Site 41			Installation	111	56	Concrete	C.Y.	RS Means, Year 2011 Quarter 1	33105704650	Structural concrete, placing, slab on grade, pumped, over 6" thick, includes strike off & consolidation, excludes material	C20	185	8	1	100%	0.6	0.3	4.8	2.4	$ -	$ 20.96	$ -	$ 5.08	$ -	$ 26.04	$ -	$ -	$ 2,890	$ 1,450				
Off-Site 42	Site Preparation		Clear Vegetation (Light)	16.0	21.4	Vegetation	Acre	RS Means, Year 2011 Quarter 1	311313101020	Selective tree and shrub removal, selective clearing brush mowing, light density, tractor with rotary mower, excludes removal offsite	B84	2	1	1	100%	8.0	10.7	8.0	10.7	$ -	$ 265.31	$ -	$ 175.93	$ -	$ 441.24	$ -	$ -	$ 7,060	$ 9,440				
Off-Site 43			Clear Vegetation (Heavy)	3.5	27.8	Vegetation	Acre	RS Means, Year 2011 Quarter 1	311110100020	Clearing & grubbing, cut & chip light trees, to 6" diameter	B7	1	6	1	100%	3.5	27.8	21.0	166.8	$ -	$ 2,618.83	$ -	$ 1,574.70	$ -	$ 4,193.53	$ -	$ -	$ 14,700	$ 117,000				
Off-Site 44			Purchase material	2,963	4,444	Soil	B.C.Y.	Local Republic landfill with surplus material												$ 16.88					$ 16.88	$ 3,960	$ 5,940	$ 54,000	$ 80,900				
Off-Site 45		*Berms for Overburden*	Deliver and Stockpile	4,148	6,222	Soil	L.C.Y.	Based on Central Stone estimate				64	1	50	100%	1.3	1.9	64.8	97.2		$ 5.22	$ -	$ 5.22	$ -	$ 10.43	$ -	$ -	$ 43,300	$ 64,900	260	389	18,200	27,230
Off-Site 46			Develop earthen berms to store relocated overburden wastes	4,148	6,222	Soil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	1.5	3	100%	1.4	2.1	6.2	9.3	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ 8,250	$ 12,400				
Off-Site 47			Relocate overburden wastes - Excavate	67,475	408,031	Non RAD Waste	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305	Excavating, bulk bank measure, 3-1/2 C.Y. capacity = 160 C.Y./hour, backhoe, hydraulic, crawler mounted, excluding truck loading	B12D	2,400	2	3	70%	13.4	81.0	80.3	485.8	$ -	$ 0.40	$ 0.17	$ 1.09	$ 0.47	$ 2.13	$ -	$ -	$ 144,000	$ 869,000				
Off-Site 48			*(additional cost to previous line)*	67,475	408,031	Non RAD Waste	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305A	Excavating, bulk bank measure, for loading onto trucks, add	B12D	16,255	2	3	70%	2.0	12.0	11.9	71.7	$ -	$ 0.02	$ 0.01	$ 0.03	$ 0.01	$ 0.24	$ -	$ -	$ 16,300	$ 98,500				
Off-Site 49	Overburden Relocation		Relocate overburden wastes - Haul and Dump	101,213	612,047	Non RAD Waste	L.C.Y.	RS Means, Year 2011 Quarter 1	312323205060	Cycle hauling(wait, load,travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 22 C.Y. truck, cycle 2000 ft, 10 MPH, excludes loading equipment	B34F	594	1	3.5	100%	48.2	291.5	170	1,030	$ -	$ 0.68	$ -	$ 2.28	$ -	$ 2.96	$ -	$ -	$ 300,000	$ 1,810,000				
Off-Site 50			Apply daily cover to relocated overburden wastes	6,748	40,803	Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316462200	Excavating, bulk, dozer, open site, bank measure, sand and gravel, 80 H.P. dozer, 150' haul	B10L	230	1.5	3	100%	9.8	59.1	44	266	$ -	$ 3.18	$ -	$ 2.14	$ -	$ 5.32	$ -	$ -	$ 35,900	$ 217,000				
Off-Site 51			Spread overburden wastes	107,960	652,850	Non RAD Waste	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	1.5	6	100%	18.0	108.8	162	979	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ 215,000	$ 1,300,000				
Off-Site 52			Compact overburden wastes	74,223	448,834	Non RAD Waste	E.C.Y.	RS Means, Year 2011 Quarter 1	312323235720	Compaction, 4 passes, 12" lifts, riding, sheepsfoot or wobbly wheel roller	B10G	2,600	1.5	2	100%	14.3	86.3	43	259	$ -	$ 0.28	$ -	$ 0.50	$ -	$ 0.78	$ -	$ -	$ 57,900	$ 350,000				
Off-Site 53			Apply daily cover to remaining excavation of RIM Wastes	3,350	30,200	Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316462200	Excavating, bulk, dozer, open site, bank measure, sand and gravel, 80 H.P. dozer, 150' haul	B10L	230	1.5	1	100%	14.6	131.3	21.8	197.0	$ -	$ 3.18	$ -	$ 2.14	$ -	$ 5.32	$ -	$ -	$ 17,800	$ 161,000				
Off-Site 54			Relocate RIM Wastes on-site - Excavate	36,850	332,200	RAD Waste	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305	Excavating, bulk bank measure, 3-1/2 C.Y. capacity = 160 C.Y./hour, backhoe, hydraulic, crawler mounted, excluding truck loading	B12D	2,400	2	3	50%	10.2	92.3	61.4	553.7	$ -	$ 0.40	$ 0.40	$ 1.09	$ 1.09	$ 2.98	$ -	$ -	$ 110,000	$ 990,000				
Off-Site 55			*(additional cost to previous line)*	36,850	332,200	RAD Waste	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305A	Excavating, bulk bank measure, for loading onto trucks, add	B12D	16,255	2	3	50%	1.5	13.6	9.1	81.7	$ -	$ 0.02	$ 0.02	$ 0.03	$ 0.03	$ 0.27	$ -	$ -	$ 9,950	$ 89,700				
Off-Site 56	RIM Relocation		Relocate RIM Wastes on-site - Haul and Dump	55,275	498,300	RAD Waste	L.C.Y.	RS Means, Year 2011 Quarter 1	312323205110	Cycle hauling(wait, load,travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 22 C.Y. truck, cycle 2 mile, 10 MPH, excludes loading equipment	B34F	374	1	5.6	100%	26.3	237.3	148	1,332	$ -	$ 1.09	$ -	$ 3.63	$ -	$ 4.72	$ -	$ -	$ 261,000	$ 2,350,000				
Off-Site 57			Transfer RIM Wastes into On-Road Trailers	36,850	332,200	RAD Waste	B.C.Y.	RS Means, Year 2011 Quarter 1	312316421300	Excavating, bulk bank measure, 3 C.Y. capacity = 130 C.Y./hour, front end loader, track mounted, excluding truck loading	B10P	1,040	1.5	4	100%	8.9	79.9	53.1	479.1	$ -	$ 0.70	$ -	$ 1.16	$ -	$ 1.86	$ -	$ -	$ 68,500	$ 618,000				
Off-Site 58			*(additional cost to previous line)*	36,850	332,200	RAD Waste	B.C.Y.	RS Means, Year 2011 Quarter 1	312316421300A	Excavating, bulk bank measure, for loading onto trucks, add	B10P	6,909	1.5	4	100%	1.3	12.0	8.0	72.1	$ -	$ 0.11	$ -	$ 0.17	$ -	$ 0.28	$ -	$ -	$ 10,300	$ 93,000				

Construction Cost Estimate -
"Complete Rad Removal" with Off-site Disposal Alternative

Step #	Category	Sub-Category	Task	Quantity Off-Site Area 1	Quantity Off-Site Area 2	Type of Material Handled	Units	Source of Costing Estimate	RS Means Reference #	RS Means Description	Crew Type	Daily Unit Rate of Constr-uction	Crew Size (Men)	Number of Crews	Effic-iency Factor	Construction (Days) Off-Site Area 1	Construction (Days) Off-Site Area 2	Crew Man-days Off-Site Area 1	Crew Man-days Off-Site Area 2	Unit Costs Extended Material Overhead and Profit	Unit Costs Extended Labor Overhead and Profit	Unit Costs Extended Labor Overhead and Profit - Ineffeciency	Unit Costs Extended Equipment Overhead and Profit	Unit Costs Extended Equipment Overhead and Profit - Ineffeciency	Unit Costs Extended Total Overhead and Profit	Material Taxes at Bridgeton (7.925%) Off-Site Area 1	Material Taxes at Bridgeton (7.925%) Off-Site Area 2	Total Cost for Line Item Off-Site Area 1	Total Cost for Line Item Off-Site Area 2	Truckloads for Delivery Off-Site Area 1	Truckloads for Delivery Off-Site Area 2	Total Miles for Delivery Off-Site Area 1	Total Miles for Delivery Off-Site Area 2
Off-Site 59			Bag and Transport RIM Wastes to Off-Site Disposal Facility via Rail	55,275	498,300	RAD Waste	L.C.Y.	Off-site Disposal Facility estimate		Load On Highway trucks at the landfill to transport to railspur		2,100	21	1	100%	26.3	237.3	553	4,983						$ 150	$ -	$ -	$ 8,290,000	$ 74,700,000	1,580	14,238	31,600	284,760
Off-Site 60			Off-Site Disposal Facility Disposal Fee	55,275	498,300	RAD Waste	L.C.Y.	Off-site Disposal Facility estimate		Transport gondola cars to disposal site. Includes disposal cost.		2,100	1	1	100%	26.3	237.3	26.3	237.3						$ 85	$ -	$ -	$ 4,700,000	$ 42,400,000				
Off-Site 61	Buffer Zone		Buffer Zone Activity	-	1	See separate Assumptions sheet		See separate Assumptions sheet						1	100%	-	6.6	-	40.3						$ 63,304	$ -	$ -	$ -	$ 63,300				
Off-Site 62	Rad. Survey		Conduct final radiological survey and wait for approval	1	1	This activity is handled by others, and does not have a direct cost to the contractor. However, there are the indirect costs due to the duration and associated waiting.								1	100%	7.0	7.0	-	-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -				
Off-Site 63			Move non-RIM waste to correct slopes in excavation - Excavate	15,915	137,914	Non RAD Waste	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305	Excavating, bulk bank measure, 3-1/2 C.Y. capacity = 160 C.Y./hour, backhoe, hydraulic, crawler mounted, excluding truck loading	B12D	2,400	2	3	100%	2.2	19.2	13.3	114.9	$ -	$ 0.40	$ -	$ 1.09	$ -	$ 1.49	$ -	$ -	$ 23,700	$ 205,000				
Off-Site 64			*(additional cost to previous line)*	15,915	137,914	Non RAD Waste	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305A	Excavating, bulk bank measure, for loading onto trucks, add	B12D	16,255	2	3	100%	0.3	2.8	2.0	17.0	$ -	$ 0.02	$ -	$ 0.03	$ -	$ 0.22	$ -	$ -	$ 3,500	$ 30,300				
Off-Site 65		*Slope Correction Cuts*	Move non-RIM waste to correct slopes in excavation - Haul and Dump	23,873	206,871	Non RAD Waste	L.C.Y.	RS Means, Year 2011 Quarter 1	312323205060	Cycle hauling(wait, load,travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 22 C.Y. truck, cycle 2000 ft, 10 MPH, excludes loading equipment	B34F	594	1	3.5	100%	11.4	98.5	40.2	348.3	$ -	$ 0.68	$ -	$ 2.28	$ -	$ 2.96	$ -	$ -	$ 70,700	$ 612,000				
Off-Site 66			Spread cut material	23,873	206,871	Non RAD Waste	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	2	6	100%	4.0	34.5	35.8	310.3	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ 47,500	$ 412,000				
Off-Site 67			Compact cut material	15,915	137,914	Non RAD Waste	E.C.Y.	RS Means, Year 2011 Quarter 1	312323235720	Compaction, 4 passes, 12" lifts, riding, sheepsfoot or wobbly wheel roller	B10G	2,600	2	2	100%	3.1	26.5	9.2	79.6	$ -	$ 0.28	$ -	$ 0.50	$ -	$ 0.78	$ -	$ -	$ 12,400	$ 108,000				
Off-Site 68			Backfill Overburden Materials stored in berms - Excavate	21,000	63,000	Non RAD Waste	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305	Excavating, bulk bank measure, 3-1/2 C.Y. capacity = 160 C.Y./hour, backhoe, hydraulic, crawler mounted, excluding truck loading	B12D	2,400	2	3	100%	2.9	8.8	17.5	52.5	$ -	$ 0.40	$ -	$ 1.09	$ -	$ 1.49	$ -	$ -	$ 31,300	$ 93,900				
Off-Site 69	Backfill and Slope Correction	*Backfill Overburden*	*(additional cost to previous line)*	21,000	63,000	Non RAD Waste	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305A	Excavating, bulk bank measure, for loading onto trucks, add	B12D	16,255	2	3	100%	0.4	1.3	2.6	7.8	$ -	$ 0.02	$ -	$ 0.03	$ -	$ 0.22	$ -	$ -	$ 4,620	$ 13,900				
Off-Site 70			Backfill Overburden Materials stored in berms - Haul and Dump	31,500	94,500	Non RAD Waste	L.C.Y.	RS Means, Year 2011 Quarter 1	312323205060	Cycle hauling(wait, load,travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 22 C.Y. truck, cycle 2000 ft, 10 MPH, excludes loading equipment	B34F	594	1	3.5	100%	15.0	45.0	53.0	159.1	$ -	$ 0.68	$ -	$ 2.28	$ -	$ 2.96	$ -	$ -	$ 93,200	$ 280,000				
Off-Site 71			Excavate additional fill material for grading	127,923	159,363	Overburden Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305	Excavating, bulk bank measure, 3-1/2 C.Y. capacity = 160 C.Y./hour, backhoe, hydraulic, crawler mounted, excluding truck loading	B12D	2,400	2	3	100%	17.8	22.1	106.6	132.8	$ -	$ 0.40	$ -	$ 1.09	$ -	$ 1.49	$ -	$ -	$ 191,000	$ 237,000				
Off-Site 72		*Additional Fill*	*(additional cost to previous line)*	127,923	159,363	Overburden Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305A	Excavating, bulk bank measure, for loading onto trucks, add	B12D	16,255	2	3	100%	2.6	3.3	15.7	19.6	$ -	$ 0.02	$ -	$ 0.03	$ -	$ 0.22	$ -	$ -	$ 28,100	$ 35,100				
Off-Site 73			Haul additional fill for grading	159,904	199,204	Overburden Soil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323205110	Cycle hauling(wait, load,travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 22 C.Y. truck, cycle 2 mile, 10 MPH, excludes loading equipment	B34F	374	1	5.6	100%	76.1	94.9	427.5	532.6	$ -	$ 1.09	$ -	$ 3.63	$ -	$ 4.72	$ -	$ -	$ 755,000	$ 940,000				
Off-Site 74			Spread additional fill	159,904	199,204	Overburden Soil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	2	6	100%	26.7	33.2	239.9	298.8	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ 318,000	$ 396,000				
Off-Site 75		*Daily Cover*	Use geotextile as a daily cover for backfill waste to reclaim slopes	33,688	194,117	Geotextile	S.Y.	RS Means, Year 2011 Quarter 1	334626100100	Geotextile Subsurface Drainage Filtration, fabric, laid in trench, polypropylene, ideal conditions	2 Clab	2,400	2	1	100%	14.0	80.9	28.1	161.8	$ 1.63	$ 0.38	$ -	$ -	$ -	$ 2.01	$ 4,350	$ 25,100	$ 72,100	$ 415,000	3	17	6,000	34,000
Off-Site 76			Use geotextile as a daily cover on bermed overburden	5,000	11,111	Geotextile	S.Y.	RS Means, Year 2011 Quarter 1	334626100100	Geotextile Subsurface Drainage Filtration, fabric, laid in trench, polypropylene, ideal conditions	2 Clab	2,400	2	1	100%	2.1	4.6	4.2	9.3	$ 1.63	$ 0.38	$ -	$ -	$ -	$ 2.01	$ 646	$ 1,440	$ 10,700	$ 23,800	1	1	2,000	2,000
Off-Site 77			Purchase clay material	61,537	151,279	Clay Material	B.C.Y.	Local Republic landfill with surplus material												$ 16.88					$ 16.88	$ 82,300	$ 202,000	$ 1,120,000	$ 2,760,000				
Off-Site 78		*Clay*	Deliver clay material to site	86,152	211,791	Clay Material	L.C.Y.	Based on Central Stone estimate				64	1	50	100%	26.9	66.2	1,346	3,309		$ 5.22	$ -	$ 5.22	$ -	$ 10.43	$ -	$ -	$ 899,000	$ 2,210,000	5,385	13,237	376,950	926,590
Off-Site 79			Spread loose lift before compaction	86,152	211,791	Clay Material	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	2	6	100%	14.4	35.3	129.2	317.7	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ 171,000	$ 421,000				
Off-Site 80	Final Cover		Compact Clay (Final Cover)	61,537	151,279	Clay Material	E.C.Y.	RS Means, Year 2011 Quarter 1	312323235720	Compaction, 4 passes, 12" lifts, riding, sheepsfoot or wobbly wheel roller	B10G	2,600	1.5	2	100%	11.8	29.1	35.5	87.3	$ -	$ 0.28	$ -	$ 0.50	$ -	$ 0.78	$ -	$ -	$ 48,000	$ 118,000				
Off-Site 81			Purchase Topsoil	32,008	81,190	Topsoil	B.C.Y.	RS Means, Year 2011 Quarter 1 - Ext. Material O&P												$ 24.94					$ 24.94	$ 63,300	$ 160,000	$ 862,000	$ 2,190,000				
Off-Site 82		*Top Soil*	Deliver Topsoil	40,009	101,487	Topsoil	L.C.Y.	Based on Central Stone estimate				68	1	50	100%	11.8	29.8	588	1,492		$ 4.12	$ -	$ 4.12	$ -	$ 8.24	$ -	$ -	$ 330,000	$ 837,000	2,354	5,970	47,080	119,400
Off-Site 83			Move and place Topsoil (Final Cover)	38,461	94,550	Topsoil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	2	6	100%	6.4	15.8	57.7	141.8	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ 76,500	$ 188,000				
Off-Site 84			Install Terraces	1,549	6,938	Topsoil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	2	1	100%	1.5	6.9	2.3	10.4	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ 3,080	$ 13,800				
Off-Site 85			Construct Ditches	2,630	7,245	Topsoil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316462200	Excavating, bulk, dozer, open site, bank measure, sand and gravel, 80 H.P. dozer, 150' haul	B10L	230	2	2	100%	5.7	15.8	17.2	47.3	$ -	$ 3.18	$ -	$ 2.14	$ -	$ 5.32	$ -	$ -	$ 14,000	$ 38,500				

Construction Cost Estimate -
"Complete Rad Removal" with Off-site Disposal Alternative

Step #	Category	Sub-Category	Task	Quantity: Off-Site Area 1	Quantity: Off-Site Area 2	Type of Material Handled	Units	Source of Costing Estimate	RS Means Reference #	RS Means Description	Crew Type	Daily Unit Rate of Constr-uction	Crew Size (Men)	Number of Crews	Effic-iency Factor	Construction (Days): Off-Site Area 1	Construction (Days): Off-Site Area 2	Crew Man-days: Off-Site Area 1	Crew Man-days: Off-Site Area 2	Unit Costs: Extended Material Overhead and Profit	Unit Costs: Extended Labor Overhead and Profit	Unit Costs: Extended Labor Overhead and Profit - Ineffeciency	Unit Costs: Extended Equipment Overhead and Profit	Unit Costs: Extended Equipment Overhead and Profit - Ineffeciency	Unit Costs: Extended Total Overhead and Profit	Material Taxes at Bridgeton (7.925%): Off-Site Area 1	Material Taxes at Bridgeton (7.925%): Off-Site Area 2	Total Cost for Line Item: Off-Site Area 1	Total Cost for Line Item: Off-Site Area 2	Truckloads for Delivery: Off-Site Area 1	Truckloads for Delivery: Off-Site Area 2	Total Miles for Delivery: Off-Site Area 1	Total Miles for Delivery: Off-Site Area 2
Off-Site 86	**Stormwater Controls (for stormwater after cover is constructed)**	*Pond*	Load Overburden Material from stockpile to off road haul truck for pond	4,023	7,944	Overburden Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305	Excavating, bulk bank measure, 3-1/2 C.Y. capacity = 160 C.Y./hour, backhoe, hydraulic, crawler mounted, excluding truck loading	B12D	2,400	2	3	100%	0.6	1.1	3.4	6.6	$ -	$ 0.40	$ -	$ 1.09	$ -	$ 1.49	$ -	$ -	$ 5,990	$ 11,800				
Off-Site 87			*(additional cost to previous line)*	4,023	7,944	Overburden Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305A	Excavating, bulk bank measure, for loading onto trucks, add	B12D	16,255	2	3	100%	0.1	0.2	0.5	1.0	$ -	$ 0.02	$ -	$ 0.03	$ -	$ 0.22	$ -	$ -	$ 885	$ 1,750				
Off-Site 88			Haul loose lift soil for Pond	5,632	11,122	Overburden Soil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323205060	Cycle hauling(wait, load,travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 22 C.Y. truck, cycle 2000 ft, 10 MPH, excludes loading equipment	B34F	594	1	3.5	100%	2.7	5.3	9.5	18.7	$ -	$ 0.68	$ -	$ 2.28	$ -	$ 2.96	$ -	$ -	$ 16,700	$ 32,900				
Off-Site 89			Spread loose lift before compaction (Pond)	5,632	11,122	Overburden Soil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	2	6	100%	0.9	1.9	8.4	16.7	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ 11,200	$ 22,100				
Off-Site 90			Compact Berm (Pond)	4,023	7,944	Overburden Soil	E.C.Y.	RS Means, Year 2011 Quarter 1	312323235060	Compaction, riding, vibrating roller, 2 passes, 12" lifts	B10Y	5,200	2	2	100%	0.4	0.8	1.2	2.3	$ -	$ 0.14	$ -	$ 0.12	$ -	$ 0.26	$ -	$ -	$ 1,050	$ 2,070				
Off-Site 91			Final Stormwater Controls	-	2,332	Riprap	S.Y.	RS Means, Year 2011 Quarter 1	313713100110	Rip-rap and rock lining, random, broken stone, 3/8 to 1/4 C.Y. pieces, machine placed for slope protection, grouted	B13	80	7	3	100%	-	9.7	-	204.0	$ 71.05	$ 38.47	$ -	$ 11.19	$ -	$ 120.71	$ -	$ 13,100	$ -	$ 295,000				
Off-Site 92	**Site Completion**		Apply seeding to cover	1,051	2,653	Seeding	M.S.F.	RS Means, Year 2011 Quarter 1	329219142400	Seeding athletic fields, seeding fescue, tall with mulch and fertilizer, 5.5 lb. per M.S.F., hydro/air seeding	B81	80	3	1	100%	13.1	33.2	39.4	99.5	$ 40.82	$ 16.91	$ -	$ 8.31	$ -	$ 66.04	$ 3,400	$ 8,580	$ 72,800	$ 184,000				
Off-Site 93			Apply seeding to soil stockpile	790		Seeding	M.S.F.	RS Means, Year 2011 Quarter 1	329219142400	Seeding athletic fields, seeding fescue, tall with mulch and fertilizer, 5.5 lb. per M.S.F., hydro/air seeding	B81	80	3	1	100%	9.9	-	29.6	-	$ 40.82	$ 16.91	$ -	$ 8.31	$ -	$ 66.04	$ 2,550	$ -	$ 54,700	$ -				
Off-Site 94			Install temporary irrigation system	87,550	221,114	Irrigation System	S.F.	RS Means, Year 2011 Quarter 1	328423100800	Underground sprinklers irrigation system, for lawns, residential system, custom, 1" supply	B20	2,000	3	10	100%	4.4	11.1	131.3	331.7	$ 0.33	$ 0.70	$ -	$ -	$ -	$ 1.03	$ 2,290	$ 5,780	$ 92,500	$ 234,000				
Off-Site 95			Install Fencing	4,078	8,285	Fencing	L.F.	RS Means, Year 2011 Quarter 1	323113200920	Fence, chain link industrial, galvanized steel, 6 ga. wire, 2-1/2" posts @ 10' OC, 8' high, includes excavation, in concrete, excludes barbed wire	B80C	180	3	2	100%	11.3	23.0	68.0	138.1	$ 29.40	$ 6.78	$ -	$ 1.18	$ -	$ 37.36	$ 9,500	$ 19,300	$ 162,000	$ 329,000				
																										Totals		***Totals***		***Totals***		***Totals***	
																										$ 200,000	$ 460,000	$ 25,100,000	$ 141,000,000	10,000	34,000	492,000	1,394,000
																										$	**661,000**	**$**	**166,000,000**		**44,000**		**1,886,000**

Off-site Transportation Costs at $150/lcy	$ 8,290,000	$ 74,700,000	$ 82,990,000
Off-site Disposal Costs at $85/lcy	$ 4,700,000	$ 42,400,000	$ 47,100,000
On-Site Costs	$ 12,100,000	$ 24,200,000	$ 36,300,000
		Total Construction:	**$ 166,390,000**

Radiological Survey Costs
"Complete Rad Removal" with Off-site Disposal Alternative

Indirect Labor Ratio	1.6
Number of Years	3.0
Number of Days for OS1A	250
Number of Days for OSL	250
Number of OS2 days	5
Number of OS5 days	19
Number of OS5A days	100
Number of OS5B days	240

Total Estimated Costs for Radiological Survey and Health & Safety Support

Total Labor Cost	$2,893,000
Total Capital Cost	$158,000
Total Expendable Cost	$219,000
Total	**$3,270,000**

3/3/2014	Estimated Start Date
2/15/2017	Estimated End Date
1,080	No. of calendar days
3.0	No. years
771	No. of working days

Estimated Labor Costs	Teams	# Days	Personnel Description	Cost/day*	Notes:
	OS1	Note 1	Safety Manager	Hire these three for	Manage all Safety Activities
$1,301,918			Rad Supervisor	$275,000/yr	Supervise Rad Activities, Conduct Rad Worker Orientation for non-Rad workers; Perform Toxicity Monitoring
			Sr Rad Tech**		Run Dosimetry Program; Environmental Monitoring - Collect samples and deliver to outside lab; Maintain records
$1,480	OS1A	Note 2	Rad Tech	$800	Run personal air sampling program; Available for decon, distributing protective clothing, assist with survey vehicle moving on-site
$370,000			Rad Tech	$680	Control entry/exit for contaminated areas
$1,750	OSL	Note 3	Lab Supervisor	$1,000	Run On-site Laboratory
$437,500			Lab Tech	$750	Conduct detailed activities at On-site laboratory
$1,480	OS2	Note 4	Sr Rad Tech	$800	Final Survey for Buffer/Crossroads property after RIM relocated
$7,400			Rad Tech	$680	Final Survey for Buffer/Crossroads property after RIM relocated
$3,540	OS5	Note 5	Sr Rad Tech	$800	Survey while moving RIM Area 1; Conduct Final Survey
$67,260			Rad Tech	$680	Survey while moving RIM Area 1; Conduct Final Survey
			Rad Tech	$680	Survey while moving RIM Area 1; Conduct Final Survey
			Rad Tech	$680	Survey Trucks loaded with RIM Area 1; Conduct final survey
			Lab Tech	$700	Process additional sample from survey during RIM moving and Survey
$3,540	OS5A	Note 6	Sr Rad Tech	$800	Survey while moving RIM Area 2; Conduct Final Survey
$354,000			Rad Tech	$680	Survey while moving RIM Area 2; Conduct Final Survey
			Rad Tech	$680	Survey while moving RIM Area 2; Conduct Final Survey
			Rad Tech	$680	Survey Trucks loaded with RIM Area 2; Conduct final survey
			Lab Tech	$700	Process additional sample from survey during RIM moving and Survey
$1,480	OS5B	Note 7	Sr Rad Tech	$800	Survey while moving RIM to Rail Location
$355,200			Rad Tech	$680	Survey while moving RIM to Rail Location

$2,893,000 Total Estimated Labor Costs during Construction

Note 1	From beginning to end of Environmental Monitoring Program ~3 years (770 work days)
Note 2	From beginning of moving overburden to end of moving RIM off-site
Note 3	From beginning of moving overburden to end of final survey
Note 4	From time after all RIM has been removed from Buffer Zone/Crossroad Property until Final Survey is complete; estimate 5 days
Note 5	Survey while RIM is being moved ~12 Days + Final survey 7 days = 19 work days tota
Note 6	Survey while RIM is being moved ~87 Days + Final survey 13 days = 100 work days tota
Note 7	Survey while moving RIM to rail location

* Includes per diem at $150/day (except salaried)

Estimate of Non-Labor Costs

Item	Capital/set-up Costs ($)	Expendable Costs: Recurring Rate ($)	Units	Number	Expendable Costs ($)
Rad survey instruments (18) - Different types needed	$45,000	$500	month	30	$15,000
Check sources	$1,000				
Rent special survey equipment (30 days @ $200/day)	$6,000				
Toxic Gas monitors (2)	$5,000				
Dosimetry Program: All long term workers need (25 people @$20/badge)	$500	$50	month	36	$1,800
Disposable clothing Need until RIM covered (60 sets/day?)		$150	day	500	$75,000
Other PPE (e.g., safety glasses @ $5)	$400				
Lab Equipment	$100,000				
Lab operation		$100	day	500	$50,000
Misc cost		$100	day	770	$77,000
Total Estimated Non-Labor Costs:	**$157,900**				**$218,800**

Environmental Monitoring Costs
"Complete Rad Removal" with Off-site Disposal Alternative

Item	Number	Cost	Shipping	Total Capital	Annual Cost
HI-Q's Polyurethane Foam (PUF) air sampling system Model 3300	15	$3,205	$100	$49,575	
Calibrator for PUP Sampler	1	$560	$15	$575	
Adapter Plate	1	$85	$10	$95	
Diversified Research ALPHA II® Continuous Radon Monitor	15	$1,775	$25	$27,000	
Install AC electrical service to all stations (lineal ft)	10,868	$25		$271,700	
Monitoring Station Foundation / Supports (assume will not be moved)	15	$2,000		$30,000	
Items requiring periodic replacement					
Environmental dosimeters 1/qtr/station	60	$30			$1,800
Kidde 442020 Radon Gas Detection Test Kit (1 kit/month/station)	180	$25			$4,500
Expendables					
Particulate air sample media Boxes of 100	10	$89	$5		$940
Toxic organic sample media Boxes of 10	75	$32	$5		$2,775
Lab services					
Analyze organic vapor filters (once per week per station)	780	$120			$93,600
Calibration Cost					
Air Samplers 1/yr	15	$100	$50		$2,250
Radon monitors 1/yr	15	$100	$25		$1,875
Labor					
Assume 2 man days/wk	16	$90			$1,440
	Subtotal - Capital			**$379,000**	
	Subtotal - Annual Expendables/Labor				**$109,000**

Capital Cost Estimate - Long-Term Monitoring
"Complete Rad Removal" with Off-site Disposal Alternative

Description	Quantity	Units	Unit Rate	Estimated Cost ($)
Secure easements	1	LS	2,000	2,000
Landfill Gas:				
Driller: Install radon/landfill gas monitoring probes, MDNR "Code Wells"; 10' dee	31	each	1,850	57,400
Misc. wellhead sampling fittings and lock:	31	each	40	1,200
Field technician observation during drilling and construction of probe	140	hour	90	12,600
Mileage for field technician during probe constructio	1,600	mile	0.51	800
Multi-gas detector (e.g., Industrial Scientific iBri™ MX6), incl regulator, tubing, calbrtn ga:	1	LS	4,400	4,400
Portable radon gas monitor and detector (e.g., Pylon AB6 monitor w/ 300A detect	1	LS	8,250	8,300
Groundwater:				
Recondition and purge existing groundwater monitoring wel	16	each	500	8,000
Flat-bottom polyethylene tank to store purge water prior to dispos	1,500	gallon	2	3,000
Estimated Long-term Monitoring Capital Costs - Total				**98,000**

Post-Construction Baseline Monitoring Cost Estimate
"Complete Rad Removal" with Off-site Disposal Alternative

(Radon in Subsurface Landfill Gas)

Description	Quantity	Units	Unit Rate	Estimated Cost ($)
Subsurface Gas (Radon):				
Number of Subsurface Gas Monitoring Wells	*31*			
Labor - field techniciar	9	hour	90	810
Field vehicle	1	day	120	120
Replacement radon detector (Pylon 300A	1	each	550	550
Data managemen	1	hour	100	100
Reporting	4	hour	130	520
Estimated Subsurface Gas (Radon) Monitoring Costs - Total				**2,100**

Capital Cost Estimate - Amend Existing/Additional Institutional Controls
"Complete Rad Removal" with Off-site Disposal Alternative

Description	Quantity	Units	Unit Rate	Estimated Cost
Prepare Institutional Controls planning documents	1	LS	10,000	10,000
Attorney labor: prepare draft amended existing and additional ICs	1	LS	20,000	20,000
Review of draft documents	1	LS	5,000	5,000
Revise amended and additional Institutional Controls documents	1	LS	10,000	10,000
Filings and registrations	1	LS	5,000	5,000
Estimated Institutional Controls Capital Costs - Total				**50,000**

Long-Term Post-Construction Monitoring (per event) Cost Estimate
"Complete Rad Removal" with Off-site Disposal Alternative

(Landfill Gas, Groundwater, and Surface Water Monitoring and Annual Post-Construction Site Inspections)

Description	**Analytical Method**	**Quantity**	**Units**	**Unit Rate ($)**	**Estimated Cost ($)**
Landfill Gas:					
Number of Landfill Gas Monitoring Wells		*31*			
Labor - field technician		9	hour	90	810
Field vehicle		1	day	120	120
Calibration gas for multi-gas detector		1	each	330	330
Data management		2	hour	100	200
Reporting		8	hour	130	1,040
Estimated Landfill Gas Monitoring Costs - Subtotal					2,500
Contingency			*%*	*20*	*500*
Estimated Landfill Gas Monitoring Costs - Total (per Event)					**3,000**
Groundwater and Surface Water:					
Number of Samples:			*For VOCs*		
Investigative Groundwater		*16*	*16*		
Investigative Surface Water		*2*	*2*		
Field Duplicates (one per every 10 investigative samples)		*2*	*2*		
Trip blank (one per day per cooler)			*5*		
Matrix Spike			*1*		
Matrix Spike Duplicate			*1*		
Sub-total number of unfiltered samples:		*20*	*27*		
Sub-total number of filtered samples for radionuclide and metals analyses:		*20*			
Total number of samples:		*40*	*27*		
Labor:					
Labor - field technicians (2 people, 4 sample locations/day)		81	hour	90	7,290
Materials and equipment:					
Sample kits, incl. filters		18	each	50	900
Field instrumentation and flowcell rental - groundwater		5	day	100	500
Field Vehicle		5	day	120	600
Overnight shipping of sample coolers (assume 1 per day to rad lab)		5	coolers	100	500
Delivery of sample coolers to local lab (2 to 3 coolers per day)		5	hour	90	450
Disposal of purge water (assumes PE tank previously purchased is onsite):					
Vacuum truck		4	hour	200	800
Transportation and disposal (assumes approx 25 gal per well per event)		400	gallon	2.00	800
Laboratory Sample Analysis:					
Gross alpha and beta	EPA 900.0	40	each	50	2,000
Uranium-234, 235, 238	EML U-02 Mod	40	each	100	4,000
Thorium-228, 230, 232	EML Th-01 Mod	40	each	100	4,000
Radium 228	EPA 904.0	40	each	85	3,400
Radium 226	EPA 903.0 Mod	40	each	85	3,400
Radon 222 - 72 hr hold time	SM 20th ED 7500-Rn B	40	each	85	3,400
Volatile Organic Compounds [VOCs] (GC/MS)	8260B	27	each	110	2,970
Semivolatile Organic Compounds [SVOCs] (GC/MS)	8270C	40	each	220	8,800
22 Metals Target Analyte List (ICP/AES)	6010B	40	each	115	4,600
Mercury (CVAA)	7470A	40	each	35	1,400
4 Anions (IC) - Bromide, Chloride, Fluoride, Sulfate	300.0	40	each	72	2,880
2 Anions (IC) - Nitrate, Nitrite - 48 hr hold time	300.0	40	each	36	1,440
Sulfide, Total	SM 4500 S2 D	40	each	35	1,400
Phosphorus, Total	365.1	40	each	40	1,600
Organic carbon, Total (TOC)	SM 5310B	40	each	40	1,600
Total Alkalinity, Carbonate, Bicarbonate	SM 2320B	40	each	20	800
Nitrogen, Ammonia	350.1	40	each	25	1,000
Level IV data deliverable		$ 48,690	%	10%	4,870
Data validation (assumes validation of 100% of Level IV data will be required)		66	DVR	100	6,600
Data management		6	SDG	100	600
Reporting		40	hour	130	5,200
Estimated Groundwater and Surface Water Monitoring Costs - Subtotal					77,800
Contingency			*%*	*20*	*15,600*
Estimated Groundwater and Surface Water Monitoring Costs - Total (per Event)					**93,000**

DVR = data validation report
SDG = sample delivery group

Annual Post-Construction Site Inspections					
Labor - Engineer		9	hour	130	1,170
Field vehicle		1	day	120	120
Site Inspection Report		8	hour	130	1,040
Estimated Annual Post-Construction Site Inspections Costs - Subtotal					2,300
Contingency			*%*	*20*	*500*
Estimated Annual Post-Construction Site Inspections Costs - Total					**2,800**

Operation and Maintenance Cost Estimate - Cover System Maintenance
"Complete Rad Removal" with Off-site Disposal Alternative

Description	Quantity	Units	Unit Rate	Estimated Cost
Mowing; tractor w/ rotary mower (once/year)	57.0	acre	40.00	2,300
Fill depressions in cover w/ topsoil, assume 1% of area; 6 inches dee	460	bcy	37.53	17,300
Seeding of filled are	24.8	M.S.F.	66.04	1,600
Estimated Cover System O&M Costs - Subtotal				21,200
Contingency		*%*	*20*	*4,200*
Estimated Annual Cover Maintenance O&M Costs - Total				**25,400**

M.S.F. = 1,000 square feet

Operation and Maintenance Cost Estimate - 5 year Review
"Complete Rad Removal" with Off-site Disposal Alternative

Description	Quantity	Units	Unit Rate	Estimated Cost ($)
Access Restrictions (inspect/repair fencing and signage	16	hours	130	2,100
Institutional Controls verificatio	8	hours	130	1,000
Document that landfill cover is effectiv	8	hours	130	1,000
Assemble Monitoring Data (landfill gas/radon, groundwater, surface wate	40	hours	130	5,200
Summarize Annual Post-Construction Site Inspection	8	hours	130	1,000
Summarize Annual Cover Maintenance Documentatic	8	hours	130	1,000
Water supply well inventory reviev	8	hours	130	1,000
Document any changes in Land Use at and around West Lake Landf	16	hours	130	2,100
Prepare Summary Repor	80	hours	130	10,400
Estimated 5-year Maint/Review O&M Costs - Subtotal				**25,000**
Contingency		*%*	*20*	*5,000*
Estimated 5-year Maintenance O&M Costs - Total				**30,000**

Cost Estimates for the
“Complete Rad Removal” with Off-Site Disposal Alternative

($295/lcy disposal cost)

Present Worth Cost Estimate (30 years)
"Complete Rad Removal" with Off-site Disposal Alternative ($295/lcy disposal cost)

			Capital Costs ($)		Operation, Maintenance, and Monitoring Costs ($/yr)									
Year	*n*	P/F(*i*=2.3%)	"Complete Rad Removal" with Off-site Disposal	Subtotal Capital Costs	Environmental Monitoring	Landfill Gas Monitoring	Groundwater/ Surface Water Monitoring	Annual Site Inspection/Cover Maintenance	5 year Review	Subtotal O&M Costs	Total Costs ($)	Cumulative Total Costs ($)	Present Worth of Annual Costs ($)	Cumulative Present Worth ($)
2013	0	1.00000	4,960,000	4,960,000	91,000		93,000			184,000	5,144,000	5,144,000	5,144,000	5,144,000
2014	1	0.97752	67,500,000	67,500,000	109,000		93,000			202,000	67,702,000	72,846,000	66,180,000	71,324,000
2015	2	0.95554	302,120,000	302,120,000	109,000		93,000			202,000	302,322,000	375,168,000	288,881,000	360,205,000
2016	3	0.93406	37,850,000	37,850,000	109,000		93,000			202,000	38,052,000	413,220,000	35,543,000	395,748,000
2017	4	0.91306	2,200,000	2,200,000	18,000	9,000	279,000	28,000		334,000	2,534,000	415,754,000	2,314,000	398,062,000
2018	5	0.89253				12,000	372,000	28,000		412,000	412,000	416,166,000	368,000	398,430,000
2019	6	0.87246				12,000	372,000	28,000		412,000	412,000	416,578,000	359,000	398,789,000
2020	7	0.85285				12,000	279,000	28,000		319,000	319,000	416,897,000	272,000	399,061,000
2021	8	0.83367				12,000	186,000	28,000	30,000	256,000	256,000	417,153,000	213,000	399,274,000
2022	9	0.81493				12,000		28,000		40,000	40,000	417,193,000	33,000	399,307,000
2023	10	0.79661				12,000	186,000	28,000		226,000	226,000	417,419,000	180,000	399,487,000
2024	11	0.77870				12,000		28,000		40,000	40,000	417,459,000	31,000	399,518,000
2025	12	0.76119				12,000	93,000	28,000		133,000	133,000	417,592,000	101,000	399,619,000
2026	13	0.74408				12,000		28,000	30,000	70,000	70,000	417,662,000	52,000	399,671,000
2027	14	0.72735				12,000	93,000	28,000		133,000	133,000	417,795,000	97,000	399,768,000
2028	15	0.71099				12,000		28,000		40,000	40,000	417,835,000	28,000	399,796,000
2029	16	0.69501				12,000	93,000	28,000		133,000	133,000	417,968,000	92,000	399,888,000
2030	17	0.67938				12,000		28,000		40,000	40,000	418,008,000	27,000	399,915,000
2031	18	0.66411				12,000	93,000	28,000	30,000	163,000	163,000	418,171,000	108,000	400,023,000
2032	19	0.64918				12,000		28,000		40,000	40,000	418,211,000	26,000	400,049,000
2033	20	0.63458				12,000	93,000	28,000		133,000	133,000	418,344,000	84,000	400,133,000
2034	21	0.62031				12,000		28,000		40,000	40,000	418,384,000	25,000	400,158,000
2035	22	0.60637				12,000	93,000	28,000		133,000	133,000	418,517,000	81,000	400,239,000
2036	23	0.59273				12,000		28,000	30,000	70,000	70,000	418,587,000	41,000	400,280,000
2037	24	0.57941				12,000	93,000	28,000		133,000	133,000	418,720,000	77,000	400,357,000
2038	25	0.56638				12,000		28,000		40,000	40,000	418,760,000	23,000	400,380,000
2039	26	0.55365				12,000	93,000	28,000		133,000	133,000	418,893,000	74,000	400,454,000
2040	27	0.54120				12,000		28,000		40,000	40,000	418,933,000	22,000	400,476,000
2041	28	0.52903				12,000	93,000	28,000	30,000	163,000	163,000	419,096,000	86,000	400,562,000
2042	29	0.51714				12,000		28,000		40,000	40,000	419,136,000	21,000	400,583,000

Estimated Non-discounted Total Costs: 419,000,000

Estimated 30-year Present Worth Costs 401,000,000

The information in this cost estimate summary is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. In accordance with USEPA Guidance, this is an order-of-magnitude engineering estimate that is expected to be within -30 to +50 percent of the actual project cost.

Present Worth Cost Estimate (1,000 years)
"Complete Rad Removal" with Off-site Disposal Alternative ($295/lcy disposal cost)

			Capital Costs ($)		Operation, Maintenance, and Monitoring Costs ($/yr)								
Year	*n*	P/F(*i* =2.3%)	"Complete Rad Removal" with Off-site Disposal	Subtotal Capital Costs	Environmental Monitoring	Landfill Gas Monitoring	Groundwater/ Surface Water Monitoring	Annual Site Inspection/Cover Maintenance	5 year Review	Subtotal O&M Costs	Total Costs ($)	Present Worth of Costs ($)	Cumulative Present Worth ($)
2013	0	1.00000	4,960,000	4,960,000	91,000					91,000	5,051,000	5,051,000	5,051,000
2014	1	0.97752	67,500,000	67,500,000	109,000					109,000	67,609,000	66,089,000	71,140,000
2015	2	0.95554	302,120,000	302,120,000	109,000					109,000	302,229,000	288,792,000	359,932,000
2016	3	0.93406	37,850,000	37,850,000	109,000					109,000	37,959,000	35,456,000	395,388,000
2017	4	0.91306	2,200,000	2,200,000	18,000	9,000	279,000	28,000		334,000	2,534,000	2,314,000	397,702,000
2018	5	0.89253				12,000	372,000	28,000		412,000	412,000	368,000	398,070,000
2019	6	0.87246				12,000	372,000	28,000		412,000	412,000	359,000	398,429,000
2020	7	0.85285				12,000	279,000	28,000		319,000	319,000	272,000	398,701,000
2021	8	0.83367				12,000	186,000	28,000	30,000	256,000	256,000	213,000	398,914,000
2022	9	0.81493				12,000		28,000		40,000	40,000	33,000	398,947,000
2023	10	0.79661				12,000	186,000	28,000		226,000	226,000	180,000	399,127,000
2024	11	0.77870				12,000		28,000		40,000	40,000	31,000	399,158,000
2025	12	0.76119				12,000	93,000	28,000		133,000	133,000	101,000	399,259,000
2026	13	0.74408				12,000		28,000	30,000	70,000	70,000	52,000	399,311,000
2027	14	0.72735				12,000	93,000	28,000		133,000	133,000	97,000	399,408,000
2028	15	0.71099				12,000		28,000		40,000	40,000	28,000	399,436,000
2029	16	0.69501				12,000	93,000	28,000		133,000	133,000	92,000	399,528,000
2030	17	0.67938				12,000		28,000		40,000	40,000	27,000	399,555,000
2031	18	0.66411				12,000	93,000	28,000	30,000	163,000	163,000	108,000	399,663,000
2032	19	0.64918				12,000		28,000		40,000	40,000	26,000	399,689,000
2033	20	0.63458				12,000	93,000	28,000		133,000	133,000	84,000	399,773,000
2034	21	0.62031				12,000		28,000		40,000	40,000	25,000	399,798,000
2035	22	0.60637				12,000	93,000	28,000		133,000	133,000	81,000	399,879,000
2036	23	0.59273				12,000		28,000	30,000	70,000	70,000	41,000	399,920,000
2037	24	0.57941				12,000	93,000	28,000		133,000	133,000	77,000	399,997,000
2038	25	0.56638				12,000		28,000		40,000	40,000	23,000	400,020,000
2039	26	0.55365				12,000	93,000	28,000		133,000	133,000	74,000	400,094,000
2040	27	0.54120				12,000		28,000		40,000	40,000	22,000	400,116,000
2041	28	0.52903				12,000	93,000	28,000	30,000	163,000	163,000	86,000	400,202,000
2042	29	0.51714				12,000		28,000		40,000	40,000	21,000	400,223,000
3012	999	0.00000				12,000		28,000		40,000	40,000	0	402,299,000

Estimated Non-discounted Total Costs: 508,000,000

Estimated 1,000-year Present Worth Costs: 402,000,000

The information in this cost estimate summary is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. In accordance with USEPA Guidance, this is an order-of-magnitude engineering estimate that is expected to be within -30 to +50 percent of the actual project cost.

Total Capital Costs

"Complete Rad Removal" with Off-site Disposal Alternative ($295/lcy disposal cost)

Cost Item		Estimated Capital Costs	Allocation to Years (includes indirects and contingencies) 2013	2014	2015	2016	2017	Total
On Site Construction Costs		$ 36,300,000		18,686,000	25,301,000	30,976,000	1,603,000	
Radiological Survey Costs		$ 3,270,000						
Environmental Monitoring Costs		$ 379,000	753,000					753,000
Long-Term Monitoring Facilities		$ 98,000					195,000	195,000
Baseline Monitoring		$ 2,000					3,900	3,900
Institutional Controls		$ 50,000					99,000	99,000
Subtotal		$ 40,100,000						
Project Management	5%	$ 2,005,000						
Engineering Design	6%	$ 2,406,000	4,211,000					4,211,000
Construction Management	6%	$ 2,406,000						
Subtotal Construction Onsite		$ 46,920,000		18,686,000	25,301,000	30,976,000	1,901,000	76,864,000
Offsite Transporation		$ 82,990,000						
Offsite Disposal (@$295/cy)		$ 163,310,000						
Subtotal - Transport/Disposal Offsite		$ 246,300,000		48,817,000	276,815,000	6,873,000		332,505,000
Contingencies:								
Scope (construction onsite)	55%	$ 25,806,000						
Scope (transport/disposal offsite)	15%	$ 36,945,000						
Bid (all activities)	20%	$ 58,644,000						
Subtotal - Contingencies		$ 121,400,000						
Total: "Complete Rad Removal" with Off-site Disposal		$ 414,600,000	4,960,000	67,500,000	302,120,000	37,850,000	2,200,000	414,600,000

Estimated Length Construction 3.0 years

Construction Cost Estimate -
"Complete Rad Removal" with Off-site Disposal Alternative ($295/lcy disposal cost)

				Quantity												Construction (Days)		Crew Man-days		Unit Costs						Material Taxes at Bridgeton (7.925%)		Total Cost for Line Item		Truckloads for Delivery		Total Miles for Delivery	
Step #	Category	Sub-Category	Task	Off-Site Area 1	Off-Site Area 2	Type of Material Handled	Units	Source of Costing Estimate	RS Means Reference #	RS Means Description	Crew Type	Daily Unit Rate of Constr-uction	Crew Size (Men)	Number of Crews	Effic-iency Factor	Off-Site Area 1	Off-Site Area 2	Off-Site Area 1	Off-Site Area 2	Extended Material Overhead and Profit	Extended Labor Overhead and Profit	Extended Labor Overhead and Profit - Ineffeciency	Extended Equipment Overhead and Profit	Extended Equipment Overhead and Profit - Ineffeciency	Extended Total Overhead and Profit	Off-Site Area 1	Off-Site Area 2	Off-Site Area 1	Off-Site Area 2	Off-Site Area 1	Off-Site Area 2	Off-Site Area 1	Off-Site Area 2
Off-Site 1	Temporary Construction Facilities / Utilities / Personnel	Construction Trailers	Capital Expenses	3		Group of Trailers		See separate Assumptions sheet								37.5	-	58.9	-						$ 87,040	$ -	$ -	$ 261,000	$ -	15	-	300	-
Off-Site 2			Operating Expenses	64		Group of Trailers	Months	See separate Assumptions sheet																	$ 2,638	$ -	$ -	$ 168,000	$ -				
Off-Site 3			Parking Area	6,667		Gravel Area	S.Y.	RS Means, Year 2011 Quarter 1	015523500050	Temporary, roads, gravel fill, 4" gravel depth, excl surfacing	B14	715	6	1	100%	9.3	-	55.9	-	$ 4.46	$ 3.97	$ -	$ 0.53	$ -	$ 8.96	$ 2,360	$ -	$ 62,100	$ -				
Off-Site 4			Portable Toilets in Construction areas	13	69	Portable Toilets	Month	RS Means, Year 2011 Quarter 1	015433406420	Rent portable toilet chemical, recycle, flush type, Incl. Hourly Oper. Cost.					100%					$ -	$ -	$ -	$ 281	$ -	$ 281	$ -	$ -	$ 3,720	$ 19,300				
Off-Site 5		Contractor's Construction Management Personnel	Project Manager	154		Personnel	Week	RS Means, Year 2011 Quarter 1	013113200220	Field personnel, project manager, maximum		0.2	1	1	100%	769	-	769	-	$ -	$ 3,650	$ -	$ -	$ -	$ 3,650	$ -	$ -	$ 563,000	$ -				
Off-Site 6			Construction Superintendent(s)	276		Personnel	Week	RS Means, Year 2011 Quarter 1	013113200260	Field personnel, superintendent, average		0.2	1	1	100%	1,377	-	1,377	-	$ -	$ 2,950	$ -	$ -	$ -	$ 2,950	$ -	$ -	$ 815,000	$ -				
Off-Site 7			Clerk(s)	276		Personnel	Week	RS Means, Year 2011 Quarter 1	013113200020	Field Personnel, clerk, average		0.2	1	1	100%	1,377	-	1,377	-	$ -	$ 630	$ -	$ -	$ -	$ 630	$ -	$ -	$ 174,000	$ -				
Off-Site 8			Field Engineer(s) / Safety Officer(s)	276		Personnel	Week	RS Means, Year 2011 Quarter 1	013113200120	Field personnel, field engineer, average		0.2	1	1	100%	1,377	-	1,377	-	$ -	$ 1,950	$ -	$ -	$ -	$ 1,950	$ -	$ -	$ 539,000	$ -				
Off-Site 9	Temporary Stormwater Infrastructure (for stormwater during construction)	Temporary Stormwater Lagoon	Excavate soil for 4th berm at former leachate lagoon area	21,379		Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316464420	Excavating, bulk, dozer, open site, bank measure, common earth, 200 H.P. dozer, 300' push	B10B	270	1.5	4	100%	19.8	-	118.8	-	$ -	$ 2.72	$ -	$ 4.65	$ -	$ 7.37	$ -	$ -	$ 158,000	$ -				
Off-Site 10			Place soil for berm	29,930		Soil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	1.5	2	100%	15.0	-	44.9	-	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ 59,600	$ -				
Off-Site 11			Compact berm	21,379		Soil	E.C.Y.	RS Means, Year 2011 Quarter 1	312323235060	Compaction, riding, vibrating roller, 2 passes, 12" lifts	B10Y	5,200	1.5	2	100%	2.1	-	6.2	-	$ -	$ 0.14	$ -	$ 0.12	$ -	$ 0.26	$ -	$ -	$ 5,560	$ -				
Off-Site 12			Install geomembrane liner	495		60 mil HDPE	M.S.F.	RS Means, Year 2011 Quarter 1	334713531220	Pond and Reservoir Liners, membrane lining systems HDPE, 100,000 S.F. or more, 60 mil thick	3 Skwk	2	3	12	100%	25.8	-	928.1	-	$ 271.46	$ 1,113.15	$ -	$ -	$ -	$ 1,384.61	$ 10,600	$ -	$ 696,000	$ -	5	-	10,000	-
Off-Site 13			Install force main from Areas 1 and 2 to lagoon	3,641	607	HDPE Pipe	L.F.	RS Means, Year 2011 Quarter 1	331113350100	Water supply distribution piping, piping HDPE, butt fusion joints, 40' lengths, 4" diameter, SDR 21	B22A	400	5	1	100%	9.1	1.5	45.5	7.6	$ 3.66	$ 6.46	$ -	$ 1.89	$ -	$ 12.01	$ 1,060	$ 176	$ 44,800	$ 7,470				
Off-Site 14			Install force main from lagoon to treatment facility	551		HDPE Pipe	L.F.	RS Means, Year 2011 Quarter 1	331113350100	Water supply distribution piping, piping HDPE, butt fusion joints, 40' lengths, 4" diameter, SDR 21	B22A	400	5	1	100%	1.4	-	6.9	-	$ 3.66	$ 6.46	$ -	$ 1.89	$ -	$ 12.01	$ 160	$ -	$ 6,780	$ -				
Off-Site 15		Treatment Facility	Construct Treatment Facility	1		Treatment Facility	Each	EMSI Estimate				0.017	7	1	100%	60.0	-	420.0	-						$ 264,000	$ -	$ -	$ 264,000	$ -				
Off-Site 16			Monthly Operation during construction	28		Treatment Facility Operation	Months	EMSI Estimate				0.4	1	1	100%	70.8	-	70.8	-						$ 9,000	$ -	$ -	$ 255,000	$ -				
Off-Site 17		Stormwater events during construction	Dewater construction after rain events	309	759	Construction stormwater	Days of Pumping	RS Means, Year 2011 Quarter 1	312319200650	Dewatering, pumping, 8 hr., attended 2 hours per day, 4" discharge pump used for 8 hours, includes 20 L.F. of suction hose and 100 L.F. of discharge hose	B10I	4	1.5	4	100%	19.3	47.4	115.8	284.6	$ -	$ 183.11	$ -	$ 35.30	$ -	$ 218.41	$ -	$ -	$ 67,400	$ 166,000				
Off-Site 18			Dispose of contact stormwater to MSD	1,500,000	3,000,000	Contact stormwater	Gallons	Metropolitan St. Louis Sewer District, May 2011							100%										$ 0.0028	$ -	$ -	$ 4,230	$ 8,460				
Off-Site 19		Post-project Stormwater Demolition	Dispose of geomembrane liner in Area 1 or 2	495		60 mil HDPE	M.S.F.	Estimating $.40/sf				20	3	1	100%	24.8	-	74.3	-						$ 400	$ -	$ -	$ 198,000	$ -				
Off-Site 20			Deconstruct 4th berm	21,379		Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316464420	Excavating, bulk, dozer, open site, bank measure, common earth, 200 H.P. dozer, 300' push	B10B	270	1.5	4	100%	19.8	-	118.8	-	$ -	$ 2.72	$ -	$ 4.65	$ -	$ 7.37	$ -	$ -	$ 158,000	$ -				
Off-Site 21			Grade berm material in lagoon for proper drainage	29,930		Soil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	1.5	2	100%	15.0	-	44.9	-	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ 59,600	$ -				
Off-Site 22	Site-wide Preparation	Mobilization	Mobilize and Demobilize Equipment Under 150HP	8		Units of Equipment up to 150HP (up to 50 miles)	Ea.	RS Means, Year 2011 Quarter 1	015436500020	Mobilization or demobilization, dozer, loader, backhoe or excavator, 70 H.P. to 150 H.P., up to 50 miles	B34N	4	1	1	100%	2.0	-	2.0	-	$ -	$ 112.25	$ -	$ 139.01	$ -	$ 251.26	$ -	$ -	$ 2,010	$ -				
Off-Site 23			*Extra Mileage for Mobilizations*	80		Per 5 additional miles		RS Means, Year 2011 Quarter 1	015436500020A	Mobilization or demobilization, each additional 5 miles haul distance, add	B34N	72	1	1	100%	1.1	-	1.1	-	$ -	$ 11.23	$ -	$ 13.90	$ -	$ 25.12	$ -	$ -	$ 2,010	$ -				
Off-Site 24			Mobilize and Demobilize Equipment Over 150HP	56		Units of Equipment over 150HP (up to 50 miles)	Ea.	RS Means, Year 2011 Quarter 1	015436500100	Mobilization or demobilization, dozer, loader, backhoe or excavator, above 150 H.P., up to 50 miles	B34K	3	1	1	100%	18.7	-	18.7	-	$ -	$ 148.59	$ -	$ 309.51	$ -	$ 458.10	$ -	$ -	$ 25,700	$ -				
Off-Site 25			*Extra Mileage for Mobilizations*	560		Per 5 additional miles		RS Means, Year 2011 Quarter 1	015436500100A	Mobilization or demobilization, each additional 5 miles haul distance, add	B34K	72	1	1	100%	7.8	-	7.8	-	$ -	$ 14.86	$ -	$ 30.95	$ -	$ 45.81	$ -	$ -	$ 25,700	$ -				
Off-Site 26			Mobilize and Demobilize Equipment, Towed	4		Units of Towed Equipment (up to 50 miles)	Ea.	RS Means, Year 2011 Quarter 1	015436500300	Mobilization or demobilization, scraper, towed type (including tractor), 6 C.Y. capacity, up to 50 miles	B34K	3	1	1	100%	1.3	-	1.3	-	$ -	$ 148.59	$ -	$ 309.51	$ -	$ 458.10	$ -	$ -	$ 1,830	$ -				
Off-Site 27			*Extra Mileage for Mobilizations*	40		Per 5 additional miles		RS Means, Year 2011 Quarter 1	015436500300A	Mobilization or demobilization, each additional 5 miles haul distance, add	B34K	72	1	1	100%	0.6	-	0.6	-	$ -	$ 14.86	$ -	$ 30.95	$ -	$ 45.81	$ -	$ -	$ 1,830	$ -				
Off-Site 28		Supplemental Mobilizations	Mobilize and Demobilize Equipment Under 150HP	16		Units of Equipment up to 150HP (up to 50 miles)	Ea.	RS Means, Year 2011 Quarter 1	015436500020	Mobilization or demobilization, dozer, loader, backhoe or excavator, 70 H.P. to 150 H.P., up to 50 miles	B34N	4	1	1	100%	4.0	-	4.0	-	$ -	$ 112.25	$ -	$ 139.01	$ -	$ 251.26	$ -	$ -	$ 4,020	$ -				
Off-Site 29			*Extra Mileage for Mobilizations*	160		Per 5 additional miles		RS Means, Year 2011 Quarter 1	015436500020A	Mobilization or demobilization, each additional 5 miles haul distance, add	B34N	72	1	1	100%	2.2	-	2.2	-	$ -	$ 11.23	$ -	$ 13.90	$ -	$ 25.12	$ -	$ -	$ 4,020	$ -				
Off-Site 30			Mobilize and Demobilize Equipment Over 150HP	112		Units of Equipment over 150HP (up to 50 miles)	Ea.	RS Means, Year 2011 Quarter 1	015436500100	Mobilization or demobilization, dozer, loader, backhoe or excavator, above 150 H.P., up to 50 miles	B34K	3	1	1	100%	37.3	-	37.3	-	$ -	$ 148.59	$ -	$ 309.51	$ -	$ 458.10	$ -	$ -	$ 51,300	$ -				

Construction Cost Estimate -
"Complete Rad Removal" with Off-site Disposal Alternative ($295/lcy disposal cost)

Step #	Category	Sub-Category	Task	Quantity: Off-Site Area 1	Quantity: Off-Site Area 2	Type of Material Handled	Units	Source of Costing Estimate	RS Means Reference #	RS Means Description	Crew Type	Daily Unit Rate of Constr-uction	Crew Size (Men)	Number of Crews	Effic-iency Factor	Construction (Days): Off-Site Area 1	Construction (Days): Off-Site Area 2	Crew Man-days: Off-Site Area 1	Crew Man-days: Off-Site Area 2	Unit Costs: Extended Material Overhead and Profit	Unit Costs: Extended Labor Overhead and Profit	Unit Costs: Extended Labor Overhead and Profit - Ineffeciency	Unit Costs: Extended Equipment Overhead and Profit	Unit Costs: Extended Equipment Overhead and Profit - Ineffeciency	Unit Costs: Extended Total Overhead and Profit	Material Taxes at Bridgeton (7.925%): Off-Site Area 1	Material Taxes at Bridgeton (7.925%): Off-Site Area 2	Total Cost for Line Item: Off-Site Area 1	Total Cost for Line Item: Off-Site Area 2	Truckloads for Delivery: Off-Site Area 1	Truckloads for Delivery: Off-Site Area 2	Total Miles for Delivery: Off-Site Area 1	Total Miles for Delivery: Off-Site Area 2
Off-Site 31			*Extra Mileage for Mobilizations*	1,120		Per 5 additional miles		RS Means, Year 2011 Quarter 1	015436500100A	Mobilization or demobilization, each additional 5 miles haul distance, add	B34K	72	1	1	100%	15.6	-	15.6	-	$ -	$ 14.86	$ -	$ 30.95	$ -	$ 45.81	$ -	$ -	$ 51,300	$ -				
Off-Site 32	Site-wide Preparation (cont.)		Mobilize and Demobilize Equipment, Towed	8		Units of Towed Equipment (up to 50 miles)	Ea.	RS Means, Year 2011 Quarter 1	015436500300	Mobilization or demobilization, scraper, towed type (including tractor), 6 C.Y. capacity, up to 50 miles	B34K	3	1	1	100%	2.7	-	2.7	-	$ -	$ 148.59	$ -	$ 309.51	$ -	$ 458.10	$ -	$ -	$ 3,660	$ -				
Off-Site 33			*Extra Mileage for Mobilizations*	80		Per 5 additional miles		RS Means, Year 2011 Quarter 1	015436500300A	Mobilization or demobilization, each additional 5 miles haul distance, add	B34K	72	1	1	100%	1.1	-	1.1	-	$ -	$ 14.86	$ -	$ 30.95	$ -	$ 45.81	$ -	$ -	$ 3,660	$ -				
Off-Site 34			Create Temporary Roads	13,333	26,667	Gravel Roads	S.Y.	RS Means, Year 2011 Quarter 1	015523500050	Temporary, roads, gravel fill, 4" gravel depth, excl surfacing	B14	715	6	1	100%	18.6	37.3	111.9	223.8	$ 4.46	$ 3.97	$ -	$ 0.53	$ -	$ 8.96	$ 4,710	$ 9,430	$ 124,000	$ 248,000				
Off-Site 35			Install TBD Traffic Improvements	$ 100,000	$ 100,000	TBD (shown as budget estimate)	$						6	1	100%	10.0	10.0	60.0	60.0	$ 1.00					$ 1.00	$ 7,930	$ 7,930	$ 108,000	$ 108,000				
Off-Site 36			Water Truck Depreciation	1	2	Water Trucks	Trucks	Estimate																	$ 50,000	$ -	$ -	$ 50,000	$ 100,000				
Off-Site 37			Water Truck Operation	12	65	Water Trucks	Months	Estimate				0.050	1	1	100%	239	1,309	239	1,309						$ 8,000	$ -	$ -	$ 95,400	$ 523,000				
Off-Site 38		*Dust Control*	Use Water to Control Dust	2,390,000	13,100,000	Water	Gal	Missouri American Water Company, 4/20/2011							100%										$ 0.0032	$ -	$ -	$ 7,610	$ 41,700				
Off-Site 39			Prepare area with Stormwater BMPs	4,078	8,285	Silt Fence	L.F.	RS Means, Year 2011 Quarter 1	312514161100	Synthetic erosion control, silt fence, polypropylene, adverse conditions, 3' high	2 Clab	950	2	1	100%	4.3	8.7	8.6	17.4	$ 0.44	$ 0.87	$ -	$ -	$ -	$ 1.31	$ 142	$ 289	$ 5,480	$ 11,100				
Off-Site 40		*Decontamination Areas*	Materials	111	56	Concrete	C.Y.	RS Means, Year 2011 Quarter 1	033105350300	Structural concrete, ready mix, normal weight, 4000 PSI, includes local aggregate, sand, Portland cement and water, delivered, excludes all additives and treatments					100%					$ 105.20					$ 105.20	$ 926	$ 463	$ 12,600	$ 6,310				
Off-Site 41			Installation	111	56	Concrete	C.Y.	RS Means, Year 2011 Quarter 1	33105704650	Structural concrete, placing, slab on grade, pumped, over 6" thick, includes strike off & consolidation, excludes material	C20	185	8	1	100%	0.6	0.3	4.8	2.4	$ -	$ 20.96	$ -	$ 5.08	$ -	$ 26.04	$ -	$ -	$ 2,890	$ 1,450				
Off-Site 42	Site Preparation		Clear Vegetation (Light)	16.0	21.4	Vegetation	Acre	RS Means, Year 2011 Quarter 1	311313101020	Selective tree and shrub removal, selective clearing brush mowing, light density, tractor with rotary mower, excludes removal offsite	B84	2	1	1	100%	8.0	10.7	8.0	10.7	$ -	$ 265.31	$ -	$ 175.93	$ -	$ 441.24	$ -	$ -	$ 7,060	$ 9,440				
Off-Site 43			Clear Vegetation (Heavy)	3.5	27.8	Vegetation	Acre	RS Means, Year 2011 Quarter 1	311110100020	Clearing & grubbing, cut & chip light trees, to 6" diameter	B7	1	6	1	100%	3.5	27.8	21.0	166.8	$ -	$ 2,618.83	$ -	$ 1,574.70	$ -	$ 4,193.53	$ -	$ -	$ 14,700	$ 117,000				
Off-Site 44			Purchase material	2,963	4,444	Soil	B.C.Y.	Local Republic landfill with surplus material												$ 16.88					$ 16.88	$ 3,960	$ 5,940	$ 54,000	$ 80,900				
Off-Site 45		*Berms for Overburden*	Deliver and Stockpile	4,148	6,222	Soil	L.C.Y.	Based on Central Stone estimate				64	1	50	100%	1.3	1.9	64.8	97.2		$ 5.22	$ -	$ 5.22	$ -	$ 10.43	$ -	$ -	$ 43,300	$ 64,900	260	389	18,200	27,230
Off-Site 46			Develop earthen berms to store relocated overburden wastes	4,148	6,222	Soil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	1.5	3	100%	1.4	2.1	6.2	9.3	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ 8,250	$ 12,400				
Off-Site 47			Relocate overburden wastes - Excavate	67,475	408,031	Non RAD Waste	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305	Excavating, bulk bank measure, 3-1/2 C.Y. capacity = 160 C.Y./hour, backhoe, hydraulic, crawler mounted, excluding truck loading	B12D	2,400	2	3	70%	13.4	81.0	80.3	485.8	$ -	$ 0.40	$ 0.17	$ 1.09	$ 0.47	$ 2.13	$ -	$ -	$ 144,000	$ 869,000				
Off-Site 48			*(additional cost to previous line)*	67,475	408,031	Non RAD Waste	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305A	Excavating, bulk bank measure, for loading onto trucks, add	B12D	16,255	2	3	70%	2.0	12.0	11.9	71.7	$ -	$ 0.02	$ 0.01	$ 0.03	$ 0.01	$ 0.24	$ -	$ -	$ 16,300	$ 98,500				
Off-Site 49	Overburden Relocation		Relocate overburden wastes - Haul and Dump	101,213	612,047	Non RAD Waste	L.C.Y.	RS Means, Year 2011 Quarter 1	312323205060	Cycle hauling(wait, load,travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 22 C.Y. truck, cycle 2000 ft, 10 MPH, excludes loading equipment	B34F	594	1	3.5	100%	48.2	291.5	170	1,030	$ -	$ 0.68	$ -	$ 2.28	$ -	$ 2.96	$ -	$ -	$ 300,000	$ 1,810,000				
Off-Site 50			Apply daily cover to relocated overburden wastes	6,748	40,803	Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316462200	Excavating, bulk, dozer, open site, bank measure, sand and gravel, 80 H.P. dozer, 150' haul	B10L	230	1.5	3	100%	9.8	59.1	44	266	$ -	$ 3.18	$ -	$ 2.14	$ -	$ 5.32	$ -	$ -	$ 35,900	$ 217,000				
Off-Site 51			Spread overburden wastes	107,960	652,850	Non RAD Waste	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	1.5	6	100%	18.0	108.8	162	979	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ 215,000	$ 1,300,000				
Off-Site 52			Compact overburden wastes	74,223	448,834	Non RAD Waste	E.C.Y.	RS Means, Year 2011 Quarter 1	312323235720	Compaction, 4 passes, 12" lifts, riding, sheepsfoot or wobbly wheel roller	B10G	2,600	1.5	2	100%	14.3	86.3	43	259	$ -	$ 0.28	$ -	$ 0.50	$ -	$ 0.78	$ -	$ -	$ 57,900	$ 350,000				
Off-Site 53			Apply daily cover to remaining excavation of RIM Wastes	3,350	30,200	Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316462200	Excavating, bulk, dozer, open site, bank measure, sand and gravel, 80 H.P. dozer, 150' haul	B10L	230	1.5	1	100%	14.6	131.3	21.8	197.0	$ -	$ 3.18	$ -	$ 2.14	$ -	$ 5.32	$ -	$ -	$ 17,800	$ 161,000				
Off-Site 54			Relocate RIM Wastes on-site - Excavate	36,850	332,200	RAD Waste	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305	Excavating, bulk bank measure, 3-1/2 C.Y. capacity = 160 C.Y./hour, backhoe, hydraulic, crawler mounted, excluding truck loading	B12D	2,400	2	3	50%	10.2	92.3	61.4	553.7	$ -	$ 0.40	$ 0.40	$ 1.09	$ 1.09	$ 2.98	$ -	$ -	$ 110,000	$ 990,000				
Off-Site 55			*(additional cost to previous line)*	36,850	332,200	RAD Waste	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305A	Excavating, bulk bank measure, for loading onto trucks, add	B12D	16,255	2	3	50%	1.5	13.6	9.1	81.7	$ -	$ 0.02	$ 0.02	$ 0.03	$ 0.03	$ 0.27	$ -	$ -	$ 9,950	$ 89,700				
Off-Site 56	RIM Relocation		Relocate RIM Wastes on-site - Haul and Dump	55,275	498,300	RAD Waste	L.C.Y.	RS Means, Year 2011 Quarter 1	312323205110	Cycle hauling(wait, load,travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 22 C.Y. truck, cycle 2 mile, 10 MPH, excludes loading equipment	B34F	374	1	5.6	100%	26.3	237.3	148	1,332	$ -	$ 1.09	$ -	$ 3.63	$ -	$ 4.72	$ -	$ -	$ 261,000	$ 2,350,000				
Off-Site 57			Transfer RIM Wastes into On-Road Trailers	36,850	332,200	RAD Waste	B.C.Y.	RS Means, Year 2011 Quarter 1	312316421300	Excavating, bulk bank measure, 3 C.Y. capacity = 130 C.Y./hour, front end loader, track mounted, excluding truck loading	B10P	1,040	1.5	4	100%	8.9	79.9	53.1	479.1	$ -	$ 0.70	$ -	$ 1.16	$ -	$ 1.86	$ -	$ -	$ 68,500	$ 618,000				
Off-Site 58			*(additional cost to previous line)*	36,850	332,200	RAD Waste	B.C.Y.	RS Means, Year 2011 Quarter 1	312316421300A	Excavating, bulk bank measure, for loading onto trucks, add	B10P	6,909	1.5	4	100%	1.3	12.0	8.0	72.1	$ -	$ 0.11	$ -	$ 0.17	$ -	$ 0.28	$ -	$ -	$ 10,300	$ 93,000				

Construction Cost Estimate -
"Complete Rad Removal" with Off-site Disposal Alternative ($295/lcy disposal cost)

				Quantity												Construction (Days)		Crew Man-days		Unit Costs						Material Taxes at Bridgeton (7.925%)		Total Cost for Line Item		Truckloads for Delivery		Total Miles for Delivery	
Step #	Category	Sub-Category	Task	Off-Site Area 1	Off-Site Area 2	Type of Material Handled	Units	Source of Costing Estimate	RS Means Reference #	RS Means Description	Crew Type	Daily Unit Rate of Constr-uction	Crew Size (Men)	Number of Crews	Effic-iency Factor	Off-Site Area 1	Off-Site Area 2	Off-Site Area 1	Off-Site Area 2	Extended Material Overhead and Profit	Extended Labor Overhead and Profit	Extended Labor Overhead and Profit - Ineffeciency	Extended Equipment Overhead and Profit	Extended Equipment Overhead and Profit - Ineffeciency	Extended Total Overhead and Profit	Off-Site Area 1	Off-Site Area 2	Off-Site Area 1	Off-Site Area 2	Off-Site Area 1	Off-Site Area 2	Off-Site Area 1	Off-Site Area 2
Off-Site 59			Bag and Transport RIM Wastes to Off-Site Disposal Facility via Rail	55,275	498,300	RAD Waste	L.C.Y.	Off-site Disposal Facility estimate		Load On Highway trucks at the landfill to transport to railspur		2,100	21	1	100%	26.3	237.3	553	4,983						$ 150	$ -	$ -	$ 8,290,000	$ 74,700,000	1,580	14,238	31,600	284,760
Off-Site 60			Off-Site Disposal Facility Disposal Fee	55,275	498,300	RAD Waste	L.C.Y.	Off-site Disposal Facility estimate		Transport gondola cars to disposal site. Includes disposal cost.		2,100	1	1	100%	26.3	237.3	26.3	237.3						$ 295	$ -	$ -	$ 16,306,125	$ 146,998,500				
Off-Site 61	Buffer Zone		Buffer Zone Activity	-	1	See separate Assumptions sheet		See separate Assumptions sheet						1	100%	-	6.6	-	40.3						$ 63,304	$ -	$ -	$ -	$ 63,300				
Off-Site 62	Rad. Survey		Conduct final radiological survey and wait for approval	1	1	This activity is handled by others, and does not have a direct cost to the contractor. However, there are the indirect costs due to the duration and associated waiting.								1	100%	7.0	7.0	-	-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -				
Off-Site 63			Move non-RIM waste to correct slopes in excavation - Excavate	15,915	137,914	Non RAD Waste	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305	Excavating, bulk bank measure, 3-1/2 C.Y. capacity = 160 C.Y./hour, backhoe, hydraulic, crawler mounted, excluding truck loading	B12D	2,400	2	3	100%	2.2	19.2	13.3	114.9	$ -	$ 0.40	$ -	$ 1.09	$ -	$ 1.49	$ -	$ -	$ 23,700	$ 205,000				
Off-Site 64			*(additional cost to previous line)*	15,915	137,914	Non RAD Waste	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305A	Excavating, bulk bank measure, for loading onto trucks, add	B12D	16,255	2	3	100%	0.3	2.8	2.0	17.0	$ -	$ 0.02	$ -	$ 0.03	$ -	$ 0.22	$ -	$ -	$ 3,500	$ 30,300				
Off-Site 65		*Slope Correction Cuts*	Move non-RIM waste to correct slopes in excavation - Haul and Dump	23,873	206,871	Non RAD Waste	L.C.Y.	RS Means, Year 2011 Quarter 1	312323205060	Cycle hauling(wait, load,travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 22 C.Y. truck, cycle 2000 ft, 10 MPH, excludes loading equipment	B34F	594	1	3.5	100%	11.4	98.5	40.2	348.3	$ -	$ 0.68	$ -	$ 2.28	$ -	$ 2.96	$ -	$ -	$ 70,700	$ 612,000				
Off-Site 66			Spread cut material	23,873	206,871	Non RAD Waste	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	2	6	100%	4.0	34.5	35.8	310.3	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ 47,500	$ 412,000				
Off-Site 67			Compact cut material	15,915	137,914	Non RAD Waste	E.C.Y.	RS Means, Year 2011 Quarter 1	312323235720	Compaction, 4 passes, 12" lifts, riding, sheepsfoot or wobbly wheel roller	B10G	2,600	2	2	100%	3.1	26.5	9.2	79.6	$ -	$ 0.28	$ -	$ 0.50	$ -	$ 0.78	$ -	$ -	$ 12,400	$ 108,000				
Off-Site 68			Backfill Overburden Materials stored in berms - Excavate	21,000	63,000	Non RAD Waste	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305	Excavating, bulk bank measure, 3-1/2 C.Y. capacity = 160 C.Y./hour, backhoe, hydraulic, crawler mounted, excluding truck loading	B12D	2,400	2	3	100%	2.9	8.8	17.5	52.5	$ -	$ 0.40	$ -	$ 1.09	$ -	$ 1.49	$ -	$ -	$ 31,300	$ 93,900				
Off-Site 69	Backfill and Slope Correction	*Backfill Overburden*	*(additional cost to previous line)*	21,000	63,000	Non RAD Waste	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305A	Excavating, bulk bank measure, for loading onto trucks, add	B12D	16,255	2	3	100%	0.4	1.3	2.6	7.8	$ -	$ 0.02	$ -	$ 0.03	$ -	$ 0.22	$ -	$ -	$ 4,620	$ 13,900				
Off-Site 70			Backfill Overburden Materials stored in berms - Haul and Dump	31,500	94,500	Non RAD Waste	L.C.Y.	RS Means, Year 2011 Quarter 1	312323205060	Cycle hauling(wait, load,travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 22 C.Y. truck, cycle 2000 ft, 10 MPH, excludes loading equipment	B34F	594	1	3.5	100%	15.0	45.0	53.0	159.1	$ -	$ 0.68	$ -	$ 2.28	$ -	$ 2.96	$ -	$ -	$ 93,200	$ 280,000				
Off-Site 71			Excavate additional fill material for grading	127,923	159,363	Overburden Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305	Excavating, bulk bank measure, 3-1/2 C.Y. capacity = 160 C.Y./hour, backhoe, hydraulic, crawler mounted, excluding truck loading	B12D	2,400	2	3	100%	17.8	22.1	106.6	132.8	$ -	$ 0.40	$ -	$ 1.09	$ -	$ 1.49	$ -	$ -	$ 191,000	$ 237,000				
Off-Site 72		*Additional Fill*	*(additional cost to previous line)*	127,923	159,363	Overburden Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305A	Excavating, bulk bank measure, for loading onto trucks, add	B12D	16,255	2	3	100%	2.6	3.3	15.7	19.6	$ -	$ 0.02	$ -	$ 0.03	$ -	$ 0.22	$ -	$ -	$ 28,100	$ 35,100				
Off-Site 73			Haul additional fill for grading	159,904	199,204	Overburden Soil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323205110	Cycle hauling(wait, load,travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 22 C.Y. truck, cycle 2 mile, 10 MPH, excludes loading equipment	B34F	374	1	5.6	100%	76.1	94.9	427.5	532.6	$ -	$ 1.09	$ -	$ 3.63	$ -	$ 4.72	$ -	$ -	$ 755,000	$ 940,000				
Off-Site 74			Spread additional fill	159,904	199,204	Overburden Soil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	2	6	100%	26.7	33.2	239.9	298.8	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ 318,000	$ 396,000				
Off-Site 75		*Daily Cover*	Use geotextile as a daily cover for backfill waste to reclaim slopes	33,688	194,117	Geotextile	S.Y.	RS Means, Year 2011 Quarter 1	334626100100	Geotextile Subsurface Drainage Filtration, fabric, laid in trench, polypropylene, ideal conditions	2 Clab	2,400	2	1	100%	14.0	80.9	28.1	161.8	$ 1.63	$ 0.38	$ -	$ -	$ -	$ 2.01	$ 4,350	$ 25,100	$ 72,100	$ 415,000	3	17	6,000	34,000
Off-Site 76			Use geotextile as a daily cover on bermed overburden	5,000	11,111	Geotextile	S.Y.	RS Means, Year 2011 Quarter 1	334626100100	Geotextile Subsurface Drainage Filtration, fabric, laid in trench, polypropylene, ideal conditions	2 Clab	2,400	2	1	100%	2.1	4.6	4.2	9.3	$ 1.63	$ 0.38	$ -	$ -	$ -	$ 2.01	$ 646	$ 1,440	$ 10,700	$ 23,800	1	1	2,000	2,000
Off-Site 77			Purchase clay material	61,537	151,279	Clay Material	B.C.Y.	Local Republic landfill with surplus material												$ 16.88					$ 16.88	$ 82,300	$ 202,000	$ 1,120,000	$ 2,760,000				
Off-Site 78		*Clay*	Deliver clay material to site	86,152	211,791	Clay Material	L.C.Y.	Based on Central Stone estimate				64	1	50	100%	26.9	66.2	1,346	3,309		$ 5.22	$ -	$ 5.22	$ -	$ 10.43	$ -	$ -	$ 899,000	$ 2,210,000	5,385	13,237	376,950	926,590
Off-Site 79			Spread loose lift before compaction	86,152	211,791	Clay Material	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	2	6	100%	14.4	35.3	129.2	317.7	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ 171,000	$ 421,000				
Off-Site 80	Final Cover		Compact Clay (Final Cover)	61,537	151,279	Clay Material	E.C.Y.	RS Means, Year 2011 Quarter 1	312323235720	Compaction, 4 passes, 12" lifts, riding, sheepsfoot or wobbly wheel roller	B10G	2,600	1.5	2	100%	11.8	29.1	35.5	87.3	$ -	$ 0.28	$ -	$ 0.50	$ -	$ 0.78	$ -	$ -	$ 48,000	$ 118,000				
Off-Site 81			Purchase Topsoil	32,008	81,190	Topsoil	B.C.Y.	RS Means, Year 2011 Quarter 1 - Ext. Material O&P												$ 24.94					$ 24.94	$ 63,300	$ 160,000	$ 862,000	$ 2,190,000				
Off-Site 82		*Top Soil*	Deliver Topsoil	40,009	101,487	Topsoil	L.C.Y.	Based on Central Stone estimate				68	1	50	100%	11.8	29.8	588	1,492		$ 4.12	$ -	$ 4.12	$ -	$ 8.24	$ -	$ -	$ 330,000	$ 837,000	2,354	5,970	47,080	119,400
Off-Site 83			Move and place Topsoil (Final Cover)	38,461	94,550	Topsoil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	2	6	100%	6.4	15.8	57.7	141.8	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ 76,500	$ 188,000				
Off-Site 84			Install Terraces	1,549	6,938	Topsoil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	2	1	100%	1.5	6.9	2.3	10.4	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ 3,080	$ 13,800				
Off-Site 85			Construct Ditches	2,630	7,245	Topsoil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316462200	Excavating, bulk, dozer, open site, bank measure, sand and gravel, 80 H.P. dozer, 150' haul	B10L	230	2	2	100%	5.7	15.8	17.2	47.3	$ -	$ 3.18	$ -	$ 2.14	$ -	$ 5.32	$ -	$ -	$ 14,000	$ 38,500				

Construction Cost Estimate -
"Complete Rad Removal" with Off-site Disposal Alternative ($295/lcy disposal cost)

Step #	Category	Sub-Category	Task	Quantity: Off-Site Area 1	Quantity: Off-Site Area 2	Type of Material Handled	Units	Source of Costing Estimate	RS Means Reference #	RS Means Description	Crew Type
Off-Site 86	Stormwater Controls (for stormwater after cover is constructed)	Pond	Load Overburden Material from stockpile to off road haul truck for pond	4,023	7,944	Overburden Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305	Excavating, bulk bank measure, 3-1/2 C.Y. capacity = 160 C.Y./hour, backhoe, hydraulic, crawler mounted, excluding truck loading	B12D
Off-Site 87			*(additional cost to previous line)*	4,023	7,944	Overburden Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305A	Excavating, bulk bank measure, for loading onto trucks, add	B12D
Off-Site 88			Haul loose lift soil for Pond	5,632	11,122	Overburden Soil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323205060	Cycle hauling(wait, load,travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 22 C.Y. truck, cycle 2000 ft, 10 MPH, excludes loading equipment	B34F
Off-Site 89			Spread loose lift before compaction (Pond)	5,632	11,122	Overburden Soil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B
Off-Site 90			Compact Berm (Pond)	4,023	7,944	Overburden Soil	E.C.Y.	RS Means, Year 2011 Quarter 1	312323235060	Compaction, riding, vibrating roller, 2 passes, 12" lifts	B10Y
Off-Site 91			Final Stormwater Controls	-	2,332	Riprap	S.Y.	RS Means, Year 2011 Quarter 1	313713100110	Rip-rap and rock lining, random, broken stone, 3/8 to 1/4 C.Y. pieces, machine placed for slope protection, grouted	B13
Off-Site 92	Site Completion		Apply seeding to cover	1,051	2,653	Seeding	M.S.F.	RS Means, Year 2011 Quarter 1	329219142400	Seeding athletic fields, seeding fescue, tall with mulch and fertilizer, 5.5 lb. per M.S.F., hydro/air seeding	B81
Off-Site 93			Apply seeding to soil stockpile	790		Seeding	M.S.F.	RS Means, Year 2011 Quarter 1	329219142400	Seeding athletic fields, seeding fescue, tall with mulch and fertilizer, 5.5 lb. per M.S.F., hydro/air seeding	B81
Off-Site 94			Install temporary irrigation system	87,550	221,114	Irrigation System	S.F.	RS Means, Year 2011 Quarter 1	328423100800	Underground sprinklers irrigation system, for lawns, residential system, custom, 1" supply	B20
Off-Site 95			Install Fencing	4,078	8,285	Fencing	L.F.	RS Means, Year 2011 Quarter 1	323113200920	Fence, chain link industrial, galvanized steel, 6 ga. wire, 2-1/2" posts @ 10' OC, 8' high, includes excavation, in concrete, excludes barbed wire	B80C

Step #	Daily Unit Rate of Constr-uction	Crew Size (Men)	Number of Crews	Effic-iency Factor	Construction (Days): Off-Site Area 1	Construction (Days): Off-Site Area 2	Crew Man-days: Off-Site Area 1	Crew Man-days: Off-Site Area 2	Unit Costs: Extended Material Overhead and Profit	Unit Costs: Extended Labor Overhead and Profit	Unit Costs: Extended Labor Overhead and Profit - Ineffeciency	Unit Costs: Extended Equipment Overhead and Profit	Unit Costs: Extended Equipment Overhead and Profit - Ineffeciency	Unit Costs: Extended Total Overhead and Profit	Material Taxes at Bridgeton (7.925%): Off-Site Area 1	Material Taxes at Bridgeton (7.925%): Off-Site Area 2	Total Cost for Line Item: Off-Site Area 1	Total Cost for Line Item: Off-Site Area 2	Truckloads for Delivery: Off-Site Area 1	Truckloads for Delivery: Off-Site Area 2	Total Miles for Delivery: Off-Site Area 1	Total Miles for Delivery: Off-Site Area 2
Off-Site 86	2,400	2	3	100%	0.6	1.1	3.4	6.6	$ -	$ 0.40	$ -	$ 1.09	$ -	$ 1.49	$ -	$ -	$ 5,990	$ 11,800				
Off-Site 87	16,255	2	3	100%	0.1	0.2	0.5	1.0	$ -	$ 0.02	$ -	$ 0.03	$ -	$ 0.22	$ -	$ -	$ 885	$ 1,750				
Off-Site 88	594	1	3.5	100%	2.7	5.3	9.5	18.7	$ -	$ 0.68	$ -	$ 2.28	$ -	$ 2.96	$ -	$ -	$ 16,700	$ 32,900				
Off-Site 89	1,000	2	6	100%	0.9	1.9	8.4	16.7	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ 11,200	$ 22,100				
Off-Site 90	5,200	2	2	100%	0.4	0.8	1.2	2.3	$ -	$ 0.14	$ -	$ 0.12	$ -	$ 0.26	$ -	$ -	$ 1,050	$ 2,070				
Off-Site 91	80	7	3	100%	-	9.7	-	204.0	$ 71.05	$ 38.47	$ -	$ 11.19	$ -	$ 120.71	$ -	$ 13,100	$ -	$ 295,000				
Off-Site 92	80	3	1	100%	13.1	33.2	39.4	99.5	$ 40.82	$ 16.91	$ -	$ 8.31	$ -	$ 66.04	$ 3,400	$ 8,580	$ 72,800	$ 184,000				
Off-Site 93	80	3	1	100%	9.9	-	29.6	-	$ 40.82	$ 16.91	$ -	$ 8.31	$ -	$ 66.04	$ 2,550	$ -	$ 54,700	$ -				
Off-Site 94	2,000	3	10	100%	4.4	11.1	131.3	331.7	$ 0.33	$ 0.70	$ -	$ -	$ -	$ 1.03	$ 2,290	$ 5,780	$ 92,500	$ 234,000				
Off-Site 95	180	3	2	100%	11.3	23.0	68.0	138.1	$ 29.40	$ 6.78	$ -	$ 1.18	$ -	$ 37.36	$ 9,500	$ 19,300	$ 162,000	$ 329,000				
															Totals		***Totals***		***Totals***		***Totals***	
															$ 200,000	$ 460,000	$ 25,100,000	$ 141,000,000	10,000	34,000	492,000	1,394,000
															$	**661,000**	**$**	**166,000,000**		**44,000**		**1,886,000**

Off-site Transportation Costs at $150/lcy	$ 8,290,000	$ 74,700,000	$ 82,990,000
Off-site Disposal Costs at $295/lcy	$ 16,310,000	$ 147,000,000	$ 163,310,000
On-Site Costs	$ 12,100,000	$ 24,200,000	$ 36,300,000
		Total Construction:	**$ 282,600,000**

Cost Estimates for the
“Complete Rad Removal” with Off-Site Disposal Alternative
(with $10 million/year limitation)

Process Used to Estimate the Costs and Schedule for the "Complete Rad Removal" with Off-site Disposal under a $10 million per year Fiscally-Constrained Scenario

Because of the $10 million per year fiscal constraint, it is assumed that the project would be divided into several smaller "annual projects". In the first year, the perimeter monitoring stations, including the associated electrical power, would be constructed and 12 months of baseline/background data would be collected. The remedial design would also be completed in the first year.

In the second and subsequent years the $10 million annual fiscal constraint construction would likely only occur for a period of one to two months per year. This would require annual startup/mobilization and season-end activities and associated additional costs. In some years, the work would involve excavation and off-site disposal of RIM that would be near the surface and the area could be cleared, excavated, backfilled and closed in the same year. In other years, the depth of the RIM would require an excavation area to be open for multiple years. For this costing scenario, it was assumed that the "average" year would have 50,000 square feet of RIM area that remains exposed at "year end" and would need to be covered until the subsequent year construction season. It was assumed that the semi-exposed RIM would be covered by a temporary geomembrane and then by a one-foot depth of intermediate cover soil that would be placed so it extends to the top of the excavation. The geomembrane would both prevent stormwater from contacting the RIM so treatment of the stormwater would not be necessary as well as prevent the intermediate cover soil from mixing with the RIM, thus allowing reuse of the soil.

Annual startup/mobilization activities would include mobilization of equipment and personnel, excavation of intermediate cover soil, disposal of the temporary membrane, and replacement of worn-out stormwater best management practice facilities. Season-end activities would include decontamination and demobilization of equipment and personnel, installation of the temporary membrane, and application and seeding of the intermediate cover. Example other duration-related and offseason costs would include project management personnel, dust control, and stormwater pumping from the excavation. It was also assumed that on-site security personnel would be required 24 hours per day for 10 months out of a year because of the open excavation area, potential for exposed RIM, and presence of construction equipment and stockpiled construction materials.

It is estimated that annual startup/mobilization, season-end activities, and associated additional costs would be approximately $548,000 per year. Subtracting this amount from the $10 million annual constraint would leave approximately $9,450,000 available for construction and monitoring activities associated with RIM removal and disposal.

The estimated total capital cost for the non-fiscally constrained "complete rad removal" with off-site disposal alternative is approximately $258 million. This estimate is fully-burdened (i.e., includes indirect costs for project management, remedial design, and construction management as well as both scope and bid contingencies) but does not include the approximately $200,000 per year for perimeter air/radon and groundwater monitoring during construction.

The estimated volume of RIM to be removed in Areas 1 and 2 is 369,050 bank cubic yards (bcy). Therefore the average unit cost to remove and dispose a bcy of RIM under the non-fiscally constrained scenario is approximately $700 per bcy. Dividing the approximately $9,450,000 of the annual $10 million that is available for construction and monitoring (see discussion above) by the average $700 per bcy results in an annual “average” RIM removal rate of approximately 13,500 bcy.

For the non-fiscally constrained “complete rad removal” with off-site disposal alternative, the maximum daily volume of RIM that could be hauled off-site because of railcar switching limitations was 1,400 bcy per day. Therefore, under this $10 million per year fiscally constrained scenario, in an “average” construction year, the construction season would only be approximately 10 days (13,500 bcy per year divided by 1,400 bcy per day). With a total volume of RIM that would need to be excavated and disposed off-site (369, 050 bcy) and an annual “average” RIM removal rate of approximately 13,500 bcy, without assuming any other project inefficiencies than those discussed above, it would take 28 years to complete this fiscally-constrained scenario.

The capital cost and present worth tables in Appendix J-3 for this scenario show how the annual $10 million per year was allocated. For the assumed 28-year “average” construction season, costs were assumed to be allocated as follows:

Capital Cost Item	Estimated Cost ($/year)
Annual costs to shutdown/startup	256,000
Site security	292,000
Construction associated with RIM removal	9,250,000
Environmental (perimeter) monitoring	109,000
Groundwater monitoring	93,000
Total	10,000,000

Present Worth Cost Estimate (30 years)
"Complete Rad Removal" with Off-site Disposal Alternative Constrained to $10M per year

Year	n	P/F(i=2.3%)	Capital Costs ($): "Complete Rad Removal" with Off-site Disposal	Capital Costs ($): Subtotal Capital Costs	Operation, Maintenance, and Monitoring Costs ($/yr): Environmental Monitoring	Landfill Gas Monitoring	Groundwater/ Surface Water Monitoring	Annual Site Inspection/Cover Maintenance	5 year Review	Subtotal O&M Costs	Total Costs ($)	Cumulative Total Costs ($)	Present Worth of Annual Costs ($)	Cumulative Present Worth ($)	
2013	0	1.00000	5,510,000	5,510,000	109,000		93,000			202,000	5,712,000	5,712,000	5,712,000	5,712,000	Construction Costs
2014	1	0.97752	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	15,714,000	9,777,000	15,489,000	
2015	2	0.95554	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	25,716,000	9,557,000	25,046,000	
2016	3	0.93406	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	35,718,000	9,342,000	34,388,000	
2017	4	0.91306	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	45,720,000	9,132,000	43,520,000	
2018	5	0.89253	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	55,722,000	8,927,000	52,447,000	
2019	6	0.87246	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	65,724,000	8,726,000	61,173,000	
2020	7	0.85285	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	75,726,000	8,530,000	69,703,000	
2021	8	0.83367	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	85,728,000	8,338,000	78,041,000	
2022	9	0.81493	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	95,730,000	8,151,000	86,192,000	
2023	10	0.79661	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	105,732,000	7,968,000	94,160,000	
2024	11	0.77870	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	115,734,000	7,789,000	101,949,000	
2025	12	0.76119	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	125,736,000	7,613,000	109,562,000	
2026	13	0.74408	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	135,738,000	7,442,000	117,004,000	
2027	14	0.72735	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	145,740,000	7,275,000	124,279,000	
2028	15	0.71099	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	155,742,000	7,111,000	131,390,000	
2029	16	0.69501	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	165,744,000	6,951,000	138,341,000	
2030	17	0.67938	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	175,746,000	6,795,000	145,136,000	
2031	18	0.66411	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	185,748,000	6,642,000	151,778,000	
2032	19	0.64918	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	195,750,000	6,493,000	158,271,000	
2033	20	0.63458	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	205,752,000	6,347,000	164,618,000	
2034	21	0.62031	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	215,754,000	6,204,000	170,822,000	
2035	22	0.60637	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	225,756,000	6,065,000	176,887,000	
2036	23	0.59273	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	235,758,000	5,929,000	182,816,000	
2037	24	0.57941	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	245,760,000	5,795,000	188,611,000	
2038	25	0.56638	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	255,762,000	5,665,000	194,276,000	
2039	26	0.55365	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	265,764,000	5,538,000	199,814,000	
2040	27	0.54120	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	275,766,000	5,413,000	205,227,000	
2041	28	0.52903	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	285,768,000	5,291,000	210,518,000	
2042	29	0.51714				12,000	372,000	28,000		412,000	412,000	286,180,000	213,000	210,731,000	OM&M Costs
				279,910,000					Estimated Non-discounted Total Costs:			286,000,000			

Estimated 30-year Present Worth Costs: 211,000,000

The information in this cost estimate summary is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. In accordance with USEPA Guidance, this is an order-of-magnitude engineering estimate that is expected to be within -30 to +50 percent of the actual project cost.

Present Worth Cost Estimate (1,000 years)
"Complete Rad Removal" with Off-site Disposal Alternative Constrained to $10M per year

Year	n	P/F(*i* =2.3%)	Capital Costs ($) "Complete Rad Removal" with Off-site Disposal	Capital Costs ($) Subtotal Capital Costs	Operation, Maintenance, and Monitoring Costs ($/yr) Environmental Monitoring	Landfill Gas Monitoring	Groundwater/ Surface Water Monitoring	Annual Site Inspection/Cover Maintenance	5 year Review	Subtotal O&M Costs	Total Costs ($)	Cumulative Total Costs ($)	Present Worth of Annual Costs ($)	Cumulative Present Worth ($)	
2013	0	1.00000	5,510,000	5,510,000	109,000		93,000			202,000	5,712,000	5,712,000	5,712,000	5,712,000	Construction Costs
2014	1	0.97752	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	15,714,000	9,777,000	15,489,000	
2015	2	0.95554	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	25,716,000	9,557,000	25,046,000	
2016	3	0.93406	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	35,718,000	9,342,000	34,388,000	
2017	4	0.91306	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	45,720,000	9,132,000	43,520,000	
2018	5	0.89253	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	55,722,000	8,927,000	52,447,000	
2019	6	0.87246	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	65,724,000	8,726,000	61,173,000	
2020	7	0.85285	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	75,726,000	8,530,000	69,703,000	
2021	8	0.83367	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	85,728,000	8,338,000	78,041,000	
2022	9	0.81493	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	95,730,000	8,151,000	86,192,000	
2023	10	0.79661	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	105,732,000	7,968,000	94,160,000	
2024	11	0.77870	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	115,734,000	7,789,000	101,949,000	
2025	12	0.76119	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	125,736,000	7,613,000	109,562,000	
2026	13	0.74408	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	135,738,000	7,442,000	117,004,000	
2027	14	0.72735	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	145,740,000	7,275,000	124,279,000	
2028	15	0.71099	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	155,742,000	7,111,000	131,390,000	
2029	16	0.69501	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	165,744,000	6,951,000	138,341,000	
2030	17	0.67938	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	175,746,000	6,795,000	145,136,000	
2031	18	0.66411	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	185,748,000	6,642,000	151,778,000	
2032	19	0.64918	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	195,750,000	6,493,000	158,271,000	
2033	20	0.63458	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	205,752,000	6,347,000	164,618,000	
2034	21	0.62031	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	215,754,000	6,204,000	170,822,000	
2035	22	0.60637	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	225,756,000	6,065,000	176,887,000	
2036	23	0.59273	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	235,758,000	5,929,000	182,816,000	
2037	24	0.57941	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	245,760,000	5,795,000	188,611,000	
2038	25	0.56638	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	255,762,000	5,665,000	194,276,000	
2039	26	0.55365	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	265,764,000	5,538,000	199,814,000	
2040	27	0.54120	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	275,766,000	5,413,000	205,227,000	
2041	28	0.52903	9,800,000	9,800,000	109,000		93,000			202,000	10,002,000	285,768,000	5,291,000	210,518,000	
2042	29	0.51714				12,000	372,000	28,000		412,000	412,000	286,180,000	213,000	210,731,000	OM&M Costs
2212	199	0.01083				12,000		28,000		40,000	40,000	302,742,000	0	213,197,000	
3012	999	0.00000				12,000		28,000		40,000	40,000	376,742,000	0	213,224,000	
				279,910,000					Estimated Non-discounted Total Costs:			377,000,000			

Estimated 1,000-year Present Worth Costs: 213,000,000

The information in this cost estimate summary is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. In accordance with USEPA Guidance, this is an order-of-magnitude engineering estimate that is expected to be within -30 to +50 percent of the actual project cost.

Total Capital Costs
"Complete Rad Removal" with Off-site Disposal
Alternative Constrained to $10M per year

Capital Cost Item	2013	2014	2015	2016	2017	2018	2019
Annual Costs to Shutdown/Startup	256,000	256,000	256,000	256,000	256,000	256,000	256,000
Site Security (10 months/year)	292,000	292,000	292,000	292,000	292,000	292,000	292,000
Subtotal - Annual "base capital costs"	548,000	548,000	548,000	548,000	548,000	548,000	548,000
Design, Setup costs for Monitoring	4,960,000						
Construction and Disposal		9,250,000	9,250,000	9,250,000	9,250,000	9,250,000	9,250,000
Total: "Complete Rad Removal with Off-site Disposal	5,510,000	9,800,000	9,800,000	9,800,000	9,800,000	9,800,000	9,800,000

Total Capital Costs
"Complete Rad Removal" with Off-site Disposal
Alternative Constrained to $10M per year

Capital Cost Item	2020	2021	2022	2023	2024	2025	2026
Annual Costs to Shutdown/Startup	256,000	256,000	256,000	256,000	256,000	256,000	256,000
Site Security (10 months/year)	292,000	292,000	292,000	292,000	292,000	292,000	292,000
Subtotal - Annual "base capital costs"	548,000	548,000	548,000	548,000	548,000	548,000	548,000
Design, Setup costs for Monitoring Construction and Disposal	9,250,000	9,250,000	9,250,000	9,250,000	9,250,000	9,250,000	9,250,000
Total: "Complete Rad Removal with Off-site Disposal	9,800,000	9,800,000	9,800,000	9,800,000	9,800,000	9,800,000	9,800,000

Total Capital Costs
"Complete Rad Removal" with Off-site Disposal
Alternative Constrained to $10M per year

Capital Cost Item	2027	2028	2029	2030	2031	2032	2033
Annual Costs to Shutdown/Startup	256,000	256,000	256,000	256,000	256,000	256,000	256,000
Site Security (10 months/year)	292,000	292,000	292,000	292,000	292,000	292,000	292,000
Subtotal - Annual "base capital costs"	548,000	548,000	548,000	548,000	548,000	548,000	548,000
Design, Setup costs for Monitoring Construction and Disposal	9,250,000	9,250,000	9,250,000	9,250,000	9,250,000	9,250,000	9,250,000
Total: "Complete Rad Removal with Off-site Disposal	9,800,000	9,800,000	9,800,000	9,800,000	9,800,000	9,800,000	9,800,000

Total Capital Costs
"Complete Rad Removal" with Off-site Disposal
Alternative Constrained to $10M per year

Capital Cost Item	2034	2035	2036	2037	2038	2039	2040
Annual Costs to Shutdown/Startup	256,000	256,000	256,000	256,000	256,000	256,000	256,000
Site Security (10 months/year)	292,000	292,000	292,000	292,000	292,000	292,000	292,000
Subtotal - Annual "base capital costs"	548,000	548,000	548,000	548,000	548,000	548,000	548,000
Design, Setup costs for Monitoring Construction and Disposal	9,250,000	9,250,000	9,250,000	9,250,000	9,250,000	9,250,000	9,250,000
Total: "Complete Rad Removal with Off-site Disposal	9,800,000	9,800,000	9,800,000	9,800,000	9,800,000	9,800,000	9,800,000

Total Capital Costs
"Complete Rad Removal" with Off-site Disposal
Alternative Constrained to $10M per year

Capital Cost Item	2041	Totals
Annual Costs to Shutdown/Startup	256,000	7,424,000
Site Security (10 months/year)	292,000	8,468,000
Subtotal - Annual "base capital costs"	548,000	15,892,000
Design, Setup costs for Monitoring Construction and Disposal	9,250,000	259,000,000
Total: "Complete Rad Removal with Off-site Disposal	9,800,000	279,910,000

Appendix K-4:

Cost Estimates for the “Complete Rad Removal” with On-Site Disposal Alternative

Present Worth Cost Estimate (30 years)
"Complete Rad Removal" with On-site Disposal Alternative

			Capital Costs ($)		Operation, Maintenance, and Monitoring Costs ($/yr)										
Year	*n*	P/F(*i* =2.3%)	"Complete Rad Removal" with On-site Disposal	Subtotal Capital Costs	Environmental Monitoring	Landfill Gas and Radon Monitoring	Groundwater/ Surface Water Monitoring	Annual Site Inspection/Cover Maintenance	5 year Review	Subtotal O&M Costs	Total Costs ($)	Cumulative Total Costs ($)	Present Worth of Annual Costs ($)	Cumulative Present Worth ($)	
2013	0	1.00000	6,703,000	6,703,000	114,000		93,000			207,000	6,910,000	6,910,000	6,910,000	6,910,000	Construction Costs
2014	1	0.97752	10,585,000	10,585,000	137,000		93,000			230,000	10,815,000	17,725,000	10,572,000	17,482,000	
2015	2	0.95554	7,672,000	7,672,000	137,000		93,000			230,000	7,902,000	25,627,000	7,551,000	25,033,000	
2016	3	0.93406	26,191,000	26,191,000	137,000		93,000			230,000	26,421,000	52,048,000	24,679,000	49,712,000	
2017	4	0.91306	31,598,000	31,598,000	137,000		93,000			230,000	31,828,000	83,876,000	29,061,000	78,773,000	
2018	5	0.89253	32,548,000	32,548,000	114,000		93,000			207,000	32,755,000	116,631,000	29,235,000	108,008,000	
2019	6	0.87246				18,000	552,000	34,000		604,000	604,000	117,235,000	527,000	108,535,000	OM&M Costs
2020	7	0.85285				18,000	552,000	34,000		604,000	604,000	117,839,000	515,000	109,050,000	
2021	8	0.83367				18,000	552,000	34,000		604,000	604,000	118,443,000	504,000	109,554,000	
2022	9	0.81493				18,000	276,000	34,000		328,000	328,000	118,771,000	267,000	109,821,000	
2023	10	0.79661				18,000	276,000	34,000	30,000	358,000	358,000	119,129,000	285,000	110,106,000	
2024	11	0.77870				18,000		34,000		52,000	52,000	119,181,000	40,000	110,146,000	
2025	12	0.76119				18,000	138,000	34,000		190,000	190,000	119,371,000	145,000	110,291,000	
2026	13	0.74408				18,000		34,000		52,000	52,000	119,423,000	39,000	110,330,000	
2027	14	0.72735				18,000	138,000	34,000		190,000	190,000	119,613,000	138,000	110,468,000	
2028	15	0.71099				18,000		34,000	30,000	82,000	82,000	119,695,000	58,000	110,526,000	
2029	16	0.69501				18,000	138,000	34,000		190,000	190,000	119,885,000	132,000	110,658,000	
2030	17	0.67938				18,000		34,000		52,000	52,000	119,937,000	35,000	110,693,000	
2031	18	0.66411				18,000	138,000	34,000		190,000	190,000	120,127,000	126,000	110,819,000	
2032	19	0.64918				18,000		34,000		52,000	52,000	120,179,000	34,000	110,853,000	
2033	20	0.63458				18,000	138,000	34,000	30,000	220,000	220,000	120,399,000	140,000	110,993,000	
2034	21	0.62031				18,000		34,000		52,000	52,000	120,451,000	32,000	111,025,000	
2035	22	0.60637				18,000	138,000	34,000		190,000	190,000	120,641,000	115,000	111,140,000	
2036	23	0.59273				18,000		34,000		52,000	52,000	120,693,000	31,000	111,171,000	
2037	24	0.57941				18,000	138,000	34,000		190,000	190,000	120,883,000	110,000	111,281,000	
2038	25	0.56638				18,000		34,000	30,000	82,000	82,000	120,965,000	46,000	111,327,000	
2039	26	0.55365				18,000	138,000	34,000		190,000	190,000	121,155,000	105,000	111,432,000	
2040	27	0.54120				18,000		34,000		52,000	52,000	121,207,000	28,000	111,460,000	
2041	28	0.52903				18,000	138,000	34,000		190,000	190,000	121,397,000	101,000	111,561,000	
2042	29	0.51714				18,000		34,000		52,000	52,000	121,449,000	27,000	111,588,000	

Estimated Non-discounted Total Costs: 121,000,000

Estimated 30-year Present Worth Costs: 112,000,000

The information in this cost estimate summary is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. In accordance with USEPA Guidance, this is an order-of-magnitude engineering estimate that is expected to be within -30 to +50 percent of the actual project cost.

Present Worth Cost Estimate (1,000 years)
"Complete Rad Removal" with On-site Disposal Alternative

			Capital Costs ($)		Operation, Maintenance, and Monitoring Costs ($/yr)										
Year	*n*	P/F(*i*=2.3%)	"Complete Rad Removal" with On-site Disposal	Subtotal Capital Costs	Environmental Monitoring	Landfill Gas and Radon Monitoring	Groundwater/ Surface Water Monitoring	Annual Site Inspection/Cover Maintenance	5 year Review	Subtotal O&M Costs	Total Costs ($)	Cumulative Total Costs ($)	Present Worth of Annual Costs ($)	Cumulative Present Worth ($)	
2013	0	1.00000	6,703,000	6,703,000	114,000		93,000			207,000	6,910,000	6,910,000	6,910,000	6,910,000	Construction Costs
2014	1	0.97752	10,585,000	10,585,000	137,000		93,000			230,000	10,815,000	17,725,000	10,572,000	17,482,000	
2015	2	0.95554	7,672,000	7,672,000	137,000		93,000			230,000	7,902,000	25,627,000	7,551,000	25,033,000	
2016	3	0.93406	26,191,000	26,191,000	137,000		93,000			230,000	26,421,000	52,048,000	24,679,000	49,712,000	
2017	4	0.91306	31,598,000	31,598,000	137,000		93,000			230,000	31,828,000	83,876,000	29,061,000	78,773,000	
2018	5	0.89253	32,548,000	32,548,000	114,000		93,000			207,000	32,755,000	116,631,000	29,235,000	108,008,000	
2019	6	0.87246				18,000	552,000	34,000		604,000	604,000	117,235,000	527,000	108,535,000	OM&M Costs
2020	7	0.85285				18,000	552,000	34,000		604,000	604,000	117,839,000	515,000	109,050,000	
2021	8	0.83367				18,000	552,000	34,000		604,000	604,000	118,443,000	504,000	109,554,000	
2022	9	0.81493				18,000	276,000	34,000		328,000	328,000	118,771,000	267,000	109,821,000	
2023	10	0.79661				18,000	276,000	34,000	30,000	358,000	358,000	119,129,000	285,000	110,106,000	
2024	11	0.77870				18,000		34,000		52,000	52,000	119,181,000	40,000	110,146,000	
2025	12	0.76119				18,000	138,000	34,000		190,000	190,000	119,371,000	145,000	110,291,000	
2026	13	0.74408				18,000		34,000		52,000	52,000	119,423,000	39,000	110,330,000	
2027	14	0.72735				18,000	138,000	34,000		190,000	190,000	119,613,000	138,000	110,468,000	
2028	15	0.71099				18,000		34,000	30,000	82,000	82,000	119,695,000	58,000	110,526,000	
2029	16	0.69501				18,000	138,000	34,000		190,000	190,000	119,885,000	132,000	110,658,000	
2030	17	0.67938				18,000		34,000		52,000	52,000	119,937,000	35,000	110,693,000	
2031	18	0.66411				18,000	138,000	34,000		190,000	190,000	120,127,000	126,000	110,819,000	
2032	19	0.64918				18,000		34,000		52,000	52,000	120,179,000	34,000	110,853,000	
2033	20	0.63458				18,000	138,000	34,000	30,000	220,000	220,000	120,399,000	140,000	110,993,000	
2034	21	0.62031				18,000		34,000		52,000	52,000	120,451,000	32,000	111,025,000	
2035	22	0.60637				18,000	138,000	34,000		190,000	190,000	120,641,000	115,000	111,140,000	
2036	23	0.59273				18,000		34,000		52,000	52,000	120,693,000	31,000	111,171,000	
2037	24	0.57941				18,000	138,000	34,000		190,000	190,000	120,883,000	110,000	111,281,000	
2038	25	0.56638				18,000		34,000	30,000	82,000	82,000	120,965,000	46,000	111,327,000	
2039	26	0.55365				18,000	138,000	34,000		190,000	190,000	121,155,000	105,000	111,432,000	
2040	27	0.54120				18,000		34,000		52,000	52,000	121,207,000	28,000	111,460,000	
2041	28	0.52903				18,000	138,000	34,000		190,000	190,000	121,397,000	101,000	111,561,000	
2042	29	0.51714				18,000		34,000		52,000	52,000	121,449,000	27,000	111,588,000	
2212	199	0.01083				18,000		34,000		52,000	52,000	143,039,000	1,000	114,406,000	
3012	999	0.00000				18,000		34,000		52,000	52,000	244,639,000	0	114,448,000	

Estimated Non-discounted Total Costs: 245,000,000

Estimated 1,000-year Present Worth Costs: 114,000,000

The information in this cost estimate summary is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. In accordance with USEPA Guidance, this is an order-of-magnitude engineering estimate that is expected to be within -30 to +50 percent of the actual project cost.

Total Capital Costs
"Complete Rad Removal" with On-site Disposal Alternative

Cost Item		Estimated Capital Costs	2013	2014	2015	2016	2017	2018	Total
			Allocation to Years (includes indirects and contingencies)						
Construction Costs		$ 50,900,000		9,686,000	7,020,000	23,966,000	28,914,000	29,288,000	98,874,000
Radiological Survey Costs		$ 4,725,000		899,000	652,000	2,225,000	2,684,000	2,719,000	9,179,000
Environmental Monitoring Costs		$ 407,000	790,000						790,000
Long-Term Monitoring Facilities		$ 224,000						435,000	435,000
Baseline Monitoring		$ 5,000						9,000	9,000
Institutional Controls		$ 50,000						97,000	97,000
Subtotal		$ 56,311,000							
Project Management	5%	$ 2,816,000							
Engineering Design	6%	$ 3,379,000	5,913,000						5,913,000
Construction Management	6%	$ 3,379,000							
Subtotal Construction On-Site		$ 65,890,000							
Scope Contingency	55%	$ 36,240,000							
Bid Contingency	20%	$ 13,178,000							
Subtotal Contingency		$ 49,420,000							
Total: "Complete Rad Removal" On-site Disposal		$ 115,300,000	6,703,000	10,585,000	7,672,000	26,191,000	31,598,000	32,548,000	115,300,000

Estimated Length Construction 4.6 years

Construction Cost Estimate -
"Complete Rad Removal" with On-site Disposal Alternative

Step #	Category	Sub-Category	Task	Quantity: On-Site Area 1	Quantity: On-Site Area 2	Quantity: On-Site Cell	Type of Material Handled	Units	Source of Costing Estimate	RS Means Reference #	RS Means Description	Crew Type	Daily Unit Rate of Constr-uction	Crew Size (Men)	Number of Crews	Effic-iency Factor
On-Site 1	Temporary Construction Facilities / Utilities / Personnel	*Construction Trailers*	Capital Expenses	3			Group of Trailers		See separate Assumptions sheet							
On-Site 2			Operating Expenses	92			Group of Trailers	Months	See separate Assumptions sheet							
On-Site 3			Parking Area	6,667			Gravel Area	S.Y.	RS Means, Year 2011 Quarter 1	015523500050	Temporary, roads, gravel fill, 4" gravel depth, excl surfacing	B14	715	6	1	100%
On-Site 4			Portable Toilets in Construction areas	14	65	28	Portable Toilets	Month	RS Means, Year 2011 Quarter 1	015433406420	Rent portable toilet chemical, recycle, flush type, Incl. Hourly Oper. Cost.					100%
On-Site 5		*Contractor's Construction Management Personnel*	Project Manager	242			Personnel	Week	RS Means, Year 2011 Quarter 1	013113200220	Field personnel, project manager, maximum		0.2	1	1	100%
On-Site 6			Construction Superintendent(s)	401			Personnel	Week	RS Means, Year 2011 Quarter 1	013113200260	Field personnel, superintendent, average		0.2	1	1	100%
On-Site 7			Clerk(s)	401			Personnel	Week	RS Means, Year 2011 Quarter 1	013113200020	Field Personnel, clerk, average		0.2	1	1	100%
On-Site 8			Field Engineer(s) / Safety Officer(s)	401			Personnel	Week	RS Means, Year 2011 Quarter 1	013113200120	Field personnel, field engineer, average		0.2	1	1	100%
On-Site 9	Temporary Stormwater Infrastructure (for stormwater during construction)	*Temporary Stormwater Lagoon*	Excavate soil for 4th berm at former leachate lagoon area	21,379			Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316464420	Excavating, bulk, dozer, open site, bank measure, common earth, 200 H.P. dozer, 300' push	B10B	270	1.5	4	100%
On-Site 10			Place soil for berm	29,930			Soil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	1.5	2	100%
On-Site 11			Compact berm	21,379			Soil	E.C.Y.	RS Means, Year 2011 Quarter 1	312323235060	Compaction, riding, vibrating roller, 2 passes, 12" lifts	B10Y	5,200	1.5	2	100%
On-Site 12			Install geomembrane liner	495			60 mil HDPE	M.S.F.	RS Means, Year 2011 Quarter 1	334713531220	Pond and Reservoir Liners, membrane lining systems HDPE, 100,000 S.F. or more, 60 mil thick	3 Skwk	2	3	12	100%
On-Site 13			Install force main from Areas 1 and 2 to lagoon	3,641	607		HDPE Pipe	L.F.	RS Means, Year 2011 Quarter 1	331113350100	Water supply distribution piping, piping HDPE, butt fusion joints, 40' lengths, 4" diameter, SDR 21	B22A	400	5	1	100%
On-Site 14			Install force main from lagoon to treatment facility	551			HDPE Pipe	L.F.	RS Means, Year 2011 Quarter 1	331113350100	Water supply distribution piping, piping HDPE, butt fusion joints, 40' lengths, 4" diameter, SDR 21	B22A	400	5	1	100%
On-Site 15		*Treatment Facility*	Construct Treatment Facility	1			Treatment Facility	Each	EMSI Estimate				0.017	7	1	100%
On-Site 16			Monthly Operation during construction	49			Treatment Facility Operation	Months	EMSI Estimate				0.4	1	1	100%
On-Site 17		*Leachate Treatment Facility*	Force main from cell to Treatment Facility			3,000	Dual-contained HDPE Pipe	L.F.	RS Means, Year 2011 Quarter 1	331113350100	Water supply distribution piping, piping HDPE, butt fusion joints, 40' lengths, 4" diameter, SDR 21	B22A	200	5	1	100%
On-Site 18			Construct Treatment Facility			1	Treatment Facility	Each	EMSI Estimate				0.022	7	1	100%
On-Site 19			Monthly Operation during construction phase			20	Treatment Facility Operation	Months	EMSI Estimate				0.400	1	1	100%
On-Site 20		*Stormwater events during construction*	Dewater construction after rain events	529	1,301	284	Construction stormwater	Days of Pumping	RS Means, Year 2011 Quarter 1	312319200650	Dewatering, pumping, 8 hr., attended 2 hours per day, 4" discharge pump used for 8 hours, includes 20 L.F. of suction hose and 100 L.F. of discharge hose	B10I	4	1.5	4	100%
On-Site 21			Dispose of contact stormwater to MSD	2,500,000	5,000,000		Contact stormwater	Gallons	Metropolitan St. Louis Sewer District, May 2011							100%
On-Site 22			Dispose of leachate to MSD			57,000,000	Construction Leachate	Gallons	Metropolitan St. Louis Sewer District, May 2011							100%
On-Site 23		*Post-project Stormwater Demolition*	Dispose of geomembrane liner in On-Site Cell	495			60 mil HDPE	M.S.F.	Estimating $.40/sf				20	3	1	100%
On-Site 24			Deconstruct 4th berm	21,379			Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316464420	Excavating, bulk, dozer, open site, bank measure, common earth, 200 H.P. dozer, 300' push	B10B	270	1.5	4	100%
On-Site 25			Grade berm material in lagoon for proper drainage	29,930			Soil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	1.5	2	100%
On-Site 26	Site-wide Preparation	*Mobilization*	Mobilize and Demobilize Equipment Under 150HP	8			Units of Equipment up to 150HP (up to 50 miles)	Ea.	RS Means, Year 2011 Quarter 1	015436500020	Mobilization or demobilization, dozer, loader, backhoe or excavator, 70 H.P. to 150 H.P., up to 50 miles	B34N	4	1	1	100%
On-Site 27			*Extra Mileage for Mobilizations*	80			Per 5 additional miles		RS Means, Year 2011 Quarter 1	015436500020A	Mobilization or demobilization, each additional 5 miles haul distance, add	B34N	72	1	1	100%
On-Site 28			Mobilize and Demobilize Equipment Over 150HP	56			Units of Equipment over 150HP (up to 50 miles)	Ea.	RS Means, Year 2011 Quarter 1	015436500100	Mobilization or demobilization, dozer, loader, backhoe or excavator, above 150 H.P., up to 50 miles	B34K	3	1	1	100%
On-Site 29			*Extra Mileage for Mobilizations*	560			Per 5 additional miles		RS Means, Year 2011 Quarter 1	015436500100A	Mobilization or demobilization, each additional 5 miles haul distance, add	B34K	72	1	1	100%
On-Site 30			Mobilize and Demobilize Equipment, Towed	4			Units of Towed Equipment (up to 50 miles)	Ea.	RS Means, Year 2011 Quarter 1	015436500300	Mobilization or demobilization, scraper, towed type (including tractor), 6 C.Y. capacity, up to 50 miles	B34K	3	1	1	100%
On-Site 31			*Extra Mileage for Mobilizations*	40			Per 5 additional miles		RS Means, Year 2011 Quarter 1	015436500300A	Mobilization or demobilization, each additional 5 miles haul distance, add	B34K	72	1	1	100%
On-Site 32			Mobilize and Demobilize Equipment, Scrapers	6			Scrapers (up to 50 miles)	Ea.	RS Means, Year 2011 Quarter 1	015436500700	Mobilization or demobilization, scraper, self-propelled, 24 C.Y. capacity, up to 50 miles	B34K	2	1	1	100%
On-Site 33			*Extra Mileage for Mobilizations*	60			Per 5 additional miles		RS Means, Year 2011 Quarter 1	015436500700A	Mobilization or demobilization, each additional 5 miles haul distance, add	B34K	72	1	1	100%
On-Site 34		*Supplemental Mobilizations*	Mobilize and Demobilize Equipment Under 150HP	16			Units of Equipment up to 150HP (up to 50 miles)	Ea.	RS Means, Year 2011 Quarter 1	015436500020	Mobilization or demobilization, dozer, loader, backhoe or excavator, 70 H.P. to 150 H.P., up to 50 miles	B34N	4	1	1	100%
On-Site 35			*Extra Mileage for Mobilizations*	160			Per 5 additional miles		RS Means, Year 2011 Quarter 1	015436500020A	Mobilization or demobilization, each additional 5 miles haul distance, add	B34N	72	1	1	100%

Step #	Construction (Days): On-Site Area 1	Construction (Days): On-Site Area 2	Construction (Days): On-Site Cell	Crew Man-days: On-Site Area 1	Crew Man-days: On-Site Area 2	Crew Man-days: On-Site Cell	Unit Costs: Extended Material Overhead and Profit	Unit Costs: Extended Labor Overhead and Profit	Unit Costs: Extended Labor Overhead and Profit - Ineffeciency	Unit Costs: Extended Equipment Overhead and Profit	Unit Costs: Extended Equipment Overhead and Profit - Ineffeciency	Unit Costs: Extended Total Overhead and Profit	Material Taxes at Bridgeton (7.925%): On-Site Area 1	Material Taxes at Bridgeton (7.925%): On-Site Area 2	Material Taxes at Bridgeton (7.925%): On-Site Cell	Total Cost for Line Item: On-Site Area 1	Total Cost for Line Item: On-Site Area 2	Total Cost for Line Item: On-Site Cell	Truckloads for Delivery: On-Site Area 1	Truckloads for Delivery: On-Site Area 2	Truckloads for Delivery: On-Site Cell	Total Miles for Delivery: On-Site Area 1	Total Miles for Delivery: On-Site Area 2	Total Miles for Delivery: On-Site Cell
On-Site 1	37.5	-	-	58.9	-	-						$ 87,040	$ -	$ -	$ -	$ 261,000	$ -	$ -	15	-	-	300	-	-
On-Site 2												$ 2,638	$ -	$ -	$ -	$ 243,000	$ -	$ -						
On-Site 3	9.3	-	-	55.9	-	-	$ 4.46	$ 3.97	$ -	$ 0.53	$ -	$ 8.96	$ 2,360	$ -	$ -	$ 62,100	$ -	$ -						
On-Site 4							$ -	$ -	$ -	$ 281	$ -	$ 281	$ -	$ -	$ -	$ 3,890	$ 18,200	$ 7,870						
On-Site 5	1,206	-	-	1,206	-	-	$ -	$ 3,650	$ -	$ -	$ -	$ 3,650	$ -	$ -	$ -	$ 883,000	$ -	$ -						
On-Site 6	2,000	-	-	2,000	-	-	$ -	$ 2,950	$ -	$ -	$ -	$ 2,950	$ -	$ -	$ -	$ 1,180,000	$ -	$ -						
On-Site 7	2,000	-	-	2,000	-	-	$ -	$ 630	$ -	$ -	$ -	$ 630	$ -	$ -	$ -	$ 253,000	$ -	$ -						
On-Site 8	2,000	-	-	2,000	-	-	$ -	$ 1,950	$ -	$ -	$ -	$ 1,950	$ -	$ -	$ -	$ 783,000	$ -	$ -						
On-Site 9	19.8	-	-	118.8	-	-	$ -	$ 2.72	$ -	$ 4.65	$ -	$ 7.37	$ -	$ -	$ -	$ 158,000	$ -	$ -						
On-Site 10	15.0	-	-	44.9	-	-	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ -	$ 59,600	$ -	$ -						
On-Site 11	2.1	-	-	6.2	-	-	$ -	$ 0.14	$ -	$ 0.12	$ -	$ 0.26	$ -	$ -	$ -	$ 5,560	$ -	$ -						
On-Site 12	25.8	-	-	928.1	-	-	$ 271.46	$ 1,113.15	$ -	$ -	$ -	$ 1,384.61	$ 10,600	$ -	$ -	$ 696,000	$ -	$ -	5	-	-	10,000	-	-
On-Site 13	9.1	1.5	-	45.5	7.6	-	$ 3.66	$ 6.46	$ -	$ 1.89	$ -	$ 12.01	$ 1,060	$ 176	$ -	$ 44,800	$ 7,470	$ -						
On-Site 14	1.4	-	-	6.9	-	-	$ 3.66	$ 6.46	$ -	$ 1.89	$ -	$ 12.01	$ 160	$ -	$ -	$ 6,780	$ -	$ -						
On-Site 15	60.0	-	-	420.0	-	-						$ 264,000	$ -	$ -	$ -	$ 264,000	$ -	$ -						
On-Site 16	121.3	-	-	121.3	-	-						$ 9,000	$ -	$ -	$ -	$ 437,000	$ -	$ -						
On-Site 17	-	-	15.0	-	-	75.0	$ 7.32	$ 19.49	$ -	$ 3.78	$ -	$ 30.59	$ -	$ -	$ 1,740	$ -	$ -	$ 93,500						
On-Site 18	-	-	45.0	-	-	315.0						$ 107,000	$ -	$ -	$ -	$ -	$ -	$ 107,000						
On-Site 19	-	-	49.1	-	-	49.1						$ 5,000	$ -	$ -	$ -	$ -	$ -	$ 98,200						
On-Site 20	33.1	81.3	17.8	198.4	487.8	106.7	$ -	$ 183.11	$ -	$ 35.30	$ -	$ 218.41	$ -	$ -	$ -	$ 116,000	$ 284,000	$ 62,100						
On-Site 21												$ 0.0028	$ -	$ -	$ -	$ 7,050	$ 14,100	$ -						
On-Site 22												$ 0.0028	$ -	$ -	$ -	$ -	$ -	$ 161,000						
On-Site 23	24.8	-	-	74.3	-	-						$ 400	$ -	$ -	$ -	$ 198,000	$ -	$ -						
On-Site 24	19.8	-	-	118.8	-	-	$ -	$ 2.72	$ -	$ 4.65	$ -	$ 7.37	$ -	$ -	$ -	$ 158,000	$ -	$ -						
On-Site 25	15.0	-	-	44.9	-	-	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ -	$ 59,600	$ -	$ -						
On-Site 26	2.0	-	-	2.0	-	-	$ -	$ 112.25	$ -	$ 139.01	$ -	$ 251.26	$ -	$ -	$ -	$ 2,010	$ -	$ -						
On-Site 27	1.1	-	-	1.1	-	-	$ -	$ 11.23	$ -	$ 13.90	$ -	$ 25.12	$ -	$ -	$ -	$ 2,010	$ -	$ -						
On-Site 28	18.7	-	-	18.7	-	-	$ -	$ 148.59	$ -	$ 309.51	$ -	$ 458.10	$ -	$ -	$ -	$ 25,700	$ -	$ -						
On-Site 29	7.8	-	-	7.8	-	-	$ -	$ 14.86	$ -	$ 30.95	$ -	$ 45.81	$ -	$ -	$ -	$ 25,700	$ -	$ -						
On-Site 30	1.3	-	-	1.3	-	-	$ -	$ 148.59	$ -	$ 309.51	$ -	$ 458.10	$ -	$ -	$ -	$ 1,830	$ -	$ -						
On-Site 31	0.6	-	-	0.6	-	-	$ -	$ 14.86	$ -	$ 30.95	$ -	$ 45.81	$ -	$ -	$ -	$ 1,830	$ -	$ -						
On-Site 32	3.0	-	-	3.0	-	-	$ -	$ 223.42	$ -	$ 466.98	$ -	$ 690.40	$ -	$ -	$ -	$ 4,140	$ -	$ -						
On-Site 33	0.8	-	-	0.8	-	-	$ -	$ 22.34	$ -	$ 46.70	$ -	$ 69.04	$ -	$ -	$ -	$ 4,140	$ -	$ -						
On-Site 34	4.0	-	-	4.0	-	-	$ -	$ 112.25	$ -	$ 139.01	$ -	$ 251.26	$ -	$ -	$ -	$ 4,020	$ -	$ -						
On-Site 35	2.2	-	-	2.2	-	-	$ -	$ 11.23	$ -	$ 13.90	$ -	$ 25.12	$ -	$ -	$ -	$ 4,020	$ -	$ -						

Construction Cost Estimate -
"Complete Rad Removal" with On-site Disposal Alternative

Step #	Category	Sub-Category	Task	Quantity: On-Site Area 1	Quantity: On-Site Area 2	Quantity: On-Site Cell	Type of Material Handled	Units	Source of Costing Estimate	RS Means Reference #	RS Means Description	Crew Type	Daily Unit Rate of Construction	Crew Size (Men)	Number of Crews	Efficiency Factor
On-Site 36			Mobilize and Demobilize Equipment Over 150HP		112		Units of Equipment over 150HP (up to 50 miles)	Ea.	RS Means, Year 2011 Quarter 1	015436500100	Mobilization or demobilization, dozer, loader, backhoe or excavator, above 150 H.P., up to 50 miles	B34K	3	1	1	100%
On-Site 37		*Supplemental Mobilizations (cont.)*	*Extra Mileage for Mobilizations*		1,120		Per 5 additional miles		RS Means, Year 2011 Quarter 1	015436500100A	Mobilization or demobilization, each additional 5 miles haul distance, add	B34K	72	1	1	100%
On-Site 38			Mobilize and Demobilize Equipment, Towed		8		Units of Towed Equipment (up to 50 miles)	Ea.	RS Means, Year 2011 Quarter 1	015436500300	Mobilization or demobilization, scraper, towed type (including tractor), 6 C.Y. capacity, up to 50 miles	B34K	3	1	1	100%
On-Site 39	Site-wide Preparation (cont.)		*Extra Mileage for Mobilizations*		80		Per 5 additional miles		RS Means, Year 2011 Quarter 1	015436500300A	Mobilization or demobilization, each additional 5 miles haul distance, add	B34K	72	1	1	100%
On-Site 40			Create Temporary Roads	13,333	26,667	13,333	Gravel Roads	S.Y.	RS Means, Year 2011 Quarter 1	015523500050	Temporary, roads, gravel fill, 4" gravel depth, excl surfacing	B14	715	6	1	100%
On-Site 41			Install TBD Traffic Improvements	$ 100,000	$ 100,000	$ 500,000	TBD (shown as budget estimate)	$						6	1	100%
On-Site 42			Water Truck Depreciation	1	2	1	Water Trucks	Trucks	Estimate							
On-Site 43			Water Truck Operation	12	62	46	Water Trucks	Months	Estimate				0.050	1	1	100%
On-Site 44		*Dust Control*	Use Water to Control Dust	2,450,000	12,400,000	9,120,000	Water	Gal	Missouri American Water Company, 4/20/2011							100%
On-Site 45			Prepare area with Stormwater BMPs	4,078	8,285	3,614	Silt Fence	L.F.	RS Means, Year 2011 Quarter 1	312514161100	Synthetic erosion control, silt fence, polypropylene, adverse conditions, 3' high	2 Clab	950	2	1	100%
On-Site 46		*Decontamination Area*	Materials	56	56		Concrete	C.Y.	RS Means, Year 2011 Quarter 1	033105350300	Structural concrete, ready mix, normal weight, 4000 PSI, includes local aggregate, sand, Portland cement and water, delivered, excludes all additives and treatments					100%
On-Site 47			Installation	56	56		Concrete	C.Y.	RS Means, Year 2011 Quarter 1	33105704650	Structural concrete, placing, slab on grade, pumped, over 6" thick, includes strike off & consolidation, excludes material	C20	185	8	1	100%
On-Site 48	Site Preparation		Clear Vegetation (Light)	16.0	21.4	17.5	Vegetation	Acre	RS Means, Year 2011 Quarter 1	311313101020	Selective tree and shrub removal, selective clearing brush mowing, light density, tractor with rotary mower, excludes removal offsite	B84	2	1	1	100%
On-Site 49			Clear Vegetation (Heavy)	3.5	27.8	0.1	Vegetation	Acre	RS Means, Year 2011 Quarter 1	311110100020	Clearing & grubbing, cut & chip light trees, to 6" diameter	B7	1	6	1	100%
On-Site 50			Purchase material	2,963	4,444		Soil	B.C.Y.	Local Republic landfill with surplus material							
On-Site 51		*Berms for Overburden*	Deliver and Stockpile	4,148	6,222		Soil	L.C.Y.	Based on Central Stone estimate				64	1	50	100%
On-Site 52			Develop earthen berms to store relocated overburden wastes	4,148	6,222		Soil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	1.5	3	100%
On-Site 53	New On-Site Cell Excavation		Excavate Excess Overburden to Subgrade Contours			490,107	Overburden Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316502400	Excavation, bulk, scrapers, bank measure, common earth, 5000' haul, 21 C.Y. bucket, self propelled scrapers, 1/4 push dozer	B33E	650	1.75	2.3	100%
On-Site 54			Purchase clay material			32,092	Clay Material	B.C.Y.	Local Republic landfill with surplus material							
On-Site 55		*Clay*	Deliver clay material to site			44,929	Clay Material	L.C.Y.	Based on Central Stone estimate				64	1	50	100%
On-Site 56			Spread loose lift before compaction in Cell Liner			44,929	Clay Material	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	1.5	6	100%
On-Site 57			Compact Clay in Cell Liner			32,092	Clay Material	E.C.Y.	RS Means, Year 2011 Quarter 1	312323235720	Compaction, 4 passes, 12" lifts, riding, sheepsfoot or wobbly wheel roller	B10G	2,600	1.5	2	100%
On-Site 58			Install Geosynthetic liner			477	60 mil HDPE	M.S.F.	RS Means, Year 2011 Quarter 1	334713531220	Pond and Reservoir Liners, membrane lining systems HDPE, 100,000 S.F. or more, 60 mil thick	3 Skwk	1.6	3	12	100%
On-Site 59			Install Cushioning geotextile			52,952	16 oz geotextile	S.Y.	RS Means, Year 2011 Quarter 1	334626100100	Geotextile Subsurface Drainage Filtration, fabric, laid in trench, polypropylene, ideal conditions	2 Clab	2,400	2	4	100%
On-Site 60			Purchase Leachate Collection Layer Drainage Material			17,651	Pea Gravel	B.C.Y.	Central Stone estimate, 4/4/2011							
On-Site 61	Construct Cell Bottom Liner		Deliver Leachate Collection Layer Drainage Material			19,769	Pea Gravel	L.C.Y.	Central Stone estimate, 4/4/2011				48	1	50	100%
On-Site 62			Load Leachate Drainage Material from stockpile to off road haul truck			17,651	Pea Gravel	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305	Excavating, bulk bank measure, 3-1/2 C.Y. capacity = 160 C.Y./hour, backhoe, hydraulic, crawler mounted, excluding truck loading	B12D	2,400	2	3	100%
On-Site 63			*(additional cost to previous line)*			17,651	Pea Gravel	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305A	Excavating, bulk bank measure, for loading onto trucks, add	B12D	16,255	2	3	100%
On-Site 64		*Leachate Collection*	Haul Leachate Drainage Material from stockpile to cell			19,769	Pea Gravel	L.C.Y.	RS Means, Year 2011 Quarter 1	312323205110	Cycle hauling(wait, load,travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 22 C.Y. truck, cycle 2 mile, 10 MPH, excludes loading equipment	B34F	374	1	5.6	100%
On-Site 65			Install Leachate Collection Layer			19,769	Pea Gravel	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	1.5	6	100%
On-Site 66			Install Leachate Collection Piping			1,362	HDPE Pipe	L.F.	RS Means, Year 2011 Quarter 1	333113203120	Public Sanitary Utility Sewerage Piping, piping HDPE Corrugated Type S with watertight gaskets, 18" diameter, excludes excavation or backfill	B21	275	3.5	1	100%
On-Site 67			Install Leachate Collection Sump			164	HDPE Pipe	L.F.	RS Means, Year 2011 Quarter 1	312319201900	Dewatering, sump hole construction, pit with gravel collar, corrugated, 12" gravel collar, 18" corr. pipe, 16 ga, includes excavation and gravel pit	B6	50	3	1	100%
On-Site 68			Install Separation Geotextile filter			52,952	4 oz geotextile	S.Y.	RS Means, Year 2011 Quarter 1	334626100100	Geotextile Subsurface Drainage Filtration, fabric, laid in trench, polypropylene, ideal conditions	2 Clab	2,400	2	4	100%

Step #	Construction (Days): On-Site Area 1	Construction (Days): On-Site Area 2	Construction (Days): On-Site Cell	Crew Man-days: On-Site Area 1	Crew Man-days: On-Site Area 2	Crew Man-days: On-Site Cell	Unit Costs: Extended Material Overhead and Profit	Unit Costs: Extended Labor Overhead and Profit	Unit Costs: Extended Labor Overhead and Profit - Ineffeciency	Unit Costs: Extended Equipment Overhead and Profit	Unit Costs: Extended Equipment Overhead and Profit - Ineffeciency	Unit Costs: Extended Total Overhead and Profit	Material Taxes at Bridgeton (7.925%): On-Site Area 1	Material Taxes at Bridgeton (7.925%): On-Site Area 2	Material Taxes at Bridgeton (7.925%): On-Site Cell	Total Cost for Line Item: On-Site Area 1	Total Cost for Line Item: On-Site Area 2	Total Cost for Line Item: On-Site Cell	Truckloads for Delivery: On-Site Area 1	Truckloads for Delivery: On-Site Area 2	Truckloads for Delivery: On-Site Cell	Total Miles for Delivery: On-Site Area 1	Total Miles for Delivery: On-Site Area 2	Total Miles for Delivery: On-Site Cell
On-Site 36	37.3	-	-	37.3	-	-	$ -	$ 148.59	$ -	$ 309.51	$ -	$ 458.10	$ -	$ -	$ -	$ 51,300	$ -	$ -						
On-Site 37	15.6	-	-	15.6	-	-	$ -	$ 14.86	$ -	$ 30.95	$ -	$ 45.81	$ -	$ -	$ -	$ 51,300	$ -	$ -						
On-Site 38	2.7	-	-	2.7	-	-	$ -	$ 148.59	$ -	$ 309.51	$ -	$ 458.10	$ -	$ -	$ -	$ 3,660	$ -	$ -						
On-Site 39	1.1	-	-	1.1	-	-	$ -	$ 14.86	$ -	$ 30.95	$ -	$ 45.81	$ -	$ -	$ -	$ 3,660	$ -	$ -						
On-Site 40	18.6	37.3	18.6	111.9	223.8	111.9	$ 4.46	$ 3.97	$ -	$ 0.53	$ -	$ 8.96	$ 4,710	$ 9,430	$ 4,710	$ 124,000	$ 248,000	$ 124,000						
On-Site 41	10.0	10.0	45.0	60.0	60.0	180.0	$ 1.00					$ 1.00	$ 7,930	$ 7,930	$ 39,600	$ 108,000	$ 108,000	$ 540,000						
On-Site 42												$ 50,000	$ -	$ -	$ -	$ 50,000	$ 100,000	$ 50,000						
On-Site 43	245	1,237	912	245	1,237	912						$ 8,000	$ -	$ -	$ -	$ 97,900	$ 495,000	$ 365,000						
On-Site 44												$ 0.0032	$ -	$ -	$ -	$ 7,810	$ 39,500	$ 29,100						
On-Site 45	4.3	8.7	3.8	8.6	17.4	7.6	$ 0.44	$ 0.87	$ -	$ -	$ -	$ 1.31	$ 142	$ 289	$ 126	$ 5,480	$ 11,100	$ 4,860						
On-Site 46							$ 105.20					$ 105.20	$ 463	$ 463	$ -	$ 6,310	$ 6,310	$ -						
On-Site 47	0.3	0.3	-	2.4	2.4	-	$ -	$ 20.96	$ -	$ 5.08	$ -	$ 26.04	$ -	$ -	$ -	$ 1,450	$ 1,450	$ -						
On-Site 48	8.0	10.7	8.8	8.0	10.7	8.8	$ -	$ 265.31	$ -	$ 175.93	$ -	$ 441.24	$ -	$ -	$ -	$ 7,060	$ 9,440	$ 7,720						
On-Site 49	3.5	27.8	0.1	21.0	166.8	0.7	$ -	$ 2,618.83	$ -	$ 1,574.70	$ -	$ 4,193.53	$ -	$ -	$ -	$ 14,700	$ 117,000	$ 503						
On-Site 50							$ 16.88					$ 16.88	$ 3,960	$ 5,940	$ -	$ 54,000	$ 80,900	$ -						
On-Site 51	1.3	1.9	-	64.8	97.2	-		$ 5.22	$ -	$ 5.22	$ -	$ 10.43	$ -	$ -	$ -	$ 43,300	$ 64,900	$ -	260	389	-	18,200	27,230	-
On-Site 52	1.4	2.1	-	6.2	9.3	-	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ -	$ 8,250	$ 12,400	$ -						
On-Site 53	-	-	326.7	-	-	1,319.5	$ -	$ 1.33	$ -	$ 4.18	$ -	$ 5.51	$ -	$ -	$ -	$ -	$ -	$ 2,700,000						
On-Site 54							$ 16.88					$ 16.88	$ -	$ -	$ 42,900	$ -	$ -	$ 584,000						
On-Site 55	-	-	14.0	-	-	702.0		$ 5.22	$ -	$ 5.22	$ -	$ 10.43	$ -	$ -	$ -	$ -	$ -	$ 469,000	-	-	2,809	-	-	196,630
On-Site 56	-	-	7.5	-	-	67.4	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ -	$ -	$ -	$ 89,400						
On-Site 57	-	-	6.2	-	-	18.5	$ -	$ 0.28	$ -	$ 0.50	$ -	$ 0.78	$ -	$ -	$ -	$ -	$ -	$ 25,000						
On-Site 58	-	-	24.8	-	-	893.6	$ 271.46	$ 1,113.15	$ -	$ -	$ -	$ 1,384.61	$ -	$ -	$ 10,300	$ -	$ -	$ 670,000	-	-	5	-	-	10,000
On-Site 59	-	-	5.5	-	-	44.1	$ 1.63	$ 0.38	$ -	$ -	$ -	$ 2.01	$ -	$ -	$ 6,840	$ -	$ -	$ 113,000	-	-	5	-	-	10,000
On-Site 60							$ 19.31					$ 19.31	$ -	$ -	$ 27,000	$ -	$ -	$ 368,000						
On-Site 61	-	-	8.2	-	-	411.8		$ 7.05	$ -	$ 7.05	$ -	$ 14.10	$ -	$ -	$ -	$ -	$ -	$ 279,000	-	-	1,648	-	-	65,920
On-Site 62	-	-	2.5	-	-	14.7	$ -	$ 0.40	$ -	$ 1.09	$ -	$ 1.49	$ -	$ -	$ -	$ -	$ -	$ 26,300						
On-Site 63	-	-	0.4	-	-	2.2	$ -	$ 0.02	$ -	$ 0.03	$ -	$ 0.22	$ -	$ -	$ -	$ -	$ -	$ 3,880						
On-Site 64	-	-	9.4	-	-	52.9	$ -	$ 1.09	$ -	$ 3.63	$ -	$ 4.72	$ -	$ -	$ -	$ -	$ -	$ 93,300						
On-Site 65	-	-	3.3	-	-	29.7	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ -	$ -	$ -	$ 39,300						
On-Site 66	-	-	5.0	-	-	17.3	$ 11.56	$ 6.68	$ -	$ 0.56	$ -	$ 18.80	$ -	$ -	$ 1,250	$ -	$ -	$ 26,900						
On-Site 67	-	-	3.3	-	-	9.8	$ 37.24	$ 26.79	$ -	$ 7.66	$ -	$ 71.69	$ -	$ -	$ 484	$ -	$ -	$ 12,200						
On-Site 68	-	-	5.5	-	-	44.1	$ 1.63	$ 0.38	$ -	$ -	$ -	$ 2.01	$ -	$ -	$ 6,840	$ -	$ -	$ 113,000	-	-	5	-	-	10,000

Construction Cost Estimate -
"Complete Rad Removal" with On-site Disposal Alternative

				Quantity													Construction (Days)			Crew Man-days			Unit Costs						Material Taxes at Bridgeton (7.925%)			Total Cost for Line Item			Truckloads for Delivery			Total Miles for Delivery		
Step #	Category	Sub-Category	Task	On-Site Area 1	On-Site Area 2	On-Site Cell	Type of Material Handled	Units	Source of Costing Estimate	RS Means Reference #	RS Means Description	Crew Type	Daily Unit Rate of Constr-uction	Crew Size (Men)	Number of Crews	Effic-iency Factor	On-Site Area 1	On-Site Area 2	On-Site Cell	On-Site Area 1	On-Site Area 2	On-Site Cell	Extended Material Overhead and Profit	Extended Labor Overhead and Profit	Extended Labor Overhead and Profit - Ineffeciency	Extended Equipment Overhead and Profit	Extended Equipment Overhead and Profit - Ineffeciency	Extended Total Overhead and Profit	On-Site Area 1	On-Site Area 2	On-Site Cell	On-Site Area 1	On-Site Area 2	On-Site Cell	On-Site Area 1	On-Site Area 2	On-Site Cell	On-Site Area 1	On-Site Area 2	On-Site Cell
On-Site 69	Overburden Relocation		Relocate overburden wastes - Excavate	67,475	408,031		Non RAD Waste	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305	Excavating, bulk bank measure, 3-1/2 C.Y. capacity = 160 C.Y./hour, backhoe, hydraulic, crawler mounted, excluding truck loading	B12D	2,400	2	3	70%	13.4	81.0	-	80.3	485.8	-	$ -	$ 0.40	$ 0.17	$ 1.09	$ 0.47	$ 2.13	$ -	$ -	$ -	$ 144,000	$ 869,000	$ -						
On-Site 70			*(additional cost to previous line)*	67,475	408,031		Non RAD Waste	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305A	Excavating, bulk bank measure, for loading onto trucks, add	B12D	16,255	2	3	70%	2.0	12.0	-	11.9	71.7	-	$ -	$ 0.02	$ 0.01	$ 0.03	$ 0.01	$ 0.24	$ -	$ -	$ -	$ 16,300	$ 98,500	$ -						
On-Site 71			Relocate overburden wastes - Haul and Dump	101,213	612,047		Non RAD Waste	L.C.Y.	RS Means, Year 2011 Quarter 1	312323205060	Cycle hauling(wait, load,travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 22 C.Y. truck, cycle 2000 ft, 10 MPH, excludes loading equipment	B34F	594	1	3.5	100%	48.2	291.5	-	170	1,030	-	$ -	$ 0.68	$ -	$ 2.28	$ -	$ 2.96	$ -	$ -	$ -	$ 300,000	$ 1,810,000	$ -						
On-Site 72			Apply daily cover to relocated overburden wastes	6,748	40,803		Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316462200	Excavating, bulk, dozer, open site, bank measure, sand and gravel, 80 H.P. dozer, 150' haul	B10L	230	1.5	3	100%	9.8	59.1	-	44	266	-	$ -	$ 3.18	$ -	$ 2.14	$ -	$ 5.32	$ -	$ -	$ -	$ 35,900	$ 217,000	$ -						
On-Site 73			Spread overburden wastes	107,960	652,850		Non RAD Waste	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	1.5	6	100%	18.0	108.8	-	162	979	-	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ -	$ 215,000	$ 1,300,000	$ -						
On-Site 74			Compact overburden wastes	74,223	448,834		Non RAD Waste	E.C.Y.	RS Means, Year 2011 Quarter 1	312323235720	Compaction, 4 passes, 12" lifts, riding, sheepsfoot or wobbly wheel roller	B10G	2,600	1.5	2	100%	14.3	86.3	-	43	259	-	$ -	$ 0.28	$ -	$ 0.50	$ -	$ 0.78	$ -	$ -	$ -	$ 57,900	$ 350,000	$ -						
On-Site 75	RIM Relocation to On-Site Cell		Apply daily cover to remaining excavation of RIM Wastes	3,350	30,200		Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316462200	Excavating, bulk, dozer, open site, bank measure, sand and gravel, 80 H.P. dozer, 150' haul	B10L	230	1.5	1	100%	14.6	131.3	-	21.8	197.0	-	$ -	$ 3.18	$ -	$ 2.14	$ -	$ 5.32	$ -	$ -	$ -	$ 17,800	$ 161,000	$ -						
On-Site 76			Relocate RIM Wastes on-site - Excavate	36,850	332,200		RAD Waste	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305	Excavating, bulk bank measure, 3-1/2 C.Y. capacity = 160 C.Y./hour, backhoe, hydraulic, crawler mounted, excluding truck loading	B12D	2,400	2	3	50%	10.2	92.3	-	61.4	553.7	-	$ -	$ 0.40	$ 0.40	$ 1.09	$ 1.09	$ 2.98	$ -	$ -	$ -	$ 110,000	$ 990,000	$ -						
On-Site 77			*(additional cost to previous line)*	36,850	332,200		RAD Waste	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305A	Excavating, bulk bank measure, for loading onto trucks, add	B12D	16,255	2	3	50%	1.5	13.6	-	9.1	81.7	-	$ -	$ 0.02	$ 0.02	$ 0.03	$ 0.03	$ 0.27	$ -	$ -	$ -	$ 9,950	$ 89,700	$ -						
On-Site 78			Relocate RIM Wastes to On-Site Cell - Haul and Dump	55,275	498,300		RAD Waste	L.C.Y.	RS Means, Year 2011 Quarter 1	312323205110	Cycle hauling(wait, load,travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 22 C.Y. truck, cycle 2 mile, 10 MPH, excludes loading equipment	B34F	374	1	5.6	100%	26.3	237.3	-	148	1,332	-	$ -	$ 1.09	$ -	$ 3.63	$ -	$ 4.72	$ -	$ -	$ -	$ 261,000	$ 2,350,000	$ -						
On-Site 79			Apply daily cover to relocated RIM Wastes	3,685	33,220		Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316462200	Excavating, bulk, dozer, open site, bank measure, sand and gravel, 80 H.P. dozer, 150' haul	B10L	230	1.5	1	100%	16.0	144.4	-	24.0	216.7	-	$ -	$ 3.18	$ -	$ 2.14	$ -	$ 5.32	$ -	$ -	$ -	$ 19,600	$ 177,000	$ -						
On-Site 80			Spread RIM Wastes at On-Site Cell	57,285	516,420		RAD Waste	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	1.5	4	100%	14.3	129.1	-	85.9	774.6	-	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ -	$ 114,000	$ 1,030,000	$ -						
On-Site 81			Compact RIM Wastes at On-Site Cell	40,535	365,420		RAD Waste	E.C.Y.	RS Means, Year 2011 Quarter 1	312323235720	Compaction, 4 passes, 12" lifts, riding, sheepsfoot or wobbly wheel roller	B10G	2,600	1.5	2	100%	7.8	70.3	-	23.4	210.8	-	$ -	$ 0.28	$ -	$ 0.50	$ -	$ 0.78	$ -	$ -	$ -	$ 31,600	$ 285,000	$ -						
On-Site 82	Buffer Zone		Buffer Zone Activity	-	1	-	See separate Assumptions sheet		See separate Assumptions sheet						1	100%	-	6.6	-	-	40.3	-						$ 63,304	$ -	$ -	$ -	$ -	$ 63,300	$ -						
On-Site 83	Rad. Survey		Conduct final radiological survey and wait for approval	1	1	-	This activity is handled by others, and does not have a direct cost to the contractor. However, there are the indirect costs due to the duration and associated waiting.								1	100%	7.0	7.0	-	-	-	-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -						
On-Site 84	Backfill and Slope Correction in Areas 1 and 2 after RIM has been removed	*Slope Correction Cuts*	Move non-RIM waste to correct slopes in excavation - Excavate	15,915	137,914		Non RAD Waste	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305	Excavating, bulk bank measure, 3-1/2 C.Y. capacity = 160 C.Y./hour, backhoe, hydraulic, crawler mounted, excluding truck loading	B12D	2,400	2	3	100%	2.2	19.2	-	13.3	114.9	-	$ -	$ 0.40	$ -	$ 1.09	$ -	$ 1.49	$ -	$ -	$ -	$ 23,700	$ 205,000	$ -						
On-Site 85			*(additional cost to previous line)*	15,915	137,914		Non RAD Waste	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305A	Excavating, bulk bank measure, for loading onto trucks, add	B12D	16,255	2	3	100%	0.3	2.8	-	2.0	17.0	-	$ -	$ 0.02	$ -	$ 0.03	$ -	$ 0.22	$ -	$ -	$ -	$ 3,500	$ 30,300	$ -						
On-Site 86			Move non-RIM waste to correct slopes in excavation - Haul and Dump	23,873	206,871		Non RAD Waste	L.C.Y.	RS Means, Year 2011 Quarter 1	312323205060	Cycle hauling(wait, load,travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 22 C.Y. truck, cycle 2000 ft, 10 MPH, excludes loading equipment	B34F	594	1	3.5	100%	11.4	98.5	-	40.2	348.3	-	$ -	$ 0.68	$ -	$ 2.28	$ -	$ 2.96	$ -	$ -	$ -	$ 70,700	$ 612,000	$ -						
On-Site 87			Spread cut material	23,873	206,871		Non RAD Waste	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	2	6	100%	4.0	34.5	-	35.8	310.3	-	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ -	$ 47,500	$ 412,000	$ -						
On-Site 88			Compact cut material	15,915	137,914		Non RAD Waste	E.C.Y.	RS Means, Year 2011 Quarter 1	312323235720	Compaction, 4 passes, 12" lifts, riding, sheepsfoot or wobbly wheel roller	B10G	2,600	2	2	100%	3.1	26.5	-	9.2	79.6	-	$ -	$ 0.28	$ -	$ 0.50	$ -	$ 0.78	$ -	$ -	$ -	$ 12,400	$ 108,000	$ -						
On-Site 89		*Backfill Overburden*	Backfill Overburden Materials stored in berms - Excavate	21,000	63,000		Non RAD Waste	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305	Excavating, bulk bank measure, 3-1/2 C.Y. capacity = 160 C.Y./hour, backhoe, hydraulic, crawler mounted, excluding truck loading	B12D	2,400	2	3	100%	2.9	8.8	-	17.5	52.5	-	$ -	$ 0.40	$ -	$ 1.09	$ -	$ 1.49	$ -	$ -	$ -	$ 31,300	$ 93,900	$ -						
On-Site 90			*(additional cost to previous line)*	21,000	63,000		Non RAD Waste	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305A	Excavating, bulk bank measure, for loading onto trucks, add	B12D	16,255	2	3	100%	0.4	1.3	-	2.6	7.8	-	$ -	$ 0.02	$ -	$ 0.03	$ -	$ 0.22	$ -	$ -	$ -	$ 4,620	$ 13,900	$ -						
On-Site 91			Backfill Overburden Materials stored in berms - Haul and Dump	31,500	94,500		Non RAD Waste	L.C.Y.	RS Means, Year 2011 Quarter 1	312323205060	Cycle hauling(wait, load,travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 22 C.Y. truck, cycle 2000 ft, 10 MPH, excludes loading equipment	B34F	594	1	3.5	100%	15.0	45.0	-	53.0	159.1	-	$ -	$ 0.68	$ -	$ 2.28	$ -	$ 2.96	$ -	$ -	$ -	$ 93,200	$ 280,000	$ -						
On-Site 92		*Additional Fill*	Excavate additional fill material for grading	127,923	159,363		Overburden Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305	Excavating, bulk bank measure, 3-1/2 C.Y. capacity = 160 C.Y./hour, backhoe, hydraulic, crawler mounted, excluding truck loading	B12D	2,400	2	3	100%	17.8	22.1	-	106.6	132.8	-	$ -	$ 0.40	$ -	$ 1.09	$ -	$ 1.49	$ -	$ -	$ -	$ 191,000	$ 237,000	$ -						
On-Site 93			*(additional cost to previous line)*	127,923	159,363		Overburden Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305A	Excavating, bulk bank measure, for loading onto trucks, add	B12D	16,255	2	3	100%	2.6	3.3	-	15.7	19.6	-	$ -	$ 0.02	$ -	$ 0.03	$ -	$ 0.22	$ -	$ -	$ -	$ 28,100	$ 35,100	$ -						
On-Site 94			Haul additional fill for grading	159,904	199,204		Overburden Soil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323205110	Cycle hauling(wait, load,travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 22 C.Y. truck, cycle 2 mile, 10 MPH, excludes loading equipment	B34F	374	1	5.6	100%	76.1	94.9	-	427.5	532.6	-	$ -	$ 1.09	$ -	$ 3.63	$ -	$ 4.72	$ -	$ -	$ -	$ 755,000	$ 940,000	$ -						
On-Site 95			Spread additional fill	159,904	199,204		Overburden Soil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	2	6	100%	26.7	33.2	-	239.9	298.8	-	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ -	$ 318,000	$ 396,000	$ -						
On-Site 96		*Daily Cover*	Use geotextile as a daily cover for backfill waste to reclaim slopes	33,688	194,117		Geotextile	S.Y.	RS Means, Year 2011 Quarter 1	334626100100	Geotextile Subsurface Drainage Filtration, fabric, laid in trench, polypropylene, ideal conditions	2 Clab	2,400	2	1	100%	14.0	80.9	-	28.1	161.8	-	$ 1.63	$ 0.38	$ -	$ -	$ -	$ 2.01	$ 4,350	$ 25,100	$ -	$ 72,100	$ 415,000	$ -	3	17	-	6,000	34,000	-
On-Site 97			Use geotextile as a daily cover on bermed overburden	5,000	11,111		Geotextile	S.Y.	RS Means, Year 2011 Quarter 1	334626100100	Geotextile Subsurface Drainage Filtration, fabric, laid in trench, polypropylene, ideal conditions	2 Clab	2,400	2	1	100%	2.1	4.6	-	4.2	9.3	-	$ 1.63	$ 0.38	$ -	$ -	$ -	$ 2.01	$ 646	$ 1,440	$ -	$ 10,700	$ 23,800	$ -	1	1	-	2,000	2,000	-

Construction Cost Estimate -
"Complete Rad Removal" with On-site Disposal Alternative

Step #	Category	Sub-Category	Task	Quantity On-Site Area 1	Quantity On-Site Area 2	Quantity On-Site Cell	Type of Material Handled	Units	Source of Costing Estimate	RS Means Reference #	RS Means Description	Crew Type	Daily Unit Rate of Construction	Crew Size (Men)	Number of Crews	Efficiency Factor
On-Site 98			Purchase of Bio-Intrusion Layer Material			54,581	8 inch Shot Rock	L.C.Y.	Fred Weber estimate, 3/23/2011							
On-Site 99		Bio-Intrusion	Deliver Bio-Intrusion Layer Material			54,581	8 inch Shot Rock	L.C.Y.	Fred Weber estimate, 3/23/2011				72	1	50	100%
On-Site 100			Spread Bio-Intrusion Layer Material			54,581	8 inch Shot Rock	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	2	6	100%
On-Site 101			Purchase clay material	61,537	151,279	16,540	Clay Material	B.C.Y.	Local Republic landfill with surplus material							
On-Site 102		Clay	Deliver clay material to site	86,152	211,791	23,156	Clay Material	L.C.Y.	Based on Central Stone estimate				64	1	50	100%
On-Site 103			Spread loose lift before compaction	86,152	211,791	23,156	Clay Material	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	2	6	100%
On-Site 104			Compact Clay (Final Cover)	61,537	151,279	16,540	Clay Material	E.C.Y.	RS Means, Year 2011 Quarter 1	312323235720	Compaction, 4 passes, 12" lifts, riding, sheepsfoot or wobbly wheel roller	B10G	2,600	1.5	2	100%
On-Site 105		Geomembrane	Install Synthetic liner for final cover			491	60 mil HDPE	M.S.F.	RS Means, Year 2011 Quarter 1	334713531220	Pond and Reservoir Liners, membrane lining systems HDPE, 100,000 S.F. or more, 60 mil thick	3 Skwk	2	3	12	100%
On-Site 106		Geotextile	Install Cushioning geotextile for final cover			54,581	16 oz geotextile	S.Y.	RS Means, Year 2011 Quarter 1	334626100100	Geotextile Subsurface Drainage Filtration, fabric, laid in trench, polypropylene, ideal conditions	2 Clab	2,400	2	4	100%
On-Site 107	Final Cover		Purchase Drainage Material			18,194	Pea Gravel	B.C.Y.	Central Stone estimate, 4/4/2011							
On-Site 108			Deliver Drainage Material			20,377	Pea Gravel	L.C.Y.	Central Stone estimate, 4/4/2011				48	1	50	100%
On-Site 109			Load material from stockpile to off road haul truck			18,194	Pea Gravel	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305	Excavating, bulk bank measure, 3-1/2 C.Y. capacity = 160 C.Y./hour, backhoe, hydraulic, crawler mounted, excluding truck loading	B12D	2,400	2	3	100%
On-Site 110		Drainage Layer	*(additional cost to previous line)*			18,194	Pea Gravel	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305A	Excavating, bulk bank measure, for loading onto trucks, add	B12D	16,255	2	3	100%
On-Site 111			Haul material from stockpile to cell			20,377	Pea Gravel	L.C.Y.	RS Means, Year 2011 Quarter 1	312323205110	Cycle hauling(wait, load,travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 22 C.Y. truck, cycle 2 mile, 10 MPH, excludes loading equipment	B34F	374	1	5.6	100%
On-Site 112			Move and Place drainage layer material for final cover			18,194	Pea Gravel	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	2	6	100%
On-Site 113			Purchase Topsoil	32,008	81,190	33,080	Topsoil	B.C.Y.	RS Means, Year 2011 Quarter 1 - Ext. Material O&P							
On-Site 114		Top Soil	Deliver Topsoil	40,009	101,487	41,349	Topsoil	L.C.Y.	Based on Central Stone estimate				68	1	50	100%
On-Site 115			Move and place Topsoil (Final Cover)	38,461	94,550	41,349	Topsoil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	2	6	100%
On-Site 116			Install Terraces	1,549	6,938	-	Topsoil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	2	1	100%
On-Site 117			Construct Ditches	2,630	7,245	-	Topsoil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316462200	Excavating, bulk, dozer, open site, bank measure, sand and gravel, 80 H.P. dozer, 150' haul	B10L	230	2	2	100%
On-Site 118			Load Overburden Material from stockpile to off road haul truck for pond	4,023	7,944	5,338	Overburden Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305	Excavating, bulk bank measure, 3-1/2 C.Y. capacity = 160 C.Y./hour, backhoe, hydraulic, crawler mounted, excluding truck loading	B12D	2,400	2	3	100%
On-Site 119	Stormwater Controls (for stormwater after cover is constructed)		*(additional cost to previous line)*	4,023	7,944	5,338	Overburden Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305A	Excavating, bulk bank measure, for loading onto trucks, add	B12D	16,255	2	3	100%
On-Site 120		Pond	Haul loose lift soil for Pond	5,632	11,122	7,473	Overburden Soil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323205060	Cycle hauling(wait, load,travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 22 C.Y. truck, cycle 2000 ft, 10 MPH, excludes loading equipment	B34F	594	1	3.5	100%
On-Site 121			Spread loose lift before compaction (Pond)	5,632	11,122	7,473	Overburden Soil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	2	6	100%
On-Site 122			Compact Berm (Pond)	4,023	7,944	5,338	Overburden Soil	E.C.Y.	RS Means, Year 2011 Quarter 1	312323235060	Compaction, riding, vibrating roller, 2 passes, 12" lifts	B10Y	5,200	2	2	100%
On-Site 123			Final Stormwater Controls	-	2,332	-	Riprap	S.Y.	RS Means, Year 2011 Quarter 1	313713100110	Rip-rap and rock lining, random, broken stone, 3/8 to 1/4 C.Y. pieces, machine placed for slope protection, grouted	B13	80	7	3	100%
On-Site 124			Apply seeding to cover	1,051	2,653	948	Seeding	M.S.F.	RS Means, Year 2011 Quarter 1	329219142400	Seeding athletic fields, seeding fescue, tall with mulch and fertilizer, 5.5 lb. per M.S.F., hydro/air seeding	B81	80	3	1	100%
On-Site 125	Site Completion		Apply seeding to soil stockpile	790			Seeding	M.S.F.	RS Means, Year 2011 Quarter 1	329219142400	Seeding athletic fields, seeding fescue, tall with mulch and fertilizer, 5.5 lb. per M.S.F., hydro/air seeding	B81	80	3	1	100%
On-Site 126			Install temporary irrigation system	87,550	221,114	446,574	Irrigation System	S.F.	RS Means, Year 2011 Quarter 1	328423100800	Underground sprinklers irrigation system, for lawns, residential system, custom, 1" supply	B20	2,000	3	10	100%
On-Site 127			Install Fencing	4,078	8,285	3,614	Fencing	L.F.	RS Means, Year 2011 Quarter 1	323113200920	Fence, chain link industrial, galvanized steel, 6 ga. wire, 2-1/2" posts @ 10' OC, 8' high, includes excavation, in concrete, excludes barbed wire	B80C	180	3	2	100%

Step #	Construction (Days) On-Site Area 1	Construction (Days) On-Site Area 2	Construction (Days) On-Site Cell	Crew Man-days On-Site Area 1	Crew Man-days On-Site Area 2	Crew Man-days On-Site Cell	Unit Costs: Extended Material Overhead and Profit	Extended Labor Overhead and Profit	Extended Labor Overhead and Profit - Ineffeciency	Extended Equipment Overhead and Profit	Extended Equipment Overhead and Profit - Ineffeciency	Extended Total Overhead and Profit	Material Taxes at Bridgeton (7.925%) On-Site Area 1	Material Taxes On-Site Area 2	Material Taxes On-Site Cell	Total Cost for Line Item On-Site Area 1	Total Cost On-Site Area 2	Total Cost On-Site Cell	Truckloads for Delivery On-Site Area 1	Truckloads On-Site Area 2	Truckloads On-Site Cell	Total Miles for Delivery On-Site Area 1	Total Miles On-Site Area 2	Total Miles On-Site Cell
On-Site 98							$ 5.80					$ 5.80	$ -	$ -	$ 25,100	$ -	$ -	$ 342,000						
On-Site 99	-	-	15.2	-	-	758		$ 2.35	$ -	$ 2.35	$ -	$ 4.69	$ -	$ -	$ -	$ -	$ -	$ 256,000	-	-	3,033	-	-	48,528
On-Site 100	-	-	9.1	-	-	81.9	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ -	$ -	$ -	$ 109,000						
On-Site 101							$ 16.88					$ 16.88	$ 82,300	$ 202,000	$ 22,100	$ 1,120,000	$ 2,760,000	$ 301,000						
On-Site 102	26.9	66.2	7.2	1,346	3,309	362		$ 5.22	$ -	$ 5.22	$ -	$ 10.43	$ -	$ -	$ -	$ 899,000	$ 2,210,000	$ 242,000	5,385	13,237	1,448	376,950	926,590	101,360
On-Site 103	14.4	35.3	3.9	129.2	317.7	34.7	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ -	$ 171,000	$ 421,000	$ 46,100						
On-Site 104	11.8	29.1	3.2	35.5	87.3	9.5	$ -	$ 0.28	$ -	$ 0.50	$ -	$ 0.78	$ -	$ -	$ -	$ 48,000	$ 118,000	$ 12,900						
On-Site 105	-	-	25.6	-	-	921.1	$ 271.46	$ 1,113.15	$ -	$ -	$ -	$ 1,384.61	$ -	$ -	$ 10,600	$ -	$ -	$ 691,000	-	-	5	-	-	10,000
On-Site 106	-	-	5.7	-	-	45.5	$ 1.63	$ 0.38	$ -	$ -	$ -	$ 2.01	$ -	$ -	$ 7,050	$ -	$ -	$ 117,000	-	-	5	-	-	10,000
On-Site 107							$ 19.31					$ 19.31	$ -	$ -	$ 27,800	$ -	$ -	$ 379,000						
On-Site 108	-	-	8.5	-	-	424.5		$ 7.05	$ -	$ 7.05	$ -	$ 14.10	$ -	$ -	$ -	$ -	$ -	$ 287,000	-	-	1,699	-	-	67,960
On-Site 109	-	-	2.5	-	-	15.2	$ -	$ 0.40	$ -	$ 1.09	$ -	$ 1.49	$ -	$ -	$ -	$ -	$ -	$ 27,100						
On-Site 110	-	-	0.4	-	-	2.2	$ -	$ 0.02	$ -	$ 0.03	$ -	$ 0.22	$ -	$ -	$ -	$ -	$ -	$ 4,000						
On-Site 111	-	-	9.7	-	-	54.5	$ -	$ 1.09	$ -	$ 3.63	$ -	$ 4.72	$ -	$ -	$ -	$ -	$ -	$ 96,200						
On-Site 112	-	-	3.0	-	-	27.3	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ -	$ -	$ -	$ 36,200						
On-Site 113							$ 24.94					$ 24.94	$ 63,300	$ 160,000	$ 65,400	$ 862,000	$ 2,190,000	$ 890,000						
On-Site 114	11.8	29.8	12.2	588	1,492	608		$ 4.12	$ -	$ 4.12	$ -	$ 8.24	$ -	$ -	$ -	$ 330,000	$ 837,000	$ 341,000	2,354	5,970	2,433	47,080	119,400	48,660
On-Site 115	6.4	15.8	6.9	57.7	141.8	62.0	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ -	$ 76,500	$ 188,000	$ 82,300						
On-Site 116	1.5	6.9	-	2.3	10.4	-	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ -	$ 3,080	$ 13,800	$ -						
On-Site 117	5.7	15.8	-	17.2	47.3	-	$ -	$ 3.18	$ -	$ 2.14	$ -	$ 5.32	$ -	$ -	$ -	$ 14,000	$ 38,500	$ -						
On-Site 118	0.6	1.1	0.7	3.4	6.6	4.4	$ -	$ 0.40	$ -	$ 1.09	$ -	$ 1.49	$ -	$ -	$ -	$ 5,990	$ 11,800	$ 7,950						
On-Site 119	0.1	0.2	0.1	0.5	1.0	0.7	$ -	$ 0.02	$ -	$ 0.03	$ -	$ 0.22	$ -	$ -	$ -	$ 885	$ 1,750	$ 1,170						
On-Site 120	2.7	5.3	3.6	9.5	18.7	12.6	$ -	$ 0.68	$ -	$ 2.28	$ -	$ 2.96	$ -	$ -	$ -	$ 16,700	$ 32,900	$ 22,100						
On-Site 121	0.9	1.9	1.2	8.4	16.7	11.2	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ -	$ 11,200	$ 22,100	$ 14,900						
On-Site 122	0.4	0.8	0.5	1.2	2.3	1.5	$ -	$ 0.14	$ -	$ 0.12	$ -	$ 0.26	$ -	$ -	$ -	$ 1,050	$ 2,070	$ 1,390						
On-Site 123	-	9.7	-	-	204.0	-	$ 71.05	$ 38.47	$ -	$ 11.19	$ -	$ 120.71	$ -	$ 13,100	$ -	$ -	$ 295,000	$ -						
On-Site 124	13.1	33.2	11.8	39.4	99.5	35.5	$ 40.82	$ 16.91	$ -	$ 8.31	$ -	$ 66.04	$ 3,400	$ 8,580	$ 3,070	$ 72,800	$ 184,000	$ 65,600						
On-Site 125	9.9	-	-	29.6	-	-	$ 40.82	$ 16.91	$ -	$ 8.31	$ -	$ 66.04	$ 2,550	$ -	$ -	$ 54,700	$ -	$ -						
On-Site 126	4.4	11.1	22.3	131.3	331.7	669.9	$ 0.33	$ 0.70	$ -	$ -	$ -	$ 1.03	$ 2,290	$ 5,780	$ 11,700	$ 92,500	$ 234,000	$ 472,000						
On-Site 127	11.3	23.0	10.0	68.0	138.1	60.2	$ 29.40	$ 6.78	$ -	$ 1.18	$ -	$ 37.36	$ 9,500	$ 19,300	$ 8,420	$ 162,000	$ 329,000	$ 143,000						
													Totals			***Totals***			***Totals***			***Totals***		
													$ 200,000	$ 460,000	$ 323,000	$ 13,500,000	$ 25,100,000	$ 12,300,000	8,000	20,000	13,000	461,000	1,109,000	579,000
													$		**983,000**			**$ 50,900,000**			**41,000**			**2,149,000**

Radiological Survey Costs
"Complete Rad Removal" with On-site Disposal Alternative

Indirect Labor Ratio	1.6
Number of Years	4.6
Number of Days for OS1A	375
Number of Days for OSL	375
Number of OS5 days	33
Number of OS5A days	113
Number of OS5B days	380

Total Estimated Costs for Radiological Survey and Health & Safety Support

Total Labor Cost	$4,314,000
Total Capital Cost	$158,000
Total Expendable Cost	$253,000
Total	**$4,725,000**

3/3/2014	Estimated Start Date
10/22/2018	Estimated End Date
1,694	No. of calendar days
4.6	No. years
1,210	No. of working days

Estimated Labor Costs	Teams	# Days	Personnel Description	Cost/day*	Notes:
	OS1	Note 1	Safety Manager	Hire these three for	Manage all Safety Activities
$2,024,000			Rad Supervisor	$275,000/yr	Supervise Rad Activities, Conduct Rad Worker Orientation for non-Rad workers; Perform Tox Monitoring
			Sr Rad Tech**		Run Dosimetry Program; Environmental Monitoring -Collect sample get to outside lab keep record
$1,480	OS1A	Note 2	Rad Tech	$800	Run personal air sampling program; Available for deon, getting out protective clothing, assist with survey vehicle moving on si
$555,000			Rad Tech	$680	Control entry/exit for comtaminated areas
$1,750	OSL	Note 3	Lab Supervisor	$1,000	Run Lab
$656,250			Lab Tech	$750	Do Lab detailed work
$3,540	OS5	Note 4	Sr Rad Tech	$800	Survey while moving RIM Area 1; Conduct Final Survey
$116,820			Rad Tech	$680	Survey while moving RIM Area 1; Conduct Final Survey
			Rad Tech	$680	Survey while moving RIM Area 1; Conduct Final Survey
			Rad Tech	$680	Survey Trucks loaded with RIM Area 1; Conduct final survey
			Lab Tech	$700	Process additional sample from survey during RIM moving and Survey
$3,540	OS5A	Note 5	Sr Rad Tech	$800	Survey while moving RIM Area 2; Conduct Final Survey
$400,020			Rad Tech	$680	Survey while moving RIM Area 2; Conduct Final Survey
			Rad Tech	$680	Survey while moving RIM Area 2; Conduct Final Survey
			Rad Tech	$680	Survey Trucks loaded with RIM Area 2; Conduct final survey
			Lab Tech	$700	Process additional sample from survey during RIM moving and Survey
$1,480	OS5B	Note 6	Sr Rad Tech	$800	Survey while moving RIM to On-site Cell; Survey holding area
$562,400			Rad Tech	$680	Survey while moving RIM to On-site Cell; Survey holding area
$4,314,000	**Total Estimated Labor Costs during Construction**				

Note 1 From beginning to end of Environmental Monitoring Program ~4.6 years (1,210 work days
Note 2 From beginning of moving overburden to end of moving RIM to on-site ce
Note 3 From beginning of moving overburden to end of final survey
Note 4 Survey while RIM is being moved ~26 Days + Final survey 7 days = 33 work days tota
Note 5 Survey while RIM is being moved ~106 Days + Final survey 7 days = 113 work days tota
Note 6 Survey while moving RIM to On-site cell 375 days + 5 days for survey holding area

* Includes per diem at $150/day

Estimate of Non-Labor Costs

Item		Capital/set-up Costs ($)	Expendable Costs: Recurring Rate ($)	Units	Number	Expendable Costs ($)
Rad survey instruments (18) - Different types needed		$45,000	$500	month	40	$20,000
Check sources		$1,000				
Rent special survey equipment (30 days @ $200/day)		$6,000				
Toxic Gas monitors (2)		$5,000				
Dosimetry Program: All long term workers need (25 people @$20/badge		$500	$50	month	55	$2,750
Disposable clothing	Need until RIM covered (60 sets/day?)		$150	day	400	$60,000
Other PPE (e.g., safety glasses @ $5)		$400				
Lab Equipment		$100,000				
Lab operation			$100	day	500	$50,000
Misc cost			$100	day	1,200	$120,000
	Total Estimated Non-Labor Costs:	**$157,900**				**$252,800**

Environmental Monitoring Costs
"Complete Rad Removal" with On-site Disposal Alternative

Item	Number	Cost	Shipping	Total Capital	Annual Cost
HI-Q's Polyurethane Foam (PUF) air sampling system Model 3300	19	$3,205	$100	$62,795	
Calibrator for PUP Sampler	1	$560	$15	$575	
Adapter Plate	1	$85	$10	$95	
Diversified Research ALPHA II® Continuous Radon Monitor	19	$1,775	$25	$34,200	
Install AC electrical service to all stations (lineal ft)	10,868	$25		$271,700	
Monitoring Station Foundation / Supports (assume will not be moved)	19	$2,000		$38,000	
<u>Items requiring periodic replacement</u>					
Environmental dosimeters 1/qtr/station	76	$30			$2,280
Kidde 442020 Radon Gas Detection Test Kit (1 kit/month/station)	228	$25			$5,700
<u>Expendables</u>					
Particulate air sample media Boxes of 100	10	$89	$5		$940
Toxic organic sample media Boxes of 10	75	$32	$5		$2,775
<u>Lab services</u>					
Analyze organic vapor filters (once per week per station)	988	$120			$118,560
<u>Calibration Cost</u>					
Air Samplers 1/yr	19	$100	$50		$2,850
Radon monitors 1/yr	19	$100	$25		$2,375
<u>Labor</u>					
Assume 2 man days/wk	16	$90			$1,440
	Subtotal - Capital			**$407,000**	
	Subtotal - Annual Expendables/Labor				**$137,000**

Capital Cost Estimate - Long-Term Monitoring
"Complete Rad Removal" with On-site Disposal Alternative

Description	Quantity	Units	Unit Rate	Estimated Cost ($)
Secure easements	1	LS	2,000	2,000
Landfill Gas:				
Driller: Install radon/landfill gas monitoring probes, MDNR "Code Wells"; 10' dee	60	each	1,850	111,000
Misc. wellhead sampling fittings and lock:	60	each	40	2,400
Field technician observation during drilling and construction of probe	280	hour	90	25,200
Mileage for field technician during probe constructio	3,200	mile	0.51	1,600
Multi-gas detector (e.g., Industrial Scientific iBri™ MX6), incl regulator, tubing, calbrtn ga:	1	LS	4,400	4,400
Portable radon gas monitor and detector (e.g., Pylon AB6 monitor w/ 300A detect	1	LS	8,250	8,300
Groundwater:				
Recondition and purge existing groundwater monitoring wel	16	each	500	8,000
Flat-bottom polyethylene tank to store purge water prior to dispo:	1,500	gallon	2	3,000
Well permitting	10	hour	90	900
Driller: Install new 60' depth 2" monitoring wells around on-site c	10	each	4,000	40,000
Field geologist log holes/oversight during drilling; prep boring logs/well completion diagra	120	hour	130	15,600
Field vehicle during drilling	10	day	120	1,200
Estimated Long-term Monitoring Capital Costs - Total				**224,000**

Post-Construction Baseline Monitoring Cost Estimate
"Complete Rad Removal" with On-site Disposal Alternative

(Radon Flux and Radon in Subsurface Landfill Gas)

Description	Quantity	Units	Unit Rate	Estimated Cost ($)
Radon Flux:				
Number of Large Area Activated Charcoal Canisters	*10*			
Labor to place and pickup LAACCs - field technicia	6	hour	90	540
Field vehicle	2	day	120	240
Shipping of LAACCs to site (20 per box) - groun	1	each	25	30
Overnight shipping of activated charcoal to laborato	1	each	50	50
Return shipping of LAACCs to lab (20 per box) - groun	1	each	25	30
Analysis of samples for radon flux (Tellco Environmental - Grand Junction, CO	10	each	22	220
Rental of LAACCs (assume 1 week per even	70	day	1.00	70
Data managemen	1	hour	100	100
Reporting	4	hour	130	520
Estimated Radon Flux Monitoring Costs - Total				**1,800**
Subsurface Gas (Radon):				
Number of Subsurface Gas Monitoring Wells	*60*			
Labor - field techniciar	16	hour	90	1,440
Field vehicle	2	day	120	240
Replacement radon detector (Pylon 300A	1	each	550	550
Data managemen	1	hour	100	100
Reporting	4	hour	130	520
Estimated Subsurface Gas (Radon) Monitoring Costs - Total				**2,900**

Capital Cost Estimate - Amend Existing/Additional Institutional Controls
"Complete Rad Removal" with On-site Disposal Alternative

Description	Quantity	Units	Unit Rate	Estimated Cost
Prepare Institutional Controls planning documents	1	LS	10,000	10,000
Attorney labor: prepare draft amended existing and additional ICs	1	LS	20,000	20,000
Review of draft documents	1	LS	5,000	5,000
Revise amended and additional Institutional Controls documents	1	LS	10,000	10,000
Filings and registrations	1	LS	5,000	5,000
Estimated Institutional Controls Capital Costs - Total				**50,000**

Long-Term Post-Construction Monitoring (per event) Cost Estimate
"Complete Rad Removal" with On-site Disposal Alternative

(Landfill Gas, Groundwater, and Surface Water Monitoring and Annual Post-Construction Site Inspections)

Description	Analytical Method	Quantity	Units	Unit Rate ($)	Estimated Cost ($)
Landfill Gas/Radon:					
Number of Landfill Gas/Radon Monitoring Wells		*60*			
Labor - field technician		16	hour	90	1,440
Field vehicle		2	day	120	240
Replacement radon detector (Pylon 300A)		1	each	550	550
Calibration gas for multi-gas detector		1	each	330	330
Data management		2	hour	100	200
Reporting		8	hour	130	1,040
Estimated Landfill Gas/Radon Monitoring Costs - Subtotal					3,800
Contingency			*%*	*20*	*800*
Estimated Landfill Gas/Radon Monitoring Costs - Total (per Event)					**4,600**
Groundwater and Surface Water:					
Number of Samples:			*For VOCs*		
Investigative Groundwater		*26*	*26*		
Investigative Surface Water		*2*	*2*		
Field Duplicates (one per every 10 investigative samples)		*3*	*3*		
Trip blank (one per day per cooler)			*7*		
Matrix Spike			*1*		
Matrix Spike Duplicate			*1*		
Sub-total number of unfiltered samples:		*31*	*40*		
Sub-total number of filtered samples for radionuclide and metals analyses:		*31*			
Total number of samples:		*62*	*40*		
Labor:					
Labor - field technicians (2 people, 4 sample locations/day)		126	hour	90	11,340
Materials and equipment:					
Sample kits, incl. filters		28	each	50	1,400
Field instrumentation and flowcell rental - groundwater		7	day	100	700
Field Vehicle		7	day	120	840
Overnight shipping of sample coolers (assume 1 per day to rad lab)		7	coolers	100	700
Delivery of sample coolers to local lab (2 to 3 coolers per day)		7	hour	90	630
Disposal of purge water (assumes PE tank previously purchased is onsite):					
Vacuum truck		4	hour	200	800
Transportation and disposal (assumes approx 25 gal per well per event)		650	gallon	2.00	1,300
Laboratory Sample Analysis:					
Gross alpha and beta	EPA 900.0	62	each	50	3,100
Uranium-234, 235, 238	EML U-02 Mod	62	each	100	6,200
Thorium-228, 230, 232	EML Th-01 Mod	62	each	100	6,200
Radium 228	EPA 904.0	62	each	85	5,270
Radium 226	EPA 903.0 Mod	62	each	85	5,270
Radon 222 - 72 hr hold time	SM 20th ED 7500-Rn B	62	each	85	5,270
Volatile Organic Compounds [VOCs] (GC/MS)	8260B	40	each	110	4,400
Semivolatile Organic Compounds [SVOCs] (GC/MS)	8270C	62	each	220	13,640
22 Metals Target Analyte List (ICP/AES)	6010B	62	each	115	7,130
Mercury (CVAA)	7470A	62	each	35	2,170
4 Anions (IC) - Bromide, Chloride, Fluoride, Sulfate	300.0	62	each	72	4,460
2 Anions (IC) - Nitrate, Nitrite - 48 hr hold time	300.0	62	each	36	2,230
Sulfide, Total	SM 4500 S2 D	62	each	35	2,170
Phosphorus, Total	365.1	62	each	40	2,480
Organic carbon, Total (TOC)	SM 5310B	62	each	40	2,480
Total Alkalinity, Carbonate, Bicarbonate	SM 2320B	62	each	20	1,240
Nitrogen, Ammonia	350.1	62	each	25	1,550
Level IV data deliverable		$ 75,260	%	10%	7,530
Data validation (assumes validation of 100% of Level IV data will be required)		88	DVR	100	8,800
Data management		8	SDG	100	800
Reporting		40	hour	130	5,200
Estimated Groundwater and Surface Water Monitoring Costs - Subtotal					115,300
Contingency			*%*	*20*	*23,100*
Estimated Groundwater and Surface Water Monitoring Costs - Total (per Event)					**138,000**

DVR = data validation report
SDG = sample delivery group

Description	Analytical Method	Quantity	Units	Unit Rate ($)	Estimated Cost ($)
Annual Post-Construction Site Inspections					
Labor - Engineer		18	hour	130	2,340
Field vehicle		2	day	120	240
Site Inspection Report		8	hour	130	1,040
Estimated Annual Post-Construction Site Inspections Costs - Subtotal					3,600
Contingency			*%*	*20*	*700*
Estimated Annual Post-Construction Site Inspections Costs - Total					**4,300**

Operation and Maintenance Cost Estimate - Cover System Maintenance
"Complete Rad Removal" with On-site Disposal Alternative

Description	Quantity	Units	Unit Rate	Estimated Cost
Mowing; tractor w/ rotary mower (once/year)	67.1	acre	40.00	2,700
Fill depressions in cover w/ topsoil, assume 1% of area; 6 inches dee	541	bcy	37.53	20,300
Seeding of filled are	29.2	M.S.F.	66.04	1,900
Estimated Cover System O&M Costs - Subtotal				24,900
Contingency		*%*	*20*	*5,000*
Estimated Annual Cover Maintenance O&M Costs - Total				**30,000**

M.S.F. = 1,000 square feet

Operation and Maintenance Cost Estimate - 5 year Review
"Complete Rad Removal" with On-site Disposal Alternative

Description	Quantity	Units	Unit Rate	Estimated Cost ($)
Access Restrictions (inspect/repair fencing and signage	16	hours	130	2,100
Institutional Controls verificatio	8	hours	130	1,000
Document that landfill cover is effectiv	8	hours	130	1,000
Assemble Monitoring Data (landfill gas/radon, groundwater, surface wate	40	hours	130	5,200
Summarize Annual Post-Construction Site Inspection	8	hours	130	1,000
Summarize Annual Cover Maintenance Documentatic	8	hours	130	1,000
Water supply well inventory reviev	8	hours	130	1,000
Document any changes in Land Use at and around West Lake Landf	16	hours	130	2,100
Prepare Summary Repor	80	hours	130	10,400
Estimated 5-year Maint/Review O&M Costs - Subtotal				**25,000**
Contingency		*%*	*20*	*5,000*
Estimated 5-year Maintenance O&M Costs - Total				**30,000**

Cost Estimates for the “Complete Rad Removal” with On-Site Disposal Alternative

(with $10 million/year limitation)

Present Worth Cost Estimate (30 years)
"Complete Rad Removal" with On-site Disposal Alternative (Constrained to $10M per year)

			Capital Costs ($)		Operation, Maintenance, and Monitoring Costs ($/yr)										
Year	*n*	P/F(*i* =2.3%)	"Complete Rad Removal" with On-site Disposal	Subtotal Capital Costs	Environmental Monitoring	Landfill Gas and Radon Monitoring	Groundwater/ Surface Water Monitoring	Annual Site Inspection/Cover Maintenance	5 year Review	Subtotal O&M Costs	Total Costs ($)	Cumulative Total Costs ($)	Present Worth of Annual Costs ($)	Cumulative Present Worth ($)	
2013	0	1.00000	7,700,000	7,700,000	114,000		93,000			207,000	7,907,000	7,907,000	7,907,000	7,907,000	Construction Costs
2014	1	0.97752	9,700,000	9,700,000	137,000		93,000			230,000	9,930,000	17,837,000	9,707,000	17,614,000	
2015	2	0.95554	8,600,000	8,600,000	137,000		93,000			230,000	8,830,000	26,667,000	8,437,000	26,051,000	
2016	3	0.93406	9,700,000	9,700,000	137,000		93,000			230,000	9,930,000	36,597,000	9,275,000	35,326,000	
2017	4	0.91306	9,900,000	9,900,000	137,000		93,000			230,000	10,130,000	46,727,000	9,249,000	44,575,000	
2018	5	0.89253	10,300,000	10,300,000	137,000		93,000			230,000	10,530,000	57,257,000	9,398,000	53,973,000	
2019	6	0.87246	10,200,000	10,200,000	137,000		93,000			230,000	10,430,000	67,687,000	9,100,000	63,073,000	
2020	7	0.85285	9,900,000	9,900,000	137,000		93,000			230,000	10,130,000	77,817,000	8,639,000	71,712,000	
2021	8	0.83367	9,900,000	9,900,000	137,000		93,000			230,000	10,130,000	87,947,000	8,445,000	80,157,000	
2022	9	0.81493	9,900,000	9,900,000	137,000		93,000			230,000	10,130,000	98,077,000	8,255,000	88,412,000	
2023	10	0.79661	9,900,000	9,900,000	137,000		93,000			230,000	10,130,000	108,207,000	8,070,000	96,482,000	
2024	11	0.77870	9,800,000	9,800,000	137,000		93,000			230,000	10,030,000	118,237,000	7,810,000	104,292,000	
2025	12	0.76119	9,400,000	9,400,000	137,000		93,000			230,000	9,630,000	127,867,000	7,330,000	111,622,000	
2026	13	0.74408	8,700,000	8,700,000	103,000	18,000	552,000	34,000		707,000	9,407,000	137,274,000	7,000,000	118,622,000	OM&M Costs
2027	14	0.72735				18,000	552,000	34,000		604,000	604,000	137,878,000	439,000	119,061,000	
2028	15	0.71099				18,000	552,000	34,000		604,000	604,000	138,482,000	429,000	119,490,000	
2029	16	0.69501				18,000	276,000	34,000		328,000	328,000	138,810,000	228,000	119,718,000	
2030	17	0.67938				18,000	276,000	34,000	30,000	358,000	358,000	139,168,000	243,000	119,961,000	
2031	18	0.66411				18,000		34,000		52,000	52,000	139,220,000	35,000	119,996,000	
2032	19	0.64918				18,000	138,000	34,000		190,000	190,000	139,410,000	123,000	120,119,000	
2033	20	0.63458				18,000		34,000		52,000	52,000	139,462,000	33,000	120,152,000	
2034	21	0.62031				18,000	138,000	34,000		190,000	190,000	139,652,000	118,000	120,270,000	
2035	22	0.60637				18,000		34,000	30,000	82,000	82,000	139,734,000	50,000	120,320,000	
2036	23	0.59273				18,000	138,000	34,000		190,000	190,000	139,924,000	113,000	120,433,000	
2037	24	0.57941				18,000		34,000		52,000	52,000	139,976,000	30,000	120,463,000	
2038	25	0.56638				18,000	138,000	34,000		190,000	190,000	140,166,000	108,000	120,571,000	
2039	26	0.55365				18,000		34,000		52,000	52,000	140,218,000	29,000	120,600,000	
2040	27	0.54120				18,000	138,000	34,000	30,000	220,000	220,000	140,438,000	119,000	120,719,000	
2041	28	0.52903				18,000		34,000		52,000	52,000	140,490,000	28,000	120,747,000	
2042	29	0.51714				18,000	138,000	34,000		190,000	190,000	140,680,000	98,000	120,845,000	

Estimated Non-discounted Total Costs: 141,000,000

Estimated 30-year Present Worth Costs: 121,000,000

The information in this cost estimate summary is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. In accordance with USEPA Guidance, this is an order-of-magnitude engineering estimate that is expected to be within -30 to +50 percent of the actual project cost.

Present Worth Cost Estimate (1,000 years)
"Complete Rad Removal" with On-site Disposal Alternative (Constrained to $10M per year)

			Capital Costs ($)		Operation, Maintenance, and Monitoring Costs ($/yr										
Year	*n*	P/F(*i* =2.3%)	"Complete Rad Removal" with On-site Disposal	Subtotal Capital Costs	Environmental Monitoring	Landfill Gas and Radon Monitoring	Groundwater/ Surface Water Monitoring	Annual Site Inspection/Cover Maintenance	5 year Review	Subtotal O&M Costs	Total Costs ($)	Cumulative Total Costs ($)	Present Worth of Annual Costs ($)	Cumulative Present Worth ($)	
2013	0	1.00000	7,700,000	7,700,000	114,000		93,000			207,000	7,907,000	7,907,000	7,907,000	7,907,000	Construction Costs
2014	1	0.97752	9,700,000	9,700,000	137,000		93,000			230,000	9,930,000	17,837,000	9,707,000	17,614,000	
2015	2	0.95554	8,600,000	8,600,000	137,000		93,000			230,000	8,830,000	26,667,000	8,437,000	26,051,000	
2016	3	0.93406	9,700,000	9,700,000	137,000		93,000			230,000	9,930,000	36,597,000	9,275,000	35,326,000	
2017	4	0.91306	9,900,000	9,900,000	137,000		93,000			230,000	10,130,000	46,727,000	9,249,000	44,575,000	
2018	5	0.89253	10,300,000	10,300,000	137,000		93,000			230,000	10,530,000	57,257,000	9,398,000	53,973,000	
2019	6	0.87246	10,200,000	10,200,000	137,000		93,000			230,000	10,430,000	67,687,000	9,100,000	63,073,000	
2020	7	0.85285	9,900,000	9,900,000	137,000		93,000			230,000	10,130,000	77,817,000	8,639,000	71,712,000	
2021	8	0.83367	9,900,000	9,900,000	137,000		93,000			230,000	10,130,000	87,947,000	8,445,000	80,157,000	
2022	9	0.81493	9,900,000	9,900,000	137,000		93,000			230,000	10,130,000	98,077,000	8,255,000	88,412,000	
2023	10	0.79661	9,900,000	9,900,000	137,000		93,000			230,000	10,130,000	108,207,000	8,070,000	96,482,000	
2024	11	0.77870	9,800,000	9,800,000	137,000		93,000			230,000	10,030,000	118,237,000	7,810,000	104,292,000	
2025	12	0.76119	9,400,000	9,400,000	137,000		93,000			230,000	9,630,000	127,867,000	7,330,000	111,622,000	
2026	13	0.74408	8,700,000	8,700,000	103,000	18,000	552,000	34,000		707,000	9,407,000	137,274,000	7,000,000	118,622,000	OM&M Costs
2027	14	0.72735				18,000	552,000	34,000		604,000	604,000	137,878,000	439,000	119,061,000	
2028	15	0.71099				18,000	552,000	34,000		604,000	604,000	138,482,000	429,000	119,490,000	
2029	16	0.69501				18,000	276,000	34,000		328,000	328,000	138,810,000	228,000	119,718,000	
2030	17	0.67938				18,000	276,000	34,000	30,000	358,000	358,000	139,168,000	243,000	119,961,000	
2031	18	0.66411				18,000		34,000		52,000	52,000	139,220,000	35,000	119,996,000	
2032	19	0.64918				18,000	138,000	34,000		190,000	190,000	139,410,000	123,000	120,119,000	
2033	20	0.63458				18,000		34,000		52,000	52,000	139,462,000	33,000	120,152,000	
2034	21	0.62031				18,000	138,000	34,000		190,000	190,000	139,652,000	118,000	120,270,000	
2035	22	0.60637				18,000		34,000	30,000	82,000	82,000	139,734,000	50,000	120,320,000	
2036	23	0.59273				18,000	138,000	34,000		190,000	190,000	139,924,000	113,000	120,433,000	
2037	24	0.57941				18,000		34,000		52,000	52,000	139,976,000	30,000	120,463,000	
2038	25	0.56638				18,000	138,000	34,000		190,000	190,000	140,166,000	108,000	120,571,000	
2039	26	0.55365				18,000		34,000		52,000	52,000	140,218,000	29,000	120,600,000	
2040	27	0.54120				18,000	138,000	34,000	30,000	220,000	220,000	140,438,000	119,000	120,719,000	
2041	28	0.52903				18,000		34,000		52,000	52,000	140,490,000	28,000	120,747,000	
2042	29	0.51714				18,000	138,000	34,000		190,000	190,000	140,680,000	98,000	120,845,000	
2212	199	0.01083				18,000	138,000	34,000		190,000	190,000	162,270,000	2,000	123,623,000	
3012	999	0.00000				18,000	138,000	34,000		190,000	190,000	263,870,000	0	123,667,000	

Estimated Non-discounted Total Costs: 264,000,000

Estimated 1,000-year Present Worth Costs 124,000,000

The information in this cost estimate summary is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. In accordance with USEPA Guidance, this is an order-of-magnitude engineering estimate that is expected to be within -30 to +50 percent of the actual project cost.

Total Capital Costs

"Complete Rad Removal" with On-site Disposal Alternative (Constrained to $10M per year)

		Estimated Capital Costs (Constrained to $10M per year)														
Cost Item		2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Total
Construction Costs			4,453,000	3,958,000	4,433,000	4,265,000	3,680,000	3,883,000	4,624,000	4,624,000	4,649,000	3,968,000	4,514,000	4,384,000	4,070,000	55,505,000
Radiological Survey Costs			546,000	468,000	569,000	853,000	1,598,000	1,371,000	469,000	468,000	468,000	1,133,000	541,000	468,000	117,000	9,069,000
Environmental Monitoring Costs		407,000														407,000
Long-Term Monitoring Facilities															224,000	224,000
Baseline Monitoring															5,000	5,000
Institutional Controls															50,000	50,000
Subtotal		407,000	4,999,000	4,426,000	5,002,000	5,118,000	5,278,000	5,254,000	5,093,000	5,092,000	5,117,000	5,101,000	5,055,000	4,852,000	4,466,000	65,260,000
Project Management	5%	20,000	250,000	221,000	250,000	256,000	264,000	263,000	255,000	255,000	256,000	255,000	253,000	243,000	223,000	3,264,000
Engineering Design	6%	3,916,000														
Construction Management	6%	24,000	300,000	266,000	300,000	307,000	317,000	315,000	306,000	306,000	307,000	306,000	303,000	291,000	268,000	3,916,000
Subtotal Construction On-Site		4,370,000	5,550,000	4,910,000	5,550,000	5,680,000	5,860,000	5,830,000	5,650,000	5,650,000	5,680,000	5,660,000	5,610,000	5,390,000	4,960,000	76,350,000
Scope Contingency	55%	2,404,000	3,053,000	2,701,000	3,053,000	3,124,000	3,223,000	3,207,000	3,108,000	3,108,000	3,124,000	3,113,000	3,086,000	2,965,000	2,728,000	41,997,000
Bid Contingency	20%	874,000	1,110,000	982,000	1,110,000	1,136,000	1,172,000	1,166,000	1,130,000	1,130,000	1,136,000	1,132,000	1,122,000	1,078,000	992,000	15,270,000
Subtotal Contingency		3,280,000	4,160,000	3,680,000	4,160,000	4,260,000	4,400,000	4,370,000	4,240,000	4,240,000	4,260,000	4,250,000	4,210,000	4,040,000	3,720,000	57,270,000
Total: "Complete Rad Removal" On-site Disposal		7,700,000	9,700,000	8,600,000	9,700,000	9,900,000	10,300,000	10,200,000	9,900,000	9,900,000	9,900,000	9,900,000	9,800,000	9,400,000	8,700,000	133,600,000

Estimated Length Construction 12.1 years

indicates that $10M per year is slightly exceeded

Radiological Survey Costs
"Complete Rad Removal" with On-site Disposal Alternative (Constrained to $10M per year)

Indirect Labor Ratio	1.6
Number of Years	12.09
Number of Days for OS1A	563
Number of Days for OSL	550
Number of OS5 days	26
Number of OS5A days	265
Number of OS5B days	291

Total Estimated Costs for Radiological Survey and Health & Safety Support

Total Labor Cost	$8,576,000
Total Capital Cost	$158,000
Total Expendable Cost	$335,000
Total	**$9,069,000**

Total Project:

3/3/2014	Estimated Start Date
4/1/2026	Estimated End Date
4,412	No. of calendar days
12.09	No. years
3,151	No. of working days, but Job Shutdown several times

Estimated Labor Costs	Teams	# Days	Personnel Description	Cost/day*	Notes:
	OS1	Note 1	Safety Manager	Hire these three for	Manage all Safety Activities
$5,319,000			Rad Supervisor	$275,000/yr	Supervise Rad Activities, Conduct Rad Worker Orientation for non-Rad workers; Perform Toxicity Monitoring
			Sr Rad Tech**		Run Dosimetry Program; Environmental Monitoring; Collect samples for outside lab; Maintain records; Assist w/ overburden surveying
$1,480	OS1A	Note 2	Rad Tech	$800	Run personal air sampling program; Available for decon, getting out protective clothing, assist with survey vehicle moving on site
$833,240			Rad Tech	$680	Control entry/exit for contaminated areas; surveying while excavating overburden
$1,750	OSL	Note 3	Lab Supervisor	$1,000	Run Lab
$963,000			Lab Tech	$750	Do Lab detailed work
$3,540	OS5	Note 4	Sr Rad Tech	$800	Survey while excavating RIM from Area 1; Conduct Final Survey Area 1
$92,000			Rad Tech	$680	Survey while excavating RIM from Area 1; Conduct Final Survey Area 1
			Rad Tech	$680	Survey while excavating RIM from Area 1; Conduct Final Survey Area 1
			Rad Tech	$680	Survey Trucks loaded with RIM from Area 1; Conduct final survey Area 1
			Lab Tech	$700	Process additional samples from survey during RIM moving and Survey
$3,540	OS5A	Note 5	Sr Rad Tech	$800	Survey while excavating RIM from Area 2; Conduct Final Survey Area 2 + BZ
$938,000			Rad Tech	$680	Survey while excavating RIM from Area 2; Conduct Final Survey Area 2 + BZ
			Rad Tech	$680	Survey while excavating RIM from Area 2; Conduct Final Survey Area 2 + BZ
			Rad Tech	$680	Survey Trucks loaded with RIM from Area 2; Conduct final survey Area 2 + BZ
			Lab Tech	$700	Process additional samples from survey during RIM moving and Survey
$1,480	OS5B	Note 6	Sr Rad Tech	$800	Survey while moving RIM to On-site Cell; then Survey of holding area
$431,000			Rad Tech	$680	Survey while moving RIM to On-site Cell; then Survey of holding area

OS1A working days:

2016	31 working days	2019	111 working days
2017	93 working days	2023	181 working days
2018	137 working days	2024	10 working days
			563 total working days

OSL working days:

2016	31 working days	2019	104 working days
2017	93 working days	2023	181 working days
2018	137 working days	2024	4 working days
			550 total working days

OS5 working days:

2016	0 working days	2019
2017	0 working days	2023
2018	0 working days	2024

OS5A working days:

2016	0 working days	2019
2017	17 working days	2023
2018	137 working days	2024

OS5B working days:

2016	0 working days	2019
2017	17 working days	2023
2018	137 working days	2024

$8,576,000 Total Estimated Radiological Survey Labor Costs during Construction

Misc cost	$50	day	3,151	$158,000

Total Estimated Non-Labor Costs: **$158,000** **$335,000**

Construction Cost Estimate -
"Complete Rad Removal" with On-site Disposal Alternative (Constrained to $10M per year)

Step #	Category	Sub-Category	Task	Quantity: On-Site Area 1	Quantity: On-Site Area 2	Quantity: On-Site Cell	Type of Material Handled	Units	Source of Costing Estimate	RS Means Reference #	RS Means Description	Crew Type	Daily Unit Rate of Construction	Crew Size (Men)	Number of Crews	Efficiency Factor
On-Site 1	Temporary Construction Facilities / Utilities / Personnel	Construction Trailers	Capital Expenses	3			Group of Trailers		See separate Assumptions sheet							
On-Site 2			Operating Expenses	92			Group of Trailers	Months	See separate Assumptions sheet							
On-Site 3			Parking Area	6,667			Gravel Area	S.Y.	RS Means, Year 2011 Quarter 1	015523500050	Temporary, roads, gravel fill, 4" gravel depth, excl surfacing	B14	715	6	1	100%
On-Site 4			Portable Toilets in Construction areas	14	65	28	Portable Toilets	Month	RS Means, Year 2011 Quarter 1	015433406420	Rent portable toilet chemical, recycle, flush type, Incl. Hourly Oper. Cost.					100%
On-Site 5		Contractor's Construction Management Personnel	Project Manager	242			Personnel	Week	RS Means, Year 2011 Quarter 1	013113200220	Field personnel, project manager, maximum		0.2	1	1	100%
On-Site 6			Construction Superintendent(s)	401			Personnel	Week	RS Means, Year 2011 Quarter 1	013113200260	Field personnel, superintendent, average		0.2	1	1	100%
On-Site 7			Clerk(s)	401			Personnel	Week	RS Means, Year 2011 Quarter 1	013113200020	Field Personnel, clerk, average		0.2	1	1	100%
On-Site 8			Field Engineer(s) / Safety Officer(s)	401			Personnel	Week	RS Means, Year 2011 Quarter 1	013113200120	Field personnel, field engineer, average		0.2	1	1	100%
On-Site 9	Temporary Stormwater Infrastructure (for stormwater during construction)	Temporary Stormwater Lagoon	Excavate soil for 4th berm at former leachate lagoon area	21,379			Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316464420	Excavating, bulk, dozer, open site, bank measure, common earth, 200 H.P. dozer, 300' push	B10B	270	1.5	4	100%
On-Site 10			Place soil for berm	29,930			Soil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	1.5	2	100%
On-Site 11			Compact berm	21,379			Soil	E.C.Y.	RS Means, Year 2011 Quarter 1	312323235060	Compaction, riding, vibrating roller, 2 passes, 12" lifts	B10Y	5,200	1.5	2	100%
On-Site 12			Install geomembrane liner	495			60 mil HDPE	M.S.F.	RS Means, Year 2011 Quarter 1	334713531220	Pond and Reservoir Liners, membrane lining systems HDPE, 100,000 S.F. or more, 60 mil thick	3 Skwk	2	3	12	100%
On-Site 13			Install force main from Areas 1 and 2 to lagoon	3,641	607		HDPE Pipe	L.F.	RS Means, Year 2011 Quarter 1	331113350100	Water supply distribution piping, piping HDPE, butt fusion joints, 40' lengths, 4" diameter, SDR 21	B22A	400	5	1	100%
On-Site 14			Install force main from lagoon to treatment facility	551			HDPE Pipe	L.F.	RS Means, Year 2011 Quarter 1	331113350100	Water supply distribution piping, piping HDPE, butt fusion joints, 40' lengths, 4" diameter, SDR 21	B22A	400	5	1	100%
On-Site 15		Treatment Facility	Construct Treatment Facility	1			Treatment Facility	Each	EMSI Estimate				0.017	7	1	100%
On-Site 16			Monthly Operation during construction	49			Treatment Facility Operation	Months	EMSI Estimate				0.4	1	1	100%
On-Site 17		Leachate Treatment Facility	Force main from cell to Treatment Facility			3,000	Dual-contained HDPE Pipe	L.F.	RS Means, Year 2011 Quarter 1	331113350100	Water supply distribution piping, piping HDPE, butt fusion joints, 40' lengths, 4" diameter, SDR 21	B22A	200	5	1	100%
On-Site 18			Construct Treatment Facility			1	Treatment Facility	Each	EMSI Estimate				0.022	7	1	100%
On-Site 19			Monthly Operation during construction phase			20	Treatment Facility Operation	Months	EMSI Estimate				0.400	1	1	100%
On-Site 20		Stormwater events during construction	Dewater construction after rain events	529	1,301	284	Construction stormwater	Days of Pumping	RS Means, Year 2011 Quarter 1	312319200650	Dewatering, pumping, 8 hr., attended 2 hours per day, 4" discharge pump used for 8 hours, includes 20 L.F. of suction hose and 100 L.F. of discharge hose	B10I	4	1.5	4	100%
On-Site 21			Dispose of contact stormwater to MSD	2,500,000	5,000,000		Contact stormwater	Gallons	Metropolitan St. Louis Sewer District, May 2011							100%
On-Site 22			Dispose of leachate to MSD			57,000,000	Construction Leachate	Gallons	Metropolitan St. Louis Sewer District, May 2011							100%
On-Site 23		Post-project Stormwater Demolition	Dispose of geomembrane liner in On-Site Cell	495			60 mil HDPE	M.S.F.	Estimating $.40/sf				20	3	1	100%
On-Site 24			Deconstruct 4th berm	21,379			Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316464420	Excavating, bulk, dozer, open site, bank measure, common earth, 200 H.P. dozer, 300' push	B10B	270	1.5	4	100%
On-Site 25			Grade berm material in lagoon for proper drainage	29,930			Soil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	1.5	2	100%
On-Site 26	Site-wide Preparation	Mobilization	Mobilize and Demobilize Equipment Under 150HP	8			Units of Equipment up to 150HP (up to 50 miles)	Ea.	RS Means, Year 2011 Quarter 1	015436500020	Mobilization or demobilization, dozer, loader, backhoe or excavator, 70 H.P. to 150 H.P., up to 50 miles	B34N	4	1	1	100%
On-Site 27			*Extra Mileage for Mobilizations*	80			Per 5 additional miles		RS Means, Year 2011 Quarter 1	015436500020A	Mobilization or demobilization, each additional 5 miles haul distance, add	B34N	72	1	1	100%
On-Site 28			Mobilize and Demobilize Equipment Over 150HP	56			Units of Equipment over 150HP (up to 50 miles)	Ea.	RS Means, Year 2011 Quarter 1	015436500100	Mobilization or demobilization, dozer, loader, backhoe or excavator, above 150 H.P., up to 50 miles	B34K	3	1	1	100%
On-Site 29			*Extra Mileage for Mobilizations*	560			Per 5 additional miles		RS Means, Year 2011 Quarter 1	015436500100A	Mobilization or demobilization, each additional 5 miles haul distance, add	B34K	72	1	1	100%
On-Site 30			Mobilize and Demobilize Equipment, Towed	4			Units of Towed Equipment (up to 50 miles)	Ea.	RS Means, Year 2011 Quarter 1	015436500300	Mobilization or demobilization, scraper, towed type (including tractor), 6 C.Y. capacity, up to 50 miles	B34K	3	1	1	100%
On-Site 31			*Extra Mileage for Mobilizations*	40			Per 5 additional miles		RS Means, Year 2011 Quarter 1	015436500300A	Mobilization or demobilization, each additional 5 miles haul distance, add	B34K	72	1	1	100%
On-Site 32			Mobilize and Demobilize Equipment, Scrapers	6			Scrapers (up to 50 miles)	Ea.	RS Means, Year 2011 Quarter 1	015436500700	Mobilization or demobilization, scraper, self-propelled, 24 C.Y. capacity, up to 50 miles	B34K	2	1	1	100%
On-Site 33			*Extra Mileage for Mobilizations*	60			Per 5 additional miles		RS Means, Year 2011 Quarter 1	015436500700A	Mobilization or demobilization, each additional 5 miles haul distance, add	B34K	72	1	1	100%
On-Site 34		Supplemental Mobilizations	Mobilize and Demobilize Equipment Under 150HP	16			Units of Equipment up to 150HP (up to 50 miles)	Ea.	RS Means, Year 2011 Quarter 1	015436500020	Mobilization or demobilization, dozer, loader, backhoe or excavator, 70 H.P. to 150 H.P., up to 50 miles	B34N	4	1	1	100%
On-Site 35			*Extra Mileage for Mobilizations*	160			Per 5 additional miles		RS Means, Year 2011 Quarter 1	015436500020A	Mobilization or demobilization, each additional 5 miles haul distance, add	B34N	72	1	1	100%

Step #	Construction (Days): On-Site Area 1	Construction (Days): On-Site Area 2	Construction (Days): On-Site Cell	Crew Man-days: On-Site Area 1	Crew Man-days: On-Site Area 2	Crew Man-days: On-Site Cell	Unit Costs: Extended Material Overhead and Profit	Unit Costs: Extended Labor Overhead and Profit	Unit Costs: Extended Labor Overhead and Profit - Ineffeciency	Unit Costs: Extended Equipment Overhead and Profit	Unit Costs: Extended Equipment Overhead and Profit - Ineffeciency	Unit Costs: Extended Total Overhead and Profit	Material Taxes at Bridgeton (7.925%): On-Site Area 1	Material Taxes: On-Site Area 2	Material Taxes: On-Site Cell	Total Cost for Line Item: On-Site Area 1	Total Cost: On-Site Area 2	Total Cost: On-Site Cell	Truckloads for Delivery: On-Site Area 1	Truckloads: On-Site Area 2	Truckloads: On-Site Cell	Total Miles for Delivery: On-Site Area 1	Total Miles: On-Site Area 2	Total Miles: On-Site Cell
On-Site 1	37.5	-	-	58.9	-	-						$ 87,040	$ -	$ -	$ -	$ 261,000	$ -	$ -	15	-	-	300	-	-
On-Site 2												$ 2,638	$ -	$ -	$ -	$ 243,000	$ -	$ -						
On-Site 3	9.3	-	-	55.9	-	-	$ 4.46	$ 3.97	$ -	$ 0.53	$ -	$ 8.96	$ 2,360	$ -	$ -	$ 62,100	$ -	$ -						
On-Site 4							$ -	$ -	$ -	$ 281	$ -	$ 281	$ -	$ -	$ -	$ 3,890	$ 18,200	$ 7,870						
On-Site 5	1,206	-	-	1,206	-	-	$ -	$ 3,650	$ -	$ -	$ -	$ 3,650	$ -	$ -	$ -	$ 883,000	$ -	$ -						
On-Site 6	2,000	-	-	2,000	-	-	$ -	$ 2,950	$ -	$ -	$ -	$ 2,950	$ -	$ -	$ -	$ 1,180,000	$ -	$ -						
On-Site 7	2,000	-	-	2,000	-	-	$ -	$ 630	$ -	$ -	$ -	$ 630	$ -	$ -	$ -	$ 253,000	$ -	$ -						
On-Site 8	2,000	-	-	2,000	-	-	$ -	$ 1,950	$ -	$ -	$ -	$ 1,950	$ -	$ -	$ -	$ 783,000	$ -	$ -						
On-Site 9	19.8	-	-	118.8	-	-	$ -	$ 2.72	$ -	$ 4.65	$ -	$ 7.37	$ -	$ -	$ -	$ 158,000	$ -	$ -						
On-Site 10	15.0	-	-	44.9	-	-	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ -	$ 59,600	$ -	$ -						
On-Site 11	2.1	-	-	6.2	-	-	$ -	$ 0.14	$ -	$ 0.12	$ -	$ 0.26	$ -	$ -	$ -	$ 5,560	$ -	$ -						
On-Site 12	25.8	-	-	928.1	-	-	$ 271.46	$ 1,113.15	$ -	$ -	$ -	$ 1,384.61	$ 10,600	$ -	$ -	$ 696,000	$ -	$ -	5	-	-	10,000	-	-
On-Site 13	9.1	1.5	-	45.5	7.6	-	$ 3.66	$ 6.46	$ -	$ 1.89	$ -	$ 12.01	$ 1,060	$ 176	$ -	$ 44,800	$ 7,470	$ -						
On-Site 14	1.4	-	-	6.9	-	-	$ 3.66	$ 6.46	$ -	$ 1.89	$ -	$ 12.01	$ 160	$ -	$ -	$ 6,780	$ -	$ -						
On-Site 15	60.0	-	-	420.0	-	-						$ 264,000	$ -	$ -	$ -	$ 264,000	$ -	$ -						
On-Site 16	121.3	-	-	121.3	-	-						$ 9,000	$ -	$ -	$ -	$ 437,000	$ -	$ -						
On-Site 17	-	-	15.0	-	-	75.0	$ 7.32	$ 19.49	$ -	$ 3.78	$ -	$ 30.59	$ -	$ -	$ 1,740	$ -	$ -	$ 93,500						
On-Site 18	-	-	45.0	-	-	315.0						$ 107,000	$ -	$ -	$ -	$ -	$ -	$ 107,000						
On-Site 19	-	-	49.1	-	-	49.1						$ 5,000	$ -	$ -	$ -	$ -	$ -	$ 98,200						
On-Site 20	33.1	81.3	17.8	198.4	487.8	106.7	$ -	$ 183.11	$ -	$ 35.30	$ -	$ 218.41	$ -	$ -	$ -	$ 116,000	$ 284,000	$ 62,100						
On-Site 21												$ 0.0028	$ -	$ -	$ -	$ 7,050	$ 14,100	$ -						
On-Site 22												$ 0.0028	$ -	$ -	$ -	$ -	$ -	$ 161,000						
On-Site 23	24.8	-	-	74.3	-	-						$ 400	$ -	$ -	$ -	$ 198,000	$ -	$ -						
On-Site 24	19.8	-	-	118.8	-	-	$ -	$ 2.72	$ -	$ 4.65	$ -	$ 7.37	$ -	$ -	$ -	$ 158,000	$ -	$ -						
On-Site 25	15.0	-	-	44.9	-	-	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ -	$ 59,600	$ -	$ -						
On-Site 26	2.0	-	-	2.0	-	-	$ -	$ 112.25	$ -	$ 139.01	$ -	$ 251.26	$ -	$ -	$ -	$ 2,010	$ -	$ -						
On-Site 27	1.1	-	-	1.1	-	-	$ -	$ 11.23	$ -	$ 13.90	$ -	$ 25.12	$ -	$ -	$ -	$ 2,010	$ -	$ -						
On-Site 28	18.7	-	-	18.7	-	-	$ -	$ 148.59	$ -	$ 309.51	$ -	$ 458.10	$ -	$ -	$ -	$ 25,700	$ -	$ -						
On-Site 29	7.8	-	-	7.8	-	-	$ -	$ 14.86	$ -	$ 30.95	$ -	$ 45.81	$ -	$ -	$ -	$ 25,700	$ -	$ -						
On-Site 30	1.3	-	-	1.3	-	-	$ -	$ 148.59	$ -	$ 309.51	$ -	$ 458.10	$ -	$ -	$ -	$ 1,830	$ -	$ -						
On-Site 31	0.6	-	-	0.6	-	-	$ -	$ 14.86	$ -	$ 30.95	$ -	$ 45.81	$ -	$ -	$ -	$ 1,830	$ -	$ -						
On-Site 32	3.0	-	-	3.0	-	-	$ -	$ 223.42	$ -	$ 466.98	$ -	$ 690.40	$ -	$ -	$ -	$ 4,140	$ -	$ -						
On-Site 33	0.8	-	-	0.8	-	-	$ -	$ 22.34	$ -	$ 46.70	$ -	$ 69.04	$ -	$ -	$ -	$ 4,140	$ -	$ -						
On-Site 34	4.0	-	-	4.0	-	-	$ -	$ 112.25	$ -	$ 139.01	$ -	$ 251.26	$ -	$ -	$ -	$ 4,020	$ -	$ -						
On-Site 35	2.2	-	-	2.2	-	-	$ -	$ 11.23	$ -	$ 13.90	$ -	$ 25.12	$ -	$ -	$ -	$ 4,020	$ -	$ -						

Construction Cost Estimate -
"Complete Rad Removal" with On-site Disposal Alternative (Constrained to $10M per year)

Step #	Category	Sub-Category	Task	Quantity: On-Site Area 1	Quantity: On-Site Area 2	Quantity: On-Site Cell	Type of Material Handled	Units	Source of Costing Estimate	RS Means Reference #	RS Means Description	Crew Type	Daily Unit Rate of Construction	Crew Size (Men)	Number of Crews	Efficiency Factor
On-Site 36			Mobilize and Demobilize Equipment Over 150HP		112		Units of Equipment over 150HP (up to 50 miles)	Ea.	RS Means, Year 2011 Quarter 1	015436500100	Mobilization or demobilization, dozer, loader, backhoe or excavator, above 150 H.P., up to 50 miles	B34K	3	1	1	100%
On-Site 37		*Supplemental Mobilizations (cont.)*	*Extra Mileage for Mobilizations*		1,120		Per 5 additional miles		RS Means, Year 2011 Quarter 1	015436500100A	Mobilization or demobilization, each additional 5 miles haul distance, add	B34K	72	1	1	100%
On-Site 38			Mobilize and Demobilize Equipment, Towed		8		Units of Towed Equipment (up to 50 miles)	Ea.	RS Means, Year 2011 Quarter 1	015436500300	Mobilization or demobilization, scraper, towed type (including tractor), 6 C.Y. capacity, up to 50 miles	B34K	3	1	1	100%
On-Site 39	Site-wide Preparation (cont.)		*Extra Mileage for Mobilizations*		80		Per 5 additional miles		RS Means, Year 2011 Quarter 1	015436500300A	Mobilization or demobilization, each additional 5 miles haul distance, add	B34K	72	1	1	100%
On-Site 40			Create Temporary Roads	13,333	26,667	13,333	Gravel Roads	S.Y.	RS Means, Year 2011 Quarter 1	015523500050	Temporary, roads, gravel fill, 4" gravel depth, excl surfacing	B14	715	6	1	100%
On-Site 41			Install TBD Traffic Improvements	$ 100,000	$ 100,000	$ 500,000	TBD (shown as budget estimate)	$						6	1	100%
On-Site 42			Water Truck Depreciation	1	2	1	Water Trucks	Trucks	Estimate							
On-Site 43			Water Truck Operation	12	62	46	Water Trucks	Months	Estimate				0.050	1	1	100%
On-Site 44		*Dust Control*	Use Water to Control Dust	2,450,000	12,400,000	9,120,000	Water	Gal	Missouri American Water Company, 4/20/2011							100%
On-Site 45			Prepare area with Stormwater BMPs	4,078	8,285	3,614	Silt Fence	L.F.	RS Means, Year 2011 Quarter 1	312514161100	Synthetic erosion control, silt fence, polypropylene, adverse conditions, 3' high	2 Clab	950	2	1	100%
On-Site 46		*Decontamination Area*	Materials	56	56		Concrete	C.Y.	RS Means, Year 2011 Quarter 1	033105350300	Structural concrete, ready mix, normal weight, 4000 PSI, includes local aggregate, sand, Portland cement and water, delivered, excludes all additives and treatments					100%
On-Site 47			Installation	56	56		Concrete	C.Y.	RS Means, Year 2011 Quarter 1	33105704650	Structural concrete, placing, slab on grade, pumped, over 6" thick, includes strike off & consolidation, excludes material	C20	185	8	1	100%
On-Site 48	Site Preparation		Clear Vegetation (Light)	16.0	21.4	17.5	Vegetation	Acre	RS Means, Year 2011 Quarter 1	311313101020	Selective tree and shrub removal, selective clearing brush mowing, light density, tractor with rotary mower, excludes removal offsite	B84	2	1	1	100%
On-Site 49			Clear Vegetation (Heavy)	3.5	27.8	0.1	Vegetation	Acre	RS Means, Year 2011 Quarter 1	311110100020	Clearing & grubbing, cut & chip light trees, to 6" diameter	B7	1	6	1	100%
On-Site 50			Purchase material	2,963	4,444		Soil	B.C.Y.	Local Republic landfill with surplus material							
On-Site 51		*Berms for Overburden*	Deliver and Stockpile	4,148	6,222		Soil	L.C.Y.	Based on Central Stone estimate				64	1	50	100%
On-Site 52			Develop earthen berms to store relocated overburden wastes	4,148	6,222		Soil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	1.5	3	100%
On-Site 53	New On-Site Cell Excavation		Excavate Excess Overburden to Subgrade Contours			490,107	Overburden Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316502400	Excavation, bulk, scrapers, bank measure, common earth, 5000' haul, 21 C.Y. bucket, self propelled scrapers, 1/4 push dozer	B33E	650	1.75	2.3	100%
On-Site 54			Purchase clay material			32,092	Clay Material	B.C.Y.	Local Republic landfill with surplus material							
On-Site 55		*Clay*	Deliver clay material to site			44,929	Clay Material	L.C.Y.	Based on Central Stone estimate				64	1	50	100%
On-Site 56			Spread loose lift before compaction in Cell Liner			44,929	Clay Material	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	1.5	6	100%
On-Site 57			Compact Clay in Cell Liner			32,092	Clay Material	E.C.Y.	RS Means, Year 2011 Quarter 1	312323235720	Compaction, 4 passes, 12" lifts, riding, sheepsfoot or wobbly wheel roller	B10G	2,600	1.5	2	100%
On-Site 58			Install Geosynthetic liner			477	60 mil HDPE	M.S.F.	RS Means, Year 2011 Quarter 1	334713531220	Pond and Reservoir Liners, membrane lining systems HDPE, 100,000 S.F. or more, 60 mil thick	3 Skwk	1.6	3	12	100%
On-Site 59			Install Cushioning geotextile			52,952	16 oz geotextile	S.Y.	RS Means, Year 2011 Quarter 1	334626100100	Geotextile Subsurface Drainage Filtration, fabric, laid in trench, polypropylene, ideal conditions	2 Clab	2,400	2	4	100%
On-Site 60			Purchase Leachate Collection Layer Drainage Material			17,651	Pea Gravel	B.C.Y.	Central Stone estimate, 4/4/2011							
On-Site 61	Construct Cell Bottom Liner		Deliver Leachate Collection Layer Drainage Material			19,769	Pea Gravel	L.C.Y.	Central Stone estimate, 4/4/2011				48	1	50	100%
On-Site 62			Load Leachate Drainage Material from stockpile to off road haul truck			17,651	Pea Gravel	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305	Excavating, bulk bank measure, 3-1/2 C.Y. capacity = 160 C.Y./hour, backhoe, hydraulic, crawler mounted, excluding truck loading	B12D	2,400	2	3	100%
On-Site 63			*(additional cost to previous line)*			17,651	Pea Gravel	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305A	Excavating, bulk bank measure, for loading onto trucks, add	B12D	16,255	2	3	100%
On-Site 64		*Leachate Collection*	Haul Leachate Drainage Material from stockpile to cell			19,769	Pea Gravel	L.C.Y.	RS Means, Year 2011 Quarter 1	312323205110	Cycle hauling(wait, load,travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 22 C.Y. truck, cycle 2 mile, 10 MPH, excludes loading equipment	B34F	374	1	5.6	100%
On-Site 65			Install Leachate Collection Layer			19,769	Pea Gravel	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	1.5	6	100%
On-Site 66			Install Leachate Collection Piping			1,362	HDPE Pipe	L.F.	RS Means, Year 2011 Quarter 1	333113203120	Public Sanitary Utility Sewerage Piping, piping HDPE Corrugated Type S with watertight gaskets, 18" diameter, excludes excavation or backfill	B21	275	3.5	1	100%
On-Site 67			Install Leachate Collection Sump			164	HDPE Pipe	L.F.	RS Means, Year 2011 Quarter 1	312319201900	Dewatering, sump hole construction, pit with gravel collar, corrugated, 12" gravel collar, 18" corr. pipe, 16 ga, includes excavation and gravel pit	B6	50	3	1	100%
On-Site 68			Install Separation Geotextile filter			52,952	4 oz geotextile	S.Y.	RS Means, Year 2011 Quarter 1	334626100100	Geotextile Subsurface Drainage Filtration, fabric, laid in trench, polypropylene, ideal conditions	2 Clab	2,400	2	4	100%

Step #	Construction (Days): On-Site Area 1	Construction (Days): On-Site Area 2	Construction (Days): On-Site Cell	Crew Man-days: On-Site Area 1	Crew Man-days: On-Site Area 2	Crew Man-days: On-Site Cell	Unit Costs: Extended Material Overhead and Profit	Unit Costs: Extended Labor Overhead and Profit	Unit Costs: Extended Labor Overhead and Profit - Ineffeciency	Unit Costs: Extended Equipment Overhead and Profit	Unit Costs: Extended Equipment Overhead and Profit - Ineffeciency	Unit Costs: Extended Total Overhead and Profit	Material Taxes at Bridgeton (7.925%): On-Site Area 1	Material Taxes at Bridgeton (7.925%): On-Site Area 2	Material Taxes at Bridgeton (7.925%): On-Site Cell	Total Cost for Line Item: On-Site Area 1	Total Cost for Line Item: On-Site Area 2	Total Cost for Line Item: On-Site Cell	Truckloads for Delivery: On-Site Area 1	Truckloads for Delivery: On-Site Area 2	Truckloads for Delivery: On-Site Cell	Total Miles for Delivery: On-Site Area 1	Total Miles for Delivery: On-Site Area 2	Total Miles for Delivery: On-Site Cell
On-Site 36	37.3	-	-	37.3	-	-	$ -	$ 148.59	$ -	$ 309.51	$ -	$ 458.10	$ -	$ -	$ -	$ 51,300	$ -	$ -						
On-Site 37	15.6	-	-	15.6	-	-	$ -	$ 14.86	$ -	$ 30.95	$ -	$ 45.81	$ -	$ -	$ -	$ 51,300	$ -	$ -						
On-Site 38	2.7	-	-	2.7	-	-	$ -	$ 148.59	$ -	$ 309.51	$ -	$ 458.10	$ -	$ -	$ -	$ 3,660	$ -	$ -						
On-Site 39	1.1	-	-	1.1	-	-	$ -	$ 14.86	$ -	$ 30.95	$ -	$ 45.81	$ -	$ -	$ -	$ 3,660	$ -	$ -						
On-Site 40	18.6	37.3	18.6	111.9	223.8	111.9	$ 4.46	$ 3.97	$ -	$ 0.53	$ -	$ 8.96	$ 4,710	$ 9,430	$ 4,710	$ 124,000	$ 248,000	$ 124,000						
On-Site 41	10.0	10.0	45.0	60.0	60.0	180.0	$ 1.00					$ 1.00	$ 7,930	$ 7,930	$ 39,600	$ 108,000	$ 108,000	$ 540,000						
On-Site 42												$ 50,000	$ -	$ -	$ -	$ 50,000	$ 100,000	$ 50,000						
On-Site 43	245	1,237	912	245	1,237	912						$ 8,000	$ -	$ -	$ -	$ 97,900	$ 495,000	$ 365,000						
On-Site 44												$ 0.0032	$ -	$ -	$ -	$ 7,810	$ 39,500	$ 29,100						
On-Site 45	4.3	8.7	3.8	8.6	17.4	7.6	$ 0.44	$ 0.87	$ -	$ -	$ -	$ 1.31	$ 142	$ 289	$ 126	$ 5,480	$ 11,100	$ 4,860						
On-Site 46							$ 105.20					$ 105.20	$ 463	$ 463	$ -	$ 6,310	$ 6,310	$ -						
On-Site 47	0.3	0.3	-	2.4	2.4	-	$ -	$ 20.96	$ -	$ 5.08	$ -	$ 26.04	$ -	$ -	$ -	$ 1,450	$ 1,450	$ -						
On-Site 48	8.0	10.7	8.8	8.0	10.7	8.8	$ -	$ 265.31	$ -	$ 175.93	$ -	$ 441.24	$ -	$ -	$ -	$ 7,060	$ 9,440	$ 7,720						
On-Site 49	3.5	27.8	0.1	21.0	166.8	0.7	$ -	$ 2,618.83	$ -	$ 1,574.70	$ -	$ 4,193.53	$ -	$ -	$ -	$ 14,700	$ 117,000	$ 503						
On-Site 50							$ 16.88					$ 16.88	$ 3,960	$ 5,940	$ -	$ 54,000	$ 80,900	$ -						
On-Site 51	1.3	1.9	-	64.8	97.2	-		$ 5.22	$ -	$ 5.22	$ -	$ 10.43	$ -	$ -	$ -	$ 43,300	$ 64,900	$ -	260	389	-	18,200	27,230	-
On-Site 52	1.4	2.1	-	6.2	9.3	-	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ -	$ 8,250	$ 12,400	$ -						
On-Site 53	-	-	326.7	-	-	1,319.5	$ -	$ 1.33	$ -	$ 4.18	$ -	$ 5.51	$ -	$ -	$ -	$ -	$ -	$ 2,700,000						
On-Site 54							$ 16.88					$ 16.88	$ -	$ -	$ 42,900	$ -	$ -	$ 584,000						
On-Site 55	-	-	14.0	-	-	702.0		$ 5.22	$ -	$ 5.22	$ -	$ 10.43	$ -	$ -	$ -	$ -	$ -	$ 469,000	-	-	2,809	-	-	196,630
On-Site 56	-	-	7.5	-	-	67.4	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ -	$ -	$ -	$ 89,400						
On-Site 57	-	-	6.2	-	-	18.5	$ -	$ 0.28	$ -	$ 0.50	$ -	$ 0.78	$ -	$ -	$ -	$ -	$ -	$ 25,000						
On-Site 58	-	-	24.8	-	-	893.6	$ 271.46	$ 1,113.15	$ -	$ -	$ -	$ 1,384.61	$ -	$ -	$ 10,300	$ -	$ -	$ 670,000	-	-	5	-	-	10,000
On-Site 59	-	-	5.5	-	-	44.1	$ 1.63	$ 0.38	$ -	$ -	$ -	$ 2.01	$ -	$ -	$ 6,840	$ -	$ -	$ 113,000	-	-	5	-	-	10,000
On-Site 60							$ 19.31					$ 19.31	$ -	$ -	$ 27,000	$ -	$ -	$ 368,000						
On-Site 61	-	-	8.2	-	-	411.8		$ 7.05	$ -	$ 7.05	$ -	$ 14.10	$ -	$ -	$ -	$ -	$ -	$ 279,000	-	-	1,648	-	-	65,920
On-Site 62	-	-	2.5	-	-	14.7	$ -	$ 0.40	$ -	$ 1.09	$ -	$ 1.49	$ -	$ -	$ -	$ -	$ -	$ 26,300						
On-Site 63	-	-	0.4	-	-	2.2	$ -	$ 0.02	$ -	$ 0.03	$ -	$ 0.22	$ -	$ -	$ -	$ -	$ -	$ 3,880						
On-Site 64	-	-	9.4	-	-	52.9	$ -	$ 1.09	$ -	$ 3.63	$ -	$ 4.72	$ -	$ -	$ -	$ -	$ -	$ 93,300						
On-Site 65	-	-	3.3	-	-	29.7	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ -	$ -	$ -	$ 39,300						
On-Site 66	-	-	5.0	-	-	17.3	$ 11.56	$ 6.68	$ -	$ 0.56	$ -	$ 18.80	$ -	$ -	$ 1,250	$ -	$ -	$ 26,900						
On-Site 67	-	-	3.3	-	-	9.8	$ 37.24	$ 26.79	$ -	$ 7.66	$ -	$ 71.69	$ -	$ -	$ 484	$ -	$ -	$ 12,200						
On-Site 68	-	-	5.5	-	-	44.1	$ 1.63	$ 0.38	$ -	$ -	$ -	$ 2.01	$ -	$ -	$ 6,840	$ -	$ -	$ 113,000	-	-	5	-	-	10,000

Construction Cost Estimate -
"Complete Rad Removal" with On-site Disposal Alternative (Constrained to $10M per year)

Step #	Category	Sub-Category	Task	Quantity: On-Site Area 1	Quantity: On-Site Area 2	Quantity: On-Site Cell	Type of Material Handled	Units	Source of Costing Estimate	RS Means Reference #	RS Means Description	Crew Type	Daily Unit Rate of Constr-uction	Crew Size (Men)	Number of Crews	Effic-iency Factor
On-Site 69	Overburden Relocation		Relocate overburden wastes - Excavate	67,475	408,031		Non RAD Waste	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305	Excavating, bulk bank measure, 3-1/2 C.Y. capacity = 160 C.Y./hour, backhoe, hydraulic, crawler mounted, excluding truck loading	B12D	2,400	2	3	70%
On-Site 70			*(additional cost to previous line)*	67,475	408,031		Non RAD Waste	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305A	Excavating, bulk bank measure, for loading onto trucks, add	B12D	16,255	2	3	70%
On-Site 71			Relocate overburden wastes - Haul and Dump	101,213	612,047		Non RAD Waste	L.C.Y.	RS Means, Year 2011 Quarter 1	312323205060	Cycle hauling(wait, load,travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 22 C.Y. truck, cycle 2000 ft, 10 MPH, excludes loading equipment	B34F	594	1	3.5	100%
On-Site 72			Apply daily cover to relocated overburden wastes	6,748	40,803		Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316462200	Excavating, bulk, dozer, open site, bank measure, sand and gravel, 80 H.P. dozer, 150' haul	B10L	230	1.5	3	100%
On-Site 73			Spread overburden wastes	107,960	652,850		Non RAD Waste	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	1.5	6	100%
On-Site 74			Compact overburden wastes	74,223	448,834		Non RAD Waste	E.C.Y.	RS Means, Year 2011 Quarter 1	312323235720	Compaction, 4 passes, 12" lifts, riding, sheepsfoot or wobbly wheel roller	B10G	2,600	1.5	2	100%
On-Site 75	RIM Relocation to On-Site Cell		Apply daily cover to remaining excavation of RIM Wastes	3,350	30,200		Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316462200	Excavating, bulk, dozer, open site, bank measure, sand and gravel, 80 H.P. dozer, 150' haul	B10L	230	1.5	1	100%
On-Site 76			Relocate RIM Wastes on-site - Excavate	36,850	332,200		RAD Waste	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305	Excavating, bulk bank measure, 3-1/2 C.Y. capacity = 160 C.Y./hour, backhoe, hydraulic, crawler mounted, excluding truck loading	B12D	2,400	2	3	50%
On-Site 77			*(additional cost to previous line)*	36,850	332,200		RAD Waste	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305A	Excavating, bulk bank measure, for loading onto trucks, add	B12D	16,255	2	3	50%
On-Site 78			Relocate RIM Wastes to On-Site Cell - Haul and Dump	55,275	498,300		RAD Waste	L.C.Y.	RS Means, Year 2011 Quarter 1	312323205110	Cycle hauling(wait, load,travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 22 C.Y. truck, cycle 2 mile, 10 MPH, excludes loading equipment	B34F	374	1	5.6	100%
On-Site 79			Apply daily cover to relocated RIM Wastes	3,685	33,220		Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316462200	Excavating, bulk, dozer, open site, bank measure, sand and gravel, 80 H.P. dozer, 150' haul	B10L	230	1.5	1	100%
On-Site 80			Spread RIM Wastes at On-Site Cell	57,285	516,420		RAD Waste	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	1.5	4	100%
On-Site 81			Compact RIM Wastes at On-Site Cell	40,535	365,420		RAD Waste	E.C.Y.	RS Means, Year 2011 Quarter 1	312323235720	Compaction, 4 passes, 12" lifts, riding, sheepsfoot or wobbly wheel roller	B10G	2,600	1.5	2	100%
On-Site 82	Buffer Zone		Buffer Zone Activity	-	1	-	See separate Assumptions sheet		See separate Assumptions sheet						1	100%
On-Site 83	Rad. Survey		Conduct final radiological survey and wait for approval	1	1	-	This activity is handled by others, and does not have a direct cost to the contractor. However, there are the indirect costs due to the duration and associated waiting.								1	100%
On-Site 84	Backfill and Slope Correction in Areas 1 and 2 after RIM has been removed	*Slope Correction Cuts*	Move non-RIM waste to correct slopes in excavation - Excavate	15,915	137,914		Non RAD Waste	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305	Excavating, bulk bank measure, 3-1/2 C.Y. capacity = 160 C.Y./hour, backhoe, hydraulic, crawler mounted, excluding truck loading	B12D	2,400	2	3	100%
On-Site 85			*(additional cost to previous line)*	15,915	137,914		Non RAD Waste	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305A	Excavating, bulk bank measure, for loading onto trucks, add	B12D	16,255	2	3	100%
On-Site 86			Move non-RIM waste to correct slopes in excavation - Haul and Dump	23,873	206,871		Non RAD Waste	L.C.Y.	RS Means, Year 2011 Quarter 1	312323205060	Cycle hauling(wait, load,travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 22 C.Y. truck, cycle 2000 ft, 10 MPH, excludes loading equipment	B34F	594	1	3.5	100%
On-Site 87			Spread cut material	23,873	206,871		Non RAD Waste	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	2	6	100%
On-Site 88			Compact cut material	15,915	137,914		Non RAD Waste	E.C.Y.	RS Means, Year 2011 Quarter 1	312323235720	Compaction, 4 passes, 12" lifts, riding, sheepsfoot or wobbly wheel roller	B10G	2,600	2	2	100%
On-Site 89		*Backfill Overburden*	Backfill Overburden Materials stored in berms - Excavate	21,000	63,000		Non RAD Waste	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305	Excavating, bulk bank measure, 3-1/2 C.Y. capacity = 160 C.Y./hour, backhoe, hydraulic, crawler mounted, excluding truck loading	B12D	2,400	2	3	100%
On-Site 90			*(additional cost to previous line)*	21,000	63,000		Non RAD Waste	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305A	Excavating, bulk bank measure, for loading onto trucks, add	B12D	16,255	2	3	100%
On-Site 91			Backfill Overburden Materials stored in berms - Haul and Dump	31,500	94,500		Non RAD Waste	L.C.Y.	RS Means, Year 2011 Quarter 1	312323205060	Cycle hauling(wait, load,travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 22 C.Y. truck, cycle 2000 ft, 10 MPH, excludes loading equipment	B34F	594	1	3.5	100%
On-Site 92		*Additional Fill*	Excavate additional fill material for grading	127,923	159,363		Overburden Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305	Excavating, bulk bank measure, 3-1/2 C.Y. capacity = 160 C.Y./hour, backhoe, hydraulic, crawler mounted, excluding truck loading	B12D	2,400	2	3	100%
On-Site 93			*(additional cost to previous line)*	127,923	159,363		Overburden Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305A	Excavating, bulk bank measure, for loading onto trucks, add	B12D	16,255	2	3	100%
On-Site 94			Haul additional fill for grading	159,904	199,204		Overburden Soil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323205110	Cycle hauling(wait, load,travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 22 C.Y. truck, cycle 2 mile, 10 MPH, excludes loading equipment	B34F	374	1	5.6	100%
On-Site 95			Spread additional fill	159,904	199,204		Overburden Soil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	2	6	100%
On-Site 96		*Daily Cover*	Use geotextile as a daily cover for backfill waste to reclaim slopes	33,688	194,117		Geotextile	S.Y.	RS Means, Year 2011 Quarter 1	334626100100	Geotextile Subsurface Drainage Filtration, fabric, laid in trench, polypropylene, ideal conditions	2 Clab	2,400	2	1	100%
On-Site 97			Use geotextile as a daily cover on bermed overburden	5,000	11,111		Geotextile	S.Y.	RS Means, Year 2011 Quarter 1	334626100100	Geotextile Subsurface Drainage Filtration, fabric, laid in trench, polypropylene, ideal conditions	2 Clab	2,400	2	1	100%

Step #	Construction (Days): On-Site Area 1	Construction (Days): On-Site Area 2	Construction (Days): On-Site Cell	Crew Man-days: On-Site Area 1	Crew Man-days: On-Site Area 2	Crew Man-days: On-Site Cell	Unit Costs: Extended Material Overhead and Profit	Unit Costs: Extended Labor Overhead and Profit	Unit Costs: Extended Labor Overhead and Profit - Ineffeciency	Unit Costs: Extended Equipment Overhead and Profit	Unit Costs: Extended Equipment Overhead and Profit - Ineffeciency	Unit Costs: Extended Total Overhead and Profit	Material Taxes at Bridgeton (7.925%): On-Site Area 1	Material Taxes at Bridgeton (7.925%): On-Site Area 2	Material Taxes at Bridgeton (7.925%): On-Site Cell	Total Cost for Line Item: On-Site Area 1	Total Cost for Line Item: On-Site Area 2	Total Cost for Line Item: On-Site Cell	Truckloads for Delivery: On-Site Area 1	Truckloads for Delivery: On-Site Area 2	Truckloads for Delivery: On-Site Cell	Total Miles for Delivery: On-Site Area 1	Total Miles for Delivery: On-Site Area 2	Total Miles for Delivery: On-Site Cell
On-Site 69	13.4	81.0	-	80.3	485.8	-	$ -	$ 0.40	$ 0.17	$ 1.09	$ 0.47	$ 2.13	$ -	$ -	$ -	$ 144,000	$ 869,000	$ -						
On-Site 70	2.0	12.0	-	11.9	71.7	-	$ -	$ 0.02	$ 0.01	$ 0.03	$ 0.01	$ 0.24	$ -	$ -	$ -	$ 16,300	$ 98,500	$ -						
On-Site 71	48.2	291.5	-	170	1,030	-	$ -	$ 0.68	$ -	$ 2.28	$ -	$ 2.96	$ -	$ -	$ -	$ 300,000	$ 1,810,000	$ -						
On-Site 72	9.8	59.1	-	44	266	-	$ -	$ 3.18	$ -	$ 2.14	$ -	$ 5.32	$ -	$ -	$ -	$ 35,900	$ 217,000	$ -						
On-Site 73	18.0	108.8	-	162	979	-	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ -	$ 215,000	$ 1,300,000	$ -						
On-Site 74	14.3	86.3	-	43	259	-	$ -	$ 0.28	$ -	$ 0.50	$ -	$ 0.78	$ -	$ -	$ -	$ 57,900	$ 350,000	$ -						
On-Site 75	14.6	131.3	-	21.8	197.0	-	$ -	$ 3.18	$ -	$ 2.14	$ -	$ 5.32	$ -	$ -	$ -	$ 17,800	$ 161,000	$ -						
On-Site 76	10.2	92.3	-	61.4	553.7	-	$ -	$ 0.40	$ 0.40	$ 1.09	$ 1.09	$ 2.98	$ -	$ -	$ -	$ 110,000	$ 990,000	$ -						
On-Site 77	1.5	13.6	-	9.1	81.7	-	$ -	$ 0.02	$ 0.02	$ 0.03	$ 0.03	$ 0.27	$ -	$ -	$ -	$ 9,950	$ 89,700	$ -						
On-Site 78	26.3	237.3	-	148	1,332	-	$ -	$ 1.09	$ -	$ 3.63	$ -	$ 4.72	$ -	$ -	$ -	$ 261,000	$ 2,350,000	$ -						
On-Site 79	16.0	144.4	-	24.0	216.7	-	$ -	$ 3.18	$ -	$ 2.14	$ -	$ 5.32	$ -	$ -	$ -	$ 19,600	$ 177,000	$ -						
On-Site 80	14.3	129.1	-	85.9	774.6	-	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ -	$ 114,000	$ 1,030,000	$ -						
On-Site 81	7.8	70.3	-	23.4	210.8	-	$ -	$ 0.28	$ -	$ 0.50	$ -	$ 0.78	$ -	$ -	$ -	$ 31,600	$ 285,000	$ -						
On-Site 82	-	6.6	-	-	40.3	-						$ 63,304	$ -	$ -	$ -	$ -	$ 63,300	$ -						
On-Site 83	7.0	7.0	-	-	-	-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -						
On-Site 84	2.2	19.2	-	13.3	114.9	-	$ -	$ 0.40	$ -	$ 1.09	$ -	$ 1.49	$ -	$ -	$ -	$ 23,700	$ 205,000	$ -						
On-Site 85	0.3	2.8	-	2.0	17.0	-	$ -	$ 0.02	$ -	$ 0.03	$ -	$ 0.22	$ -	$ -	$ -	$ 3,500	$ 30,300	$ -						
On-Site 86	11.4	98.5	-	40.2	348.3	-	$ -	$ 0.68	$ -	$ 2.28	$ -	$ 2.96	$ -	$ -	$ -	$ 70,700	$ 612,000	$ -						
On-Site 87	4.0	34.5	-	35.8	310.3	-	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ -	$ 47,500	$ 412,000	$ -						
On-Site 88	3.1	26.5	-	9.2	79.6	-	$ -	$ 0.28	$ -	$ 0.50	$ -	$ 0.78	$ -	$ -	$ -	$ 12,400	$ 108,000	$ -						
On-Site 89	2.9	8.8	-	17.5	52.5	-	$ -	$ 0.40	$ -	$ 1.09	$ -	$ 1.49	$ -	$ -	$ -	$ 31,300	$ 93,900	$ -						
On-Site 90	0.4	1.3	-	2.6	7.8	-	$ -	$ 0.02	$ -	$ 0.03	$ -	$ 0.22	$ -	$ -	$ -	$ 4,620	$ 13,900	$ -						
On-Site 91	15.0	45.0	-	53.0	159.1	-	$ -	$ 0.68	$ -	$ 2.28	$ -	$ 2.96	$ -	$ -	$ -	$ 93,200	$ 280,000	$ -						
On-Site 92	17.8	22.1	-	106.6	132.8	-	$ -	$ 0.40	$ -	$ 1.09	$ -	$ 1.49	$ -	$ -	$ -	$ 191,000	$ 237,000	$ -						
On-Site 93	2.6	3.3	-	15.7	19.6	-	$ -	$ 0.02	$ -	$ 0.03	$ -	$ 0.22	$ -	$ -	$ -	$ 28,100	$ 35,100	$ -						
On-Site 94	76.1	94.9	-	427.5	532.6	-	$ -	$ 1.09	$ -	$ 3.63	$ -	$ 4.72	$ -	$ -	$ -	$ 755,000	$ 940,000	$ -						
On-Site 95	26.7	33.2	-	239.9	298.8	-	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ -	$ 318,000	$ 396,000	$ -						
On-Site 96	14.0	80.9	-	28.1	161.8	-	$ 1.63	$ 0.38	$ -	$ -	$ -	$ 2.01	$ 4,350	$ 25,100	$ -	$ 72,100	$ 415,000	$ -	3	17	-	6,000	34,000	-
On-Site 97	2.1	4.6	-	4.2	9.3	-	$ 1.63	$ 0.38	$ -	$ -	$ -	$ 2.01	$ 646	$ 1,440	$ -	$ 10,700	$ 23,800	$ -	1	1	-	2,000	2,000	-

Construction Cost Estimate -
"Complete Rad Removal" with On-site Disposal Alternative (Constrained to $10M per year)

Step #	Category	Sub-Category	Task	Quantity On-Site Area 1	Quantity On-Site Area 2	Quantity On-Site Cell	Type of Material Handled	Units	Source of Costing Estimate	RS Means Reference #	RS Means Description	Crew Type	Daily Unit Rate of Construction	Crew Size (Men)	Number of Crews	Efficiency Factor
On-Site 98			Purchase of Bio-Intrusion Layer Material			54,581	8 inch Shot Rock	L.C.Y.	Fred Weber estimate, 3/23/2011							
On-Site 99		Bio-Intrusion	Deliver Bio-Intrusion Layer Material			54,581	8 inch Shot Rock	L.C.Y.	Fred Weber estimate, 3/23/2011				72	1	50	100%
On-Site 100			Spread Bio-Intrusion Layer Material			54,581	8 inch Shot Rock	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	2	6	100%
On-Site 101			Purchase clay material	61,537	151,279	16,540	Clay Material	B.C.Y.	Local Republic landfill with surplus material							
On-Site 102		Clay	Deliver clay material to site	86,152	211,791	23,156	Clay Material	L.C.Y.	Based on Central Stone estimate				64	1	50	100%
On-Site 103			Spread loose lift before compaction	86,152	211,791	23,156	Clay Material	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	2	6	100%
On-Site 104			Compact Clay (Final Cover)	61,537	151,279	16,540	Clay Material	E.C.Y.	RS Means, Year 2011 Quarter 1	312323235720	Compaction, 4 passes, 12" lifts, riding, sheepsfoot or wobbly wheel roller	B10G	2,600	1.5	2	100%
On-Site 105		Geomembrane	Install Synthetic liner for final cover			491	60 mil HDPE	M.S.F.	RS Means, Year 2011 Quarter 1	334713531220	Pond and Reservoir Liners, membrane lining systems HDPE, 100,000 S.F. or more, 60 mil thick	3 Skwk	2	3	12	100%
On-Site 106		Geotextile	Install Cushioning geotextile for final cover			54,581	16 oz geotextile	S.Y.	RS Means, Year 2011 Quarter 1	334626100100	Geotextile Subsurface Drainage Filtration, fabric, laid in trench, polypropylene, ideal conditions	2 Clab	2,400	2	4	100%
On-Site 107	Final Cover		Purchase Drainage Material			18,194	Pea Gravel	B.C.Y.	Central Stone estimate, 4/4/2011							
On-Site 108			Deliver Drainage Material			20,377	Pea Gravel	L.C.Y.	Central Stone estimate, 4/4/2011				48	1	50	100%
On-Site 109			Load material from stockpile to off road haul truck			18,194	Pea Gravel	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305	Excavating, bulk bank measure, 3-1/2 C.Y. capacity = 160 C.Y./hour, backhoe, hydraulic, crawler mounted, excluding truck loading	B12D	2,400	2	3	100%
On-Site 110		Drainage Layer	*(additional cost to previous line)*			18,194	Pea Gravel	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305A	Excavating, bulk bank measure, for loading onto trucks, add	B12D	16,255	2	3	100%
On-Site 111			Haul material from stockpile to cell			20,377	Pea Gravel	L.C.Y.	RS Means, Year 2011 Quarter 1	312323205110	Cycle hauling(wait, load,travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 22 C.Y. truck, cycle 2 mile, 10 MPH, excludes loading equipment	B34F	374	1	5.6	100%
On-Site 112			Move and Place drainage layer material for final cover			18,194	Pea Gravel	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	2	6	100%
On-Site 113			Purchase Topsoil	32,008	81,190	33,080	Topsoil	B.C.Y.	RS Means, Year 2011 Quarter 1 - Ext. Material O&P							
On-Site 114		Top Soil	Deliver Topsoil	40,009	101,487	41,349	Topsoil	L.C.Y.	Based on Central Stone estimate				68	1	50	100%
On-Site 115			Move and place Topsoil (Final Cover)	38,461	94,550	41,349	Topsoil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	2	6	100%
On-Site 116			Install Terraces	1,549	6,938	-	Topsoil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	2	1	100%
On-Site 117			Construct Ditches	2,630	7,245	-	Topsoil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316462200	Excavating, bulk, dozer, open site, bank measure, sand and gravel, 80 H.P. dozer, 150' haul	B10L	230	2	2	100%
On-Site 118			Load Overburden Material from stockpile to off road haul truck for pond	4,023	7,944	5,338	Overburden Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305	Excavating, bulk bank measure, 3-1/2 C.Y. capacity = 160 C.Y./hour, backhoe, hydraulic, crawler mounted, excluding truck loading	B12D	2,400	2	3	100%
On-Site 119	Stormwater Controls (for stormwater after cover is constructed)		*(additional cost to previous line)*	4,023	7,944	5,338	Overburden Soil	B.C.Y.	RS Means, Year 2011 Quarter 1	312316420305A	Excavating, bulk bank measure, for loading onto trucks, add	B12D	16,255	2	3	100%
On-Site 120		Pond	Haul loose lift soil for Pond	5,632	11,122	7,473	Overburden Soil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323205060	Cycle hauling(wait, load,travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 22 C.Y. truck, cycle 2000 ft, 10 MPH, excludes loading equipment	B34F	594	1	3.5	100%
On-Site 121			Spread loose lift before compaction (Pond)	5,632	11,122	7,473	Overburden Soil	L.C.Y.	RS Means, Year 2011 Quarter 1	312323170020	Fill, dumped material, spread, by dozer, excludes compaction	B10B	1,000	2	6	100%
On-Site 122			Compact Berm (Pond)	4,023	7,944	5,338	Overburden Soil	E.C.Y.	RS Means, Year 2011 Quarter 1	312323235060	Compaction, riding, vibrating roller, 2 passes, 12" lifts	B10Y	5,200	2	2	100%
On-Site 123			Final Stormwater Controls	-	2,332	-	Riprap	S.Y.	RS Means, Year 2011 Quarter 1	313713100110	Rip-rap and rock lining, random, broken stone, 3/8 to 1/4 C.Y. pieces, machine placed for slope protection, grouted	B13	80	7	3	100%
On-Site 124			Apply seeding to cover	1,051	2,653	948	Seeding	M.S.F.	RS Means, Year 2011 Quarter 1	329219142400	Seeding athletic fields, seeding fescue, tall with mulch and fertilizer, 5.5 lb. per M.S.F., hydro/air seeding	B81	80	3	1	100%
On-Site 125	Site Completion		Apply seeding to soil stockpile	790			Seeding	M.S.F.	RS Means, Year 2011 Quarter 1	329219142400	Seeding athletic fields, seeding fescue, tall with mulch and fertilizer, 5.5 lb. per M.S.F., hydro/air seeding	B81	80	3	1	100%
On-Site 126			Install temporary irrigation system	87,550	221,114	446,574	Irrigation System	S.F.	RS Means, Year 2011 Quarter 1	328423100800	Underground sprinklers irrigation system, for lawns, residential system, custom, 1" supply	B20	2,000	3	10	100%
On-Site 127			Install Fencing	4,078	8,285	3,614	Fencing	L.F.	RS Means, Year 2011 Quarter 1	323113200920	Fence, chain link industrial, galvanized steel, 6 ga. wire, 2-1/2" posts @ 10' OC, 8' high, includes excavation, in concrete, excludes barbed wire	B80C	180	3	2	100%

Step #	Construction (Days) On-Site Area 1	Construction (Days) On-Site Area 2	Construction (Days) On-Site Cell	Crew Man-days On-Site Area 1	Crew Man-days On-Site Area 2	Crew Man-days On-Site Cell	Unit Costs: Extended Material Overhead and Profit	Extended Labor Overhead and Profit	Extended Labor Overhead and Profit - Ineffeciency	Extended Equipment Overhead and Profit	Extended Equipment Overhead and Profit - Ineffeciency	Extended Total Overhead and Profit	Material Taxes at Bridgeton (7.925%) On-Site Area 1	Material Taxes On-Site Area 2	Material Taxes On-Site Cell	Total Cost for Line Item On-Site Area 1	Total Cost On-Site Area 2	Total Cost On-Site Cell	Truckloads for Delivery On-Site Area 1	Truckloads On-Site Area 2	Truckloads On-Site Cell	Total Miles for Delivery On-Site Area 1	Total Miles On-Site Area 2	Total Miles On-Site Cell
On-Site 98							$ 5.80					$ 5.80	$ -	$ -	$ 25,100	$ -	$ -	$ 342,000						
On-Site 99	-	-	15.2	-	-	758		$ 2.35	$ -	$ 2.35	$ -	$ 4.69	$ -	$ -	$ -	$ -	$ -	$ 256,000	-	-	3,033	-	-	48,528
On-Site 100	-	-	9.1	-	-	81.9	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ -	$ -	$ -	$ 109,000						
On-Site 101							$ 16.88					$ 16.88	$ 82,300	$ 202,000	$ 22,100	$ 1,120,000	$ 2,760,000	$ 301,000						
On-Site 102	26.9	66.2	7.2	1,346	3,309	362		$ 5.22	$ -	$ 5.22	$ -	$ 10.43	$ -	$ -	$ -	$ 899,000	$ 2,210,000	$ 242,000	5,385	13,237	1,448	376,950	926,590	101,360
On-Site 103	14.4	35.3	3.9	129.2	317.7	34.7	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ -	$ 171,000	$ 421,000	$ 46,100						
On-Site 104	11.8	29.1	3.2	35.5	87.3	9.5	$ -	$ 0.28	$ -	$ 0.50	$ -	$ 0.78	$ -	$ -	$ -	$ 48,000	$ 118,000	$ 12,900						
On-Site 105	-	-	25.6	-	-	921.1	$ 271.46	$ 1,113.15	$ -	$ -	$ -	$ 1,384.61	$ -	$ -	$ 10,600	$ -	$ -	$ 691,000	-	-	5	-	-	10,000
On-Site 106	-	-	5.7	-	-	45.5	$ 1.63	$ 0.38	$ -	$ -	$ -	$ 2.01	$ -	$ -	$ 7,050	$ -	$ -	$ 117,000	-	-	5	-	-	10,000
On-Site 107							$ 19.31					$ 19.31	$ -	$ -	$ 27,800	$ -	$ -	$ 379,000						
On-Site 108	-	-	8.5	-	-	424.5		$ 7.05	$ -	$ 7.05	$ -	$ 14.10	$ -	$ -	$ -	$ -	$ -	$ 287,000	-	-	1,699	-	-	67,960
On-Site 109	-	-	2.5	-	-	15.2	$ -	$ 0.40	$ -	$ 1.09	$ -	$ 1.49	$ -	$ -	$ -	$ -	$ -	$ 27,100						
On-Site 110	-	-	0.4	-	-	2.2	$ -	$ 0.02	$ -	$ 0.03	$ -	$ 0.22	$ -	$ -	$ -	$ -	$ -	$ 4,000						
On-Site 111	-	-	9.7	-	-	54.5	$ -	$ 1.09	$ -	$ 3.63	$ -	$ 4.72	$ -	$ -	$ -	$ -	$ -	$ 96,200						
On-Site 112	-	-	3.0	-	-	27.3	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ -	$ -	$ -	$ 36,200						
On-Site 113							$ 24.94					$ 24.94	$ 63,300	$ 160,000	$ 65,400	$ 862,000	$ 2,190,000	$ 890,000						
On-Site 114	11.8	29.8	12.2	588	1,492	608		$ 4.12	$ -	$ 4.12	$ -	$ 8.24	$ -	$ -	$ -	$ 330,000	$ 837,000	$ 341,000	2,354	5,970	2,433	47,080	119,400	48,660
On-Site 115	6.4	15.8	6.9	57.7	141.8	62.0	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ -	$ 76,500	$ 188,000	$ 82,300						
On-Site 116	1.5	6.9	-	2.3	10.4	-	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ -	$ 3,080	$ 13,800	$ -						
On-Site 117	5.7	15.8	-	17.2	47.3	-	$ -	$ 3.18	$ -	$ 2.14	$ -	$ 5.32	$ -	$ -	$ -	$ 14,000	$ 38,500	$ -						
On-Site 118	0.6	1.1	0.7	3.4	6.6	4.4	$ -	$ 0.40	$ -	$ 1.09	$ -	$ 1.49	$ -	$ -	$ -	$ 5,990	$ 11,800	$ 7,950						
On-Site 119	0.1	0.2	0.1	0.5	1.0	0.7	$ -	$ 0.02	$ -	$ 0.03	$ -	$ 0.22	$ -	$ -	$ -	$ 885	$ 1,750	$ 1,170						
On-Site 120	2.7	5.3	3.6	9.5	18.7	12.6	$ -	$ 0.68	$ -	$ 2.28	$ -	$ 2.96	$ -	$ -	$ -	$ 16,700	$ 32,900	$ 22,100						
On-Site 121	0.9	1.9	1.2	8.4	16.7	11.2	$ -	$ 0.73	$ -	$ 1.26	$ -	$ 1.99	$ -	$ -	$ -	$ 11,200	$ 22,100	$ 14,900						
On-Site 122	0.4	0.8	0.5	1.2	2.3	1.5	$ -	$ 0.14	$ -	$ 0.12	$ -	$ 0.26	$ -	$ -	$ -	$ 1,050	$ 2,070	$ 1,390						
On-Site 123	-	9.7	-	-	204.0	-	$ 71.05	$ 38.47	$ -	$ 11.19	$ -	$ 120.71	$ -	$ 13,100	$ -	$ -	$ 295,000	$ -						
On-Site 124	13.1	33.2	11.8	39.4	99.5	35.5	$ 40.82	$ 16.91	$ -	$ 8.31	$ -	$ 66.04	$ 3,400	$ 8,580	$ 3,070	$ 72,800	$ 184,000	$ 65,600						
On-Site 125	9.9	-	-	29.6	-	-	$ 40.82	$ 16.91	$ -	$ 8.31	$ -	$ 66.04	$ 2,550	$ -	$ -	$ 54,700	$ -	$ -						
On-Site 126	4.4	11.1	22.3	131.3	331.7	669.9	$ 0.33	$ 0.70	$ -	$ -	$ -	$ 1.03	$ 2,290	$ 5,780	$ 11,700	$ 92,500	$ 234,000	$ 472,000						
On-Site 127	11.3	23.0	10.0	68.0	138.1	60.2	$ 29.40	$ 6.78	$ -	$ 1.18	$ -	$ 37.36	$ 9,500	$ 19,300	$ 8,420	$ 162,000	$ 329,000	$ 143,000						
													Totals			***Totals***			***Totals***			***Totals***		
													$ 200,000	$ 460,000	$ 323,000	$ 13,500,000	$ 25,100,000	$ 12,300,000	8,000	20,000	13,000	461,000	1,109,000	579,000
													$		**983,000**			**$ 50,900,000**			**41,000**			**2,149,000**

Environmental Monitoring Costs
"Complete Rad Removal" with On-site Disposal Alternative (Constrained to $10M per year)

Item	Number	Cost	Shipping	Total Capital	Annual Cost
HI-Q's Polyurethane Foam (PUF) air sampling system Model 3300	19	$3,205	$100	$62,795	
Calibrator for PUP Sampler	1	$560	$15	$575	
Adapter Plate	1	$85	$10	$95	
Diversified Research ALPHA II® Continuous Radon Monitor	19	$1,775	$25	$34,200	
Install AC electrical service to all stations (lineal ft)	10,868	$25		$271,700	
Monitoring Station Foundation / Supports (assume will not be moved)	19	$2,000		$38,000	
Items requiring periodic replacement					
Environmental dosimeters 1/qtr/station	76	$30			$2,280
Kidde 442020 Radon Gas Detection Test Kit (1 kit/month/station)	228	$25			$5,700
Expendables					
Particulate air sample media Boxes of 100	10	$89	$5		$940
Toxic organic sample media Boxes of 10	75	$32	$5		$2,775
Lab services					
Analyze organic vapor filters (once per week per station)	988	$120			$118,560
Calibration Cost					
Air Samplers 1/yr	19	$100	$50		$2,850
Radon monitors 1/yr	19	$100	$25		$2,375
Labor					
Assume 2 man days/wk	16	$90			$1,440
	Subtotal - Capital			**$407,000**	
	Subtotal - Annual Expendables/Labor				**$137,000**

Capital Cost Estimate - Long-Term Monitoring
"Complete Rad Removal" with On-site Disposal Alternative (Constrained to $10M per year)

Description	Quantity	Units	Unit Rate	Estimated Cost ($)
Secure easements	1	LS	2,000	2,000
Landfill Gas:				
Driller: Install radon/landfill gas monitoring probes, MDNR "Code Wells"; 10' dee	60	each	1,850	111,000
Misc. wellhead sampling fittings and lock:	60	each	40	2,400
Field technician observation during drilling and construction of probe	280	hour	90	25,200
Mileage for field technician during probe constructio	3,200	mile	0.51	1,600
Multi-gas detector (e.g., Industrial Scientific iBri™ MX6), incl regulator, tubing, calbrtn ga:	1	LS	4,400	4,400
Portable radon gas monitor and detector (e.g., Pylon AB6 monitor w/ 300A detect	1	LS	8,250	8,300
Groundwater:				
Recondition and purge existing groundwater monitoring wel	16	each	500	8,000
Flat-bottom polyethylene tank to store purge water prior to dispo:	1,500	gallon	2	3,000
Well permitting	10	hour	90	900
Driller: Install new 60' depth 2" monitoring wells around on-site c	10	each	4,000	40,000
Field geologist log holes/oversight during drilling; prep boring logs/well completion diagra	120	hour	130	15,600
Field vehicle during drilling	10	day	120	1,200
Estimated Long-term Monitoring Capital Costs - Total				**224,000**

Post-Construction Baseline Monitoring Cost Estimate
"Complete Rad Removal" with On-site Disposal Alternative (Constrained to $10M per year)

(Radon Flux and Radon in Subsurface Landfill Gas)

Description	Quantity	Units	Unit Rate	Estimated Cost ($)
Radon Flux:				
Number of Large Area Activated Charcoal Canisters	*10*			
Labor to place and pickup LAACCs - field technicia	6	hour	90	540
Field vehicle	2	day	120	240
Shipping of LAACCs to site (20 per box) - groun	1	each	25	30
Overnight shipping of activated charcoal to laborato	1	each	50	50
Return shipping of LAACCs to lab (20 per box) - groun	1	each	25	30
Analysis of samples for radon flux (Tellco Environmental - Grand Junction, CO	10	each	22	220
Rental of LAACCs (assume 1 week per event	70	day	1.00	70
Data managemen	1	hour	100	100
Reporting	4	hour	130	520
Estimated Radon Flux Monitoring Costs - Total				**1,800**
Subsurface Gas (Radon):				
Number of Subsurface Gas Monitoring Wells	*60*			
Labor - field techniciar	16	hour	90	1,440
Field vehicle	2	day	120	240
Replacement radon detector (Pylon 300A	1	each	550	550
Data managemen	1	hour	100	100
Reporting	4	hour	130	520
Estimated Subsurface Gas (Radon) Monitoring Costs - Total				**2,900**

Capital Cost Estimate - Amend Existing/Additional Institutional Controls
"Complete Rad Removal" with On-site Disposal Alternative (Constrained to $10M per year)

Description	Quantity	Units	Unit Rate	Estimated Cost
Prepare Institutional Controls planning documents	1	LS	10,000	10,000
Attorney labor: prepare draft amended existing and additional ICs	1	LS	20,000	20,000
Review of draft documents	1	LS	5,000	5,000
Revise amended and additional Institutional Controls documents	1	LS	10,000	10,000
Filings and registrations	1	LS	5,000	5,000
Estimated Institutional Controls Capital Costs - Total				**50,000**

Long-Term Post-Construction Monitoring (per event) Cost Estimate
"Complete Rad Removal" with On-site Disposal Alternative (Constrained to $10M per year)

(Landfill Gas, Groundwater, and Surface Water Monitoring and Annual Post-Construction Site Inspections)

Description	Analytical Method	Quantity	Units	Unit Rate ($)	Estimated Cost ($)
Landfill Gas/Radon:					
Number of Landfill Gas/Radon Monitoring Wells		*60*			
Labor - field technician		16	hour	90	1,440
Field vehicle		2	day	120	240
Replacement radon detector (Pylon 300A)		1	each	550	550
Calibration gas for multi-gas detector		1	each	330	330
Data management		2	hour	100	200
Reporting		8	hour	130	1,040
Estimated Landfill Gas/Radon Monitoring Costs - Subtotal					3,800
Contingency			*%*	*20*	*800*
Estimated Landfill Gas/Radon Monitoring Costs - Total (per Event)					**4,600**
Groundwater and Surface Water:					
Number of Samples:			*For VOCs*		
Investigative Groundwater		*26*	*26*		
Investigative Surface Water		*2*	*2*		
Field Duplicates (one per every 10 investigative samples)		*3*	*3*		
Trip blank (one per day per cooler)			*7*		
Matrix Spike			*1*		
Matrix Spike Duplicate			*1*		
Sub-total number of unfiltered samples:		*31*	*40*		
Sub-total number of filtered samples for radionuclide and metals analyses:		*31*			
Total number of samples:		*62*	*40*		
Labor:					
Labor - field technicians (2 people, 4 sample locations/day)		126	hour	90	11,340
Materials and equipment:					
Sample kits, incl. filters		28	each	50	1,400
Field instrumentation and flowcell rental - groundwater		7	day	100	700
Field Vehicle		7	day	120	840
Overnight shipping of sample coolers (assume 1 per day to rad lab)		7	coolers	100	700
Delivery of sample coolers to local lab (2 to 3 coolers per day)		7	hour	90	630
Disposal of purge water (assumes PE tank previously purchased is onsite):					
Vacuum truck		4	hour	200	800
Transportation and disposal (assumes approx 25 gal per well per event)		650	gallon	2.00	1,300
Laboratory Sample Analysis:					
Gross alpha and beta	EPA 900.0	62	each	50	3,100
Uranium-234, 235, 238	EML U-02 Mod	62	each	100	6,200
Thorium-228, 230, 232	EML Th-01 Mod	62	each	100	6,200
Radium 228	EPA 904.0	62	each	85	5,270
Radium 226	EPA 903.0 Mod	62	each	85	5,270
Radon 222 - 72 hr hold time	SM 20th ED 7500-Rn B	62	each	85	5,270
Volatile Organic Compounds [VOCs] (GC/MS)	8260B	40	each	110	4,400
Semivolatile Organic Compounds [SVOCs] (GC/MS)	8270C	62	each	220	13,640
22 Metals Target Analyte List (ICP/AES)	6010B	62	each	115	7,130
Mercury (CVAA)	7470A	62	each	35	2,170
4 Anions (IC) - Bromide, Chloride, Fluoride, Sulfate	300.0	62	each	72	4,460
2 Anions (IC) - Nitrate, Nitrite - 48 hr hold time	300.0	62	each	36	2,230
Sulfide, Total	SM 4500 S2 D	62	each	35	2,170
Phosphorus, Total	365.1	62	each	40	2,480
Organic carbon, Total (TOC)	SM 5310B	62	each	40	2,480
Total Alkalinity, Carbonate, Bicarbonate	SM 2320B	62	each	20	1,240
Nitrogen, Ammonia	350.1	62	each	25	1,550
Level IV data deliverable		$ 75,260	%	10%	7,530
Data validation (assumes validation of 100% of Level IV data will be required)		88	DVR	100	8,800
Data management		8	SDG	100	800
Reporting		40	hour	130	5,200
Estimated Groundwater and Surface Water Monitoring Costs - Subtotal					115,300
Contingency			*%*	*20*	*23,100*
Estimated Groundwater and Surface Water Monitoring Costs - Total (per Event)					**138,000**

DVR = data validation report
SDG = sample delivery group

Description	Analytical Method	Quantity	Units	Unit Rate ($)	Estimated Cost ($)
Annual Post-Construction Site Inspections					
Labor - Engineer		18	hour	130	2,340
Field vehicle		2	day	120	240
Site Inspection Report		8	hour	130	1,040
Estimated Annual Post-Construction Site Inspections Costs - Subtotal					3,600
Contingency			*%*	*20*	*700*
Estimated Annual Post-Construction Site Inspections Costs - Total					**4,300**

Operation and Maintenance Cost Estimate - Cover System Maintenance
"Complete Rad Removal" with On-site Disposal Alternative (Constrained to $10M per year)

Description	Quantity	Units	Unit Rate	Estimated Cost
Mowing; tractor w/ rotary mower (once/year)	67.1	acre	40.00	2,700
Fill depressions in cover w/ topsoil, assume 1% of area; 6 inches dee	541	bcy	37.53	20,300
Seeding of filled are:	29.2	M.S.F.	66.04	1,900
Estimated Cover System O&M Costs - Subtotal				24,900
Contingency		*%*	*20*	*5,000*
Estimated Annual Cover Maintenance O&M Costs - Total				**30,000**

M.S.F. = 1,000 square feet

Operation and Maintenance Cost Estimate - 5 year Review
"Complete Rad Removal" with On-site Disposal Alternative (Constrained to $10M per year)

Description	Quantity	Units	Unit Rate	Estimated Cost ($)
Access Restrictions (inspect/repair fencing and signage	16	hours	130	2,100
Institutional Controls verificatio	8	hours	130	1,000
Document that landfill cover is effectiv	8	hours	130	1,000
Assemble Monitoring Data (landfill gas/radon, groundwater, surface wate	40	hours	130	5,200
Summarize Annual Post-Construction Site Inspection	8	hours	130	1,000
Summarize Annual Cover Maintenance Documentatic	8	hours	130	1,000
Water supply well inventory reviev	8	hours	130	1,000
Document any changes in Land Use at and around West Lake Landf	16	hours	130	2,100
Prepare Summary Repor	80	hours	130	10,400
Estimated 5-year Maint/Review O&M Costs - Subtotal				**25,000**
Contingency		*%*	*20*	*5,000*
Estimated 5-year Maintenance O&M Costs - Total				**30,000**

ID	Task Name	Start	Finish	Details	2014					2019				
					'14	'15	'16	'17	'18	'19	'20	'21	'22	'23
1	**On-Site Disposal Alternative**	**Mon 3/3/14**	**Wed 4/1/26**	Cost	$4,453,391.67	$3,957,929.67	$4,432,897.32	$4,264,837.33	$3,680,448.85	$3,883,147.40	$4,624,160.08	$4,623,886.11	$4,648,505.40	$3,967,755
	Trailers Operation	*Mon 3/3/14*	*Wed 4/1/26*	Cost	$28,753.11	$34,424.59	$34,424.59	$34,292.69	$34,424.59	$34,424.59	$34,556.48	$34,424.59	$34,292.69	$34,292
	Project Manager	*Mon 3/3/14*	*Wed 4/1/26*	Cost	$159,139.97	$190,529.96	$190,529.96	$189,799.96	$190,529.96	$190,529.96	$191,259.96	$190,529.96	$189,799.96	$189,799
	Construction Superintendent	*Mon 3/3/14*	*Wed 4/1/26*	Cost	$128,619.97	$153,989.97	$153,989.97	$153,399.97	$153,989.97	$153,989.97	$154,579.97	$153,989.97	$153,399.97	$153,399
	Clerk	*Mon 3/3/14*	*Wed 4/1/26*	Cost	$27,467.99	$32,885.99	$32,885.99	$32,759.99	$32,885.99	$32,885.99	$33,011.99	$32,885.99	$32,759.99	$32,759
	Field/Safety Engineer	*Mon 3/3/14*	*Wed 4/1/26*	Cost	$85,019.98	$101,789.98	$101,789.98	$101,399.98	$101,789.98	$101,789.98	$102,179.98	$101,789.98	$101,399.98	$101,399
2	**Site-wide Preparation**	**Mon 3/3/14**	**Mon 6/16/25**	Cost	$3,085,279.84									
3	**Temporary Construction Facilities / Utilities / Personnel**	**Mon 3/3/14**	**Tue 5/6/14**	Cost	$323,209.84									
6	**Temporary Stormwater Infrastructure**	**Tue 4/8/14**	**Mon 6/16/25**	Cost	$1,442,710.00									
25	**Mobilization**	**Mon 3/3/14**	**Tue 4/8/14**	Cost	$67,360.00									
34	**Create Temporary Roads**	**Tue 4/8/14**	**Mon 7/21/14**	Cost	$496,000.00									
38	**Install TBD Traffic Improvements**	**Tue 4/8/14**	**Tue 5/20/14**	Cost	$756,000.00									
42				Cost										
43	**On-Site Cell**	**Tue 4/8/14**	**Wed 7/9/25**	Cost	$939,110.81	$3,120,979.17	$2,156,314.23	$115,945.06	$116,391.00	$116,391.00	$116,836.95	$116,391.00	$115,945.06	$115,945
44	**Construction**	**Tue 4/8/14**	**Mon 3/21/16**	Cost	$803,712.81	$3,004,588.17	$2,039,923.23							
45	**Site Preparation**	**Tue 4/8/14**	**Mon 4/21/14**	Cost	$13,083.00									
49	**Stormwater Events (Weather Delays)**	**Tue 9/2/14**	**Fri 9/26/14**	Cost	$222,861.21									
51	**New On-Site Cell Excavation**	**Fri 9/26/14**	**Mon 12/28/15**	Cost	$567,768.60	$2,132,231.40								
53	**Construct Cell Bottom Liner**	**Mon 12/28/15**	**Mon 3/21/16**	Cost		$872,356.77	$2,039,923.23							
74	Cell is Ready for Waste	Mon 3/21/16	Mon 3/21/16	Cost										
75	**Closure of On-Site Cell**	**Fri 1/26/24**	**Wed 7/9/25**	Cost										
	Leachate Treatment Facility	*Fri 1/26/24*	*Wed 7/9/25*	Cost										
76	**Final Cover**	**Fri 1/26/24**	**Fri 5/16/25**	Cost										
99	**Post-Construction Stormwater Controls**	**Fri 5/16/25**	**Thu 5/22/25**	Cost										
107	**On-Site Cell Site Completion**	**Thu 5/22/25**	**Wed 7/9/25**	Cost										
111				Cost										
112	**Area 2**	**Sun 11/1/15**	**Tue 2/21/23**	Cost		$323,330.00	$1,762,962.59	$3,637,239.67	$3,050,437.35	$3,253,135.90	$3,991,734.75	$3,993,874.61	$4,020,907.74	$1,789,350
113	**Site Preparation**	**Sun 11/1/15**	**Wed 12/9/15**	Cost		$303,530.00								
124	**Stormwater Events (Weather Delays)**	**Mon 3/21/16**	**Tue 7/12/16**	Cost			$298,192.70							
126	**Construction Activities**	**Thu 11/17/16**	**Tue 2/21/23**	Cost			$1,347,319.90	$3,520,239.68	$2,932,987.36	$3,135,685.91	$3,873,834.76	$3,876,424.62	$3,903,907.75	$1,772,948
	Water Truck Operation	*Thu 11/17/16*	*Tue 2/21/23*	Cost			$25,600.00	$208,000.02	$208,800.02	$208,800.02	$209,600.02	$208,800.02	$208,000.02	$29,158
	Water (10 kgal/day)	*Thu 11/17/16*	*Tue 2/21/23*	Cost			$2,041.60	$16,588.00	$16,651.80	$16,651.80	$16,715.60	$16,651.80	$16,588.00	$2,325
	Portable Toilet - Area 2	*Thu 11/17/16*	*Tue 2/21/23*	Cost			$449.36	$3,651.05	$3,665.09	$3,665.09	$3,679.14	$3,665.09	$3,651.05	$511
	Water Truck Depreciation	*Thu 11/17/16*	*Tue 2/21/23*	Cost			$100,000.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0
127	**Overburden Relocation**	**Thu 11/17/16**	**Mon 4/17/17**	Cost			$1,219,228.94	$3,425,271.06						
137	**2017 Job Shutdown Cost Adjustments**	**Mon 4/17/17**	**Mon 4/17/17**	Cost				($311,400.00)						
140	**RIM Relocation to On-Site Cell**	**Fri 12/8/17**	**Fri 5/17/19**	Cost				$178,129.55	$2,703,870.45	$1,968,600.00				
141	**2017-2018**	**Fri 12/8/17**	**Wed 7/11/18**	Cost				$178,129.55	$2,934,770.45					
150	**2018 Job Shutdown Cost Adjustments**	**Wed 7/11/18**	**Wed 7/11/18**	Cost					($230,900.00)					
153	**2019**	**Wed 1/2/19**	**Fri 5/17/19**	Cost						$1,968,600.00				
162	**Buffer Zone**	**Fri 5/17/19**	**Tue 5/28/19**	Cost						$63,300.00				
164	**Radiological Survey**	**Tue 5/28/19**	**Thu 6/6/19**	Cost										
167	**2019 Job Shutdown Cost Adjustments**	**Thu 6/6/19**	**Thu 6/6/19**	Cost						($162,800.00)				
170	**Backfill and Slope Correction, Area 2**	**Mon 11/4/19**	**Fri 10/2/20**	Cost						$1,037,469.00	$2,764,150.00			
192	**Final Cover, Area 2**	**Fri 10/2/20**	**Mon 1/30/23**	Cost							$879,690.00	$3,647,307.71	$3,675,668.68	$521,333
204	**Post-Construction Stormwater Controls**	**Mon 1/30/23**	**Tue 2/21/23**	Cost										$417,920

ID	Task Name	Start	Finish	Details	2014 '14	'15	'16	'17	'18	2019 '19	'20	'21	'22	'23
215	**Site Completion, Area 2**	**Fri 1/13/23**	**Tue 2/21/23**	Cost										$801,700
220				Cost										
221	**Area 1**	**Tue 2/21/23**	**Wed 4/1/26**	Cost										$1,550,807
222	**Site Preparation**	**Tue 2/21/23**	**Fri 3/3/23**	Cost										$140,550
233	**Stormwater Events (Weather Delays)**	**Fri 3/3/23**	**Wed 4/19/23**	Cost										$122,612
235	**Construction Activities**	**Wed 4/19/23**	**Wed 4/1/26**	Cost										$1,187,045
	Water Truck Operation	*Wed 4/19/23*	*Wed 4/1/26*	Cost										$73,020
	Water (10 kgal/day)	*Wed 4/19/23*	*Wed 4/1/26*	Cost										$5,823
	Portable Toilet - Area 1	*Wed 4/19/23*	*Wed 4/1/26*	Cost										$2,563
236	**Overburden Relocation**	**Wed 4/19/23**	**Wed 12/6/23**	Cost										$769,100
246	**RIM Relocation to On-Site Cell**	**Wed 12/6/23**	**Wed 1/17/24**	Cost										$336,538
247	**2023**	**Wed 12/6/23**	**Thu 12/28/23**	Cost										$336,538
256	**2024**	**Tue 1/2/24**	**Wed 1/17/24**	Cost										
265	**Radiological Survey**	**Wed 1/17/24**	**Fri 1/26/24**	Cost										
268	**Backfill and Slope Correction, Area 1**	**Thu 1/2/25**	**Mon 5/26/25**	Cost										
290	**2025 Job Shutdown Cost Adjustments**	**Mon 5/26/25**	**Mon 5/26/25**	Cost										
293	**Final Cover, Area 1**	**Fri 1/2/26**	**Thu 2/26/26**	Cost										
303	**Post-Construction Stormwater Controls**	**Thu 2/26/26**	**Fri 3/6/26**	Cost										
313	**Site Completion, Area 1**	**Fri 3/6/26**	**Wed 4/1/26**	Cost										

ID	Task Name	Details		2024					2029					2034
			'23	'24	'25	'26	'27	'28	'29	'30	'31	'32	'33	'34
1	**On-Site Disposal Alternative**	Cost	$3,967,755.23	$4,513,734.36	$4,384,443.44	$4,070,081.26								
	Trailers Operation	Cost	$34,292.69	$34,556.48	$34,424.59	$8,445.46								
	Project Manager	Cost	$189,799.96	$191,259.96	$190,529.96	$46,743.11								
	Construction Superintendent	Cost	$153,399.97	$154,579.97	$153,989.97	$37,778.68								
	Clerk	Cost	$32,759.99	$33,011.99	$32,885.99	$8,067.99								
	Field/Safety Engineer	Cost	$101,399.98	$102,179.98	$101,789.98	$24,972.35								
2	**Site-wide Preparation**	Cost			$415,600.00									
3	**Temporary Construction Facilities / Utilities / Personnel**	Cost												
6	**Temporary Stormwater Infrastructure**	Cost			$415,600.00									
25	**Mobilization**	Cost												
34	**Create Temporary Roads**	Cost												
38	**Install TBD Traffic Improvements**	Cost												
42		Cost												
43	**On-Site Cell**	Cost	$115,945.06	$3,536,246.06	$1,723,761.98									
44	**Construction**	Cost												
45	**Site Preparation**	Cost												
49	**Stormwater Events (Weather Delays)**	Cost												
51	**New On-Site Cell Excavation**	Cost												
53	**Construct Cell Bottom Liner**	Cost												
74	Cell is Ready for Waste	Cost												
75	**Closure of On-Site Cell**	Cost		$3,419,409.11	$1,663,159.22									
	Leachate Treatment Facility	Cost		$60,683.80	$33,974.53									
76	**Final Cover**	Cost		$3,358,725.31	$901,074.69									
99	**Post-Construction Stormwater Controls**	Cost			$47,510.00									
107	**On-Site Cell Site Completion**	Cost			$680,600.00									
111		Cost												
112	**Area 2**	Cost	$1,789,350.15											
113	**Site Preparation**	Cost												
124	**Stormwater Events (Weather Delays)**	Cost												
126	**Construction Activities**	Cost	$1,772,948.78											
	Water Truck Operation	Cost	$29,158.00											
	Water (10 kgal/day)	Cost	$2,325.35											
	Portable Toilet - Area 2	Cost	$511.81											
	Water Truck Depreciation	Cost	$0.00											
127	**Overburden Relocation**	Cost												
137	**2017 Job Shutdown Cost Adjustments**	Cost												
140	**RIM Relocation to On-Site Cell**	Cost												
141	**2017-2018**	Cost												
150	**2018 Job Shutdown Cost Adjustments**	Cost												
153	**2019**	Cost												
162	**Buffer Zone**	Cost												
164	**Radiological Survey**	Cost												
167	**2019 Job Shutdown Cost Adjustments**	Cost												
170	**Backfill and Slope Correction, Area 2**	Cost												
192	**Final Cover, Area 2**	Cost	$521,333.61											
204	**Post-Construction Stormwater Controls**	Cost	$417,920.00											

ID	Task Name	Details	'23	2024 '24	'25	'26	'27	'28	2029 '29	'30	'31	'32	'33	2034 '34
215	**Site Completion, Area 2**	Cost	$801,700.00											
220		Cost												
221	**Area 1**	Cost	$1,550,807.42	$461,899.91	$1,731,460.97	$3,944,073.69								
222	**Site Preparation**	Cost	$140,550.00											
233	**Stormwater Events (Weather Delays)**	Cost	$122,612.89											
235	**Construction Activities**	Cost	$1,187,045.91	$343,999.92	$1,614,010.98	$3,915,259.44								
	Water Truck Operation	Cost	$73,020.99	$104,799.99	$104,399.99	$25,612.66								
	Water (10 kgal/day)	Cost	$5,823.42	$8,357.80	$8,325.90	$2,042.61								
	Portable Toilet - Area 1	Cost	$2,563.49	$3,679.13	$3,665.09	$899.16								
236	**Overburden Relocation**	Cost	$769,100.00											
246	**RIM Relocation to On-Site Cell**	Cost	$336,538.00	$227,163.00										
247	**2023**	Cost	$336,538.00											
256	**2024**	Cost		$227,163.00										
265	**Radiological Survey**	Cost												
268	**Backfill and Slope Correction, Area 1**	Cost			$1,661,820.00									
290	**2025 Job Shutdown Cost Adjustments**	Cost			($164,200.00)									
293	**Final Cover, Area 1**	Cost				$3,506,500.00								
303	**Post-Construction Stormwater Controls**	Cost				$52,905.00								
313	**Site Completion, Area 1**	Cost				$327,300.00								

Appendix K-5:

Estimated Added Costs if Mixed Wastes are Encountered

Appendix K-5: Estimated Added Total Costs if Mixed Wastes are Encountered

	ROD-Selected Remedy				"Complete Rad Removal" Alternatives			
	ROD-Selected Remedy		ROD-Selected Remedy w/ Starter Berm		Off-site Disposal		On-site Disposal	
Potentially Excavated Material:								
Relocation volume - Area 1 (bcy)	31,464		29,744					
Relocation volume - Area 2 (bcy)	147,916		66,493					
Subtotal (bcy)	179,380		96,237					
Overburden wastes								
Area 1 (bcy)					67,475		67,475	
Area 2 (bcy)					408,031		408,031	
Subtotal (bcy)					475,506		475,506	
RIM Material								
Area 1					33,500		33,500	
Area 2					302,000		302,000	
Subtotal (bcy)					335,500		335,500	
Total Potentially Excavated Material (bcy)	179,380		96,237		811,006		811,006	
Total Potentially Excavated Material (lcy)	269,100		144,400		1,216,500		1,216,500	
Assumed Mixed Waste mass (1% of RIM lcy)	2,690		1,440		12,170		12,170	
Excavate ($1.56/bcy), haul/stockpile ($2.61/lcy)	$9,800		$5,300		$44,400		$44,400	
Sampling and analysis:								
# samples (assume 1 sample per every 100 lcy)	*27*		*15*		*122*		*122*	
Sampling labor (0.5 hrs/sample at $75/hr)	$2,000		$1,100		$9,200		$9,200	
TCLP analysis ($1,000 per sample)	$27,000		$15,000		$122,000		$122,000	
Data validation and management($100/sample)	$2,700		$1,500		$12,200		$12,200	
Preparation of Manifests (0.5 hrs/100 lcy at $75/hr)	$2,000		$1,100		$9,200		$9,200	
Load trucks from stockpile ($1.56/bcy)	$2,800		$1,500		$12,700		$12,700	
Method of Transport to Off-site Disposal Facility	Truck		Truck		Rail		Truck	
Transportation								
unit cost range (per lcy)	*$200*	*$470*	*$200*	*$470*	*$150*	*$150*	*$200*	*$470*
Cost Range	$538,000	$1,264,000	$288,000	$677,000	$1,826,000	$1,826,000	$2,434,000	$5,720,000
Treatment								
unit cost range (per ton)	*$45*	*$100*	*$45*	*$100*	*$45*	*$100*	*$45*	*$100*
unit cost range (per lcy)	*$23*	*$50*	*$23*	*$50*	*$23*	*$50*	*$23*	*$50*
Cost Range	$61,000	$135,000	$32,000	$72,000	$274,000	$609,000	$274,000	$609,000
Disposal ($85/lcy)	$229,000	$229,000	$122,000	$122,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000
Sub-total Costs for Mixed Waste Transportation, Treatment, and Disposal	$874,000	$1,674,000	$468,000	$897,000	$3,344,000	$3,679,000	$3,952,000	$7,573,000
Scope contingency (15%)	*$131,000*	*$251,000*	*$70,000*	*$135,000*	*$502,000*	*$552,000*	*$593,000*	*$1,136,000*
Bid contingency (20%)	*$175,000*	*$335,000*	*$94,000*	*$179,000*	*$669,000*	*$736,000*	*$790,000*	*$1,515,000*
Total Costs for Mixed Waste Transportation, Treatment, and Disposal (millions)	$1.2	$2.3	$0.6	$1.2	$4.5	$5.0	$5.3	$10.2