799084
EPA/AMD/A2006080001239
2006

EPA Superfund
Record of Decision Amendment:

ROCKY MOUNTAIN ARSENAL (USARMY)
EPA ID: CO5210020769
OU 03
ADAMS COUNTY, CO
10/20/2005

AMENDMENT TO THE RECORD OF DECISION FOR THE ON-POST OPERABLE UNIT, ROCKY MOUNTAIN ARSENAL FEDERAL FACILITY SITE

SECTION 36 LIME BASINS REMEDIATION

BASIN F PRINCIPAL THREAT SOIL REMEDIATION

Prepared by:
Tetra Tech EC, Inc.

Prepared for:
Rocky Mountain Arsenal Remediation Venture Office
Department of the Army
Shell Oil Company
U.S. Fish and Wildlife Service

Revision	Prepared By	Reviewed By	Approved By	Date	Pages Affected
0	S. Ache	P. Patton	J. Lowrey	October 20, 2005	All

CONTENTS

Section **Page**

APPENDIX

TABLES

FIGURES

ACRONYMS AND ABBREVIATIONS

ARAR	Applicable or Relevant and Appropriate Requirement
As	Arsenic
BANCS	Basin A Neck Containment System
bcy	bank cubic yard(s)
bgs	below ground surface
CDPHE	Colorado Department of Public Health and Environment
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
COC	Contaminant of Concern
CSRG	Containment System Remediation Goal
DIMP	diisopropyl methylphosphonate
DMP	Demonstration Mixing Pad
D/T	Dilution(s) to Threshold
ELF	Enhanced Hazardous Waste Landfill
EPA	U.S. Environmental Protection Agency
FFA	Federal Facility Agreement
FS	Feasibility Study
HH	Human Health
HHE	Human Health Exceedance
HWL	Hazardous Waste Landfill
IEA/RC	Integrated Endangerment Assessment/Risk Characterization
IRA	Interim Response Action
IRMAICP	Interim RMA Institutional Control Plan
JARDF	Joint Administrative Record Document Facility
MEC	Munitions and Explosives of Concern
NCP	National Contingency Plan
NPL	National Priorities List
O&M	Operations and Maintenance
OCP	Organochlorine Pesticide
OU	Operable Unit
PFT	Paint Filter Test
PT	Principal Threat
RAB	Restoration Advisory Board
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RMA	Rocky Mountain Arsenal
ROD	Record of Decision
RVO	Remediation Venture Office
SEC	Site Evaluation Criteria
SQCSR	Soil Quantity Calculation Summary Report
SSAB	Site Specific Advisory Board
SVOC	Semivolatile Organic Compound
TCHD	Tri-County Health Department

TMV	Toxicity, Mobility and/or Volume
µg/g	microgram(s) per gram
USFWS	U.S. Fish and Wildlife Service
VOC	Volatile Organic Compound
WWTF	Wastewater Treatment Facility

DECLARATION

SITE NAME AND LOCATION

Rocky Mountain Arsenal Federal Facility Site
Operable Unit 03: On-Post
Commerce City, Adams County, Colorado

STATEMENT OF BASIS AND PURPOSE

This decision document amends the remedy decision for the Section 36 Lime Basins (Lime Basins) and Basin F Principal Threat (PT) Soil projects of the Rocky Mountain Arsenal (RMA) Federal Facility Site. The RMA is located in southern Adams County east of Commerce City, Colorado. The Lime Basins are located in the southwest comer of Section 36 of the RMA adjacent to Basin A. Basin F is located in the north central part of Section 26 of the RMA. The original remedy decision is documented in the Record of Decision (ROD) for the On-Post Operable Unit (OU) (FWENC 1996a). The ROD was signed June 11, 1996 and is currently being implemented for the remainder of the 17.2 square miles of the OU. A change in the ROD-selected remedy for the Lime Basins was necessitated due to significant increases In contaminated material volume to be placed in the Enhanced Hazardous Waste Landfill (ELF) and short-term risks associated with the excavation identified during remedial design. A review of the overall RMA remediation identified contaminated soil in Basin F for possible excavation and disposal in the available volume in the ELF. Evaluation of Basin F alternatives resulted in selecting a new remedy for Basin F as well. The new remedies were selected based on the administrative record for the site and were chosen in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986, and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan. This amendment does not change the selected remedy for groundwater, structures or soil at RMA other than the Lime Basins and Basin F PT soil projects.

The Army and U.S. Environmental Protection Agency (EPA) have selected the remedies documented in this ROD Amendment with concurrence from the State of Colorado.

ASSESSMENT OF SITE

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in the 1996 ROD or this ROD amendment, may present an imminent and substantial endangerment to public health, welfare, or the environment.

Lime Basins

The Lime Basins, constructed in 1942, were designed to remove arsenic (As) from South Plants wastewater and to receive other aqueous waste from South Plants (WCC 1989). Three basins were constructed, each approximately 1 acre in size. Through November 1943, wastewater from the production of Lewisite was routinely treated with lime prior to discharge to the unlined Lime Basins and subsequently discharged by gravity flow into Basin A, located just north of the Lime Basins.

The lime was used to precipitate metals and reduce the As concentration in the wastewater. This precipitation process produced a lime sludge that contained high levels of heavy metals, including As (WCC 1990).

After Lewisite manufacturing ceased in November 1943, the Army stopped putting lime slurry into the Lime Basins. The Lime Basins continued to receive aqueous waste from South Plants, from both Army and Shell productions, including pesticide production wastewater. These wastes were transported through two chemical sewers that discharged into the South side of the Lime Basins. In addition, acetylene production by Shell generated lime as a by-product. This lime was deposited as a slurry in the South Plants Lime Pond. Between 1955 and 1963, Shell periodically hauled lime waste from the South Plants Lime Pond to the Lime Basins. In late 1963, a three-inch pipe line was installed to transfer the lime slurry directly from South Plants to the Lime Basins. Lime slurry was disposed in this manner until July 1974. Aerial photographs from 1975 indicate the basins were no longer in use and had been filled in (ESE 1987). In 1993, an Interim Response Action (IRA) was undertaken to mitigate the threat of releases from the Lime Basins, which were identified as a source of groundwater contamination. The remedy selected under this IRA included construction of a subsurface barrier around the basins, extraction and treatment of groundwater, and a vegetative cover over the entire Lime Basins area. However, due to the discovery of munitions-related items during construction only the vegetative cover and a storm sewer line were constructed.

Remedial Investigation sampling identified contaminants of concern (COCs) present in the Lime Basins as organochlonine pesticides (OCPs), As and mercury. These COCs are present throughout the sludge and in the soil surrounding the Lime Basins at concentrations exceeding the site evaluation criteria (SEC) established in the ROD and are a source of groundwater contamination. Based on the soil contamination present in the Lime Basins, the ROD estimated the Human Health Exceedance (HHE) soil volume for the Lime Basins area at 54,151 bank cubic yards (bcy) and a PT soil volume of 9,015 bcy. The HHE soil was identified both within and surrounding the actual basins; however, a significant portion of the basins was not identified as exceeding the HHE criteria based on several nonexceedance samples located within the basins.

During design for the Lime Basins, the HHE boundary was revised to incorporate the entirety of the three basins based on the presence of lime material encountered throughout the basins during post-ROD treatability studies. Test pits showed time material present throughout the extent of the basins at depths down to 15 feet. Boundary changes between the Lime Basins and Basin A also resulted in changes to the HHE area, In addition, the southern and western overall project boundaries were revised to match the IRA soil cover constructed in 1993. Soil volume was recalculated based on these changes and a revised remediation volume of 89,450 bcy was identified (TtFW 2005a).

Basin F

The Army constructed the Basin F surface impoundment in 1956 to contain liquid wastes from Army and Shell chemical operations on the RMA. The impoundment was created by constructing a dike around a natural depression and lining it with a 3/8-inch asphalt membrane and a 1-foot-thick soil protective layer. The impoundment had a surface area of approximately 93 acres and a capacity of approximately 243 million gallons (ESE 1988c). Basin F was used continuously between December 1956 and December 1981 for the solar evaporation of contaminated liquid wastes. The basin was preliminarily closed by the removal of all conveyance systems into the basin on July 14, 1982.

In 1988, the Army initiated an accelerated remediation to address concerns regarding liquid and soil contamination in and under Basin F. The IRA was conducted to prevent potential infiltration of contamination from the basins to the underlying groundwater, eliminate potential adverse impacts to wildlife, and eliminate emissions of volatile chemicals from the basin. The initial IRA for Basin F hazardous liquid waste, sludge, and soil remediation was performed during 1988 and 1989 (Army 1988). Liquid waste was removed from the basin and incinerated at an on-site facility. Approximately 480,000 cy of contaminated soil, crystalline sludge, sludge, overburden, and asphalt liner were stripped, partially dried by piling and turning, then transferred to the Basin F Wastepile. After the designated contaminated material had been consolidated into the Wastepile, the Basin F surface area was covered with a clay cover, topsoil, and vegetative cover.

Remedial Investigation sampling identified concentrations of OCPs, dicyclopentadiene and chloroacetic acid exceeding the SEC established in the ROD. Concentrations of aldrin and dieldrin also exceed the PT criteria. Groundwater sampling conducted during the RI indicated that Basin F is a source of groundwater contamination. Major contaminants present in the groundwater in the Basin F area include chloroform, benzene, trichloroethylene, dieldrin, diisopropyl methylphosphonate, and dibromochloropropane. Groundwater flow from Basin F is to the north and is currently captured and treated at the North Boundary Containment System.

Soil contamination in Basin F resulted in identification of HHE and PT soil for the ROD. The ROD identified a PT soil volume for Basin F of 191,047 bcy. These PT soil areas are located in the southeast and east central portions of Basin F and comprise approximately 22.6 acres. Because the ROD identified an in situ remediation for the Basin F PT, the 191,047 bcy reported represents an in situ volume. The Soil Quantity Calculation Summary Report (SQCSR) reports a corresponding excavation volume of 266,708 bcy. The additional soil volume is comprised of the PT soil volume and HHE soil that is overlying or interbedded with the PT soil and must be excavated in order to completely excavate the PT soil.

During design for the Basin F/Basin F Exterior project, the project boundary between Basin F and the Basin F Exterior area was modified to more accurately correspond to the historic limits of the basin. The Basin F PT soil volume was recalculated incorporating the boundary change resulting in a revised PT soil volume of approximately 165,000 bcy. The revised total excavation volume is approximately 233,000 bcy, including the PT soil, 52,000 bcy of overlying HHE soil and 16,000 bcy of interbedded HHE soil.

RATIONALE FOR REMEDY CHANGE

The ROD remedy for the Lime Basins is excavation of PT and HHE soil with disposal in the on-site triple-lined landfill. The excavated area is backfilled with clean borrow and the IRA soil cover is repaired/reinstalled over the Lime Basins area. Remedial design for the Lime Basins commenced in 2002 to develop specific plans for remediation of the basins and surrounding soil. The design process progressed through the 60 percent stage with the 60 percent design analysis provided to the Regulatory Agencies in October 2003. During design for the Lime Basins, it became apparent that actual conditions at the Lime Basins differed significantly from those discussed in the ROD. In particular, the remediation volume to be placed in the ELF and short-term risks associated with the excavation had increased significantly.

New information developed during design and treatability study field characterization resulted in a significant volume increase for the project. Design volume increased from the ROD-identified HHE volume of 54,151 bcy to 89,450 bcy, representing a 65 percent increase over the ROD volume. In addition, although the ROD recognized the potential for dewatering, it did not indicate that any special handling was required to accomplish landfill disposal. Treatability studies performed in support of design determined that some of the Lime Basins material, even when dewatered prior to excavation, could not be placed directly in the ELF because it required stabilization prior to disposal to allow proper compaction (FWENC 2000a). Consequently, the 60 percent design incorporated mixing the wet Lime Basins material with surrounding dry soil prior to disposal in the ELF, increasing the ELF disposal volume to approximately 130,000 bcy, more than double the volume identified for disposal in the ROD.

The additional material handling and mixing requirements result in an increased potential for emissions and odors. Although the ROD included odor control as a necessary component for excavation of the basins, the additional volume and mixing required for disposal in the ELF increase these short-term risks. In addition, excavation activities require shoring side slopes to prevent the excavation walls from collapsing. To accomplish this, the 60 percent design included the installation of sheet pile walls around the deeper basin excavations to stabilize the excavation sidewalls. The addition of sheet pile walls adds to the overall cost and complexity of the project. Numerous geophysical anomalies were also identified during the design resulting in the addition of anomaly clearance requirements during excavation. These additional clearance activities further increase the short-term risks beyond what the ROD identified.

The significant increase in remediation volume and short-term risks associated with the excavation resulted in a cost increase compared to the ROD estimate. Consideration of all the changes encountered and associated cost increases resulted in a determination to reevaluate the remedial action for the Lime Basins project.

With reevaluation of the Lime Basins remedy in progress, the possibility of not excavating the Lime Basins presented a potential opportunity to use a portion of the landfill space in the ELF for containment of waste from the remaining nonexcavation projects. The remaining soil projects to be implemented at RMA were reviewed to determine whether they were compatible with the design for containment within the ELF. The evaluation criteria included identifying an area of contamination not already slated for excavation and landfill, checking that the contaminated soil was consistent with the type of contamination used in the ELF compatibility studies, and that it consisted of a volume suitable for the design capacity of the ELF. This review resulted in identification of the Basin F PT soil for possible disposal in the ELF.

The ROD remedy for the Basin F PT soil is in situ solidification/stabilization of the PT soil to a depth of 10 feet. Before any change to the remedy could be considered, a reevaluation of remedial actions for the Basin F PT soil project was necessary to ensure that overall remedy remained protective.

DESCRIPTION OF SELECTED REMEDIES

The selected remedy for the Lime Basins is construction of a vertical groundwater barrier surrounding the Lime Basins and a Resource Conservation and Recovery Act (RCRA)-equivalent cover, including biota barrier, over the entire Lime Basins area. Dewatering wells are installed inside the barrier wall and the extracted groundwater is treated at an on-site treatment facility. The vertical groundwater barrier wall is constructed to fully encompass the three historic Lime Basins to prevent migration of groundwater through the buried waste. The barrier wall is keyed into competent bedrock, approximately 45 to 50 feet deep, and will have a minimum thickness of 2 feet. A compatibility study will be conducted prior to final design to determine the appropriate barrier material. The RCRA-equivalent cover is contiguous with the Basin A and South Plants covers since the Lime Basins area is situated between these cover areas. The cover is designed consistent with the other RMA RCRA-equivalent covers and includes a minimum 18-inch-thick biota barrier, chokestone, capillary break, 4-ft-thick soil/vegetation layer, and lysimeters for compliance monitoring. The final surface of the RCRA-equivalent cover will be vegetated as required for the other RCRA-equivalent covers. Engineering controls are implemented for the cover including warning signs, obelisks to demark the covered areas, fences, survey monuments and erosion/settlement monuments. Long-term surveillance and maintenance, including institutional and engineering controls, will be managed in accordance with the Environmental Management System for remedy components at RMA. Long-term monitoring and maintenance requirements for the RCRA-equivalent cover are equivalent to the requirements for other RCRA-equivalent covers at RMA. These requirements will be defined in the Long-Term Care Program Plan. Institutional controls will be implemented to protect the engineered structures and to prevent contact with contaminated media.

The selected remedy for Basin F is excavation of PT soil with disposal in the on-site ELF. Excavation of PT soil is completed to a maximum depth of 10 feet from the IRA final excavation surface. Approximately 165,000 bcy of PT soil is excavated, transported to the ELF and disposed. The HHE soil overlying or interbedded with PT soil is also excavated and disposed in the ELF resulting in a total excavation volume, and ELF disposal volume, of approximately 233,000 bcy. Excavation, transportation, and disposal of PT soils are conducted using vapor and odor suppression measures as necessary. The excavated area is backfilled and the residual contaminated soil in Basin F is contained in place beneath the ROD-required RCRA-equivalent cover as part of the Basin F/Basin F Exterior Soil Remediation Project. The cover is designed consistent with the other RMA RCRA-equivalent covers and includes a minimum 18-inch-thick biota barrier, chokestone, capillary break, 4-ft-thick soil/vegetation layer, and lysimeters for compliance monitoring. Engineering controls are implemented for the cover including warning signs, obelisks to demark the covered areas, fences, survey monuments and erosion/settlement monuments. Long-term surveillance and maintenance, including institutional and engineering controls, will be managed in accordance with the Environmental Management System for remedy components at RMA. Long-term monitoring and maintenance requirements for the RCRA-equivalent cover are equivalent to the requirements for other RCRA-equivalent covers at RMA. These requirements will be defined in the Long-Term Care Program Plan. Institutional controls will be implemented to protect the engineered structures and to prevent contact with contaminated media.

STATUTORY DETERMINATIONS

The new, selected remedies for the Lime Basins and Basin F PT satisfy the requirements of CERCLA Section 121 and are protective of human health and the environment, comply with federal and state requirements that are legally applicable or relevant and appropriate to the remedial action, are cost effective and use permanent solutions through proper containment of the wastes and disposal in the on-post ELF. The remedies selected in this ROD Amendment do not satisfy the statutory preference for treatment as a principal element of the remedy for the following reasons. For Basin F, the containment alternative for Basin F PT soil provides substantial long-term risk reduction through containment of waste material in the on-post ELF, is easier to implement, and is lower cost than the ROD-identified treatment alternative. Treatment alternatives for the Lime Basins were eliminated at the alternative screening stage because they were ineffective, difficult to implement or not cost effective.

The Lime Basins and Basin F areas will be retained by the Army and assessed every 5 years, as part of the site-wide 5-year review process, to ensure that the overall remedy continues to provide adequate protection of human health and the environment and complies with applicable regulations. In addition, site-wide institutional controls identified in the RMA Federal Facility Agreement (FFA) are included as requirements in the ROD. These requirements restrict future land use and prohibit certain activities such as agriculture, use of on-post groundwater as a drinking source, and consumption of fish and game taken at RMA.

SIGNATURES

For U.S. Environmental Protection Agency

Max H. Dodson Date 10/20/05

Max H. Dodson
Assistant Regional Administrator
Office of Ecosystems Protection and Remediation

For U.S. Army

Addison D. Davis, IV Date 20 OCT 05

Addison D. Davis, IV
Deputy Assistant Secretary of the Army
Environment, Safety, and Occupational Health

For State of Colorado

Gary W. Baughman Date 10/20/05

Gary W. Baughman
Director, Hazardous Materials and Waste Management Division
Colorado Department of Public Health and Environment

DECISION SUMMARY

1.0 INTRODUCTION

This Amendment documents the change to the remedy for the Section 36 Lime Basins (Lime Basins) and Basin F Principal Threat (PT) Soil remediation projects of the Rocky Mountain Arsenal (RMA) Federal Facility Site. The RMA On-Post Operable Unit (OU) is a federally owned facility located in southern Adams County, Colorado, approximately 10 miles northeast of downtown Denver, directly north of the former Stapleton International Airport and west of Denver International Airport (Figure 1.0-1). The RMA On-Post OU site encompasses 17.2 square miles and is currently on the U.S. Environmental Protection Agency (EPA) National Priorities List (NPL) for environmental cleanup as a result of contamination released during previous RMA operations. The Lime Basins are located in the southwest comer of Section 36 of RMA adjacent to Basin A. Basin F is located in the north central part of Section 26 of RMA. These areas are shown on Figure 1.0-1.

The Record of Decision (ROD) (FWENC 1996a), which describes the remedy for the entire On-Post OU of RMA, was signed by the U.S. Army, the EPA, and the Colorado Department of Public Health and Environment (CDPHE) on June 11, 1996. The selected remedy includes 31 cleanup projects for soil, structures, and treatment of groundwater contamination. Implementation of the remedy for the remainder of the OU is currently underway and will continue through approximately 2011. As the site-wide remediation is completed, most of the On-Post OU of RMA will become a National Wildlife Refuge, as provided for in Public Law #102-402.

The Army is the lead agency for RMA and is issuing this ROD Amendment as part of its responsibilities under Section 117 of the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendment and Reauthorization Act of 1986, and pursuant to the National Contingency Plan (NCP), 40 Code of Federal Regulations (CFR) Section 300.435(c)(2)(ii). Regulatory oversight is conducted by the EPA, CDPHE, and the Tri-County Health Department (TCHD). The TCHD oversees local public health and environmental issues in Adams, Arapahoe, and Douglas Counties.

The selected remedy in the 1996 ROD for the Lime Basins project included excavation of the waste and contaminated soil and disposal in the on-site Enhanced Hazardous Waste Landfill (ELF). During design for the Lime Basins, treatability studies and field investigations were conducted to provide additional detail necessary to complete the remedial design for the ROD-selected remedy. As the new information was evaluated, it became apparent that site conditions at the Lime Basins required a significantly different approach than that envisioned at the time of the ROD selection. In particular, remediation volume increased more than 65 percent, costs increased more than 400 percent and there was the likelihood of experiencing additional short-term risks beyond those presented in the ROD. Based on the new information and difference in site conditions, the Army reevaluated the Lime Basins remedy in accordance with CERCLA guidance (A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other remedy Selection Decision Documents, OSWER 9200.1-23P) (EPA 1999) and the NCP (40 CFR 300.430) to ensure that the most appropriate remedy is implemented. As the Lime Basins remedy options were explored, the possibility of not excavating the Lime Basins presented a potential opportunity to use a portion of the landfill space in the ELF for containment of waste from the remaining nonexcavation projects. A review of the remaining soil projects to be implemented at RMA was conducted to determine whether any were compatible with the design for containment within the ELF. The evaluation criteria included identifying an area of contamination not already slated for excavation and landfill, checking that the contaminated soil was consistent with the type of contamination used in the ELF compatibility studies, and that it consisted of a volume suitable for the design capacity of the ELF. This review resulted in identification of the Basin F PT soil for possible disposal in the ELF. At RMA, PT soil has been defined as soil presenting excess cancer risk greater than 1 x 10^{-3} or a noncancer hazard index greater than 1,000. The current remedy for the Basin F PT soil is in situ solidification/stabilization of the PT soil to a depth of 10 feet.

Therefore, evaluation of a change to the ROD-selected Lime Basins remedy progressed to include evaluation of a change to the ROD-selected Basin F remedy as well. This Amendment summarizes information regarding the Lime Basins and Basin F from documents in the Administrative Record and remedy files, which were used as the basis to select the new remedial alternatives. The changes in remedy for the two projects are documented here together to ensure that the overall remedy remains protective.

This Amendment will become part of the Administrative Record as required by the NCP, 40 CFR 300.825(a)(2). The Administrative Record is available to the public at the Joint Administrative Record Document Facility (JARDF) that is located on the RMA in Building 129, Room 2024. The JARDF is open Monday through Friday between Noon and 4 pm or by appointment. The telephone number for the JARDF is 303-289-0362.

2.0 SITE HISTORY, CONTAMINATION AND SELECTED REMEDY

2.1 RMA Operational History

The RMA was established in 1942 by the Army to manufacture chemical warfare agents and agent-filled munitions and to produce incendiary munitions for use in World War 11. Initial facility building activities included construction of the South Plants manufacturing complex, extension of railway systems onto RMA, construction of a railway classification yard and service and maintenance facilities, modifications to preexisting irrigation reservoirs and construction of a new reservoir to supply South Plants with process cooling water, and construction of three seepage ponds in a large earthen depression in Section 36. Prior to 1942, the area was largely undeveloped ranchland and farmland. Following the war and through the early 1980s, the facilities continued to be used by the Army. Beginning in 1946, parts of the South Plants facilities were leased to private companies to manufacture industrial and agricultural chemicals. Shell Oil Company (Shell), the principal lessee, manufactured pesticides from 1952 to 1982 at the site. Common industrial and waste disposal practices used during those years resulted in contamination of structures, soil, surface water, and groundwater.

The On-Post OU is one of two primary operable units at RMA. The Off-Post OU addresses contamination north and northwest of RMA. The On-Post OU addresses contamination within the originally fenced 27 square miles of RMA. As of January 2004, 9.4 square miles of the On-Post OU have been determined to meet cleanup requirements and are no longer part of the NPL site. Implementation of the remedy for the remaining 17.2 square miles is ongoing and is scheduled for completion in 2011. At completion of the remedy, the Army and Shell will retain long-term maintenance responsibilities for approximately 1, 100 acres since waste will be contained in place in these areas.

The contaminated areas within the On-Post OU included approximately 3,000 acres of soil, 15 groundwater plumes, and 798 structures. The most highly contaminated areas were identified in South Plants (the central processing area, Hex Pit, Buried M-1 Pits, and the chemical sewers), Basins A and F, the Lime Basins, and the Complex (Army) and Shell Disposal Trenches. The primary contaminants found in soil and groundwater in these areas are organochlorine pesticides (OCPs), solvents, metals, and chemical warfare agent byproducts.

The areas with the highest levels and/or the greatest variety of contaminants are located in the central manufacturing, transport, and waste disposal areas. The highest contaminant concentrations tend to occur in soil within five feet of the ground surface, although exceptions are noted, particularly where burial trenches, disposal basins, or manufacturing complexes were located.

The characteristics and locations of the groundwater plumes suggest that the greatest contaminant releases to the groundwater have come from Basin A and the Lime Basins, the South Plants chemical sewer, the South Plants tank farm and production area, the Complex (Army) and Shell trenches in Section 36, and the former Basin F. The Motor Pool/Rail Yard and North Plants areas have been other sources of contaminant releases to the groundwater.

2.2 Section 36 Lime Basins History and Contamination Summary

The Lime Basins are located just north of 7th Avenue along the southwestern portion of Section 36. Three basins were constructed in 1942, each approximately 15 feet deep and I acre in size. The entire Lime Basins project area occupies approximately 5 acres.

The Lime Basins were designed to remove arsenic (As) from South Plants wastewater and to receive other aqueous waste from South Plants (WCC 1989). Through November 1943, wastewater from the production of Lewisite was routinely treated with time prior to discharge to the unlined Lime Basins and subsequently discharged by gravity flow into Basin A, just north of the Lime Basins. The lime was used to precipitate metals and reduce the As concentration in the wastewater. This precipitation process produced a lime sludge that contained high levels of heavy metals, including As (WCC 1990).

After Lewisite manufacturing ceased in November 1943, the Army stopped putting lime slurry into the Lime Basins. The Lime Basins continued to receive aqueous waste from South Plants, from both Army and Shell productions, including pesticide production wastewater. These wastes were transported through two chemical sewers that discharged into the south side of the Lime Basins. In January 1957, both the Army and Shell ceased using Basin A and the Lime Basins for aqueous waste following the completion of Basin F and the chemical sewer lines leading to Basin F (WCC 1990).

Between 1950 and 1974, acetylene production by Shell generated lime as a by-product. This lime was deposited as a slurry in the South Plants Lime Pond. Between 1955 and 1963, Shell periodically hauled lime waste from the South Plants Lime Pond to the Lime Basins. In late 1963, a three-inch line was installed to transfer the lime slurry directly from South Plants to the Lime Basins. Lime slurry was disposed in this manner until July 1974 (Unknown 1982). Aerial photographs from 1975 indicate the basins were no longer in use and had been filled in (ESE 1987).

It was alleged that the Lime Basins also might have received more than 150 drums of mustard agent from 1959 to 1960. It was believed that the mustard was neutralized, and that the term "drum" refers to a volume of chemical agent materiel, not an actual drum (WCC 1989). This unsubstantiated report was later refuted by testimony from U.S. Army personnel who stated that no drums of mustard were ever deposited in the Lime Basins. In addition, it is reported that rejected batches of sarin with greater than three percent of diisopropyl methylphosphonate (DIMP) and/or greater than a trace amount of isopropyl methylphosphonate were neutralized with sodium hydroxide and disposed in the Lime Basins (Kuznear 1980). Sodium hydroxide has been shown to be an effective neutralizing agent for GB (Army undated) and was routinely used by the Army for that purpose. In 1974 or 1975, the Army bulldozed the embankments of the Lime Basins and leveled them off with the existing ground surface.

2.2.1 Section 36 Lime Basins Remedial Investigation

The Remedial Investigation (RI) for the Lime Basins was conducted in two phases. Phase I was performed in the spring of 1985 and included soil sampling and field observations. Results are presented in the Phase I Contamination Assessment Report (CAR) (ESE 1987). The Phase II program began in the summer of 1987 and consisted of additional soil sampling and field observations to further define the lateral and vertical extents of contamination associated with the Lime Basins.

The Phase I program consisted of collecting 22 samples from 10 borings. The borings were located within the basins and surrounding berms and were completed to depths ranging from 3 to 11 feet. Samples were analyzed for volatile organic compounds (VOCs) (with the exception of 0- to 1-foot samples), semivolatile organic compounds (SVOCs), Inductively Coupled Plasma metals, As and Hg. Concentrations of OCPs were detected above the human health (HH) site evaluation criteria (SEQ. Arsenic was present above the indicator level; however, concentrations did not exceed the HH SEC. Gray to white lime material was reported in six of the ten borings.

For Phase II, the investigation was expanded to include the area surrounding the immediate Lime Basins based on visual evidence of lime material outside the basins. The Phase II program included 18 borings yielding 47 samples. Results were similar to Phase I results with concentrations of OCPs exceeding the HH SEC in several samples. Concentrations of As and Hg were also present above their indicator levels; however, concentrations did not exceed the HH SEC (ESE 1988b).

The RI soil samples collected from the Lime Basins were, as a matter of standard site procedures, screened for potential chemical agent materiel before leaving the site for analytical testing. During Phase II sampling, nine samples from three borings indicated the possible presence of Lewisite during surety screening and could not be submitted for analysis. These three locations were redrilled in May 1988 and new soil samples were collected. The samples were submitted for analysis using a more reliable method for Lewisite detection. The resulting analyses indicated that Lewisite was not present. In 1990, to support design of the Interim Response Action (IRA), soil borings were completed to determine depth to bedrock (USACE 1990). Soil samples were collected from those borings at 5- and 10-ft depths to further characterize the area. Sample results were similar to the RI results with detections of OCPs in most samples. One sample had OCP concentrations greater than the HH SEC.

In 1994, additional soil samples were collected as part of the Feasibility Study (FS) Soil Volume Refinement Program. Ten borings yielding 35 samples were located in the Lime Basins area. The FS results confirmed the RI sample results indicating OCP concentrations greater than the HH SEC. In addition, As was detected in two samples at concentrations greater than the HH SEC (Ebasco 1994).

Groundwater sampling conducted during the RI indicated that the Lime Basins are a source of groundwater contamination. In the southern portion of the Lime Basins, the bottom 2 to 3 feet of waste (approximately 15 feet depth) is currently within the groundwater aquifer. Major contaminants present in the groundwater in the Lime Basins area include OCPs, As and VOCs. These contaminants are also present in groundwater upgradient from the Lime Basins in the South Plants plume; however, As concentrations are significantly higher in the downgradient wells. Groundwater flow from the Lime Basins is to the northwest and is currently captured and treated at the Basin A Neck treatment facility.

2.2.2 Section 36 Lime Basins Geology

The RMA ties within the Colorado Piedmont section of the Great Plains physiographic province. This area is characterized by surface deposits of windblown and alluvial materials. The RMA lies near the eastern edge of the valley along the South Platte River. The topography of the RMA area consists of gently rolling hills with occasional prominent hills which contain bedrock outcrops.

Bedrock beneath the Lime Basins site is the Cretaceous-Tertiary Denver Formation. The unconformable contact between the bedrock and the overlying surficial deposits is irregular due to erosion of the surface of the bedrock prior to the deposition of the surficial material. The uppermost portions of the Denver Formation are weathered and often fractured. The Denver formation in the vicinity of the Lime Basins site consists of claystone and sandstone. The claystone is generally soft to moderately hard, brown and blocky, and is occasionally silty. Sandstone lenses are also frequently encountered. The sandstone units are fine-grained and vary from soft to hard, depending upon the degree of cementation and weathering. These sandstones also contain slit, thus making them less pervious.

The Denver Formation bedrock lies at depths of 13.5 to 31 feet below the surface in the Lime Basins area. The local slope of the surface of the bedrock is very gentle, about two degrees down, to the north-northeast. It also displays paleochannel valleys and benches. This type of paleotopography is due to stream erosion. The dip of the Denver Formation has not been determined, but is probably the same as the regional dip.

The overburden in the Lime Basins area is of Quaternary age and is the result of deposition by the ancient Platte River drainage network and eolian processes. The thickness of the overburden ranges between 13.5 and 31 feet in the Lime Basins area. The soils consist mostly of poorly graded, silty, fine-grained sand with moderate amounts of sandy, silty clay and minor amounts of clayey sand, sandy clay, silty clay, and clay. The sand ranges from loose to dense and the clay ranges from soft to very stiff. The overburden soil ranges from dry to saturated with moisture content increasing with depth.

2.2.3 Section 36 Lime Basins Interim Response Action Various

IRAs were designed to mitigate major active sources of potential contaminants to migration pathways. The IRA for the Lime Basins included relocation of sludge material from outside the basins to within the basin area, a subsurface barrier around the basins, groundwater extraction system, and soil vegetative cap over the Lime Basins (WCC 1990). In 1990, to support design of the slurry wall, 16 soil samples were collected from 8 locations (USACE 1990). Sample results were similar to the RI results with detections of OCPs in most samples. One sample had OCP concentrations greater than the HH SEC. The final design for implementation of the IRA specified a slurry wall as the subsurface barrier (USACE 1991).

During excavation for construction of the slurry wall and groundwater extraction system at the site, munitions debris was discovered indicating the potential for encountering chemically configured ordnance if excavation continued (Army 1993). As a result of this discovery, only the minimum 18-inch thick vegetative cap and storm sewer line were constructed to route drainage around the south and east sides. The vegetative cap was constructed over the entire Lime Basins project area. This work was completed in 1993 (EPA/Army 2000a).

2.2.4 Section 36 Lime Basins Soil Contamination Summary

The ROD identifies contaminants of concern (COCs) based on RI/FS analytical results for the Lime Basins as OCPs, As and Hg (FWENC 1996a). These COCs are present throughout the sludge and in the soil surrounding the Lime Basins. Table 2.2.4-1 provides a summary of the COCs and concentrations for soil data collected for the Lime Basins.

Based on the contamination present in the Lime Basins, the ROD identified the Human Health Exceedance (HHE) soil volume for the Lime Basins area as 54,151 bank cubic yards (bcy) and a PT soil volume of 9,015 bcy. Details of the ROD-identified volumes as well as the location and depths are presented in the September 1996 Soil Quantity Calculation Summary Report (SQCSR) (FWENC 1996b). The soil exceedance volumes were developed based on soil contaminant modeling using the existing analytical data. The HHE soil was identified both within and surrounding the actual basins; however, a significant portion of the basins was modeled as not exceeding the HHE criteria based on several nonexceedance samples located within the basins. The PT soil was identified primarily within the basins and was associated with several samples exceeding the PT criteria present at one location within the basins.

During remedial design for the Lime Basins, the project boundary between the Lime Basins and Basin A Consolidation Area was modified. The boundary was relocated to a topographic feature (top of berm from Basin A), which acts as the operational boundary between the two projects (FWENC 2000b). This boundary modification transferred approximately 12,500 bcy of HHE soil identified in the ROD from the Lime Basins to the Basin A project. The HHE boundary was also revised to incorporate the entirety of the three basins as identified through historic aerial photographs. Although the RI samples and ROD soil volume model did not show HHE soil over a portion of the basins, the boundary was modified to include the entire basins due to the presence of lime material encountered throughout the basins during the post-ROD treatability studies. In addition, the southern and western overall project boundaries were revised to match the IRA soil cover placed in 1993. All area outside the IRA cover boundary was included in the Section 36 Balance of Areas Soil Remediation Project (FWENC 2003b). Figure 2.2.4-1 indicates the ROD boundary of the Lime Basins along with the revised design boundaries described here.

Soil volume was recalculated based on the boundary changes described above. All three basins were considered HHE soil and excavation depths were determined based on the test pits completed during the treatability study. Test pits showed lime material present throughout the extent of the basins at depths down to 15 feet below ground surface (bgs). Surrounding soil was identified for remediation based on recalculation of HHE soil using the ROD soil volume model incorporating the boundary changes. The revised design HHE soil volume is 89,450 bcy (TtFW 2005a). This volume includes the PT volume present within the basins. The PT soil volume was not recalculated since there is no difference in handling requirements between HHE and PT soil; however, since the PT soil volume was based on exceedance samples at one location within the basins, the volume is expected to be relatively unchanged from the ROD estimate.

2.2.5 Section 36 Lime Basins Geophysical Surveys

In the summer of 1998, a magnetic geophysical survey was performed to assess the presence of debris or other anomalies within the boundary of the site (SCA 1998). Four Geometries 858 cesium vapor total field magnetometers rigged up in an integrated cart system were used as survey sensors for geophysical screening. This is a passive sensor technology that measures the strength of the Earth's magnetic field and detects ferrous (iron/steel) metals by measuring variations in the Earth's ambient magnetic field caused by buried targets/anomalies.

The target analysis for Section 36, Zone 0101 (Lime Basins B1 and B2 as shown on Figure 2.2.4-1) indicated numerous deep (15 feet) and large (>500 lbs) contacts throughout the area, most notably in the southeast comer of Basin B I and the northwest comer of Basin B2. The target analysis for Section 36, Zone 0102 (Lime Basins B2 and B3) showed numerous deep (15 feet) and large (>500 lbs) contacts throughout the area, most notably on the east side of Basin B3.

2.2.6 Section 36 Lime Basins Post-ROD Treatability Studies

In the spring of 2000, a treatability study was performed in support of remedial design to determine the best method for stabilizing the waste material prior to disposal in the ELF. The treatability study determined that the material from the Lime Basins was "wet" (fails paint filter test [PFT]) in the lower depths (>6 ft bgs) of the former basins. The remaining HHE soil, outside the former basins, is anticipated to pass the PFT. The results of the treatability study indicated that the wetter pit material should be combined with the surrounding drier HHE soil along with shredded newspaper and diatomaceous earth to control moisture and stabilize the waste (FWENC 2000a). This type of remediation would require a pug mill to efficiently mix the separate soil components, and possibly an enclosure or some type of air handling system to handle air emissions.

As a part of this treatability study, odor samples were collected for odor screening analysis. The odor screening results were random, but appeared to have the highest concentration in the area of the former basins, Odor concentrations ranged from Dilutions to Threshold (D/T) values up to 50 in the northern part of the project area and D/T values up to 10,000 for the "wet" sample located within the basins.

In the fail of 2002, additional site soil samples were obtained for geotechnical analysis and a field demonstration soil mixing study was performed (FWENC 2002a, 2002b). For these tests, soil samples were obtained both above and below the existing water table. The field demonstration mixing pad (DMP) study was performed to determine whether the drier surrounding soil could be combined with the wetter Lime Basins material to produce a soil product that could be placed directly in the ELF without additives. The results of the DMP field study indicated that a 3:1 mix ratio of surrounding soil to Lime Basins material would produce a product that would pass the PFT and could be compacted in the ELF with minimal rutting. This remediation technique was chosen over the previous one due to its relative ease of construction, lack of a pug mill, and no need to import additives during the remediation process.

In August and September of 2003, additional soil and groundwater samples were obtained for odor flux analysis (FWENC 2003a). For this activity, 16 test pits were excavated within the Lime Basins project area. Two samples were collected from all test pits dug within the basins. Test pits located in the HHE area surrounding the basins where Lime Basins material was encountered also produced two samples. Otherwise, only one sample was collected from these test pits. The new results confirmed Air Pathway Analysis Task 2 (Task 2 WG 1998) results, that there is an isolated area of surrounding soil north of the basins that has higher odor potential (flux of 292.3), but also demonstrated that most soil samples had low odor potentials (flux less than 11). Note, all flux measurements given in this section have The units of $(D/T\text{-}m^3)/(min\text{-}m^2)$.

In addition, groundwater samples were collected from 5 wells and piezometers located within and to the south of the basins and analyzed for odor flux and chemical concentrations. Groundwater within the eastern basin (B3) has the highest odor potential (flux of 19.0), while groundwater within the other basins had tower odor potential (flux of 2.9). Groundwater to the south of the western basin (B 1) had a higher odor potential (flux of 8. 1) when compared to groundwater south of B3 (flux of 0.7).

2.3 Basin F History and Contamination Summary

Construction of the Basin F (NCSA-3) surface impoundment occurred between July and December 1956 in a natural depression located immediately north of Basin C. The impoundment was created by constructing a dike around a natural depression and lining it with a 3/8-inch asphalt membrane. A 1-foot-thick soil protective layer was placed on top of the asphalt membrane. The impoundment had a surface area of approximately 93 acres, a maximum depth of approximately 12 feet, and a capacity of approximately 243 million gallons (ESE 1988c). The impoundment was to be used to contain liquid wastes from Army and Shell chemical operations, including the Chlorine Plant, Shell Manufacturing Area and the Sarin (GB) complex.

Basin F was used continuously between December 1956 and December 1981 for the solar evaporation of contaminated liquid wastes. After December 1956, no other evaporative basins on site were used for this purpose, with one exception. In the spring and summer of 1957, Basins A and C were used for temporary liquid waste containment while repairs were made to the liner and protective soil layer of Basin F, which had been damaged by severe wave action within the basin. In the summer of 1964, the Army constructed an earthen fill dike across the southeast comer of Basin F, creating a 1-million-gallon surge basin identified as F-1. This modification was added to accelerate settling and minimize the time available for the growth of unfilterable bacterial organisms in the contents of the effluent. When F-1 was completed, liquid waste discharge from the chemical sewer bypassed Basin F and was taken directly to the Deep Well Injection Facility.

Following the termination of at I waste discharges to the chemical sewer in December 1981, the Army implemented a series of measures designed to accelerate the evaporation of the remaining liquids in the basin, prevent sewer-transported flows from infiltrating both ground and surface waters, and prevent surface runoff from generating additional liquid waste volumes contained in the basin. These measures included: 1) removal of the chemical sewer trunk line and lateral connection to Basin F from South Plants and North Plants; 2) construction of a pipe trickler system in the basin to enhance natural solar evaporation; 3) installation of a dike in the basin separating the 'wet' from 'dry' areas; and 4) construction of a north-south surface runoff interceptor ditch along the eastern basin perimeter. The basin was preliminarily closed by the removal of all conveyance systems into the basin on July 14, 1982.

2.3.1 Former Basin F Remedial Investigation

The RI for Basin F was conducted in two phases. Phase I was performed in the fall of 1985 and the summer of 1986 and included soil sampling and field observations. Results are presented in the Phase I CAR (ESE 1988c). The Phase II program began in February 1988 to complement the IRA by indicating the lateral and vertical extents of contamination remaining at the site.

The Phase I program consisted of collecting 40 soil samples from 14 locations below the liner and 3 soil samples from an adjacent drainage ditch on the east side of the basin. An additional 13 soil samples from 7 locations together with 42 observations were then collected to correlate liner condition with the underlying soil chemistry as an aid in determining volumes of contaminated subliner soil to be removed during the IRA. In total, 56 samples were collected from 22 locations throughout the site.

Observations made during the Phase I effort included the following: "Liner overburden became more discolored and sludge-like as excavations approached the liner. " The liner was intact over a large area in the central and western portions of the basin and along the northern boundary. Damage to the liner was observed in the southern and eastern parts of the basin.

The Phase I survey yielded results that appear to match the observations listed above. In areas where the physical integrity of the liner was poor, the samples were found to contain elevated concentrations of organic contaminants to depths of 20 feet bgs. The concentrations in these locations remained relatively uniform with depth, and high concentrations of many contaminants occurred in the soil at or above the water table elevation. In contrast, moderate to low contaminant concentrations were detected in most samples taken where the liner was still intact and concentrations decreased with depth. However, the data also indicated that detectable levels of contaminants were present at depths greater than 3 feet in areas where the liner integrity was still good and an adjacent portion of the liner was damaged. This is most probably due to lateral downslope migration of the contaminants from areas where the liner was damaged.

The Phase II program was conducted in two stages.

- Phase IIa consisted of sample collection outside the basin area to assess both the lateral and vertical extent of soil contamination outside the Basin F fence. This was accomplished through a series of 16 borings ranging in depth from 10 to 40 feet. Phase IIa results indicated that airborne particulates emanating from Basin F resulted in contamination of surficial soils adjacent to Basin F, based on sample results from the 0 to 0.5-foot interval.

- Phase IIb consisted of sample collection inside the basin during the IRA after the overburden, liner and some of the underlying soils were removed.

The results of Phase IIa and IIb are presented in separate CARS (ESE 1988a, 1989).

Phase IIa, started in February 1988, collected 63 soil samples from 16 borings around the Basin F perimeter and 25 surficial samples along 5 radial vectors corresponding to the RMA primary wind rose. The majority of the samples collected during this phase demonstrated that the highest contaminant concentrations were located on the east side of the basin, primarily on the surface. The ROD includes a boundary for Basin F that encompasses some of these Phase IIa perimeter samples resulting in an overall Basin F area of approximately 108 acres.

The Phase IIb sampling program started in the spring of 1988 and collected 128 soil samples from 25 soil borings. The results from this program generally paralleled the results collected during the Phase I sampling effort. The Phase IIb sampling again showed that the greatest concentrations of contaminants were found in the eastern and southern portions of the basin. The contaminant types that exceeded the SEC were again organics and metals.

Groundwater sampling conducted during the RI indicated that Basin F is a source of groundwater contamination. Depth to groundwater in the Basin F area ranges from 20 feet to more than 40 feet. Major contaminants present in the groundwater in the Basin F area include chloroform, benzene, trichloroethylene, dieldrin, DIMP, and dibromochloropropane. Groundwater flow from Basin F is to the north and is currently captured and treated at the North Boundary Containment System.

2.3.2 Basin F Interim Response Action

In 1988, the Army initiated an accelerated remediation to address concerns regarding liquid and soil contamination in and under Basin F. The IRA was conducted to prevent potential infiltration of contamination from the basins to the underlying groundwater, eliminate potential adverse impacts to wildlife, and eliminate emissions of volatile chemicals from the basin. The initial IRA for Basin F hazardous liquid waste, sludge, and soil remediation was performed during 1988 and 1989 (Army 1988).

During May 1988, the Army began transferring Basin F hazardous liquid waste into the three lined tanks at the Tank Farm for interim storage. Additional liquid retention capacity in two surface ponds (double-lined impoundment identified as Ponds A and B) was used because of unexpected liquids found perched between a false bottom (salt lenses) and the asphalt basin floor, and seasonal precipitation which increased the volume of the liquid beyond the initial estimate. The hazardous liquid was subsequently incinerated on site by Submerged Quench Incineration between 1993 and 1995.

Approximately 480,000 cy of contaminated soil, crystalline sludge, sludge, overburden, and asphalt liner were stripped, partially dried by piling and turning, then transferred to the Basin F Wastepile. The depth to which contaminated materials were removed from Basin F varied depending on field observations. However, because it was impractical to remove all of the contamination down to depths approaching 40 feet, Basin F soil removal was halted at a depth of 6.5 feet below the asphalt liner elevation. After the designated contaminated material had been consolidated into the Wastepile, the Basin F surface area was covered with a clay cover, topsoil, and vegetative cover.

2.3.3 Basin F Soil Contamination Summary

The concentrations of the contaminants vary widely throughout the Basin F PT soil area, from PT level concentrations for pesticides to nondetections for all contaminants. The ROD (FWENC 1996a) identifies COCs based on RI analytical results for Basin F as OCPs, chloroacetic acid and dicyclopentadiene. However, only OCPs (aldrin and dieldrin) exceed the PT criteria. Table 2.3.3-1 provides a summary of the COCs and concentrations for soil data collected within the Basin F PT soil area during the RI/FS. Contaminant levels exceed the PT criteria to a depth of 20 feet bgs.

Soil contamination in Basin F resulted in identification of HHE and PT soil for the ROD. Details of the ROD-identified volumes are provided in the SQCSR (FWENC 1996b). The ROD and SQCSR identified a PT soil volume for Basin F of 191,047 bcy and a HHE soil volume of 743,432 bcy (HHE soil volume includes PT soil volume). These PT soil areas are located in the southeast and east central portions of Basin F and comprise approximately 22.6 acres of the 108-acre site. The soil exceedance volumes were developed based on soil contaminant modeling using the existing analytical data. Because the ROD identified an in situ remediation for the Basin F PT, the 191,047 bcy reported represents an in situ volume. The SQCSR reports a corresponding excavation volume of 266,708 bcy. The additional soil volume is comprised of the PT soil volume and HHE soil that is overlying or interbedded with the PT soil and must be excavated in order to completely excavate the PT soil.

During design for the Basin F/Basin F Exterior project, the project boundary between Basin F and the Basin F Exterior area was modified to more accurately correspond to the historic limits of the basin. Historic aerial photographs and topographic mapping were used to identify the maximum elevation contour limits of liquid waste during the history of the basin as a waste impoundment. Additional soil contamination characterization was performed to verify that impounded liquid waste did not exceed the limits of the elevation contour that defined the soil berm that bounded the basin. The results of this characterization (sampling and analysis) for the boundary modification are documented in the Final Data Summary Report for the Basin F Perimeter (FWENC 2002c). This boundary change resulted in a reduction of the Basin F area from the ROD-identified 108 acres to an area inside the berm of approximately 92.2 acres (FWENC 2001). The new design area correlates well with the reported historic area of approximately 93 acres. Figure 2.3.3-1 indicates the ROD boundary of Basin F along with the revised design boundary described here.

The Basin F PT soil volume was recalculated using the ROD soil volume model incorporating the boundary change described above. The revised PT area comprises approximately 17 acres of the 92-acre project area and is shown on Figure 2.3.3-1. The revised total excavation volume is approximately 233,000 bcy. This volume includes approximately 165,000 bcy of PT soil, 52,000 bcy of overlying HHE soil and 16,000 bcy of interbedded HHE soil. Contaminated soil outside the revised Basin F boundary was excavated as part of the Basin F Exterior project (FWENC 2001).

The soil volume model uses a 1041 maximum depth for volume calculations based on the exposure scenario described in the Integrated Endangerment Assessment/Risk Characterization (IEA/RC) (FWENC 1994). Typically, this depth is applied from the existing ground surface; however, for Basin F, the depth was applied to the postexcavation surface achieved during the IRA (EPA/Army 2000b). Consequently, actual remediation depths are greater than 10 feet from the current ground surface due to the placement of gradefill and soil cover over the IRA cut surface. Additional PT soil volume exists below the 10-ft exposure depth developed in the IEA/RC and used in the ROD, Although the deeper volume is not calculated in the SQCSR, it is estimated to extend deeper than 20 feet bgs in some places based on the existing sample data exceeding the PT criteria in the basin.

Contaminated soil outside the revised Basin F boundary was excavated as part of the Basin F/Basin F Exterior project. The Basin F Exterior area includes contaminated soil located adjacent to Basin F along the eastern boundary of the basin. Because the Basin F and Basin F Exterior areas share this common boundary, a decrease in the Basin F area resulted in a corresponding increase in the Basin F Exterior area. The transferred soil area, shown on Figure 2.3.3-1, added 17,701 bcy of HHE soil and 1,980 bcy of biota soil to the Basin F Exterior project (FWENC 2001). In addition to the transferred soil volume, the Basin F/Basin F Exterior project experienced volume growth due to actual excavation beyond the design depth requirements. The overexcavated soil was disposed at the hazardous waste landfill (HWL) along with the HH soil and the entire volume was accounted for as HH soil volume in the project records (TTFW 2005b). The resulting documented HH soil volume increased from the ROD estimate of 71,906 bcy to an actual landfill volume of 129,449 bcy, representing an 80 Percent increase in HH soil volume for the project.

2.3.4 Former Basin F Post-ROD Treatability Studies

In 2001 and 2002, Basin F PT soil samples were collected and analyzed for a wide range of VOCs, SVOCs and metals. The soil sampling and analysis program was conducted to collect data on the types and concentrations of contaminants present in the Basin F soils to assist in initial selection of solidification reagents. In addition it was also necessary to identify any chemical constituents that might neutralize or reduce the effectiveness of prospective solidification reagents.

The soil sampling and analysis program did not detect any chemical compounds which would contraindicate the use of the primary solidification reagents of portland cement, activated carbon, blast furnace slag and bentonite (TtFW 2005c). In addition, the results of the soil analysis program supported the data collected during the RI, indicating that the only contaminants at PT concentrations are aldrin and dieldrin. Other contaminants identified in the RI, such as isodrin, endrin, metals and other SVOCs, are not present at PT concentrations. Chloroacetic acid was not detected in any soil sample.

Other contaminants present in the Basin F PT soil volume were dicyclopentadiene and non-COCs including bicycloheptadiene and dimethyl disulfide, which are known to generate odors during soil excavation and handling activities.

2.4 Summary of the Selected Remedy from the On-Post ROD

The overall remedy required by the 1996 ROD for the On-Post OU includes the following:

- Interception and treatment of contaminated groundwater at the three existing on-site treatment plants

- Construction of new Resource Conservation and Recovery Act (RCRA) - and Toxic Substances Control Act-compliant landfills on-post. The on-post facilities include the HWL and a triple-lined landfill, referred to as the ELF.

- Demolition of structures with no designated future use and disposal of the debris in either the new, on-post HWL or the Basin A consolidation area, depending upon the degree of contamination

- The contaminated soil at RMA is addressed primarily through containment in the on-post HWL (or ELF) or under caps/covers, or through treatment depending upon the type and degree of contamination. Areas that have caps or covers require long-term maintenance and will be retained by the Army. These areas will not become part of the wildlife refuge.

- The Basin A disposal area is used for consolidation of biota risk soil and structural debris from other RMA contamination areas and is covered with a soil cover including a biota barrier.

2.5 Summary of the Selected Remedy for the Lime Basins from the On-Post ROD

The selected remedial action listed in the ROD is excavation and containment of the PT and HHE soil in a triple-lined landfill cell at the on-post hazardous waste landfill (ELF). The ROD-identified remedy includes the following elements for the Lime Basins:

- Remove overburden and existing soil cover and set aside.

- Excavate HHE soil and PT soil.

- Monitor for chemical agent during excavation. Treat (caustic washing) any agent-contaminated soil and dispose in the ELF.

- Dispose HHE soil and PT soil in a triple-lined cell at the on-post hazardous waste landfill (ELF).

- Backfill excavation with clean borrow.

- Repair existing soil cover and revegetate.

The remediation standard for excavation as stated in Table 9.5-1 of the ROD is as follows:

- Standard: Excavate all contaminated soil identified in the ROD for treatment, landfilling, or consolidation that corresponds to the areal and vertical extent detailed by the soil volume calculations in the administrative record.

The ROD soil volume calculations are documented in the SQCSR (FWENC 1996b). For the Lime Basins, the ROD identified 54,151 bcy of HHE soil (including 9,015 bcy of PT soil) for excavation and disposal in the ELF.

In addition, the ROD goals and standards for ELF disposal include:

- Standard: Landfill principal threat and human health soil exceedance volumes and agent-contaminated material.
- Standard: Design landfill to meet 1,000-year siting criteria.
- Standard: Ensure all material disposed in landfill passes EPA paint filter test.

2.6 Summary of the Selected Remedy for Basin F from the On-Post ROD

For the Basin F PT soil, the ROD includes the following:

- Treat PT soil using in situ solidification/stabilization to reduce the mobility of the contaminants.
- Perform treatability testing during remedial design to determine the mixture of solidification reagents, verify the effectiveness of the treatment process, and establish the operating parameters for implementation.
- Cap the entire Basin F area as shown on Figure 2.3.3-1, which includes the Basin F Wastepile footprint and the Former Basin F project area, with RCRA-equivalent cap that includes a biota barrier.

The ROD and SQCSR identify a PT soil volume of 191,047 bcy for treatment based on a maximum treatment depth of 10 feet from the IRA final excavation surface (FWENC 1996b). The ROD did not include any specific performance goals or standards for solidification/stabilization in Basin F, instead referencing the Basin F closure plan and design documents for requirements related to the treatment. The Basin F closure plan Is similarly indefinite and indicates that treatability studies be conducted as part of remedial design to determine the spec ic solidification process and treatment goals for in situ solidification of Basin F. Because the potential mobility reduction of the organic contaminants in Basin F was unknown, the treatability study did not specify a treatment goal. Instead, the treatability study set goals for material strength and hydraulic conductivity to provide a solidified mass that would reduce contaminant mobility and left any specific goals for development during design. Because the design for Basin F solidification was not completed prior to reevaluating remedial alternatives, there are no specific goals or standards to reference.

3.0 BASIS FOR THE AMENDMENT

3.1 Lime Basins

In accordance with the ROD, remedial design for the Lime Basins commenced in 2002 to develop specific plans for remediation of the basins and surrounding soil. The design process progressed through the 60 percent stage with the 60 percent design analysis provided to the Regulatory Agencies in October 2003. During design for the Lime Basins, it became apparent that actual conditions at the Lime Basins differed significantly from those discussed in the ROD. In particular, the remediation volume to be placed in the ELF and short-term risks associated with the excavation increased significantly.

The ROD and SQCSR identified 54,151 bcy of HHE soil for Lime Basins remediation including both contaminated material within the basins and contaminated surrounding soil (FWENC 1996b). Because the RI included few samples within the actual basins and the ROD volume model did not differentiate between the basins and surrounding soil, the ROD-identified HHE area did not include the full extent of the basins as observed in the field investigations or described in historical documentation. Conversely, some of the surrounding soil was modeled with high concentrations of contaminants based on one sample location within the basins. Therefore, the volume model was revised to include the entire basins as HHE soil based on the observance of lime material throughout the basins during the field investigations. The surrounding soil model was revised to estimate contaminated volume based only on samples existing within the surrounding soil. In addition, the revised volume model incorporated minor boundary changes to match the existing IRA soil cover boundary, as described in Section 2.2.4. The revised contaminated soil volume is 89,450 bcy representing a 65 percent increase over the ROD volume (TtFW 2005a).

Although the ROD acknowledges the potential for wet material, the remedy includes only groundwater pumping to lower the water table and does not indicate that any special handling of waste is required to accomplish landfill disposal. However, treatability studies performed in support of design determined that some of the Lime Basins material was wet, failing the PFT, and cannot be disposed directly in the ELF (FWENC 2000a). While lowering the groundwater table in the vicinity of the deep excavations would aid in the excavation of the material, results of the treatability study indicate that the LB material retains its high moisture content even when located above the groundwater table regardless of the dewatering effort. This material requires stabilization prior to disposal to allow proper compaction. Consequently, the 60 percent design incorporated mixing the wet Lime Basins material with surrounding dry soil prior to disposal in the ELF, increasing the ELF disposal volume to approximately 130,000 bcy, more than double the volume identified for disposal in the ROD. In addition, excavation activities require shoring side slopes to prevent the excavation walls from collapsing. To accomplish this, the 60 percent design included the installation of sheet pile walls around the deeper basin excavations to stabilize the excavation sidewalls. The addition of sheet pile walls adds to the overall cost and complexity of the project.

The additional material handling and mixing requirements increase the potential for emissions and odors. Although the ROD included odor control as a necessary component for excavation of the basins, the additional volume and mixing required for disposal in the ELF increase these risks.

Additional short-term risks associated with Lime Basins excavation include the potential for chemical agent contamination and presence of anomalies requiring clearance during excavation. The ROD included the potential for chemical agent contamination in the Lime Basins; however, the identification of numerous geophysical anomalies during the design resulted in the addition of anomaly clearance requirements during excavation. These additional clearance activities further increase the short-term risks beyond what the ROD identified.

The significant increase in remediation volume and short-term risks associated with the excavation resulted in a cost increase compared to the ROD estimate. Consideration of all the changes encountered and associated cost increases resulted in a determination to reevaluate the remedial action for the Lime Basins project.

3.2 Basin F

With reevaluation of the Lime Basins remedy in progress, the possibility of not excavating the Lime Basins presented a potential opportunity to use a portion of the landfill space in the ELF for containment of waste from remaining nonexcavation projects. The remaining soil projects to be implemented at RMA were reviewed to determine whether they were compatible with the design for containment within the ELF. The evaluation criteria included identifying an area of contamination not already slated for excavation and landfill and checking that the contaminated soil was consistent with the type of contamination used in the ELF compatibility studies and that it consisted of a volume suitable for the design capacity of the ELF. This review resulted in identification of the Basin F PT soil for possible disposal in the ELF.

The ROD remedy for the Basin F PT soil is in situ solidification/stabilization of the PT soil to a depth of 10 feet. Before any change to the remedy could be considered, a reevaluation of remedial actions for the Basin F PT soil project was necessary to ensure that the overall remedy remained protective.

4.0 REMEDY DESCRIPTION

4.1 Remedial Action Objectives

Section 7.4.2 of the 1996 ROD identified the Remedial Action Objectives (RAOs) for the soil medium (which includes the Lime Basins and Basin F) as follows:

<u>Human Health</u>

- Prevent ingestion of, inhalation of, or dermal contact with soil or sediments containing COCs at concentrations that generate risks in excess of 1×10^{-4} (carcinogenic) or a Hazard Index greater than 1.0 (noncarcinogenic) based on the lowest calculated reasonable maximum exposure (5th percentile) preliminary pollutant limit values (which generally represent the on-site biological worker population).

- Prevent inhalation of COC vapors emanating from soil or sediments in excess of acceptable levels, as established in the Human Health Risk Characterization.

- Prevent migration of COCs from soil or sediment that may result in off-post groundwater, surface water, or windblown particulate contamination in excess of off-post remediation goals.

- Prevent contact with physical hazards such as unexploded ordnance. Prevent ingestion of, inhalation of, or dermal contact with acute chemical agent hazards.

Ecological Protection

- Ensure that biota are not exposed to COCs in surface water, due to migration from soil or sediment, at concentrations capable of causing acute or chronic toxicity via direct exposure or bioaccumulation.

- Ensure that biota are not exposed to COCs in soil and sediments at toxic concentrations via direct exposure or bioaccumulation.

There are no changes to the RAOs resulting from this ROD Amendment, and the level of protection of human health and the environment remains the same. All remedy components presented in the ROD for groundwater and structures are unaffected by this ROD Amendment. In addition, no changes to the future land use of RMA are anticipated as a result of this ROD Amendment.

4.2 Description of Alternatives for Lime Basins

Based on the historical Lime Basins information and new information obtained since the ROD was signed, three alternatives were evaluated for remediation of the Lime Basins. In addition to the NCP requirement to consider a no-action alternative (which serves as a point of departure from other alternatives under consideration), the ROD-identified remedy and one other remedial alternative was considered.

Alternative 1 - No additional action specifically for the Lime Basins. The basins are contained beneath the existing 18-inch soil cover that was constructed as part of the IRA for the Lime Basins.

Alternative 2 - (ROD remedy) Contaminated soil and lime material are excavated and disposed in the on-post ELF. Air emissions and odors are controlled during excavation and landfill activities. The excavation is backfilled and the existing IRA soil cover is repaired.

Alternative 3 - Install a vertical groundwater barrier keyed into competent bedrock to isolate the Lime Basins. Install dewatering wells within the barrier wall; treat contaminated groundwater at on-site facilities. Construct a RCRA-equivalent cover over the entire Lime Basins project area.

No impacts are expected on any other ROD-designated soil projects outside of the Lime Basins. Alternative 3 would impact the ELF as excess capacity is generated by not disposing the Lime Basins material at the ELF. Under any of the alternatives evaluated, long-term groundwater monitoring is required to assess remedy effectiveness. Also, the covered area will be retained by the Army and assessed every 5 years, as part of the site-wide 5-year review process, to ensure that the overall remedy continues to provide adequate protection of human health and the environment and complies with applicable regulations. In addition, site-wide institutional controls identified in the RMA FFA are included as requirements in the ROD. These requirements restrict future land use and prohibit certain activities such as agriculture, use of on-post groundwater as a drinking source, and consumption of fish and game taken at RMA (EPA et al 1989).

4.2.1 Alternative 1: No Further Action

The evaluation of a no action alternative is generally required to establish a baseline for comparison of remedial alternatives. Under this alternative, no additional action specific to the Lime Basins is taken. The 89,450 bcy of HHE soil, including the approximately 9,000 bcy of PT soil, remains in place and the soil cover constructed as part of the Lime Basins IRA continues to act as containment for the waste. Maintenance of the existing IRA soil cover continues and existing groundwater treatment at Basin A Neck and the RMA boundary systems continues. Long-term groundwater monitoring is also required to assess remedy effectiveness. Key Applicable or Relevant and Appropriate Requirements (ARARs) relating to this remedy are those regulations pertaining to groundwater monitoring. Although there is no action taken specific to the Lime Basins, human health RAOs are achieved since the waste is contained beneath the existing IRA soil cover. However, implementation of this remedy does not achieve biota RAOs since the existing IRA cover does not include a biota barrier. Five-year site reviews and groundwater compliance monitoring are conducted to assess potential migration of contaminants from the Lime Basins.

There are no capital costs for Alternative 1. The estimated cost for implementing this alternative includes an annual Operations and Maintenance (O&M) cost of $48,200. The total estimated present worth cost is $656,000. These costs include groundwater sampling and analysis costs to assess any migration of the waste left in place, and cover inspection and maintenance costs. A summary of project costs is provided in Table 4.2.1-1. There is no design or construction required for this alternative.

4.2.2 Alternative 2: Excavate; On-Post Landfill

This alternative is the ROD-identified alternative for the Lime Basins. The HHE soil volume of 89,450 bcy (revised from 54,151 in the ROD) is excavated, transported to and disposed in the ELF. Treatability studies performed in support of design identified that the wet portion of the Lime Basins material requires stabilization prior to disposal to allow proper compaction. The 60 percent design incorporated mixing the wet Lime Basins material with surrounding dry soil prior to disposal in the ELF, increasing the ELF disposal volume to approximately 130,000 bcy. The additional material handling and mixing requirements result in an increased potential for emissions and odors. Excavation activities require shoring side slopes to prevent the excavation walls from collapsing.

Air and odor emissions are managed by excavating/exposing a minimal area at any one time and by use of soil covers, foam application, and/or geomembrane tarps that are placed over the excavated areas as needed. These controls are applied during the Lime Basins excavation, transportation and placement of waste in the ELF. Monitoring for chemical agent is performed during soil excavation activities. If confirmed, any agent-contaminated soil is excavated and transported to an on-post caustic washing unit. Treated soil is then disposed at the ELF. Inspection for potential ordnance items is required during excavation as well. Anomaly clearance activities are also required during excavation. Excavation of the Lime Basins will expose subsurface anomalies, which will require clearance by munitions experts to ensure that munitions and explosives of concern (MEQ are safely and appropriately handled and are not disposed in the ELF.

Following excavation, the soil cover is repaired to provide containment of residual contamination at the Lime Basins. The soil cover is revegetated with native grasses that are designed to discourage burrowing animals from using the area as habitat. Maintenance activities ensure the continued integrity of the soil cover.

This Alternative for the Lime Basins cannot be implemented if Alternative 3 (Excavate; On-Post Landfill) is selected for the Basin F PT soil project. Key ARARs relating to this remedy are regulations pertaining to waste management/on-post disposal, stormwater and erosion control, particulate and odor emissions, and groundwater monitoring. Implementation of this remedy achieves RAOs through containment of the waste within the ELF.

The estimated cost for implementing this alternative includes an estimated capital cost of $16,400,000 and estimated annual O&M cost of $48,200. The total estimated present worth cost, including long-term groundwater monitoring and cover maintenance costs, is $17, 100,000. This cost differs significantly from the ROD-estimated cost of $4,000,000 as a result of the new information developed during the design treatability studies. A summary of project costs is provided in Table 4.2.2-1. Implementation for design and construction of this alternative is expected to take approximately 21 months.

4.2.3 Alternative 3: Vertical Groundwater Barrier; RCRA-Equivalent Cover

This alternative relies on containment in place and entails no excavation and disposal of the contaminated soil. The 89,450 bcy of HHE soil, including the approximately 9,000 bcy of PT soil, is contained beneath a RCRA-equivalent cover. A vertical groundwater barrier watt and dewatering within the barrier wall are included to provide effective overall containment. The cover is constructed over the entire Lime Basins project area, including the basins and surrounding contaminated soil. This cover is contiguous with the Basin A and South Plants covers since the Lime Basins area is situated between these cover areas. The cover is designed consistent with other RMA RCRA-equivalent covers and includes a minimum 18-inch-thick biota barrier, chokestone, capillary break, 4-ft-thick soil/vegetation layer, and lysimeters for compliance monitoring. The final surface of the RCRA-equivalent cover is vegetated in accordance with similar RCRA-equivalent covers. Engineering controls are implemented for the cover including warning signs, obelisks to demark the covered areas, fences, survey monuments and erosion/settlement monuments. Long-term surveillance and maintenance, including institutional and engineering controls, will be managed in accordance with the Environmental Management System for remedy components at RMA. Long-term monitoring and maintenance requirements for the RCRA-equivalent cover are equivalent to the requirements for other RCRA-equivalent covers at RMA. These requirements will be defined in the Long-Term Care Program Plan.

Because this alternative will result in principal threat and human health exceedance contamination being left in place, certain land use controls will be required. Any excavation in the area will be prohibited in order to prevent contact with hazardous substances and to maintain the integrity of the engineered structures that are part of the remedy (RCRA-equivalent cover, vertical groundwater barrier wall, and groundwater monitoring and extraction wells). These controls will be maintained until the concentration of hazardous substances in the soil and groundwater are at such levels to allow unrestricted use and exposure. These specific controls are in addition to site-wide land use controls identified in the ROD, which restrict current and future land use, specify that the U.S. government shall retain ownership of RMA, and prohibit certain activities such as agriculture, use of on-post groundwater as a drinking source, and consumption of fish and game taken at RMA.

A vertical groundwater barrier wall is constructed to fully encompass the three historic Lime Basins, as shown on Figure 6.0-1, to prevent migration of groundwater through the buried waste. The barrier wall is keyed into competent bedrock, approximately 45 to 50 feet deep. Exact depths of the barrier wall will be incorporated in the project design after analysis of the Lime Basins investigation results has been completed. Based on successful barrier wall construction at the Shell Trenches and Complex Trenches projects, a slurry mixture of attapulgite clay and fly ash is expected to produce a satisfactory slurry material that is compatible with the locally contaminated groundwater. However, a compatibility study will be conducted prior to final design to determine the appropriate slurry material. The barrier wall will have a minimum thickness of 2 feet.

Due to its location, agent monitoring is required during barrier wall installation. In addition, geotechnical borings are completed along the alignment of the wall to determine appropriate location and depth. A geophysical survey is performed over the Lime Basins project area to assist in identifying a corridor for the barrier wall and to improve the avoidance potential of sub-surface anomalies while performing the geotechnical borings. The final alignment of the barrier wall will be determined during remedial design. Although use of the geophysical survey data to align the barrier wall will minimize the potential to encounter subsurface anomalies, construction techniques for barrier wall installation may expose some anomalies. Any anomalies encountered will be cleared by munitions experts to ensure that MEC are safely and appropriately handled.

Dewatering wells are installed inside the barrier wall to extract groundwater and maintain a positive gradient from the outside to the inside of the barrier wall. The dewatering wells will maintain groundwater levels below the identified Lime Basins contamination and will remove contaminant mass by treatment of the extracted groundwater. As long as the surrounding local groundwater table is in the alluvium, the dewatering wells will operate as necessary to meet the goals and standards. Extracted groundwater is treated initially at the CERCLA Wastewater Treatment Facility (WWTF). No modifications are expected for the CERCLA WWTF. When CERCLA shuts down, treatment of the extracted groundwater will be transferred to the Basin A Neck Containment System (BANCS) treatment plant. Modifications to the BANCS will be made as necessary to ensure that Containment System Remediation Goals (CSRGs) specified in the ROD for Basin A Neck continue to be met. The BANCS CSRG list will be evaluated and revised as necessary.

Key ARARs relating to this remedy are regulations pertaining to particulate and odor emissions, stormwater and erosion control, groundwater monitoring and cover design. Implementation of this remedy achieves RAOs through containment of waste in place.

The estimated present worth cost for implementing this alternative includes an estimated capital cost of $7,600,000 and estimated annual O&M cost of $258,000. The total estimated present worth cost is $10,900,000. A summary of project costs is provided in Table 4.2.3-1. Implementation for design and construction of this alternative is expected to take approximately 18 months. Compatibility testing of groundwater with selected vertical barrier materials would be completed during design.

4.3 Description of Alternatives for Basin F

The current Basin F remedy includes construction of a RCRA-equivalent cover with biota barrier over the entire Basin F project area including the Basin F Wastepile footprint. Construction of the cover is required to provide containment for HHE soil and PT soil (including solidified soil if treated, and residual PT soil deeper than 10 feet if excavation is performed). Construction of the cover will be completed under the Basin F/Basin F Exterior Project. Therefore, the following discussion concerning remedial options for the Basin F PT soil does not include any change to the RCRA-equivalent cover requirement. Because the cost of the cover is already included in the cost for the Basin F/Basin F Exterior Project, the remedial alternatives discussed here do not include costs for cover construction or maintenance. Implementation times do not include the time required to design and construct the cover. In addition, all the alternatives rely on continuation of existing groundwater treatment at the boundary treatment systems to address potential migration of contaminants to groundwater.

The following alternatives were considered for remediation of Basin F PT soil.

Alternative 1 - No additional action specifically for the Basin F PT soil. (A RCRA-equivalent cover will be constructed over the entire Basin F project area.)

Alternative 2 - (ROD remedy) The Basin F PT soil is treated through in situ solidification/stabilization. Air emissions and odors are controlled during treatment. (A RCRA-equivalent cover will be constructed over the entire Basin F project area.)

Alternative 3 - The Basin F PT soil is excavated and disposed in the on-post ELF. Air emissions and odors are controlled during excavation and landfill activities. The excavation is backfilled. (A RCRA-equivalent cover will be constructed over the entire Basin F project area.)

No impacts are expected on any other ROD-designated soil projects outside of Basin F. Under any of the alternatives evaluated, long-term groundwater monitoring is required to assess remedy effectiveness. Also, the Basin F area will be retained by the Army and assessed every 5 years, as part of the site-wide 5-year review process, to ensure that the overall remedy continues to provide adequate protection of human health and the environment and complies with applicable regulations.

Because these alternatives will result in principal threat and human health exceedance contamination being left in place, certain land use controls will be required. Any excavation in the area will be prohibited in order to prevent contact with hazardous substances and to maintain the integrity of the engineered structures that are part of the remedy (RCRA-equivalent cover and groundwater monitoring and extraction wells). These controls will be maintained until the concentration of hazardous substances in the soil and groundwater are at such levels to allow unrestricted use and exposure. These specific controls are in addition to site-wide land use controls identified in the ROD, which restrict current and future land use, specify that the U.S. government shall retain ownership of RMA, and prohibit certain activities such as agriculture, use of on-post groundwater as a drinking source, and consumption of fish and game taken at RMA.

4.3.1 Alternative 1: No Further Action

Under this alternative, no additional action specific to Basin F PT soil is taken. The contaminated soil remains in place and, once the ROD-required RCRA-equivalent cover is constructed, the PT soil is contained beneath the cover. Gradefill material is placed over the site followed by construction of the cover. No changes are proposed for the RCRA-equivalent cover requirements. Maintenance of the

RCRA-equivalent cover is performed as required under the Long-Term Care Program Plan. Existing groundwater treatment at the RMA boundary systems continues. Long-term groundwater monitoring is also required to assess remedy effectiveness. Key ARARs relating to this remedy are those regulations pertaining to groundwater monitoring. Although there is no action taken specific to the Basin F PT soil, RAOs are achieved since the waste is contained beneath the RCRA-equivalent cover. Five-year site reviews and groundwater compliance monitoring are conducted to assess potential migration of contaminants from Basin F.

There is no cost associated with this alternative. The RCRA-equivalent cover construction is completed under the Basin F/Basin F Exterior project (not the Basin F PT soil project), therefore costs for cover construction are also assigned to that project. Likewise, there is no design or construction required for this alternative. Long-term cover maintenance and groundwater monitoring costs are also included in the Basin F/Basin F Exterior project and are therefore not included here.

4.3.2 Alternative 2: In Situ Solidification/Stabilization

This alternative is the ROD-identified alternative for the Basin F PT soil. The in situ treatment volume identified in the ROD is 191,047 bcy; however, as described in Section 2.3.4, the current design estimate of in situ PT soil volume is approximately 165,000 bcy due to the change in the Basin F boundary. Treatability studies have been conducted to identify solidification reagents in preparation for remedial design and a successful mix of reagents has been identified. The treatment consists of properly mixing the solidification reagents directly into the soil. Treatment is completed to a depth of 10 feet below the excavation surface from the IRA. Air emissions and odor controls are applied as necessary during treatment.

The overall Basin F remedy includes construction of a RCRA-equivalent cover with biota barrier over the entire basin. The RCRA-equivalent cover is not specific to just the PT soil remedy and is the ROD-identified remedy for contaminated soil remaining in Basin F, including the solidified soil and PT soil deeper than 10 feet. No changes are proposed for the RCRA-equivalent cover requirements. Long-term groundwater monitoring is required to ensure effectiveness. Key ARARs relating to this remedy are regulations pertaining to particulate and odor emissions, stormwater/erosion control and groundwater monitoring.

The estimated cost for implementing this alternative includes an estimated capital cost of $36,200,000. Annual O&M costs, for cover maintenance and groundwater monitoring, are associated with the Basin F/Basin F Exterior project and are not included here. This cost decreased from the ROD-estimated cost of $42 million based on the mix of reagents identified during the design treatability studies. A summary of project costs is provided in Table 4.3.2-1. Implementation for design and construction of this alternative is expected to take approximately 29 months.

4.3.3 Alternative 3: Excavate; On-Post Landfill

This alternative was developed to take advantage of available capacity in the ELF based on the Lime Basins Alternative 3. Because ELF capacity is critical to the successful completion of this alternative, it is contingent upon selection of the Lime Basins remedy. This alternative for Basin F cannot be implemented if Alternative 2 is selected for the Lime Basins project.

The existing IRA soil cover and gradefill are removed as overburden and set aside. Excavation of PT soil is completed to a maximum depth of 10 feet from the previous IRA excavation surface. Approximately 165,000 bcy of PT soil is excavated, transported to the ELF and disposed. In order to minimize potential emissions impacts, HHE soil overlying or interbedded with PT soil is also excavated and disposed in the ELF, avoiding separation and additional soil handling. The total excavation volume, and ELF disposal volume, is estimated at 233,000 bcy. Stockpiled cover soil and gradefill are used as backfill for the excavation.

Excavation, transportation, and disposal of PT soils are conducted using vapor and odor suppression measures as necessary to meet the goals and objectives set forth in the Site-Wide Air Quality Monitoring Program Plan (SWAQMP) (FWENC 1999a) and Site-Wide Odor Monitoring Program Plan (SWOMP) (FWENC 1999b). These measures will be determined during design, but are expected to be similar to those used for excavation of the Basin F Wastepile and may be modified following design based on experience gained during the Basin F Wastepile excavation project. Vapor and odor suppression measures may include, but are not limited to, the following:

- Limits on excavation rates and the ability to further reduce excavation rates when necessary to properly control emissions

- Limits on excavation and active waste placement surface areas in Basin F and at the ELF, and the ability to implement additional reductions of open areas to properly control emissions

- Requirements to promptly backfill excavations. Backfill soil will be the stockpiled cover soil, biota soil from the Basin F Exterior area and/or clean soil from on-post borrow sources.

- Requirements to use a variety of emission control materials such as foams, soil covers, composite soil/polyethylene sheeting covers, and geomembranes

- Requirements to implement a variety of routine emission control work practices that will minimize unacceptable emissions

- Stringent dust control requirements

- Provisions to suspend work during periods of unfavorable atmospheric conditions or when emission levels can't be adequately controlled

- Covered excavation and covered placement with air handling systems, or other control strategies, to manage/treat emissions

To assist in the design and selection of vapor and odor suppression measures, a detailed odor/chemical flux characterization will be conducted prior to final design to augment existing data on potential chemical and odor emissions and the lateral and vertical variation of this potential throughout the defined PT excavation volume. The characterization plan will include sections to describe soil sample collection, odor flux/chemical flux sample collection, sample analysis, emission dispersion modeling and presentation of results. This study will use sampling procedures similar to those used in the Former Basin F Solidification Treatability Study, and modeling procedures similar to those used in the Basin F Wastepile Design. Unless additional data developed or acquired during design indicates otherwise, a pilot-scale demonstration of proposed odor/chemical emission control measures for excavation, material handling, disposal, and interim cover periods will be required during design to verify that the measures will be adequate to control project odors/emissions for the highest flux soil at Former Basin F. Requirements for field demonstrations will be determined during design. The design will include detailed characterization of the distribution of odor and chemical emissions causing soils, well defined decision criteria for implementing appropriate controls, and provisions for an independent construction quality assurance (CQA) program. The independent CQA oversight activities will be consistent with the Basin F Closure Plan and similar to those used for the Basin F Wastepile project, including certification by a CQA Engineer that Alternative 3 was completed in accordance with the approved plans and specifications. Information provided through the Air Pathway Analysis will be used in developing the design and the design team will work in close coordination with the Air Pathway Analysis work group.

The residual contaminated soil in Basin F is contained in place beneath the ROD-required RCRA-equivalent cover as part of the Basin F/Basin F Exterior Soil Remediation Project. Residual soil will include HHE soil identified in the ROD as well as HHE and PT soil located deeper than 10 ft below the IRA excavation surface. The 92-acre cover is designed consistent with other RMA RCRA-equivalent covers and includes a minimum 18-inch-thick biota barrier, chokestone, capillary break, 4-ft-thick soil/vegetation layer, lysimeters for compliance monitoring. The final surface of the RCRA-equivalent cover is vegetated in accordance with similar RCRA-equivalent covers. Engineering controls are implemented for the cover including warning signs, obelisks to demark the covered areas, fences, survey monuments and erosion/settlement monuments. Long-term surveillance and maintenance, including institutional and engineering controls, will be managed in accordance with the Environmental Management System for remedy components at RMA. Long-term monitoring and maintenance requirements, for the RCRA-equivalent cover are equivalent to the requirements for other RCRA-equivalent covers at RMA. These requirements will be defined in the Long-Term Care Program Plan. Key ARARs relating to this remedy are regulations pertaining to particulate and odor emissions, stormwater/erosion control, waste management/on-post disposal, cover design and groundwater monitoring.

The estimated cost for implementing this alternative includes an estimated capital cost of $14,500,000. Annual O&M costs, for cover maintenance and groundwater monitoring, are associated with the Basin F/Basin F Exterior project and are not included here. A summary of project costs is provided in Table 4.3.3-1. Implementation for design and construction of this alternative is expected to take approximately 26 months.

5.0 COMPARATIVE ANALYSIS OF ALTERNATIVES

The NCP, Section 300.430, identifies nine criteria to be used in the evaluation of remedial alternatives (EPA 1990). The evaluation consists of an assessment of individual alternatives against each of the nine criteria and a comparative analysis that focuses on the relative performance of each alternative against each other. The criteria are grouped into three categories. The first two criteria, overall protection of human health and the environment and compliance with ARARs, are considered "threshold criteria" that must be met by each alternative to be eligible for selection. The next group of criteria is considered "balancing criteria" because they are used to achieve the best overall solution. These criteria include long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability, and cost. The final two criteria.. support agency acceptance and community acceptance, are modifying criteria and are used to evaluate the feasibility of implementing an alternative in terms of its acceptance by Support Agencies and the community.

This section of the ROD Amendment provides an evaluation of each alternative against the nine criteria, noting how it compares to the other alternatives under consideration. This evaluation provides the basis for determining which alternative provides the best balance with respect to the statutory balancing criteria in Section 121 of CERCLA and in Section 300.430 of the NCP. For comparison, Table 5.0-1 provides a side-by-side summary of the evaluation of the three alternatives for the Lime Basins project and Table 5.0-2 provides a summary of the evaluation of the three alternatives for the Basin F PT Soil project.

5.1 Overall Protection of Human Health and the Environment

Overall protection of human health and the environment assesses whether each alternative provides adequate protection of human health and the environment and describes how risks posed through each exposure pathway are eliminated, reduced, or controlled, through treatment, engineering controls, and/or institutional controls.

For the Lime Basins, all three alternatives provide protection of human health through containment, either in place or by excavation and disposal in the ELF. Alternative 1 (No Further Action) does not achieve RAOs for biota since the existing IRA cover does not include a biota barrier and is therefore not protective of the environment. Alternatives 2 and 3 are protective of the environment. Alternative 1 also relies on continuation of existing groundwater treatment to achieve overall protection, since waste is currently in contact with the groundwater. Alternative 2 results in on-site landfill disposal of 89,450 bcy of HHE soil, including 9,000 bcy of PT soil. All alternatives include soil covers for the Lime Basins; however, Alternative 3 (Vertical Groundwater Barrier/RCRA-Equivalent Cover) includes a RCRA-equivalent cover, groundwater barrier wall and dewatering wells to provide containment. Long-term maintenance and monitoring are required to ensure the effectiveness of the containment.

For Basin F, all of the alternatives would provide protection of human health and the environment by reducing risk through containment, treatment or a combination of both. Alternative 1 (No Further Action/RCRA-Equivalent Cover), is also expected to provide adequate protection because the Basin F RCRA-equivalent cover will be constructed regardless of the remedy selected for remediation of Basin F PT soil. Alternative 2 (In Situ Solidification/Stabilization of PT Soil) includes solidification to minimize potential migration of contaminants; however, treated soil is left in place, All the alternatives rely on continuation of existing groundwater treatment to achieve overall protection to address potential migration of contaminants to groundwater.

5.2 Compliance with ARARs

Section 121 (d) of CERCLA and the NCP, 40 CFR 300.430(f)(1)(ii)(B), require that remedial actions at CERCLA sites at least attain legally applicable or relevant and appropriate Federal and State requirements, standards, criteria, and limitations, collectively referred to as ARARs, unless such ARARs are waived under CERCLA section 121 (d)(4). All of the alternatives being evaluated comply with Federal and State ARARs and comply with the location-, chemical-, and action-specific ARARs listed the ROD, which remain unchanged for the implementation of any of the proposed alternatives.

5.3 Long-Term Effectiveness and Permanence

Long-term effectiveness and permanence refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup levels have been met. This criterion includes the consideration of residual risk that will remain on site following remediation and the adequacy and reliability of controls.

Lime Basins Alternative 2 (Excavate/Landfill) achieves long-term effectiveness with the least residual risk. Landfill controls provide adequate and reliable containment with appropriate long-term monitoring and maintenance. Alternative 3 (Vertical Groundwater Barrier/RCRA-Equivalent Cover) also achieves long-term effectiveness; however, containment in the ELF is considered more reliable than containment in place and results in less volume, or residual risk, remaining in the project area. In addition, Alternative 3 relies on the vertical groundwater barrier wall and dewatering wells to provide containment. Alternative 1 (No Further Action) provides a two-foot soil barrier to exposure that also lessens the potential migration of contaminants through containment under the existing cover. Long-term monitoring would be required for all alternatives to assess effectiveness.

Basin F Alternative 3 (Excavate/Landfill PT Soil) achieves long-term effectiveness with the least residual risk. Landfill controls provide adequate and reliable containment with appropriate long-term monitoring and maintenance. Alternative 2 (In Situ Solidification/Stabilization of PT Soil) also achieves long-term effectiveness through a combination of in-place treatment and containment; however, containment in the ELF is considered more reliable than containment in place and results in less volume, or residual risk, remaining in the project areas. Both Alternatives 2 and 3 rely on the RCRA-equivalent cover to isolate any PT soil remaining in place below 10 ft depth. Alternative 1 (No Further Action/RCRA-equivalent Cover) would reduce exposure and migration of contaminants through containment in place but results in the highest residual risk since the untreated waste remains in place. Long-term monitoring would be required for all alternatives to assess effectiveness.

Implementing Alternative 3 for both projects provides an overall gain in long-term effectiveness since a higher volume of PT soil is excavated and disposed in the ELF, 165,000 bcy from Basin F compared to 9,000 bcy for Lime Basins Alternative 2.

5.4 Reduction in Toxicity, Mobility and Volume (TMV)

Reduction of TMV through treatment refers to the anticipated performance of the treatment technologies that may be included as part of the remedy.

None of the alternatives for the Lime Basins involve treatment of the Lime Basins waste, relying instead on containment for reduction of mobility. Alternative 3 (Vertical Groundwater Barrier/RCRA-Equivalent Cover) does include treatment of extracted groundwater, which reduces the toxicity and volume of contaminants. There is no reduction in TMV through treatment for Alternative 1 (No Further Action) or Alternative 2 (Excavate/Landfill). Under Alternative 2, the Lime Basins volume increases due to soil mixing requirements for disposal in the ELF.

For Basin F, Alternative 2 (In Situ Solidification/Stabilization of PT Soil) reduces the mobility of the contaminants through the solidification treatment. However, there is an increase in volume due to the addition of solidification reagents introduced during the treatment process. Alternative 1 (No Further Action/RCRA-equivalent cover) and Alternative 3 (Excavate/Landfill PT Soil) do not result in reduction in mobility or volume through treatment, relying on containment for reduction of mobility. There is no reduction in toxicity for any alternative.

5.5 Short-Term Effectiveness

Short-term effectiveness addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to workers, the community and the environment during construction and operation of the remedy until cleanup levels are achieved.

Lime Basins Alternative 2 (Excavate/Landfill) requires excavation of contaminated materials and therefore presents the highest potential for short-term risks to on-site workers. Air and odor controls would be required to mitigate the risks from excavation activities. Short-term risks are considerably higher than anticipated by the ROD due to increased volume and multiple material handling requirements to allow placement of soil in the ELF. Additional short-term risks associated with Lime Basins excavation include excavation slope stability, potential for chemical agent contamination and presence of anomalies requiring clearance during excavation. Alternative 3 (Vertical Groundwater Barrier/RCRA-Equivalent Cover) presents a moderate potential for short-term risk due to the potential for emissions and odor during intrusive activities associated with the barrier wall construction and dewatering well installation. The potential to encounter subsurface anomalies for Alternative 3 is minimized by selecting an alignment for the barrier wall that avoids the subsurface anomalies. Alternative 1 (No Further Action) poses the least short-term risk since the waste is contained in place and would not be disturbed.

For Basin F, Alternative 3 (Excavate/Landfill PT Soil) requires excavation of contaminated materials and therefore presents the highest potential for short-term risks to on-site workers. Alternative 2 (In Situ Solidification/Stabilization of PT Soil) also presents a moderate potential for short-term risk during in-place soil mixing to achieve stabilization of the PT soil. Air and odor controls would be required to mitigate the risks from excavation or treatment activities. Alternative 1 (No Further Action/RCRA-equivalent Cover) poses the least short-term risk since the waste is contained in place and would not be disturbed.

5.6 Implementability

Implementability addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as availability of services, administrative feasibility, and coordination with other government entities are also considered. All of the alternatives evaluated are technically and administratively feasible and rely on readily available equipment, techniques and on-site disposal facilities. All alternatives can be implemented within the overall schedule for RMA remediation (PMRMA 2004).

For the Lime Basins, issues related to material handling, stability for landfill disposal, odor potential, potential agent contamination and geophysical anomalies were identified for Alternative 2 (Excavate/Landfill). There is sufficient capacity in the ELF for disposal of all the identified exceedance soil plus the additional soil required for stabilization mixing. Alternative 3 (Vertical Groundwater Barrier/RCRA-Equivalent Cover) would require evaluation of the groundwater for compatibility with the vertical barrier material. No implementation issues are identified for Alternative 1 (No Further Action).

Basin F Alternative 2 (In Situ Solidification/Stabilization of PT Soil), might present implementation issues for full-scale solidification due to potential difficulty in achieving uniform mixing and mobility reduction. Vapor/odor emissions generated during solidification mixing require adequate control measures. Odor/emission control during excavation is the primary implementation issue for Basin F Alternative 3 (Excavate/Landfill). Again, adequate control measures are required during excavation, transportation and disposal activities. The ELF volume calculated by the Remediation Venture Office (RVO) indicates that there is sufficient capacity for disposal of all the identified PT soil and the overlying and interbedded HHE soil as well as the odor control soil required. There are no significant implementation issues for construction of the RCRA-equivalent cover (Alternative 1).

Although Basin F Alternative 3 (Excavate/Landfill) includes a larger landfill volume than Lime Basins Alternative 2 (Excavate/Landfill), there is sufficient capacity in the ELF for disposal of the exceedance volume for either alternative. However, selection of one of these alternatives precludes the other since there is not sufficient capacity for both.

5.7 Cost

Evaluation of cost includes the estimated capital, operating and maintenance costs of each alternative in comparison to other equally protective alternatives. Cost estimates are expected to be accurate within a range of plus 50 to minus 30 percent.

For the Lime Basins, Alternative 1 (No Further Action) is the lowest cost alternative, $656,000, with only long-term O&M costs. Alternative 2 (Excavate/Landfill) is the highest cost at $17.1 million. Factors contributing to the high cost of excavating the Lime Basins include material handling to stabilize the waste prior to disposal in the ELF, excavation slope shoring, dewatering, agent monitoring and potential anomaly clearance. Cost for implementing Alternative 3 (Vertical Groundwater Barrier/RCRA- Equivalent Cover) is approximately $10.9 million. Cost uncertainty exists for all alternatives but is highest for Alternative 2 due to the possibility of encountering unknowns during excavation and the required material handling steps for ELF disposal.

For Basin F, Alternative 3 (Excavate/Landfill PT Soil) is much lower cost, $14.5 million, than Alternative 2 (In Situ Solidification/Stabilization of PT Soil), $36.2 million. Cost uncertainty exists for both alternatives but is higher for Alternative 2 due to potential difficulties in achieving uniform mixing during in situ treatment. Cost uncertainty for Alternative 3 is associated with uncertainty related to odor/emission control measures required for excavation of the PT soil. Specific control measures will be determined during design and could be up to 30 percent higher than estimated depending on the design odor/emission characterization. Alternative 1 (No Further Action/RCRA-equivalent Cover) has no cost associated with it since all costs for RCRA-equivalent cover construction arid long-term O&M are already included in the Basin F/Basin F Exterior project.

5.8 Agency Acceptance

The EPA and state (CDPHE) have expressed their support for Alternative 3 for both the Lime Basins and Basin F. The CDPHE prefers the combination of Alternative 3 for both projects because it results in a higher volume of PT soil being disposed in the ELF. Nevertheless, odor and chemical flux results made available to the Regulatory Agencies in September 2005 and subsequent air modeling using those data have indicated that odor/chemical emissions control at Basin F will be challen6na. On the basis of this information, CDPHE believes that stringent measures, which might include excavation within enclosures, are likely in some areas of Basin F. Although CDPHE agrees that these measures should be developed during design, the design must include detailed characterization of the distribution of odor and chemical emissions causing soils, well-defined decision criteria for implementing appropriate controls, a pilot-scale demonstration of proposed odor/chemical emissions control measures and provisions for an independent CQA program. The independent CQA oversight activities will be consistent with the Basin F Closure Plan and similar to those used for the Basin F Wastepile project, including certification that Alternative 3 was completed in accordance with the approved plans and specifications. Careful design and project implementation will be required to ensure that odor/chemical emission controls are fully protective as defined by ARARs and site-wide agreements and that the ELF capacity meets the requirements of this amendment. The short-term risks for the Lime Basins Alternative 2 are at least as great or greater than for Basin F Alternative 3 and may be just as difficult to manage. On the other hand, the long-term benefit of selecting Alternative 3 for both projects, which results in a higher volume of PT soil being disposed in the ELF, is very favorable. The Alternative 3 remedies also appear to be more cost effective. The agencies do not support Alternative 1 for the Lime Basins as the IRA cover does not achieve biota RAOs and might not provide adequate long-term protection of the groundwater.

5.9 Community Acceptance

Comments received during presentations to the public and the public comment period indicate that the community, in general, prefers excavation and landfilling alternatives for both projects. While this indicates support for Alternative 3 (Excavate/Landfill PT Soil) for Basin F, the commenters expressed a preference to retain the original ROD remedy for the Lime Basins (Alternative 2, Excavate/Landfill) rather than implement the preferred alternative (Alternative 3, Vertical Groundwater Barrier/RCRA-Equivalent Cover). Specific concerns raised on the Lime Basins alternative included long-term protectiveness of in-place containment, the ability to isolate the waste from the groundwater, and the inability to accommodate both projects with the existing ELF capacity. Generally, the commenters felt that the cost criterion was given more emphasis than the other criteria. Alternative 1 for either project was not preferred because the wastes would not be directly addressed. Community involvement and responses to the community's specific comments are provided in Section 9.

6.0 SELECTED REMEDY

Based on the comparative analysis presented in Section 5, the selected remedial alternative for cleanup of the Lime Basins is Alternative 3: Vertical Groundwater Barrier; Dewatering with On-Site Treatment; RCRA-Equivalent Cover. This is the same alternative presented as the preferred alternative in the proposed plan issued in April 2005 (PMRMA 2005). This alternative includes construction of a vertical groundwater barrier surrounding the Lime Basins and a RCRA-equivalent cover, including biota barrier, over the entire Lime Basins area. Dewatering wells are installed inside the barrier wall and the extracted groundwater is treated at an on-site treatment facility. Remedy components for the selected remedy are shown in Figure 6.0-1.

Because this alternative will result in principal threat and human health exceedance contamination being left in place, certain land use controls will be required. Any excavation in the area will be prohibited in order to prevent contact with hazardous substances and to maintain the integrity of the engineered structures that are part of the remedy (RCRA-equivalent cover, vertical groundwater barrier wall, and groundwater monitoring and extraction wells). These controls will be maintained until the concentration of hazardous substances in the soil and groundwater are at such levels to allow unrestricted use and exposure. These specific controls are in addition to site-wide land use controls identified in the ROD, which restrict current and future land use, specify that the U.S. government shall retain ownership of RMA, and prohibit certain activities such as agriculture, use of on-post groundwater as a drinking source, and consumption of fish and game taken at RMA.

To meet the land use control objectives the following actions and restrictions shall be implemented and maintained on the land areas identified in Figures 6.0-1 and 6.0-2. The prohibition on excavation in these areas shall be incorporated into the Interim RMA Institutional Control Plan (IRTMAICP), including but not limited to, RVO SOP: ES&H 110, Activity Coordination Permits, which shall be amended to ensure that no excavations are permitted in these areas.

The vertical groundwater barrier wall is constructed to fully encompass the three historic Lime Basins to prevent migration of groundwater through the buried waste soil. The barrier wall is keyed into competent bedrock, approximately 45 to 50 feet deep, and will have a minimum thickness of 2 feet. A compatibility study will be conducted prior to final design to determine the appropriate barrier material.

The RCRA-equivalent cover is contiguous with the Basin A and South Plants covers since the Lime Basins area is situated between these cover areas. The RCRA-equivalent cover is designed consistent with other RMA RCRA-equivalent covers and includes a minimum 18-inch-thick biota barrier, chokestone, capillary break, 4-ft-thick soil/vegetation layer, and lysimeters for compliance monitoring. The final surface of the RCRA-equivalent cover will be vegetated as required for other RCRA-equivalent covers at RMA. Engineering controls are implemented for the cover including warning signs, fences, obelisks to demark the covered areas, survey monuments, and erosion/settlement monuments. Long-term surveillance and maintenance, including institutional and engineering controls, will be managed in accordance with the Environmental Management System for remedy components at RMA. Long-term monitoring and maintenance requirements for the RCRA-equivalent cover are equivalent to the requirements for other RCRA-equivalent covers at RMA. These requirements will be defined in the Long-Term Care Program Plan.

The selected remedial alternative for Basin F is Alternative 3: Excavate Principal Threat Soil; On-Post Landfill (RCRA-Equivalent Cover). This is the same alternative presented as the preferred alternative in the proposed plan issued in April 2005 (PMRMA 2005). This alternative includes excavation of PT soil from Basin F with disposal in the on-site ELF. Excavation of PT soil is completed to a maximum depth of 10 feet from the previous IRA excavation surface. Approximately 165,000 bcy of PT soil is excavated, transported to the ELF and disposed. The HHE soil overlying or interbedded with PT soil is also excavated and disposed in the ELF resulting in a total excavation volume, and ELF disposal volume, of approximately 233,000 bcy. The PT soil excavation areas and depths are shown in Figure 6.0-2.

Excavation, transportation, and disposal of PT soils are conducted using vapor and odor suppression measures as necessary. To assist in the design and selection of vapor and odor suppression measures, a flux characterization will be conducted prior to final design to augment existing data on potential chemical and odor emissions and the variation of this potential throughout the defined PT excavation volume, Results from Basin F PT soil characterization will be considered along with experience gained during the Basin F Wastepile excavation project to determine the appropriate control measures. Specific odor/emission control measures will be identified during design.

The excavated area is backfilled and the residual contaminated soil remaining in Basin F is contained in place beneath the ROD-required RCRA-equivalent cover as part of the Basin F/Basin F Exterior Soil Remediation Project. Residual soil includes HHE soil identified in the ROD as well as HHE and PT soil located deeper than 10 ft below the IRA excavation surface. The RCRA-equivalent cover is designed consistent with other RMA RCRA-equivalent covers and includes a minimum 18-inch-thick biota barrier, chokestone, capillary break, 4-ft-thick soil/vegetation layer, lysimeters for compliance monitoring. Engineering controls are implemented for the cover including warning signs, fences, obelisks to demark the covered areas, survey monuments, and erosion/settlement monuments. Long-term surveillance and maintenance, including institutional and engineering controls, will be managed in accordance with the Environmental Management System for remedy components at RMA. Long-term monitoring and maintenance requirements for the RCRA-equivalent cover are equivalent to the requirements for other RCRA-equivalent covers at RMA. These requirements will be defined in the Long-Term Care Program Plan.

The preferred alternatives were selected over the other alternatives because they provide substantial risk reduction through containment of waste material in place or in the on-post ELF within a reasonable time frame and at a lower cost than the ROD-identified alternatives. Together, these alternatives result in containment of a much larger volume of PT soil in the ELF. The selected alternatives meet RAOs by containing the waste in place or in the ELF, thereby preventing future exposure to or migration of contaminants. Although the covered waste containment areas will not be transferred to the U.S. Fish and Wildlife Service (USFWS) as part of the refuge, the selected alternatives will not inhibit use of the remaining RMA property for the anticipated future land use as a wildlife refuge.

The Army is responsible for implementing, maintaining, reporting on, and enforcing all land use controls. Although the Army may later transfer these procedural responsibilities to another party, by contract, property transfer agreement, or by other means, the Army shall retain ultimate responsibility for the remedy integrity. Monitoring of the land use restrictions and controls will be conducted annually by the Army. The monitoring results will be included in a separate report or as a section of another environmental report, if appropriate, and provided to EPA and the CDPHE. The annual monitoring report will evaluate the status of the land use controls and how any land use control deficiencies or inconsistent uses have been addressed. The annual monitoring reports will be used in preparation of the Five Year Review to evaluate the effectiveness of the remedy.

The Army shall provide notice to EPA and the State within 10 days of discovery of any activity that is inconsistent with the land use control requirements or objectives, or any action that may interfere with the effectiveness of the land use controls. The Amy shall include in such notice a list of corrective actions taken or planned to address such deficiency or failure.

The Army shall notify EPA and the State 45 days in advance of any proposed land use changes that are inconsistent with the land use control objectives of the selected remedy. The Army shall not modlfv or terminate land use controls or implementation actions or modify land use without approval by EPA and the CDPHE. The Army shall seek prior concurrence before any anticipated action that may disrupt the effectiveness of the land use controls or any action that may alter or negate the need for land use controls.

The IRMAICP contains internal procedures for implementing land use controls. The Army shall notify EPA and the State 45 days in advance of any proposed changes to these internal procedures, and such changes will be made in accordance with a formal modification process developed, if any.

The estimated costs for the selected Lime Basins and Basin F alternatives are $10.9 million and $14.5 million respectively. Summaries of the estimated cost elements are provided in Table 4.2.3-1 and 4.3.3-1. The information in these tables is based on the best available information regarding the anticipated scope of the project and site experience for other soil remediation projects completed at RMA. Changes in the cost elements are likely to occur as a result of new information and data collected during remedial design. This is an order of magnitude engineering cost estimate and is expected to be within plus 50 to minus 30 percent of the actual project cost.

The selected remedies are consistent with soil remedies described in the 1996 ROD and components of the selected remedies will meet the remediation goals and standards as described in the ROD. These relevant goals and standards are listed below. Where appropriate, a revised standard is presented if new information since the 1996 ROD has resulted in a modification to the standard. The selected remedies will also comply with ARAR performance standards.

Excavation

- Standard: Excavate all contaminated soil identified in the ROD for treatment, landfilling, or consolidation that corresponds to the areal and vertical extent detailed by the soil volume calculations in the administrative record.

Barrier Wall

- Goal: Minimize groundwater flow across the barrier wallwith a design goal 1 X 10^{-7} cm/sec hydraulic conductivity.
- Goal: Construct barrier wall with sufficient thickness to withstand maximum hydraulic gradient.
- Goal: Construct barrier wall with materials that are compatible with the surrounding groundwater chemistry.
- Goal: Minimize migration by keying the barrier wall into competent bedrock.
- Standard: Dewater as necessary to maintain a positive gradient from the outside to the inside of the barrier wall and maintain groundwater level below the level of the Lime Basins waste for as long as the surrounding local groundwater table is in the alluvium.

(Replaces general goal of dewater to ensure containment.)

- Monitor to ensure that the dewatering standard is met. If the groundwater table drops below the level of the alluvium inside the wall, monitor annually thereafter to check that the groundwater table remains below the alluvium inside the wall.

RCRA-Equivalent Cover

- Ensure cover performance is equivalent to RCRA landfill cap with these objectives:
  - Standard: Limit infiltration through the cover to 1.3 millimeters/year. (This is a refinement to the 1996 ROD standards which required a range of infiltration no greater than that which would pass through an EPA-approved RCRA cover, and a field demonstration of cover performance. The demonstration was completed resulting ' in the 1.3 millimeters/year standard.)
  - Standard: Prevent contact between hazardous materials and humans/biota by using biota barriers and maintaining institutional controls.

  - Goal: Serve as effective long-term barriers.

- Goal: Maximize runoff and minimize ponding.

- Standard: Maintain cover percolation less than or equal to the percolation of the underlying native soil.

- Goal: Minimize erosion by wind and water.

- Goal: Prevent damage to integrity of cover by biota and humans.

- Goal: maintain cover of locally adapted perennial vegetation.

UXO Clearance

- Standard: Identify, transport off post, neutralize, and destroy explosives/explosive residue.

Agent Decontamination

- Standard: Certify 3X decontamination or caustic wash of soil and structural debris to achieve3X decontamination.

- Standard: Ensure disposal of 3X-decontaminated soil and structural debris in the on-post RCRA landfill.

Air Emissions Control

- Goal: Control emissions, as necessary, during remediation.

- Standard: Control emissions and odors for Basin F Wastepile excavation and Former Basin F remediation, in accordance with Basin F closure plan and design documents.

- Standard: Meet air quality and odor standards that are ARARs.

- Goal: Control air emissions as necessary to attain criteria that will be developed via an air pathway analysis program that will ensure that the remedial action will be protective of human health and the environment and minimize nuisance odors.

ELF Disposal

- Standard: Landfill principal threat and human health soil-exceedance volumes and agent-contaminated material.

- Standard: Design landfill to meet 1,000-year siting criteria.

- Standard: Ensure all material disposed in landfill passes EPA paint filter test.

In addition, for Basin F remediation, the remedy will comply with all requirements of the Basin F Closure Plan (HLA 1996).

7.0 AGENCY COMMENTS

A draft ROD Amendment was provided to the Regulatory Agencies (EPA, CDPHE and TCHD) for review and comment. A summary of the major comments submitted by each agency is provided below. Comments received from the agencies have been incorporated into the final ROD Amendment.

The main comments received from EPA related to the overemphasis of cost as the basis for the ROD Amendment, the need for a greater level of detail on the institutional controls, and the need for ARARs to include those ARARs pertaining to the design of caps and covers (40 CFR 264). The EPA views cost as just one of the reasons that contributed to the reevaluation of remedial actions. Cost was an offshoot of the significant increase in volume requiring disposal in the ELF and short-term risks currently associated with the ROD remedy, as compared to conditions and understanding at the time of the ROD. With respect to institutional controls, the need for a greater level of detail is driven by recent EPA efforts to support and document institutional control requirements.

The CDPHE commented in support of the selected remedies since a larger volume of principal threat is disposed in the ELF than under the ROD remedy. The CDPHE also commented that the design effort should be carefully developed and managed to ensure that vapor emissions and odor control are fully protective and that ELF capacity meets the requirements of the ROD Amendment.

The TCHD reviewed the draft ROD Amendment and provided a letter to the Army stating that the Department concurred with the selected remedies presented in the draft document. The TCHD indicated that the selected remedy for Basin F will offer challenges related to odor and air emission controls. However, with a comprehensive design and diligent execution, TCHD believes that the remediation can be completed in a manner that will meet air and odor goals defined in site-wide plans.

8.0 STATUTORY DETERMINATIONS

Based on the information available, the Army, in consultation with EPA, believes the selected alternatives provide the best balance of tradeoffs with respect to the balancing and modifying criteria. The selected alternatives satisfy the requirements of CERCLA Section 121 and are protective of human health and the environment, comply with federal and state requirements that are legally applicable or relevant and appropriate to the remedial actions, use a permanent solution through proper disposal and containment of the wastes either in place or in the on-post ELF, and are cost effective. In addition, when the selected alternatives are considered in conjunction with the overall selected remedy in the 1996 ROD, the overall remedy uses a combination of treatment and containment as principal elements to permanently reduce toxicity, mobility or volume of contaminants. The remedies selected in this ROD Amendment do not satisfy the statutory preference for treatment as a principal element of the remedy for the following reasons. For Basin F, the containment alternative for Basin F PT soil provides long-term risk reduction through containment of waste material in the on-post ELF, is easier to implement, and is lower cost than the ROD-identified treatment alternative. Treatment alternatives for the Lime Basins were eliminated at the alternative screening stage because they were ineffective, difficult to implement or not cost effective. The CDPHE concurs on the selection of Alternative 3 for remediation of the Lime Basins and Alternative 3 for remediation of Basin F.

Protection of Human Health and the Environment

The selected remedy for the Lime Basins protects human health and the environment by providing vertical and horizontal containment of the Lime Basins waste, thereby reducing the associated risks to below acceptable levels. For Basin F, protection of human health and the environment is accomplished by removing PT soil with containment in the on-post ELF, eliminating exposure pathways and significantly reducing mobility to other media. There are moderate short-term risks to on-site workers associated with vapor and odor emissions during barrier wall installation and Basin F PT soil excavation that cannot be completely eliminated, although the risks are minimized by engineering and administrative controls. These engineering and administrative controls minimize any risks from vapor and odor emissions to the adjacent community.

Compliance with ARARs

The selected remedies comply with all location-, chemical-, and action-specific ARARs that are pertinent to Lime Basins and Basin F remediation at RMA. In particular, the selected remedies comply with closure requirements of 40 CFR 264.3 10 through construction of the RCRA-equivalent covers. The project ARARs, developed in compliance with Section 121 (d) of CERCLA, are presented in the following tables: Table 8.0-1, Location-Specific ARARs; Table 8.0-2, Chemical-Specific ARARs; Table 8.0-3, Action-Specific ARARs for Lime Basins Remediation; and Table 8.0-4, Action-Specific ARARs for Basin F Remediation.

Cost Effectiveness

Cost effectiveness is assessed by evaluating three of the five balancing criteria to determine overall effectiveness: long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; and short-term effectiveness. Overall effectiveness is then compared to cost to determine whether the remedy is cost effective.

Proportional to cost, the selected remedies provide the best overall effectiveness of the alternatives considered. The selected remedies will achieve the RAOs for the contaminated material and

permanently reduce mobility of contaminants. The remedy makes use of proven technologies that will be protective over the long term and minimize or mitigate short-term impacts during remediation.

Utilization of Permanent Solutions and Alternative Treatment Technologies to the Maximum Extent Practicable

The remedies selected in this ROD Amendment represent the maximum extent to which permanent solutions and treatment technologies can be practicably used at the Lime Basins and Basin F. Of the alternatives that are protective of human health and the environment and comply with ARARs, the selected remedies provide the best balance of trade-offs between the five balancing criteria. Also considered was the statutory preference for treatment as a principal element as well as support agency and community acceptance.

For the Lime Basins, all of the alternatives would achieve long-term effectiveness; however, there is a continued risk to groundwater and biota associated with Alternative 1 because the Lime Basins waste remains in contact with the groundwater and the existing cover does not include a biota barrier. Alternative 2 presents the least long-term risk due to containment of the Lime Basins waste in the ELF; however, the excavation activities would result in significantly increased short-term risks to on-site workers. Alternative 3 would incur substantially less short-term risk than Alternative 2 due to in-place containment without sacrificing substantial long-term protection. In addition, the cost for implementing Alternative 2 is higher due to the increased remediation volume and controls necessary to mitigate the short-term risks. There is no reduction in TMV through treatment for any of the alternatives and implementability issues can be addressed for all alternatives. The substantial reduction in short-term risk realized by implementing Alternative 3 proved to be the critical criterion in the decision process.

Similarly for Basin F, all of the alternatives would achieve long-term effectiveness; however, Alternative 1 results in the highest long-term risk to groundwater because the waste remains in place untreated. Alternative 3 was selected over the other alternatives because it results in greater risk reduction than the ROD-identified alternative through containment of waste material in the on-site ELF and at a lower cost. Alternative 3 carries the highest short-term risk but is easier to implement and results in the best long-term effectiveness at a lower cost than Alternative 2. Alternative 2 provides a reduction in mobility through treatment but is more difficult to implement, costs more and does not provide the long-term effectiveness that Alternative 3 achieves by disposal in the ELF.

Preference for Treatment as a Principal Element of the Remedy

The remedies selected in this ROD Amendment do not satisfy the statutory preference for treatment as a principal element of the remedy for the following reasons. For Basin F, the containment alternative for Basin F PT soil provides long-term risk reduction through containment of waste material in the on-post ELF, is easier to implement, and is lower cost than the ROD-identified treatment alternative. Treatment alternatives for the Lime Basins for were eliminated at the alternative screening stage because they were ineffective, difficult to implement or not cost effective.

Five-Year Review Requirements

Both project areas will be retained by the Army and assessed every 5 years, as part of the site-wide 5-year review process, to ensure that the overall remedy continues to provide adequate protection of human health and the environment and complies with applicable regulations. In addition, site-wide institutional controls identified in the RMA FFA are included as requirements in the ROD. These requirements restrict future land use and prohibit certain activities such as agriculture, use of on-post groundwater as a drinking source, and consumption of fish and game taken at RMA (EPA et at 1989).

9.0 COMMUNITY PARTICIPATION COMPLIANCE

9.1 Overview

The selected remedy in the 1996 ROD for the Lime Basins included excavation of the contaminated soil and lime material and disposal in the on-post ELF. Design efforts for the Lime Basins commenced in 2002 to develop specific plans for remediation of the basins and surrounding soil in accordance with the ROD. Also, in support of Lime Basins design, a treatability study was performed to determine the best method for excavation and disposal of the Lime Basins material in the ELF. During the Lime Basins design process, a public comment period was provided at the 30 percent design phase and a public availability presentation was made to the Restoration Advisory Board (RAB) on April 24, 2003. No comments were received from the public on the 30 percent design. An additional presentation was made to the RAB at the 60 percent design stage on November 4, 2003.

For Basin F PT soil, the 1996 ROD remedy included in situ solidification/stabilization of the PT soil. Also, in accordance with the ROD, a treatability study was conducted to determine an appropriate solidification reagent for treatment of the Basin F PT soil. Although results of the treatability study confirmed that solidification was implementable, design activities had not yet been initiated when the Revised Proposed Plan was issued for the Lime Basins and Basin F.

For the revised remedies, the Army proposed containment in place for the Lime Basins, including a vertical groundwater barrier and a RCRA-equivalent cover. Dewatering wells were included to provide overall containment with extracted groundwater treated at existing on-site facilities. For Basin F, the proposed remedy included excavation of PT soil with disposal in the on-site ELF. Excavation would be followed by containment of residual HHE and PT soil beneath the ROD-required RCRA-equivalent cover.

In general, the community seemed to support the preferred alternative of excavating the Basin F PT soil with on-site landfill disposal rather than solidifying and leaving the waste in place. Three recurring comments were received with respect to the proposed alternative for the Lime Basins project. Specifically, a preference to excavate and landfill contaminated soil from both projects was expressed. In addition, two commenters questioned why a treatment alternative was not evaluated for the lime basins material. Lastly, a concern was voiced regarding the long-term protectiveness of leaving the Lime Basins material in place.

9.2 Background on Community Involvement

In accordance with CERCLA Section 117 and the NCP, 40 CFR 300.435(c)(2)(ii), the Army issued a Revised Proposed Plan for public comment describing the changes in the preferred remedy for the Lime Basins and Basin F (PMRMA 2005). The Revised Proposed Plan and supporting information were made available at the JARDF, Building 129, Room 2024. Legal notice of availability of the Revised Proposed Plan and the public comment period was published in The Denver Post on April 20, 2005. Notices were also published in the Commerce City Beacon and the Commerce City Gateway. The Proposed Plan was also posted on the RMA Web site April 20, 2005.

The Army conducted a public meeting on May 12, 2005 to present the information regarding the Lime Basins and Basin F remediation and the Revised Proposed Plan. A 30-day public comment period was provided to receive written comments on the Revised Proposed Plan. In response to a request received, the public comment period was extended an additional 30 days and closed on June 20, 2005. Written comments received as well as comments received at the public meeting are summarized with responses in Section 9.4 and 9.5.

In addition to the JARDF and public meetings, the Army regularly provides information to the public regarding cleanup activities at RMA through RAB meetings. This board serves as the primary forum through which neighboring communities can receive and share information as well as provide input to the parties involved in the RMA's cleanup. Established in April 1994 by the Department of Defense, the RAB is comprised of community members, elected officials, governmental agencies and the RVO (U.S. Army, Shell Oil Company and the USFWS). These entities work together to review remediation designs and discuss cleanup issues of interest to the community. The goal of RMA's RAB is to encourage community participation by discussing and exchanging information regarding the final environmental clean-Lip of RMA. The RAB has been involved in the Lime Basins and Basin F remediation projects through review of the treatability study reports and Lime Basins design documents, available for public review at the JARDF. For more information concerning the RAB, contact the RMA Public Affairs Office at (303) 289-0250.

Prior to issuing the Revised Proposed Plan, the Army provided a discussion of the remedial alternatives being considered for the Lime Basins and Basin F and solicited input from the RAB on these alternatives. No comments opposing the remedial alternatives being considered were received from the RAB. All comments received during the public comment period were considered before finalizing selection of the remedies for the Lime Basins and Basin F.

9.3 Summary of Comments

The public meeting for the Revised Proposed Plan for the Lime Basins and Basin F PT Soil was held on May 12, 2005. The Army provided a presentation on the remedial alternatives evaluation and the new preferred alternatives. Questions and comments followed the presentation. A court reporter recorded the meeting and provided a transcript, available in the JARDF. In addition, written comments were received from two community members and from the Site-Specific Advisory Board (SSAB) during the public comment period. The SSAB, founded in 1994, is a group of community members that meets periodically and provides an additional forum for community involvement at the RMA. Copies of the letters received are included in Appendix A. This section summarizes comments received at the public meeting and during the public comment period. The selected remedy was chosen after careful consideration of public comments received on the Revised Proposed Plan for this ROD Amendment.

Lack of Treatment Options

Several commenters questioned whether treatment options had been reevaluated for the Lime Basins given the new circumstances at the site or whether treatment options had been discarded simply because they included treatment. Specifically, the applicability of soil flushing was questioned for the Lime Basins project.

Response: Evaluation of remedial alternatives for the Lime Basins included a review of all potential alternatives including landfill, in-place containment and treatment alternatives. No remedial alternatives were discarded simply because they were treatment alternatives. One of the preliminary steps in the evaluation was to screen the alternatives in accordance with the NCP and EPA guidance to evaluate effectiveness, implementability and cost. Because this process was completed for a wide range of alternatives prior to the 1996 ROD, the Feasibility Study (FS) information related to the evaluation of the Lime Basins alternatives was reviewed as a starting point for the evaluation.

The conclusions from the FS were reviewed to determine if the changed conditions at the Lime Basins resulted in a different evaluation or conclusion for each alternative. Results of this evaluation were discussed with the Regulatory Agencies early on at meetings to determine the range of alternatives to include in the detailed evaluation. Each treatment option was eliminated due to limited effectiveness, implementation difficulties or high cost and was not carried forward to the detailed evaluation presented in the Proposed Plan. In particular the soil flushing alternative was eliminated based on moderate effectiveness, difficult implementability and high cost.

Remedial Alternative Preference

During the public meeting, one commenter expressed concern over the long-term stability of the Lime Basins area and commented that both projects should be landfilled for long-term protection. This comment was also voiced by a member of the RAB. In addition, two comments were received from community members to keep the remedies selected in the 1996 ROD and not change to the preferred remedies identified in the Revised Proposed Plan. The commenters were concerned with the adequacy of information related to the alternative evaluation and long-term protectiveness of the preferred remedy.

Response: Long-term protection is one of nine CERCLA criteria considered during the evaluation and selection of remedial alternatives. However, the remedial alternative selection process requires consideration of all the primary balancing criteria (including short-term risk, reduction in TMV through treatment, implementability, and cost) to weigh the major trade-offs between alternatives and achieve the best overall solution. Although the evaluation indicates that excavation and landfill of the Lime Basins waste results in the least long-term risk, it also results in substantially higher short-term risks and cost than the selected alternative and is more difficult to implement. The selected remedy provides for substantial and adequate risk reduction through containment of the waste using a combination of the RCRA-equivalent cover, groundwater barrier wall and dewatering wells. The selected remedy provides significant short-term risk reduction at a much lower cost without sacrificing significant long-term protection. Therefore, the selected remedy provides the best balance between the evaluation criteria.

Landfill Capacity

One commenter questioned why the ELF could not be expanded to accommodate both the Lime Basins and Former Basin F material.

Response: The slope of the landfill cell sideslopes and covers are dictated by the strength properties of the clay, geosynthetic and geocomposite materials that comprise the liner and cover systems. In other words, situations similar to mud slides could occur if steeper slopes were constructed to increase the landfill capacity. Consequently, the only way to increase the capacity of the landfill is to increase its footprint by constructing a new landfill cell. This option would be difficult to implement due to potential issues for proper siting on the RTMA and would result in a significant delay to the overall RMA remediation schedule to allow for resolution of these issues, legal and public process requirements to effect the change, and design and construction of the new landfill.

Potential for Unknown Obiects or Leakina Containers and Impact to Groundwater

Two commenters expressed concern about unknown buried objects present in the Lime Basins. Specific concerns were related to the lack of information associated with the reported 500-pound anomalies and the potential for leaking containers in the Lime Basins. One commenter questioned the effectiveness of the containment remedy. Response: The containment strategy employed for the selected remedy relies on well proven technologies to effectively contain all waste at the Lime Basins, including potential containers if they are present or other unknown buried objects. A review of the site history did not reveal any documentation indicating disposal of leaking containers. The geophysical survey methods used identify metallic anomalies but can provide only an estimate of the overall mass. Although the geophysical survey completed over the Lime Basins area identified numerous, large contacts throughout the basins, the technology is incapable of differentiating between one 500-pound item and 500 one-pound items, or even determining the nature of the anomaly, i.e., distinguishing a container from scrap metallic debris. The combination of the RCRA-equivalent cover, groundwater barrier wall and dewatering within the wall provide containment features to minimize the potential for future impacts to groundwater outside the barrier wall. In addition, groundwater will continue to be captured and treated at the Basin A Neck treatment system, downgradient of the Lime Basins, until shut-off criteria identified in the ROD are met. Similar remedies were selected and are being successfully implemented at RMA for the Complex Army Trenc hes and Shell Disposal Trenches projects, both of which have extensive history of container disposal.

Depth of Excavation in Basin F

The SSAB commented that they supported the preferred alternative for Basin F PT Soil, Excavate/On-Post Landfill. However, they expressed concern related to residual contamination extending deeper than the maximum proposed excavation depth of 10 feet and suggested that all contaminated soil in Basin F be excavated and disposed in the ELF.

Response: Although there are contaminated soils at depths greater than 10 feet in Former Basin F, the bulk of the PT soil is located in the upper 10 feet and is addressed by the selected remedy. The combination of PT soil excavation and containment of HHE soil and residual soil at depth beneath a RCRA-Equivalent cover is fully protective of human health and the environment and meets Applicable or Relevant and Appropriate Requirements. Construction of the RCRA-equivalent cover eliminates direct exposure to Former Basin F contaminated soil and minimizes the potential for future impacts to groundwater. In addition, groundwater will continue to be treated at the boundary treatment systems until shut-off criteria are met.

Because the RCRA-equivalent cover provides effective containment, continued excavation beyond 10 feet of PT soil increases short-term risk by extending the excavation schedule without adding substantial long-term protection. In addition, there is not available capacity in the ELF for all contaminated soil present in Former Basin F. Evaluation of remedial alternatives for Basin F principal threat soil in this ROD Amendment are dependent on the disposal capacity available in the ELF. Excavation and landfill of the ROD-identified principal threat soil volume is feasible and provides the best balance of long-term effectiveness and short-term risk.

In-Place Containment

The SSAB commented that containment of the Lime Basins wastes in place violates the Congressional Land Ban by inappropriately siting contaminated waste outside of a certified, designated hazardous waste landfill. They further suggested that, although the 1996 ROD included designation of a CANTU, the CANTU regulations have since been changed and the proposal to leave waste in place must comply with the revised regulations.

Response: In the Superfund LDR Guide #1 (OSWER Directive 9347.3-01FS, July 1989) EPA stated:

> ("i)t is important to note that LDRs apply prospectively to wastes that are land disposed after the effective date of the restrictions (i.e., the LDRs do not require that wastes land disposed prior to the date of the restrictions be removed and treated)".

The Congressional Land Ban noted in the comment is a more formal term for what is commonly known as the Land Disposal Restrictions. As noted above, the Land Disposal Restrictions only apply when hazardous waste is actively managed and placement in a RCRA land disposal unit occurs. Active management and placement of the Lime Basins waste is not being proposed. It is correct that recent changes have been made to the CANTU regulations, but the above condition remains unchanged. In addition, Section 264.550(b) of the new CANTU rule allows CAMUs that were designated prior to the rule change in 2004 to operate under the regulation in effect when they were designated.

Adequacy of Geologic Information

Comments were received from the SSAB and one community member suggesting insufficient information related to the geological formations underlying the Lime Basins. They expressed concern over the lack of information regarding risk to groundwater and commented that the assumptions as to the soundness and impermeability of the geological formation underlying the Lime Basins are not adequately substantiated. The SSAB further commented that additional investigations in the form of Three-D Seismic Imaging, Ground Penetrating Radar or other readily available technologies be conducted to provide assurance of the absence of vertical cracks and lenses that would allow for contaminant migration to the underlying groundwater.

Response: The subject of tectonic fracturing and faulting was addressed during the RI/FS and determined not to be a factor for vertical migration of groundwater contaminants. Thus, Basin A (including the Lime Basins) was deemed to be an effective natural containment feature for the remedy. This conclusion was based primarily on borehole and well information, of which, few sites rival RMA for the number and density of borings and wells. Boreholes provide direct observation of fractured zones when they are encountered. The number of boreholes was adequate to detect potential offset of the lignite marker beds, which was not observed. Other than weathering-related fracturing (caused when the bedrock was exposed), fracture zones that may be vertical conduits for groundwater migration were not observed. Additionally, numerous aquifer tests were conducted in the bedrock. These results were consistent with the lithology of the zone tested, and again there were no indications of deep-seated fracture zones. Finally, the location of RMA in the Denver Basin and the lithology of the Denver Formation bedrock do not tend themselves to deep-seated tectonic fracturing or faulting. RMA is located near the structural axis of the Denver Basin. Most of the faulting occurred near the western uplift. The majority of the bedrock at RMA consists of weakly consolidated plastic claystone. The sandstone units are unconsolidated to weakly consolidated, and typically are thin and discontinuous. Thus, the bedrock is not comprised of brittle rocks, but would deform plastically without creating fracture or fault zones, as the direct observations have shown.

To support the ROD amendment, much additional hydrogeologic characterization of the bedrock has been done in the Lime Basins area (TtEC 2005). Using closely spaced borings, cores and hydraulic testing showed no indications of fracture zones, faults, or lenses that could act as vertical migration pathways.

Characterization of Waste

The SSAB commented that comprehensive analysis and characterization of the Lime Basins waste needs to be performed in order for posterity to have the greatest amount of information. Response: There has already been extensive characterization of the Lime Basins area during the RI/FS as well as additional data collected during design. The existing information provides a clear picture of the type and concentrations of contaminants and is sufficient to provide the basis for selecting and implementing remedial actions. The existing knowledge about the Lime Basins waste also provides an adequate basis for evaluating future groundwater monitoring data to verify the effectiveness of the selected remedy.

Groundwater Treatment

The SSAB commented that in addition to the dewatering at the Lime Basin, downstream of the alluvial flow at the low point of bedrock in Basin A should be similarly dewatered and monitored. This additional well would provide the public and the regulators with needed long-term information related to the correctness of the underlying assumptions and the long-term remedy effectiveness.

Response: Dewatering of South Plants and Basin A was considered in the remedy evaluation process but was not selected in the final remedy. As we have discussed, the only outlets for groundwater flow in Basin A are at the Basin A-Neck Containment System and the Bedrock Ridge system where the contaminated flow is extracted and treated. Although dewatering in the middle of Basin A would help lower water levels in that area, it would not significantly shorten the duration of operation of the existing systems. As stated in the 1997 Basin A Design Document, once the Basin A cover is installed, 7 monitoring wells will be installed within the Basin A boundary. These wells will provide long-term information concerning the underlying assumptions and long-term remedy effectiveness of the Lime Basins remedy.

Cost Detail

The SSAB commented that the Revised Proposed Plan did not include adequate information regarding the costs of the proposed changes, making it impossible to compare these proposed remedy changes relative to cost.

Response: Although summary costs were presented in the Revised Proposed Plan, detailed cost estimates for each alternative were provided in the Summary of Remedial Alternatives for Section 36 Lime Basins and Former Basin F Principal Threat Soil Remediation Projects, which was made available for public review at the same time as the Proposed Plan and remains in the JARDF as supporting documentation. These detailed estimates provide the basis for evaluation of the cost criterion.

Adequacy of Slurry Wall Technology
One commenter at the public meeting questioned whether other slurry walls at RIMA had failed and if this had any impact on selecting a remedy to construct another one. Another commenter stated that the slurry wall remedy was inappropriate because it had failed in the past.

Response: Slurry walls have been constructed at RMA as part of the groundwater boundary treatment systems and also around the Shelf Trenches and Complex (Army) Trenches as part of the ROD remedy. These walls appear to be functioning property. One wall, previously constructed around the Shell Trenches as part of an IRA in 1991, is suspected to be failing and leaking. This wall was only 6 inches thick. The Lime Basins wall is expected to be two to three feet thick and design will include a compatibility study to make sure that the material used to construct the Lime Basins barrier wall is compatible with the groundwater contaminants that will be in contact with the wall. Design for the Shell Trenches and Complex Trenches slurry walls also included compatibility studies that resulted in a successful slurry material being identified. Therefore, it is expected that one of the materials anticipated to be used for the Lime Basins barrier wall will be found to be compatible with the Lime Basins groundwater. The resulting compatibility will minimize potential deterioration of the wall and provide for long-term successful containment.

Public Participation Process
One concern received from the SSAB that there was not sufficient time allowed between the public meeting on May 12, 2005 and the scheduled close of the public comment period on May 20, 2005. A 60-day extension was requested. Response: The public comment period was extended thirty days to allow adequate time to review and comment on the proposed changes. With the extension, the public comment period closed on June 20, 2005.

9.4 Responses to Clarifying Questions from Public Meeting

This section summarizes technical comments or clarifying questions received during the public meeting. The commenter's name is indicated, followed by the comment/question and response. Although these questions are not direct comments on the preferred remedy, they are included here to provide a complete record of all information made available to the public either during or after the public meeting. A complete copy of the public meeting transcript is available in the JARDF.

Ms. Jaquith: How long will it take to dry out the entire Lime Basins aquifer?

Response: Some clarifications to the question are needed. If the question refers to the shallow (alluvial) aquifer within the proposed Lime Basins slurry wall, that is not the objective of the proposed mass removal/dewatering system. The dewatering objectives will be the following:

1) Create an inward hydraulic gradient across the slurry wall to prevent water inside the slurry wall from leaving

2) Lower water levels below the waste to reduce the transfer of contamination from the waste to the groundwater

However, achieving these objectives will require lowering the water levels inside the slurry wall significantly.

There are approximately four million gallons of water in the alluvial aquifer inside the proposed slurry wall alignment around the basins. At an assumed pumping rate of two gallons per minute, which would be determined during the design phase, it would take approximately four years to pump out four million gallons. This does not account for infiltration of precipitation before the cover is installed. Completely drying out the alluvial aquifer within the Lime Basins slurry wall likely will not occur until water levels outside the slurry wall fall below the bedrock elevation inside the slurry wall. This will not occur until well after the Basin A, South Plants, and Lime Basins covers/caps are installed. It is impossible to accurately predict how long that will take.

Mr. Union: If exposure to odors were to occur (during Basin F excavation), would it be hazardous to that person or persons?

Response: Nuisance odors from the primary odor-causing chemicals may be perceived at concentrations well below health-based criteria developed specifically for the RMA. Therefore, exposure to odor at these low levels would not be hazardous to residents in nearby communities. Exposure to concentrations of odors high enough to cause health effects, including irritation of the eyes and respiratory tract, are unlikely based on predicted project emissions. Chemical emissions will be measured at the project boundary and the fence line on a regular basis by the standard air monitoring equipment to confirm project emission estimates. The results of this monitoring are typically reported within 2-3 weeks of the sampling. These data can be used in conjunction with procedures that are in place to correct conditions resulting in excess emissions, if they should occur. In addition, if a significant nuisance odor event did occur on site, an air sample would be collected by RMA experts to confirm that air concentrations of both odor-causing and odorless chemicals are below acute (short-term) air criteria.

Mr. Mulqueen: How much do you know about communication between the deeper and shallow aquifer in the Lime Basins area. What have you done to investigate the deep and alluvial aquifer?

Response: Hydraulic communication of groundwater between the shallow and deeper zones is governed by the vertical hydraulic gradient between the zones, and the permeability, or ability to transmit water, of the individual zones. The vertical hydraulic gradient in the Lime Basins area is downward from the alluvial aquifer to the bedrock. Thus, upward Dow into the alluvium from below is not possible in the Lime Basins area. The Denver Formation is the uppermost bedrock unit and is 200 to 500 feet thick at RMA. The bedrock has very low permeability, which limits the amount of flow from the alluvial aquifer to the bedrock to a very small amount. Thus, although the direction of flow is downward, the contamination in the underlying bedrock is very shallow and the deeper zone in the Denver Formation is not becoming contaminated. Several paired wells or well clusters (i.e., two or more wells in the same general area that monitor different depths within or between aquifers) were present historically in the Lime Basins area that monitored water levels in the shallow alluvial and deeper bedrock zones. The historical data from these wells, as well as current data from the remaining wells, provide a clear picture of this interaction.

Mr. Mulqueen: What is the speed of the alluvial aquifer?

Response: The average groundwater velocity in the alluvial aquifer in the vicinity of the Lime Basins is approximately 125 feet per year, depending on the hydraulic gradient, which can vary.

Mr. Mulqueen: When was the South Plants aboveground water tank removed?

Response: The South Plants water tank was demolished in December 1999.

Mr. Mulqueen: Mr. Mulqueen commented that we should select the best alternative for each project and not change the Lime Basins remedy from the ROD unless there is a convincing argument to do so. Mr. Mulqueen also commented that cost should be the least considered criteria for this evaluation.

Response: The Army believes the selected remedies do represent the best remedial alternatives for both the Lime Basins and Basin F projects. Cost, along with long-term risk, short-term risk, reduction in TMV through treatment, and implementability, is one of the CERCLA primary balancing criteria considered during the evaluation and selection of remedial alternatives. These criteria are considered to evaluate the major trade-offs between alternatives and achieve the best overall solution. The change from the ROD-identified remedy to the selected remedy for the Lime Basins is based on this CERCLA evaluation and was necessary due to significant changes in site conditions from what was considered during the ROD evaluation, particularly significant increases in remediation volume and short-term risks. The selected remedy was chosen primarily for providing the best balance between evaluation criteria, which includes the remedy being the lower cost alternative.

Ms. Jaquith: Is there a straw or capillary effect on the slurry wall from the groundwater?

Response: No, there is not a straw or capillary effect on the slurry wall. After soil has been mixed with the slurry, the wall takes on the consistency of soft clay. The wall would be designed to withstand the hydraulic pressures applied to it by the surrounding water and will not be altered as a result of these.

Mr. Yelenick: Mr. Yelenick commented that air sparging was not an acceptable alternative.

Response: The Army agrees. Air sparging was not considered as a remedial alternative.

Ms. Jaquith: How much space is available in the ELF after the Basin F Wastepile is placed into the cell?

Response: The Lime Basins waste and its leachate are incompatible with the Basin F Wastepile waste material and must be isolated in two separate cells within the ELF. Under the scenario where the Lime Basins material is placed in its own cell within the ELF that is designed for containing this material, the space available for disposal of this material is approximately 130,000 cubic yards plus 50% additional for daily cover soil for odor control, access ramps inside the cell and the waste containment berms for isolation of stormwater within the cell. If the Former Basin F material is placed with the Basin F Wastepile material in the ELF, the two materials and their leachates are compatible and do not have to be segregated within the landfill. Consequently, an increase in capacity is realized by not having to construct the segregation features required for the containment of waste in two separate cells. Under this scenario, the space available for disposal of the Former Basin F material is approximately 233,000 cubic yards (165,000 principal threat, 68,000 overlying and adjacent Human Health Exceedance) plus 50% additional for daily cover soil for odor control, access ramps inside the cell and the waste containment berms for isolation of stormwater within the cell.

Mr. Mulqueen: Requested a response to his Arsenic question asked at the August 17, 2004, SSAB meeting regarding the Revised Proposed Plan on the Rocky Mountain Arsenal On-Post Operable Unit Section 36 Lime Basins and former Basin F.

Response: The response to Mr. Mulqueen's question, as well as other questions asked at that meeting about the Revised Proposed Plan on the Rocky Mountain Arsenal On-Post Operable Unit Section 36 Lime Basins and Former Basin F, was sent to Mr. Mulqueen and SSAB members on October 19, 2004. A copy of that information was sent to Mr. Mulqueen on May 16, 2005.

9.5 Remaining Concerns

Based on the comments received, the Army is aware that the major concern is not providing a remedy that allows on-site disposal of contaminated soil from both the Lime Basins and Basin F. On-site disposal of contaminated soil from both projects is not possible without construction of an additional landfill. This option would be difficult to implement due to potential issues for proper siting on the RMA and would result in a significant delay to the overall RMA remediation schedule to allow for resolution of these issues, legal and public process requirements to effect the change, and design and construction of the new landfill. However, the selected remedy makes use of the available landfill capacity to dispose of the highest possible volume of the most contaminated material, PT soil.

The Army acknowledges that in-place containment for the Lime Basins is considered marginally less protective than containment in the ELF; however, the selected remedy provides adequate long-term protection through both vertical and horizontal containment and provides the best balance between long-term protectiveness and the other evaluation criteria. In addition, long-term monitoring and maintenance requirements will ensure continued protection. The remedial designs, as well as other long-term care provision, will be made available for public review and comment before being finalized.

All other concerns and issues raised at the RAB presentations, the Revised Proposed Plan public meeting or during the public comment period for the Revised Proposed Plan were addressed in this ROD Amendment. Based on the written and verbal comments received, no changes to the remedy selections as they were identified in the Revised Proposed Plan were necessary.

9.6 Community Relations Activities

Table 9.6-1 includes a list of community relations activities related to the Lime Basins and Basin F during site characterization, treatability studies, remedial design and development of this ROD Amendment.

10.0 DOCUMENTATION OF SIGNIFICANT CHANGES

The Proposed Plan, provided for public comment on April 20, 2005, identified Alternative 3 (Vertical Groundwater Barrier, Dewatering with On-Site Treatment, RCRA-Equivalent Cover) for the Lime Basins and Alternative 3 (Excavate PT Soil, On-Post Landfill, RCRA-Equivalent Cover) for Basin F PT Soil as the preferred alternatives. For the Lime Basins, no significant changes to the remedy as identified in the Proposed Plan are necessary.

For Basin F, recent odor flux measurements indicate odor flux during excavation and disposal activities may be as much as 4 times higher than previously expected for portions of the PT soil. Based on these higher odor flux measurements, covered excavation and/or placement was added to the range of potential odor/emission control measures for implementation of the selected remedy. The specific odor/emission control measures necessary will be determined during remedial design and may be adjusted during implementation to ensure that odor/emission goals identified in the SWAQMP and SWOMP are met. The addition of enclosures for potential odor/emission control provides a full range of options capable of dealing with odors/emissions from the project. Implementing the project within an enclosure or employing other more restrictive odor/emission control measures identified in Section 4.2.3 could increase project cost as much as 30 percent and would potentially extend the schedule. However, these potential cost and schedule changes are not significant enough to change the selection of Alternative 3 for Basin F.

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TABLES

Table 2.2.4-1 Section 36 Lime Basins Soil Contamination Summary

COC	Maximum Concentration (ppm)	Average Concentration (ppm)	Human Health Chronic SEC (ppm)	Principal Threat SEC (ppm)
Aldrin	310,000	5,995	71.2	716
Dieldrin	2,100	49.3	41.4	414
Endrin	1,100	30.8	232	232,000
Isodrin	810	39.7	52.4	52,400
Chlordane	730	80.6	55.1	55,100
DDE	31	3.32	1,250	12,500
DDT	8.6	1.32	409	13,500
Arsenic	1,100	67.9	417	4,170
Mercury	110	2.46	574	574,000

Note: Data provided from RMA Environmental Database.
COC – contaminant of concern
DDE – p,p-dichlorodiphenyldichloroethylene
DDT - p,p-dichlorodiphenyltrichloroethane
ppm - part per million
SEC – site evaluation criteria

Table 2.3.3-1 Basin F Contamination Summary for Principal Threat Soil

COC	Maximum Concentration (ppm)	Average Concentration (ppm)	Human Health Chronic SEC (ppm)	Principal Threat SEC (ppm)
Aldrin	5,700	1,245	71.2	716
Dieldrin	3,900	528	41.4	414
Endrin	2,100	419	232	232,000
Isodrin	11,000	1,025	52.4	52,400
DCPD	22,000	2,289	3,690	NA
CLC2A	8,000	1,610	77.1	77,100

Note: Data provided from RMA Environmental Database.
CLC2A - chloroacetic acid
COC – contaminant of concern
DCPD - dicyclopentadiene
ppm - part per million
SEC – site evaluation criteria

Table 4.2.1-1 Section 36 Lime Basins Cost Estimate Summary for Alternative 1: No Further Action (IRA Cover and Groundwater Monitoring)

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
Operation & Maintenance Costs					
1.	Cover Inspection and Maintenance	100	yr	$ 31,200.00	$ 3,120,000
2.	Monitoring Well Ops, Sampling & Analysis	30	yr	$ 17,000.00	$ 510,000
Total Operation & Maintenance Costs				$ 48,200.00	**$ 3,630,000**
Total Estimated Cost[2]					**$ 3,630,000**

Summary of Present Value Analysis

Year	Capital Cost	Annual O&M Cost	Present Value[3]
0	$ -	$ -	$ -
1-30		$ 48,200	$ 598,116
31-100		$ 31,200	$ 58,039
Totals	$ -	$ 3,630,000	$ 656,155

Total Estimated Present Value **$ 656,155**

[1]Environmental, Safety and Quality (ESQ) incentive for subcontractor based on performance.

[2]Cost estimate is expected to be within -30 to +50 percent of actual cost.

[3]Discount rate of 7 percent used for present value estimates.

Table 4.2.2-1 Section 36 Lime Basins Cost Estimate Summary for Alternative 2: Excavate/Landfill HHE and Principal Threat Soil

Item No.	Item Description	Quantity	Unit		Unit Cost		Total Cost
Capital Costs							
1.	Mobilization						
1a.	Preconstruction Submittals	1	ls	$	150,000.00	$	150,000
1b.	Mobilize Personnel & Equipment	1	ls	$	80,000.00	$	80,000
1c.	Set Up Temporary Support Facilities	1	ls	$	100,000.00	$	100,000
1d.	Stormwater Control Measures	1	ls	$	36,000.00	$	36,000
1e.	Temporary Site Access Roads	1,500	lf	$	20.00	$	30,000
	Mobilization Subtotal					$	396,000
		100,222					
2.	HHE and PT Excavation						
2a.	Construct Soil Mixing Pad	20,000	sf	$	8.00	$	160,000
2b.	Remove & Stockpile Existing Soil Cover	19,038	bcy	$	6.50	$	123,747
2c.	Excavate & Stockpile Surrounding Soils	71,895	bcy	$	7.00	$	503,264
2d.	Excavation Support (Sheet Piling)	64,575	sf	$	42.50	$	2,744,438
2e.	Excavate Wet LB Soils	38,349	bcy	$	10.00	$	383,493
2f.	Soil Mixing/Blending	129,282	bcy	$	12.00	$	1,551,386
2g.	Transport Mixed Soils to ELF	129,282	bcy	$	8.50	$	1,098,899
2i.	Odor Controls (Foam and/or Tarps)	1,500,000	sf	$	0.75	$	1,125,000
2j.	Dewatering/Water Disposal	2,000,000	gal	$	0.20	$	400,000
2k.	Remove/Dispose Mixing Pad	1,500	cy	$	11.50	$	17,250
2l.	Remove/Dispose Access Road	3,000	cy	$	10.00	$	30,000
	Excavation Subtotal					$	8,137,477
3.	Fill and Backfill						
3a.	Backfill Excavation Areas	122,494	bcy	$	11.00	$	1,347,434
3b.	Construct/Replace Soil Cover	72,600	bcy	$	6.50	$	471,900
	Fill and Backfill Subtotal					$	1,819,334
4.	Institutional Controls - Survey Monuments						
4a.	Survey/Erosion Control Monuments	15	ea	$	375.00	$	5,625
5.	Demobilization						
5a.	Equipment Decontamination	1	ls	$	72,000.00	$	72,000
5b.	Remove Temporary Facilities	1	ls	$	60,000.00	$	60,000
5c.	Demobilize Personnel & Equipment	1	ls	$	40,000.00	$	40,000
	Demobilization Subtotal					$	172,000
6.	Verification Surveys	1	ls	$	285,000.00	$	285,000
7.	Monitoring Well Abandonment	12	ea	$	2,950.00	$	35,400
8.	Agent Monitoring	200	day	$	8,930.00	$	1,786,000
9.	Soil Amendments						
9a.	Lime Basins	13.5	ac	$	3,475.00	$	46,913
9b.	Borrow Area 3	8.0	ac	$	3,475.00	$	27,800
	Soil Amendments Subtotal					$	74,713

Table 4.2.2-1 Section 36 Lime Basins Cost Estimate Summary for Alternative 2: Excavate/Landfill HHE and Principal Threat Soil

Item No.	Item Description	Quantity	Unit		Unit Cost		Total Cost
10.	Revegetation						
10a.	Lime Basins	13.5	ac	$	2,540.00	$	34,290
10b.	Borrow Area 3	8.0	ac	$	2,540.00	$	20,320
	Revegetation Subtotal					$	54,610
11.	Subcontractor ESQ[1] Incentive	145,730	hr	$	2.50	$	364,325
12.	PMC Services	25	%			$	3,282,600
Total Capital Costs						**$**	**16,413,083**
Operation & Maintenance Costs							
13.	Cover Inspection and Maintenance	100	yr	$	31,200.00	$	3,120,000
14.	Monitoring Well Ops, Sampling & Analysis	30	yr	$	17,000.00	$	510,000
Total Operation & Maintenance Costs				$	48,200.00	**$**	**3,630,000**
Total Estimated Cost[2]						**$**	**20,043,083**

Summary of Present Value Analysis

Year	Capital Cost	Annual O&M Cost		Present Value[3]
0	$ 16,413,083	$ -	$	16,413,083
1-30		$ 48,200	$	598,116
31-100		$ 31,200	$	58,039
Totals	$ 16,413,083	$ 3,630,000	$	17,069,238

Total Estimated Present Value	**$**	**17,069,238**

[1]Environmental, Safety and Quality (ESQ) incentive for subcontractor based on performance.

[2]Cost estimate is expected to be within -30 to +50 percent of actual cost.

[3]Discount rate of 7 percent used for present value estimates.

Table 4.2.3-1 Section 36 Lime Basins Cost Estimate Summary for Alternative 3: Vertical Groundwater Barrier; RCRA-Equivalent Cover

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
Capital Costs					
1.	Barrier Wall				
1a.	Preconstruction Submittals	1	ls	$ 36,000.00	$ 36,000
1b.	Mobilization	1	ls	$ 273,500.00	$ 273,500
1c.	Barrier Wall[1]	99,900	sf	$ 16.00	$ 1,598,400
1d.	Agent Air Monitoring	30	day	$ 10,050.00	$ 301,500
1e.	Monitoring Well Abandonment	12	ea	$ 3,350.00	$ 40,200
1f.	Demobilization	1	ls	$ 158,600.00	$ 158,600
1g.	Subcontractor ESQ[2] Incentive	5,500	hr	$ 2.50	$ 13,750
	Barrier Wall Subtotal				$ 2,421,950
2.	Subgrade Construction				
2a.	Preconstruction Submittals	1	ls	$ 16,000.00	$ 16,000
2b.	Mobilization	1	ls	$ 32,000.00	$ 32,000
2c.	Excavate, Place & Compact Gradefill	160,000	cy	$ 6.00	$ 960,000
2d.	Demobilization	1	ls	$ 12,000.00	$ 12,000
2e.	Subcontractor ESQ[2] Incentive	10,000	hr	$ 2.50	$ 25,000
	Subgrade Construction Subtotal				$ 1,045,000
3.	Dewatering System Installation				
3a.	Preconstruction Submittals	1	ls	$ 25,000.00	$ 25,000
3b.	Mobilization	1	ls	$ 50,000.00	$ 50,000
3c.	Groundwater Extraction Wells/Pumping System	3	ea	$ 25,000.00	$ 75,000
3d.	Agent Air Monitoring	10	day	$ 10,050.00	$ 100,500
3e.	Conveyance Piping	1	ls	$ 82,000.00	$ 82,000
3f.	Demobilization	1	ls	$ 36,000.00	$ 36,000
3g.	Subcontractor ESQ[2] Incentive	264	hr	$ 2.50	$ 660
	Dewatering Subtotal				$ 369,160
4.	RCRA-Equivalent Cover				
4a.	Preconstruction Submittals	1	ls	$ 20,000.00	$ 20,000
4b.	Mobilization	1	ls	$ 48,000.00	$ 48,000
4c.	Biota Barrier Procurement	53,190	tn	$ 12.50	$ 664,875
4d.	Biota Barrier Placement	32,670	cy	$ 16.50	$ 539,055
4e.	Chokestone Layer	7,260	cy	$ 40.50	$ 294,030
4f.	RCRA Soil Cover	84,200	cy	$ 6.50	$ 547,300
4g.	Geotechnical Testing	1	ls	$ 2,500.00	$ 2,500
4h.	Demobilization	1	ls	$ 24,000.00	$ 24,000
4i.	Soil Amendments (Site + Borrow Area)	28.0	ac	$ 3,475.00	$ 97,300
4j.	Revegetation (Site + Borrow Area)	28.0	ac	$ 1,600.00	$ 44,800
4k.	Irrigation	28.0	ac	$ 100.00	$ 2,800
4l.	Subcontractor ESQ[2] Incentive	12,256	hr	$ 2.50	$ 30,640
4m.	Engineering Controls	1	ls	$ 92,400.00	$ 92,400
	RCRA-Equivalent Cover Subtotal				$ 2,407,700

Table 4.2.3-1 Section 36 Lime Basins Cost Estimate Summary for Alternative 3: Vertical Groundwater Barrier; RCRA-Equivalent Cover

Item No.	Item Description	Quantity	Unit	Unit Cost		Total Cost
5.	PMC Services[3]	25	%		$	1,394,700
Total Capital Costs					**$**	**7,638,510**
Operation & Maintenance Costs						
6.	Groundwater Treatment	30	yr	$ 210,240.00	$	6,307,200
7.	Cover Inspection and Maintenance	100	yr	$ 17,000.00	$	1,700,000
8.	Monitoring Well Ops, Sampling & Analysis	30	yr	$ 31,200.00	$	936,000
Total Operation & Maintenance Costs				$ 258,440.00	**$**	**8,943,200**
Total Estimated Cost[4]					**$**	**16,581,710**

Summary of Present Value Analysis

Year	Capital Cost	Annual O&M Cost		Present Value[5]
0	$ 7,638,510	$ -	$	7,638,510
1-30		$ 258,440	$	3,206,993
31-100		$ 17,000	$	31,624
Totals	$ 7,638,510	$ 8,943,200	$	10,877,127

Total Estimated Present Value	**$**	**10,877,127**

[1]Barrier wall construction method is assumed, for costing purposes, to be deep soil mixing method.
[2]Environmental, Safety and Quality (ESQ) incentive for subcontractor based on performance.
[3]PMC service cost factored on total cost except biota barrier procurement.
[4]Cost estimate is expected to be within -30 to +50 percent of actual cost.
[5]Discount rate of 7 percent used for present value estimates.

Table 4.3.2-1 Basin F Cost Estimate Summary for Alternative 2: In Situ Solidification of Principal Threat Soil

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
Capital Costs					
1.	Mobilization	1	ls	$ 1,500,000.00	$ 1,500,000
2.	Soil Drilling and Mixing	233,000	cy	$ 33.00	$ 7,689,000
3.	Reagent	233,000	cy	$ 41.00	$ 9,553,000
4.	Demobilization	1	ls	$ 500,000.00	$ 500,000
	Subtotal				$ 19,242,000
5.	Contingency	50	%		$ 9,621,000
	Subtotal				$ 28,863,000
6.	Subcontractor ESQ[1] Incentive	50,000	hr	$ 2.50	$ 125,000
7.	PMC Services	25	%		$ 7,247,000
Total Capital Costs					**$ 36,235,000**
Operation & Maintenance Costs[2]					**$ -**
Total Estimated Cost[3]					**$ 36,235,000**

Summary of Present Value Analysis

Year	Capital Cost	Annual O&M Cost[2]	Present Value4
0	$ 36,235,000	$ -	$ 36,235,000
1-100		$ -	$ -
Totals	$ 36,235,000	$ -	$ 36,235,000

Total Estimated Present Value **$ 36,235,000**

[1]Environmental, Safety and Quality (ESQ) incentive for subcontractor based on performance.
[2]Annual O&M cost is zero because cover inspection and maintenance costs and groundwater monitoring costs are already included in the Basin F/Basin F Exterior project.
[3]Cost estimate is expected to be within -30 to +50 percent of actual cost. Cost for RCRA-equivalent cover is not included since this element is not proposed for change from ROD.
[4]Discount rate of 7 percent used for present value estimates.

Table 4.3.3-1 Basin F Cost Estimate Summary for Alternative 3: Excavate/ Landfill Principal Threat Soil

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
Capital Costs					
1.	Mobilization				
1a.	Preconstruction Submittals	1	ls	$ 100,000.00	$ 100,000
1b.	Mobilize Personnel & Equipment	1	ls	$ 150,000.00	$ 150,000
1c.	Temporary Support Facilities	1	ls	$ 80,000.00	$ 80,000
1d.	Install Stormwater Controls	1	ls	$ 24,000.00	$ 24,000
	Mobilization Subtotal				$ 354,000
2.	Principal Threat Soil Excavation[1]				
2a.	Soil Excavation & Transport	50,000	bcy	$ 30.00	$ 1,500,000
2b.	Truck Decontamination/Tarps	3,400	ld	$ 120.00	$ 408,000
2c.	Haul Road Maintenance	65	day	$ 3,200.00	$ 208,000
2d.	Material Sampling & Testing	130	ea	$ 800.00	$ 104,000
2e.	Odor/Vapor Control (Chemical Foam)	626,250	sf	$ 0.47	$ 294,338
	Excavation Subtotal				$ 2,514,338
3.	Additional Excavation[2]				
3a.	Additional Stormwater Controls	1	ls	$ 36,000.00	$ 36,000
3b.	Soil Excavation & Transport	183,000	bcy	$ 20.00	$ 3,660,000
3c.	Truck Decontamination/Tarps	12,300	ld	$ 80.00	$ 984,000
3d.	Haul Road Maintenance	150	day	$ 3,200.00	$ 480,000
3e.	Material Sampling & Testing	300	ea	$ 800.00	$ 240,000
3f.	Odor/Vapor Control (Chemical Foam)	1,127,250	sf	$ 0.47	$ 529,808
	Additional Excavation Subtotal				$ 5,929,808
4.	Stormwater/Wastewater Management				
4a.	Stormwater/Wastewater Disposal	537,500	gal	$ 0.65	$ 349,375
5.	Backfill of Excavation Area[3]				
5a.	Borrow Excavation & Stockpile	256,300	cy	$ 6.00	$ 1,537,800
5b.	Place & Compact Backfill	256,300	cy	$ 2.50	$ 640,750
	Backfill Subtotal				$ 2,178,550
6.	Demobilization				
6a.	Equipment Decontamination	1	ls	$ 60,000.00	$ 60,000
6b.	Site Restoration & Cleanup	1	ls	$ 48,000.00	$ 48,000
6c.	Demobilize Personnel & Equipment	1	ls	$ 75,000.00	$ 75,000
	Demobilization Subtotal				$ 183,000
8.	Subcontractor ESQ[4] Incentive	30,000	hr	$ 2.50	$ 75,000
9.	PMC Services	25	%		$ 2,896,000
Total Capital Costs					**$ 14,480,070**
Operation & Maintenance Costs[5]					**$ -**
Total Estimated Cost[6]					**$ 14,480,070**

Table 4.3.3-1 Basin F Cost Estimate Summary for Alternative 3: Excavate/ Landfill Principal Threat Soil

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost

Summary of Present Value Analysis

Year	Capital Cost	Annual O&M Cost[5]	Present Value[7]
0	$ 14,480,070	$ -	$ 14,480,070
1-100		$ -	$ -
Totals	$ 14,480,070	$ -	$ 14,480,070

Total Estimated Present Value **$ 14,480,070**

[1]Principal threat soil excavation with higher odor potential.

[2]Additional excavation of PT and interbedded HHE soil with lower odor potential. Excavation rate to be verified during odor

[3]No revegetation component since entire project area is beneath RCRA-equivalent cover.

[4]Environmental, Safety and Quality (ESQ) incentive for subcontractor based on performance.

[5]Annual O&M cost is zero because cover inspection and maintenance costs and groundwater monitoring costs are already included in the Basin F/Basin F Exterior project.

[6]Cost estimate is expected to be within -30 to +50 percent of actual cost. Cost for RCRA-equivalent cover is not included since this element is not proposed for change from ROD.

[7]Discount rate of 7 percent used for present value estimates.

Table 5.0-1 Comparative Analysis of Remedial Alternatives – Section 36 Lime Basins

Criteria	Alternative 1: No Further Action (IRA Soil Cover)	Alternative 2: Excavate; On-Post Landfill; Repair IRA Soil Cover	Alternative 3: Vertical Groundwater Barrier; Dewatering with Treatment; RCRA-Equivalent Cover
Overall Protection of Human Health and the Environment	*Not Protective* of the environment. Exposure prevented by containing waste beneath the existing IRA soil cover; however, biota RAOs are not met since there is no biota barrier included. Groundwater still requires treatment due to contact with Lime Basins material.	*Protective.* Exposure prevented by containing waste in the ELF. Impacts to groundwater are minimized through removal and containment in the ELF. Groundwater is treated at existing facilities.	*Protective.* Exposure prevented by containing waste in place. Impacts to groundwater are minimized through vertical (groundwater barrier wall) and horizontal (RCRA-equivalent cover) containment. Groundwater extracted within barrier wall is treated at existing facilities.
Compliance with ARARs	*Complies* with action-, chemical- and location-specific ARARs.	*Complies* with action-, chemical- and location-specific ARARs.	*Complies* with action-, chemical- and location-specific ARARs.
Long-Term Effectiveness and Permanence	*Highest residual risk.* Relies on containment beneath existing IRA soil cover to reduce migration and exposure. Waste remains in contact with groundwater.	*Least residual risk.* Relies on disposal in ELF to prevent migration and exposure.	*Moderate residual risk.* Relies on containment from vertical groundwater barrier and RCRA-equivalent cover to reduce migration and exposure. Groundwater extracted from within barrier wall enhances effectiveness.
Reduction of Toxicity, Mobility, or Volume (TMV) through Treatment	No reduction in TMV through treatment.	No reduction in TMV through treatment.	No reduction in TMV through treatment of waste. Treatment of extracted groundwater reduces the toxicity and volume of contaminants.
Short-Term Effectiveness	*Least short-term risk.* No intrusive activity or contaminated material handling. Waste is left in place beneath existing IRA soil cover. No air/odor impacts.	*Highest short-term risk* to workers and community from potential emissions and odors during soil excavation, stabilization mixing, transportation, and disposal of PT and HHE soil. Risks manageable through adequate odor/emission control and material handling procedures. Highest risk to workers due to potential for encountering ordnance or chemical agent during excavation activities.	*Moderate short-term risk.* Lime Basins material is not disturbed as the vertical barrier is installed outside of the basin footprints. Waste is left in place and covered with RCRA-equivalent cover. Minimal air/odor emissions during barrier installation are adequately controlled. Some risk to workers during barrier wall construction due to potential for encountering ordnance or chemical agent.
Implementability	*Easiest to Implement.* No implementation required beyond long-term groundwater monitoring.	*Most difficult to Implement.* Readily available technologies. ELF available to accept material, provided waste acceptance criteria are met. Additional material handling to stabilize the waste increases the potential for emissions/odors and requires multiple handlings of material in order to achieve placement in the ELF. Vapor/odor emissions generated during excavation, stabilization mixing, stockpiling, transportation and placement in ELF require adequate control measures. Agent screening and anomaly management (potential OE presence) may impact excavation productivity. Long-term groundwater monitoring required. Implementation time is 21 months.	*Difficult to Implement.* Readily available technologies. Verification of barrier wall to groundwater compatibility required. Treatment capacity required for groundwater extracted from within barrier wall. Cover easily implementable. Agent monitoring and geophysical clearance required during barrier wall construction may impact productivity. Long-term groundwater monitoring required. Implementation time is 18 months.

Table 5.0-1 Comparative Analysis of Remedial Alternatives – Section 36 Lime Basins

Criteria	Alternative 1: No Further Action (IRA Soil Cover)	Alternative 2: Excavate; On-Post Landfill; Repair IRA Soil Cover	Alternative 3: Vertical Groundwater Barrier; Dewatering with Treatment; RCRA-Equivalent Cover
Cost	*Least Cost.* Long-term monitoring cost estimated at $656,000.	*Highest Cost.* Estimated cost is $17,100,000.	*Moderate Cost.* Estimated cost is $10,900,000.
Support Agency Acceptance	*Not Acceptable.* Lime Basins waste is left in contact with the groundwater and might not provide adequate long-term protection. IRA cover does not include a biota barrier.	*Acceptable.* Containment in ELF provides better long-term protection. However, short-term risks to workers and the community are higher during excavation, stabilization mixing, transportation and disposal.	*Preferred.* Adequate long-term protection is provided through containment using barrier wall, dewatering wells and RCRA-equivalent cover. Short-term risks are minimized on site and eliminated for the community.
Community Acceptance	*Least preferred.* Community prefers to address the Lime Basins directly rather than leaving in place under the IRA soil cover.	*Most Preferred* due to containment in ELF. Concerns were related to landfill capacity to allow disposal of waste from both projects.	*Acceptable.* Concerns were related to long-term protectiveness and possibility of groundwater contamination resulting from containing the waste in place.

Table 5.0-2 Comparative Analysis of Remedial Alternatives – Basin F Principal Threat Soil

Criteria	Alternative 1: No Further Action (RCRA-Equivalent Cover)	Alternative 2: In Situ Solidification/Stabilization; (RCRA-Equivalent Cover)	Alternative 3: Excavate PT Soil; On-Post Landfill (RCRA-Equivalent Cover)
Overall Protection of Human Health and the Environment	*Protective.* Exposure prevented by containing waste in place. Impacts to groundwater reduced by the RCRA-equivalent cover. Groundwater treated at existing boundary treatment facilities.	*Protective.* Exposure prevented by containing waste in place. Future impacts to groundwater are minimized by decreasing permeability of waste soil to 10 ft depth and containment beneath RCRA-equivalent cover. Groundwater treated at existing boundary treatment facilities.	*Protective.* Exposure prevented by containing PT waste less than 10 ft depth in the ELF. Residual soil remaining in Basin F is contained in place beneath the RCRA-equivalent cover. Impacts to groundwater from PT soils are decreased through removal and containment in the ELF. Groundwater treated at existing boundary treatment facilities.
Compliance with ARARs	*Complies* with action-, chemical- and location-specific ARARs.	*Complies* with action-, chemical- and location-specific ARARs.	*Complies* with action-, chemical- and location-specific ARARs.
Long-Term Effectiveness and Permanence	*Highest residual risk.* Relies on containment beneath RCRA-equivalent cover to reduce migration and exposure. Groundwater treated at existing treatment facilities.	*Moderate residual risk.* Relies on containment beneath RCRA-equivalent cover and solidification to minimize migration and exposure. Groundwater treated at existing treatment facilities.	*Least residual risk.* Relies on disposal in ELF and containment of remaining waste beneath RCRA-equivalent cover to prevent migration and exposure. Groundwater treated at existing treatment facilities.
Reduction of Toxicity, Mobility, or Volume (TMV) through Treatment	No reduction in TMV through treatment.	Mobility of contaminants reduced through treatment (solidification/ stabilization); however, the volume increases due to addition of solidification reagents. No reduction in toxicity.	No reduction in TMV through treatment.
Short-Term Effectiveness	*Least short-term risk.* No intrusive activity or contaminated material handling. Waste is left in place and covered with RCRA-equivalent cover. No air/odor impacts.	*Moderate short-term risk* to workers and community from potential emissions and odors during in-place soil mixing for solidification of PT soil. Risks manageable through adequate odor/emission control and material handling procedures.	*Highest short-term risk* to workers and community from potential emissions and odors during soil excavation, transportation, and disposal of PT and HHE soil. Risks manageable through adequate odor/emission control and material handling procedures.
Implementability	*Easiest to Implement.* No implementation required beyond RCRA-equivalent cover and long-term groundwater monitoring. Implementation time is 12 months.	*Most Difficult to Implement.* Readily available technology. Potential difficulties in achieving uniform mixing of soil and reagents to provide consistent mobility reduction through entire PT volume. Vapor/odor emissions generated during solidification mixing require adequate control measures. Long-term groundwater monitoring required. Implementation time is 29 months.	*Moderate Difficulty to Implement.* Readily available technology. ELF available to accept material, provided waste acceptance criteria is met. Vapor/odor emissions generated during excavation, transportation and placement in ELF require adequate control measures. Implementation time is 26 months.
Cost	*Least Cost.* Costs associated with cover construction and long-term groundwater monitoring are included in the Basin F/Basin F Exterior project.	*Highest Cost.* Estimated cost is $36,200,000.	*Moderate Cost.* Estimated cost is $14,500,000.

Table 5.0-2 Comparative Analysis of Remedial Alternatives – Basin F Principal Threat Soil

Criteria	Alternative 1: No Further Action (RCRA-Equivalent Cover)	Alternative 2: In Situ Solidification/Stabilization; (RCRA-Equivalent Cover)	Alternative 3: Excavate PT Soil; On-Post Landfill (RCRA-Equivalent Cover)
Agency Acceptance	*Not Acceptable.* Basin F PT soil is left in place and might not provide adequate long-term protection of groundwater.	*Acceptable.* Adequate long-term protection is provided through in situ solidification and subsequent containment beneath the RCRA-equivalent cover. Short-term risks to workers and the community are lower than excavation option.	*Preferred.* Containment in ELF provides better long-term effectiveness than in-place solidification. This alternative maximizes PT soil volume disposal. Short-term risks to workers and the community are higher during excavation, transportation and disposal activities, requiring odor/emission control.
Community Acceptance	*Least preferred.* Community prefers to address Basin F PT soil directly rather than leaving in place under the Basin F RCRA-equivalent cover.	No comments received on this alternative.	*Most Preferred* due to containment in ELF. Concerns were related to landfill capacity to allow disposal of waste from both the Lime Basins and Basin F projects and to odor control during excavation.

Table 8.0-1 Location-Specific ARARs and TBCs

Item	Citation	Requirement
Endangered Species Act	16 USC Section 1531	The requirements for the Endangered Species Act are embodied in § 44.2 (c) of the RMA FFA. Specifically, wildlife habitat shall be preserved and managed as necessary to protect endangered species of wildlife to the extent required by the Act, migratory birds to the extent required by the Migratory Bird Treaty Act, and bald eagles to the extent required by the Bald and Golden Eagle Protection Act. (**NOTE:** The cited acts are not ARARs, but independently apply to remedial activities.)
National Wildlife Refuge System Administration Act	16 USC 668dd 50 CFR 25	The National Wildlife Refuge Administration Act prohibits the taking or possessing of any fish, bird, mammal or other wild vertebrate or invertebrate animals or part or nest or egg thereof within any such area; or entering, using or otherwise occupying any such area for any purpose; unless such activities are performed by persons authorized to manage such area or unless such activities are permitted. (**NOTE:** NWRSAA is an independently applicable regulatory requirement, not an ARAR.)

Table 8.0-2 Chemical-Specific ARARs and TBCs

Item	Citation	Requirement
National Ambient Air Quality Standards	40 CFR 50	Sources cannot cause or contribute to an exceedance of a national ambient air quality standard.
Colorado Ambient Air Quality Standards	5 CCR 1001-5, Regulation 3 5 CCR 1001-14	Sources cannot cause or contribute to an exceedance of a national or ambient air quality standard as follows: • Lead—1.5 μg/m^3 (Max. arithmetic mean avg. over calendar quarter) • TSP—75 & 260 μg/m^3 (primary standard –annual (geometric), 24-hr) PM—150 & 50 μg/m^3 (24-hr average concentration & annual arithmetic mean, respectively)
Colorado Standards for Control of Hazardous Air Pollutants	5 CCR 1001-10 Regulation 8, Part C, Section 1	The standards for hazardous air pollutants are not to be exceeded.

Table 8.0-3 Action-Specific ARARS and TBCs for Lime Basins Remediation

Item	Citation	Requirement
Worker Protection		
Health and Safety Protection	29 CFR Part 1910	29 CFR Part 1910 provides guidelines for workers engaged in activities requiring protective health and safety measures regulated by OSHA. Requirements provided in 29 CFR 1910.120 apply specifically to the handling of hazardous waste/materials at controlled hazardous waste sites. Note: OSHA regulations are independently applicable regulatory requirements, not ARARs.
	29 CFR 1910.120 (b) to (j)	Provides guidelines for workers involved in hazardous waste operations and emergency response actions on sites regulated under RCRA and CERCLA. Specific provisions include the following: • Health and safety program participation required by on-site workers • Site characterization and analysis • Site control • On-site training • Medical surveillance • Engineering controls • Work practices • Personal protective equipment • Emergency response plan • Drum handling • Sanitation • Air monitoring
	29 CFR 1926 Subpart P	Provides guidelines for workers engaged in activities related to construction and utilization of trenches and ditches.
Worker Exposure	ACGIH 1991-1992 [TBC] NIOSH 1990 [TBC] 29 CFR 1910.1000	Chemical-specific worker exposure guidelines established by OSHA, ACGIH, and NIOSH. **Aldrin** ACGIH-TWA = 0.25 mg/m^3 (skin) NIOSH-REL = 0.25 mg/m^3 (skin) OSHA-PEL = 0.25 mg/m^3 (8- hr TWA) (skin) **Arsenic** ACGIH-TWA = 0.1 mg/m^3 OSHA-PEL = 10.0 g/m^3 (8- hr TWA) **Chlordane** ACGIH-TWA=0.5 mg/ m^3 (skin) NIOSH-REL=0.5 mg/ m^3 (skin) OSHA-PEL=0.5 mg/ m^3 (8-hr TWA)(skin) **DDT** ACGIH-TWA = 1 mg/m^3 NIOSH-REL = 0.5 mg/m^3 OSHA-PEL =1 mg/m^3 (8- hr TWA) (skin) **Dieldrin** ACGIH-TWA=0.25 mg/m^3 (skin) NIOSH-REL=0.25 mg/m^3 OSHA-PEL=0.25 mg/m^3 (skin) **Endrin** ACGIH-TWA=0.1 mg/m^3 (skin) NIOSH-REL=0.1 mg/m^3 (10-hr TWA) (skin) OSHA-PEL=0.1 mg/m^3 (8-hr TWA) (skin) **Mercury (as Hg inorganic)** ACGIH-TWA vapor=0.025 mg/ m^3 (skin) NIOSH-REL vapor=0.05mg/ m^3 (10 hour TWA)(skin) OSHA-Ceiling= 0.1 mg/ m^3(skin)

Item	Citation	Requirement
Air/Odor Emissions		
Particulate Emissions During Excavation/ Cap/Cover Installation	5 CCR 1001-3, Regulation 1, Section III (D) (h) (iii) 5 CCR 1001-5, Regulation 3 5 CCR 1001-2, Section II	Colorado air pollution regulations require owners or operators of sources that emit fugitive particulates to minimize emissions through use of all available methods to reduce, prevent, and control emissions. In addition, no off-site transport of particulate matter is allowed. Estimated air emissions from the proposed remedial activity per Colorado APEN requirements.
Emission of hazardous air pollutants	5 CCR 1001-10, Regulation 8 40 CFR Part 61 42 USC Section 7412	Emission of certain hazardous air pollutants is controlled by NESHAPs. Remedial activities could cause volatization of some organic and/or metal contaminants. • Emissions to the atmosphere from mercury shall not exceed 1,600 grams/24 hr. period
Odor emissions	5 CCR 1001-4, Regulation 2	Colorado odor emission regulations require that no person shall allow emission of odorous air contaminants that result in detectable odors that are measured at the fence line in excess of the following limits: 1. For residential and commercial areas—odors detected after the odorous air has been diluted with seven more volumes of odor-free air 2. For all other land use areas—odors detected after the odorous air has been diluted with 15 more volumes of odor-free air
Volatile organic chemical emissions	5 CCR 1001-9, Regulation 7 Subparts III and IV	VOC regulations apply to ozone nonattainment areas. The air quality control area for RMA is currently nonattainment for ozone. Storage and transfer of VOCs and petroleum liquids are controlled by these requirements. Disposal of VOCs is regulated for all areas, including ozone nonattainment. The regulations control the disposal of VOCs by evaporation or spilling unless reasonable available control technologies are utilized.
Emission Control for Opacity	5 CCR 1001-3 Regulation 1, Section II	Slurry walls shall not cause the emission into the atmosphere of any air pollutant which is in excess of 20% opacity.
Air emissions from diesel-powered vehicles associated with excavation and backfill operations	5 CCR 1001-15, Regulation 12	Applies to motor vehicles intended, designed and manufactured primarily for use in carrying passengers or cargo on roads, streets, and highways, and state as follows: 1. No person shall emit or cause to be emitted into the atmosphere from any diesel-powered motor vehicle weighing 7,500 pounds and less, empty weight, any air contaminant, for a period greater than 5 consecutive seconds, which is of such a shade or density as to obscure an observer's vision to a degree in excess of 40% opacity. 2. No person shall emit or cause to be emitted into the atmosphere from any diesel-powered motor vehicle weighing more than 7,500 pounds, empty weight, any air contaminant, for a period greater than 5 consecutive seconds, which is of such a shade or density as to obscure an observer's vision to a degree in excess of 35% opacity, with the exception of subpart "C." 3. No person shall emit or cause to be emitted into the atmosphere from any naturally aspired (non-turbocharged) diesel-powered motor vehicle weighing 7,500 pounds and less, empty weight, any air contaminant, for a period greater than 5 consecutive seconds, which is of such a shade or density as to obscure an observer's vision to a degree in excess of 40% opacity. 4. Any diesel-powered motor vehicle exceeding these requirements shall be exempt for a period of 10 minutes if the emissions are a direct result of a cold engine start-up and provided the vehicle is in a stationary position.

Item	Citation	Requirement
		5. These standards shall apply to motor vehicles intended, designed, and manufactured primarily for travel or use in transporting persons, property, auxiliary equipment, and/or cargo over roads, streets, and highways. **NOTE: A diesel vehicle does not include the following: vehicles registered pursuant to 42-3-123(11) or 42-3-128, CRS; off-the-road diesel powered vehicles or heavy construction equipment.**
Visibility Protection	40 CFR 51.300-307 40 CFR 52.26-29 5 CCR 1001-14	Remediation activities must be conducted in a manner that does not cause adverse impacts on visibility. Visibility impairment interferes with the management, protection, preservation or enjoyment of federal Class I areas.
Smoke and opacity	5 CCR 1001-3, Regulation 1, Section II.A.(2)	Remediation activities must be conducted in a manner that will not allow or cause emission into the atmosphere of any pollutant that is in excess of the applicable opacity standard.
<u>Construction of Caps and Covers</u>		
Design and Installation of caps/covers	Final Covers on Hazardous Waste Landfills and Surface Impoundments EPA/530/SW-89/047 [TBC]	Caps and covers must be designed and installed to prevent wind dispersal of hazardous wastes. They should be designed, constructed and installed as specified in EPA/530/SW-89/047.
	40 CFR 264.310 6 CCR 1007-3, Part 264.310	Final covers must be designed and constructed to meet the requirements of 40 CFR 264.310 for proper closure and post-closure care.
<u>Stormwater Management</u>		
Discharge of stormwater to on-post surface water	40 CFR Part 122-125	Stormwater runoff, snow melt runoff, and surface runoff and drainage associated with industrial activity (as defined in 40 CFR 122) from RMA remedial actions that disturb 5 acres or more and that discharge to surface waters must be conducted in compliance with the stormwater management regulations.
<u>Groundwater Reinjection</u>		
Reinjection of Treated Groundwater	RCRA Section 3020(b) OSWER Directive 9234.1-06 [TBC] 40 CFR 124, 144, 146, 147 (Subpart G) and 148	Reinjection of treated groundwater must be managed in accordance with guidelines in OSWER Directive 9234.1-06. Wells must be constructed and installed and managed in accordance with the substantive requirements of 40 CFR 124, 144, 146, 147 (Subpart G) and 148.
<u>Monitoring</u>		
Groundwater Monitoring	40 CFR 264 Subpart G 6 CCR 1007-3 Part 264 Subpart F 2CCR 402-2, Rule 10 TEGD [TBC] 6 CCR 1007-3	Groundwater monitoring will be conducted for the presence of hazardous constituents in the groundwater downgradient from the solid waste management unit. Monitoring wells should be constructed and installed according to the requirements of 2 CCR 402-02, Rule 10 and the guidance in the RCRA Groundwater Monitoring Technical Enforcement Guidance Document. Colorado groundwater regulations specify requirements for determining groundwater quality.

Table 8.0-3 Action-Specific ARARS and TBCs for Lime Basins Remediation

Item	Citation	Requirement
Wastewater Management		
Discharge of liquid wastes and wastewater	40 CFR Part 122 40 CFR Part 125 40 CFR Part 129 40 CFR Part 262 6 CCR 1007-3, Part 262	Any wastewater generated during remedial activities will be routed to the on-post CERCLA Wastewater Treatment Plant if it is not hazardous waste and will not interrupt the existing treatment system. If wastewater is routed to the on-post treatment plant, it must be treated in accordance with NPDES requirements. Wastewater that is determined to be a hazardous waste must be treated in accordance with the provisions of RCRA.
Waste Characterization		
Solid waste determination	40 CFR 260, 260.30-.31, 261.2, 261.4 6 CCR 1007-3 260, 260.30, 260.31, 261.2, 261.4	A solid waste is any discarded material not excluded by a variance granted under 40 CFR 260.30 and 260.31. Discarded material includes abandoned, recycled, and waste-like materials.
Solid waste classification	6 CCR 1007-2, Section I	Wastes that do not meet the criteria for hazardous wastes are classified as solid wastes. Colorado solid waste rules contain five solid waste categories: industrial wastes, community wastes, commercial wastes, special wastes, and inert material.
Determination of Hazardous waste	40 CFR 262.11 6 CCR 1007-3, Section 262.11 40 CFR Part 261 6 CCR 1007-3, Part 261	Wastes generated during excavation activities must be characterized and evaluated according to the following method to determine whether the waste is hazardous: · Determine whether the waste is identified in 40 CFR 261.4. · Determine whether the waste is listed under 40 CFR 261. · Determine whether the waste is identified in 40 CFR 261 by testing the waste according to specified test methods or by applying knowledge of the hazardous characteristics of the waste in light of the materials or the process used.
Waste Management		
Treatment, storage, or disposal of RCRA hazardous waste	40 CFR Part 264 6 CCR 1007-3, Part 264 40 CFR Part 268 6 CCR 1007-3, Part 268	If remediation of waste/soil at RMA generates hazardous wastes, the wastes must be treated, stored, or disposed in accordance with substantive requirements of RCRA regulations.
	40 CFR 264.171-173 6 CCR 1007-3, Section 264.171-173.	Requirements for managing containers used to store hazardous wastes.
	40 CFR 264.16 (a) (1) 6 CCR 1007-3, Section 264. 16 (a)(1).	Requirements for personnel training.
	40 CFR 264.52 (a) 6 CCR 1007-3, Section 264.52(a).	Requirements for preparing contingency plan.
	40 CFR 264.97(g)(3)	General groundwater monitoring requirements.
	40 CFR 264.190(c)	Applicability of requirements for tanks and/or tank systems.
	40 CFR 264 Subpart CC	Air emissions from tanks.

Item	Citation	Requirement
Treatment, storage and disposal of hazardous debris	40 CFR 264.52 (a) 40 CFR 268.45 6 CCR 1007-3, Section 268.45	Hazardous debris must be treated using specific technologies to extract, destroy, or immobilize hazardous constituents on or in the debris. In certain cases after treatment, the debris may no longer be subject to RCRA subtitle C regulation.
Corrective Action Management Units	40 CFR 264, Subpart S 6 CCR 1007-3, Part 264, Subpart S	The CAMU regulations allow for exceptions from otherwise generally applicable LDRs and minimum technology requirements for remediation wastes managed at CAMUs. These regulations provide flexibility and allow for expedition of remedial decisions in the management of remediation wastes. One or more CAMUs may be designated at a facility. Placement of hazardous remediation wastes into or within the CAMU does not constitute land disposal of hazardous wastes, so the LDRs are not triggered.
Temporary Units (TU)	6 CCR 1007-3, Section 264.553 40 CFR 264.553	Design, operating or closure standards for temporary tanks and container storage areas may be replaced by alternative requirements. The TU must be located within the facility boundary, used only for treatment/storage of remediation waste, and will be limited to one year of operation with a one-year extension upon approval by the regulatory authority.
Chemical Agent Decontamination		
Agent Decontamination	AR 385-61	Decontamination of chemical agent-contaminated material will comply with the requirements of AR 385-61 and AR 50-6.
Access Restrictions		
Access Controls	40 CFR 264.14 6 CCR 1007-3, Section 264.14	Access controls will be provided that will prevent unknowing entry and minimize unauthorized entry of persons or livestock into active portions of RMA. These may include 24-hour surveillance or a barrier (either natural or artificial) and means of controlling access.
Land Use/Deed Restrictions		
Land Use and Deed Restrictions for Former Hazardous Waste Disposal Units	40 CFR 264.119 6 CCR 1007-3, Section 264.119	If RMA ceases to be a federal government property, a notation on the deed must indicate that the land was previously used to manage hazardous wastes and its use is restricted under 40 CFR 264 Subpart G regulations. A record of the type, location, and quantity of hazardous waste managed at each disposal unit must be supplied to the local zoning authority or through authority over local land use.
Transportation		
On-Post Transportation	5 CCR 1001-15, Regulation 12 5 CCR 1001-4, Regulation 2 5 CCR 1001-3, Regulation 1 Section III (D)(2) 5 CCR 1001-5, Regulation 3	All on-post shipments of hazardous waste may be required to meet the provisions of 5 CCR 1001, 40 CFR Parts 52 and 81, and AR 50-6 including, but not limited to the following: 1. Transportation of wastes in diesel-powered vehicles may be subject to state opacity and visibility standards. 2. Loading, unloading, or transportation of wastes may cause odors or emissions from contaminants that exceed state odor limits. 3. Transportation on unpaved roadways may be subject to state requirements to reduce particulate emissions resulting from the use of the roadway.

Item	Citation	Requirement
Noise		
Noise Abatement	Colorado Revised Statue, Section 25-12-103	The Colorado noise Abatement Statute provides that: 1. Applicable activities shall be conducted in a manner so any noise produced is not objectionable due to intermittence, beat frequency, or shrillness. Noise is defined to be a public nuisance if sound levels radiating from a property line at a distance of twenty-five feet or more exceed the sound levels established for the specified time periods and zones. **Zone** / **7:00 a.m. to next 7:00 p.m.** / **7:00 p.m. to next 7:00 a.m.** Residential / 55 db(A) / 50 db(A) Commercial / 60 db(A) / 55 db(A) Light Industrial / 70 db(A) / 65 db(A) Industrial / 80 db(A) / 75 db(A) 2. In the hours between 7:00 a.m. and the next 7:00 p.m., the noise levels permitted in Requirement a (above) may be increased by 10 decibels for a period not to exceed 15 minutes in any one-hour period. 3. Periodic, impulsive, or shrill noises shall be considered a public nuisance when such noises are at a sound level of 5 decibels less than those listed in Requirement a (above). 4. Construction projects shall be subject to the maximum permissible noise levels specified for industrial zones for the period within which construction is to be completed pursuant to any applicable construction permit issued by proper authority or, if no time limitation is imposed, for a reasonable period of time for completion of the project. 5. For the purpose of this article, measurements with sound level meters shall be made when the wind velocity at the time and place of such measurement is not more than 5 miles per hour. 6. In all sound level measurements, consideration shall be given to the effect of the ambient noise level created by the encompassing noise of the environment from all sources at the time and place of such sound level measurements.

Table 8.0-4 Action-Specific ARARS and TBCs for Basin F PT Soil Remediation

Item	Citation	Requirement
Worker Protection		
Health and Safety Protection	29 CFR Part 1910	29 CFR Part 1910 provides guidelines for workers engaged in activities requiring protective health and safety measures regulated by OSHA. Requirements provided in 29 CFR 1910.120 apply specifically to the handling of hazardous waste/materials at controlled hazardous waste sites. Note: OSHA regulations are independently applicable regulatory requirements, not ARARs.
	29 CFR 1910.120 (b) to (j)	Provides guidelines for workers involved in hazardous waste operations and emergency response actions on sites regulated under RCRA and CERCLA. Specific provisions include the following: · Health and safety program participation required by on-site workers · Site characterization and analysis · Site control · On-site training · Medical surveillance · Engineering controls · Work practices · Personal protective equipment · Emergency response plan · Drum handling · Sanitation · Air monitoring
	29 CFR 1926 Subpart P	Provides guidelines for workers engaged in activities related to construction and utilization of trenches and ditches.
Worker Exposure	ACGIH 1991-1992 [TBC] NIOSH 1990 [TBC] 29 CFR 1910.1000	Chemical-specific worker exposure guidelines established by OSHA, ACGIH, and NIOSH. **Aldrin** ACGIH-TWA = 0.25 mg/m^3 (skin) NIOSH-REL = 0.25 mg/m^3 (skin) OSHA-PEL = 0.25 mg/m^3 (8- hr TWA) (skin) **Dieldrin** ACGIH-TWA=0.25 mg/m^3 (skin) NIOSH-REL=0.25 mg/m^3 OSHA-PEL=0.25 mg/m^3 (skin) **Endrin** ACGIH-TWA=0.1 mg/m^3 (skin) NIOSH-REL=0.1 mg/m^3 (10-hr TWA) (skin) OSHA-PEL=0.1 mg/m^3 (8-hr TWA) (skin) **Dicyclopentadiene (DCPD)** ACGIH-TWA=5 ppm, 27 mg/ m^3 OSHA-PEL=5 ppm, 30 mg/ m^3 (8 hour TWA)(skin) **Chloroacetic Acid** Animal toxicity data only

Item	Citation	Requirement
Air/Odor Emissions		
Particulate Emissions During Excavation/ Cap/Cover Installation	5 CCR 1001-3, Regulation 1, Section III (D) (h) (iii) 5 CCR 1001-5, Regulation 3 5 CCR 1001-2, Section II	Colorado air pollution regulations require owners or operators of sources that emit fugitive particulates to minimize emissions through use of all available methods to reduce, prevent, and control emissions. In addition, no off-site transport of particulate matter is allowed. Estimated air emissions from the proposed remedial activity per Colorado APEN requirements.
Emission of hazardous air pollutants	5 CCR 1001-10, Regulation 8 40 CFR Part 61 42 USC Section 7412	Emission of certain hazardous air pollutants is controlled by NESHAPs. Remedial activities could cause volatization of some organic and/or metal contaminants. • Emissions to the atmosphere from mercury shall not exceed 1,600 grams/24 hr. period • Lead 1.5 $\mu g/m^3$ (Average over month)
Odor emissions	5 CCR 1001-4, Regulation 2	Colorado odor emission regulations require that no person shall allow emission of odorous air contaminants that result in detectable odors that are measured at the fence line in excess of the following limits: 1. For residential and commercial areas—odors detected after the odorous air has been diluted with seven more volumes of odor-free air 2. For all other land use areas—odors detected after the odorous air has been diluted with 15 more volumes of odor-free air
Volatile organic chemical emissions	5 CCR 1001-9, Regulation 7 Subparts III and IV	VOC regulations apply to ozone nonattainment areas. The air quality control area for RMA is currently nonattainment for ozone. Storage and transfer of VOCs and petroleum liquids are controlled by these requirements. Disposal of VOCs is regulated for all areas, including ozone nonattainment. The regulations control the disposal of VOCs by evaporation or spilling unless reasonable available control technologies are utilized.
Air emissions from diesel-powered vehicles associated with excavation and backfill operations	5 CCR 1001-15, Regulation 12	Applies to motor vehicles intended, designed and manufactured primarily for use in carrying passengers or cargo on roads, streets, and highways, and state as follows: 1. No person shall emit or cause to be emitted into the atmosphere from any diesel-powered motor vehicle weighing 7,500 pounds and less, empty weight, any air contaminant, for a period greater than 5 consecutive seconds, which is of such a shade or density as to obscure an observer's vision to a degree in excess of 40% opacity. 2. No person shall emit or cause to be emitted into the atmosphere from any diesel-powered motor vehicle weighing more than 7,500 pounds, empty weight, any air contaminant, for a period greater than 5 consecutive seconds, which is of such a shade or density as to obscure an observer's vision to a degree in excess of 35% opacity, with the exception of subpart "C." 3. No person shall emit or cause to be emitted into the atmosphere from any naturally aspired (non-turbocharged) diesel-powered motor vehicle weighing 7,500 pounds and less, empty weight, any air contaminant, for a period greater than 5 consecutive seconds, which is of such a shade or density as to obscure an observer's vision to a degree in excess of 40% opacity. 4. Any diesel-powered motor vehicle exceeding these requirements shall be exempt for a period of 10 minutes if the emissions are a direct result of a cold engine start-up and provided the vehicle is in a stationary position.

Item	Citation	Requirement
		5. These standards shall apply to motor vehicles intended, designed, and manufactured primarily for travel or use in transporting persons, property, auxiliary equipment, and/or cargo over roads, streets, and highways. **NOTE: A diesel vehicle does not include the following: vehicles registered pursuant to 42-3-123(11) or 42-3-128, CRS; off-the-road diesel powered vehicles or heavy construction equipment.**
Visibility Protection	40 CFR 51.300-307 40 CFR 52.26-29 5 CCR 1001-14	Remediation activities must be conducted in a manner that does not cause adverse impacts on visibility. Visibility impairment interferes with the management, protection, preservation or enjoyment of federal Class I areas.
Smoke and opacity	5 CCR 1001-3, Regulation 1, Section II.A.(2)	Remediation activities must be conducted in a manner that will not allow or cause emission into the atmosphere of any pollutant that is in excess of the applicable opacity standard.
<u>Construction of Caps and Covers</u>		
Design and Installation of caps/covers	Final Covers on Hazardous Waste Landfills and Surface Impoundments EPA/530/SW-89/047 [TBC]	Caps and covers must be designed and installed to prevent wind dispersal of hazardous wastes. They should be designed, constructed and installed as specified in EPA/530/SW-89/047.
	40 CFR 264.310 6 CCR 1007-3, Part 264.310	Final covers must be designed and constructed to meet the requirements of 40 CFR 264.310 for proper closure and post-closure care.
<u>Stormwater Management</u>		
Discharge of stormwater to on-post surface water	40 CFR Part 122-125	Stormwater runoff, snow melt runoff, and surface runoff and drainage associated with industrial activity (as defined in 40 CFR 122) from RMA remedial actions that disturb 5 acres or more and that discharge to surface waters must be conducted in compliance with the stormwater management regulations.
<u>Monitoring</u>		
Groundwater Monitoring	40 CFR 264 Subpart G 6 CCR 1007-3 Part 264 Subpart F 2CCR 402-2, Rule 10 TEGD [TBC] 6 CCR 1007-3	Groundwater monitoring will be conducted for the presence of hazardous constituents in the groundwater downgradient from the solid waste management unit. Monitoring wells should be constructed and installed according to the requirements of 2 CCR 402-02, Rule 10 and the guidance in the RCRA Groundwater Monitoring Technical Enforcement Guidance Document. Colorado groundwater regulations specify requirements for determining groundwater quality.
<u>Wastewater Management</u>		
Discharge of liquid wastes and wastewater	40 CFR Part 122 40 CFR Part 125 40 CFR Part 129	Any wastewater generated during remedial activities will be routed to the on-post CERCLA Wastewater Treatment Plant if it is not hazardous waste and will not interrupt the existing treatment system. If wastewater is routed to the on-post treatment plant, it must be treated in accordance with NPDES requirements.
	40 CFR Part 262 6 CCR 1007-3, Part 262	Wastewater that is determined to be a hazardous waste must be treated in accordance with the provisions of RCRA.

Item	Citation	Requirement
Waste Characterization		
Solid waste determination	40 CFR 260, 260.30-.31, 261.2, 261.4 6 CCR 1007-3 260, 260.30, 260.31, 261.2, 261.4	A solid waste is any discarded material not excluded by a variance granted under 40 CFR 260.30 and 260.31. Discarded material includes abandoned, recycled, and waste-like materials.
Solid waste classification	6 CCR 1007-2, Section I	Wastes that do not meet the criteria for hazardous wastes are classified as solid wastes. Colorado solid waste rules contain five solid waste categories: industrial wastes, community wastes, commercial wastes, special wastes, and inert material.
Determination of Hazardous waste	40 CFR 262.11 6 CCR 1007-3, Section 262.11 40 CFR Part 261 6 CCR 1007-3, Part 261	Wastes generated during excavation activities must be characterized and evaluated according to the following method to determine whether the waste is hazardous: • Determine whether the waste is identified in 40 CFR 261.4. • Determine whether the waste is listed under 40 CFR 261. • Determine whether the waste is identified in 40 CFR 261 by testing the waste according to specified test methods or by applying knowledge of the hazardous characteristics of the waste in light of the materials or the process used.
Waste Management		
Treatment, storage, or disposal of RCRA hazardous waste	40 CFR Part 264 6 CCR 1007-3, Part 264 40 CFR Part 268 6 CCR 1007-3, Part 268	If remediation of waste/soil at RMA generates hazardous wastes, the wastes must be treated, stored, or disposed in accordance with substantive requirements of RCRA regulations.
	40 CFR 264.171-173 6 CCR 1007-3, Section 264.171-173.	Requirements for managing containers used to store hazardous wastes.
	40 CFR 264.16 (a) (1) 6 CCR 1007-3, Section 264. 16 (a)(1).	Requirements for personnel training.
	40 CFR 264.52 (a) 6 CCR 1007-3, Section 264.52(a).	Requirements for preparing contingency plan.
	40 CFR 264.97(g)(3)	General groundwater monitoring requirements.
Treatment, storage and disposal of hazardous debris	40 CFR 264.52 (a) 40 CFR 268.45 6 CCR 1007-3, Section 268.45	Hazardous debris must be treated using specific technologies to extract, destroy, or immobilize hazardous constituents on or in the debris. In certain cases after treatment, the debris may no longer be subject to RCRA subtitle C regulation.
Corrective Action Management Units	40 CFR 264, Subpart S 6 CCR 1007-3, Part 264, Subpart S	The CAMU regulations allow for exceptions from otherwise generally applicable LDRs and minimum technology requirements for remediation wastes managed at CAMUs. These regulations provide flexibility and allow for expedition of remedial decisions in the management of remediation wastes. One or more CAMUs may be designated at a facility. Placement of hazardous remediation wastes into or within the CAMU does not constitute land disposal of hazardous wastes, so the LDRs are not triggered.

Table 8.0-4 Action-Specific ARARS and TBCs for Basin F PT Soil Remediation

Item	Citation	Requirement
Temporary Units (TU)	6 CCR 1007-3, Section 264.553 40 CFR 264.553	Design, operating or closure standards for temporary tanks and container storage areas may be replaced by alternative requirements. The TU must be located within the facility boundary, used only for treatment/storage of remediation waste, and will be limited to one year of operation with a one-year extension upon approval by the regulatory authority.
Access Restrictions		
Access Controls	40 CFR 264.14 6 CCR 1007-3, Section 264.14	Access controls will be provided that will prevent unknowing entry and minimize unauthorized entry of persons or livestock into active portions of RMA. These may include 24-hour surveillance or a barrier (either natural or artificial) and means of controlling access.
Land Use/Deed Restrictions		
Land Use and Deed Restrictions for Former Hazardous Waste Disposal Units	40 CFR 264.119 6 CCR 1007-3, Section 264.119	If RMA ceases to be a federal government property, a notation on the deed must indicate that the land was previously used to manage hazardous wastes and its use is restricted under 40 CFR 264 Subpart G regulations. A record of the type, location, and quantity of hazardous waste managed at each disposal unit must be supplied to the local zoning authority or through authority over local land use.
Transportation		
On-Post Transportation	5 CCR 1001-15, Regulation 12 5 CCR 1001-4, Regulation 2 5 CCR 1001-3, Regulation 1 Section III (D)(2) 5 CCR 1001-5, Regulation 3	All on-post shipments of hazardous waste may be required to meet the provisions of 5 CCR 1001, 40 CFR Parts 52 and 81, and AR 50-6 including, but not limited to the following: 1. Transportation of wastes in diesel-powered vehicles may be subject to state opacity and visibility standards. 2. Loading, unloading, or transportation of wastes may cause odors or emissions from contaminants that exceed state odor limits. 3. Transportation on unpaved roadways may be subject to state requirements to reduce particulate emissions resulting from the use of the roadway.
Noise		
Noise Abatement	Colorado Revised Statue, Section 25-12-103	The Colorado noise Abatement Statute provides that: 1. Applicable activities shall be conducted in a manner so any noise produced is not objectionable due to intermittence, beat frequency, or shrillness. Noise is defined to be a public nuisance if sound levels radiating from a property line at a distance of twenty-five feet or more exceed the sound levels established for the specified time periods and zones. **Zone** / **7:00 a.m. to next 7:00 p.m.** / **7:00 p.m. to next 7:00 a.m.** Residential / 55 db(A) / 50 db(A) Commercial / 60 db(A) / 55 db(A) Light Industrial / 70 db(A) / 65 db(A) Industrial / 80 db(A) / 75 db(A) 2. In the hours between 7:00 a.m. and the next 7:00 p.m., the noise levels permitted in Requirement a (above) may be increased by 10 decibels for a period not to exceed 15 minutes in any one-hour period. 3. Periodic, impulsive, or shrill noises shall be considered a public nuisance when such noises are at a sound level of 5 decibels less than those listed in Requirement a (above).

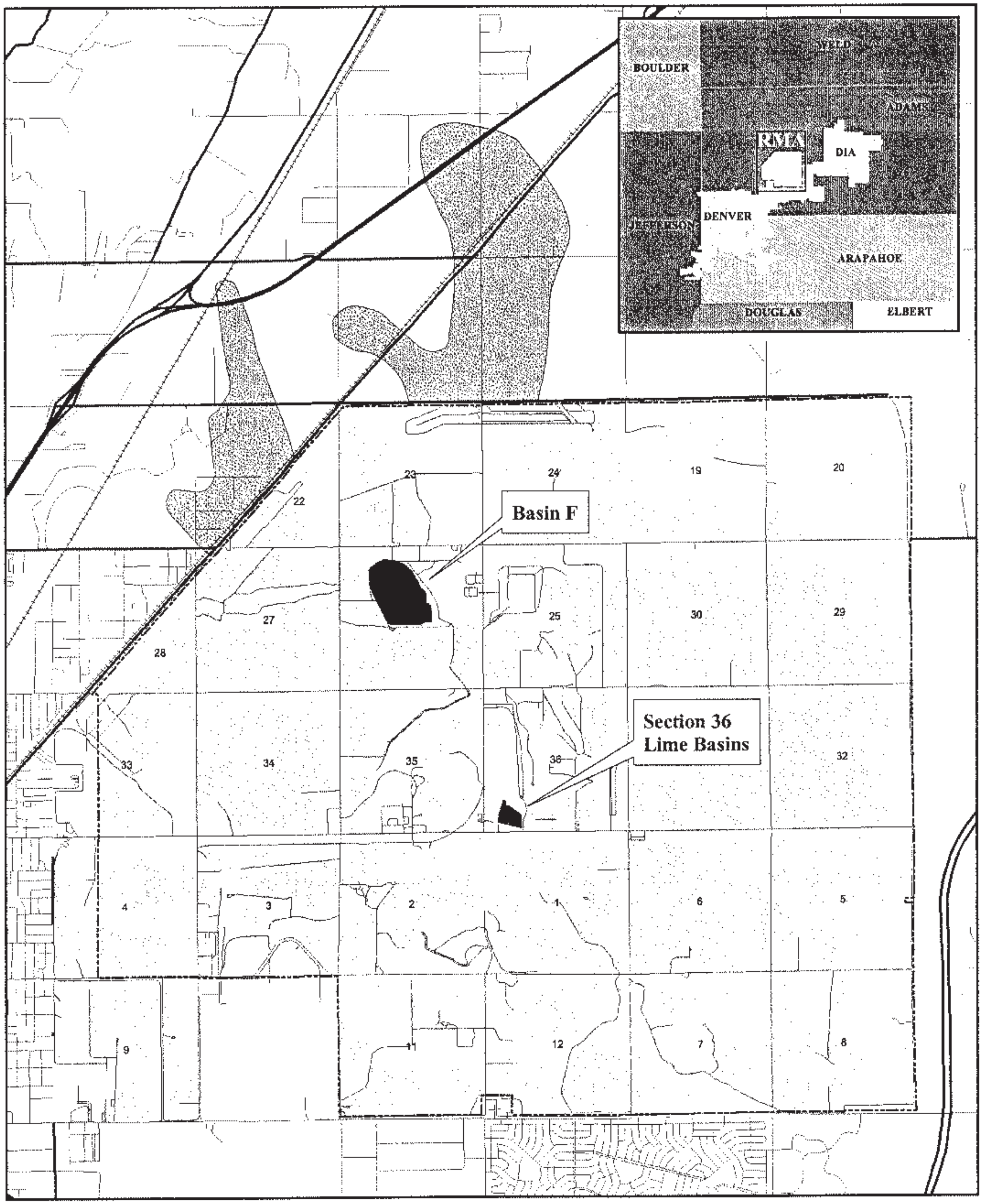
Table 8.0-4 Action-Specific ARARS and TBCs for Basin F PT Soil Remediation

Item	Citation	Requirement
		4. Construction projects shall be subject to the maximum permissible noise levels specified for industrial zones for the period within which construction is to be completed pursuant to any applicable construction permit issued by proper authority or, if no time limitation is imposed, for a reasonable period of time for completion of the project 5. For the purpose of this article, measurements with sound level meters shall be made when the wind velocity at the time and place of such measurement is not more than 5 miles per hour. 6. In all sound level measurements, consideration shall be given to the effect of the ambient noise level created by the encompassing noise of the environment from all sources at the time and place of such sound level measurements.
Interim Status Closure/Post-Closure Plan Requirements		
Surface Impoundment Closure/Post Closure Care	6 CCR 1007-3, Section 265.228(a)(2)	Close the impoundment and provide post-closure care for a surface impoundment undergoing closure under Subpart G and 265.310.
Surface Impoundment Closure Performance Standard	6 CCR 1007-3, Section 265.111	Close the surface impoundment in a manner that minimizes the need for further maintenance, and controls, minimizes or eliminates, post-closure escape of hazardous waste, hazardous constituents, leachate, or contaminated runoff to the ground or surface waters or to the atmosphere.
Amend Closure Plan	6 CCR 1007-3 Section 265.112 (c) and (d)(4)	Amend Closure Plan to incorporate Design Analysis content. Obtain CDPHE approval of the amended plan, and solicit public comment, in accordance with 6 CCR 1007-3, Section 265.112 (d)(4) at least 60 days prior to initiating proposed actions.
Manifest Requirements	6 CCR 1007-3 Section 262, Subpart B	Waste designated for off-site disposal as a RCRA hazardous waste must be accompanied by a proper manifest.
Certification of Closure	6 CCR 1007-3 Section 265.115	Submit Closure Certification within 60 days of closure completion, signed by the owner or operator and by an independent Colorado registered professional engineer, certifying that the Wastepile has been closed in accordance with the Closure Plan.
Groundwater Sampling and Analysis	6 CCR 1007-3. 265.92	Groundwater (GW) samples to be collected per Groundwater Monitoring Plan (GWMP) approved by CDPHE. Samples to be analyzed to indicated parameters in the GWMP.
Groundwater Data Evaluation	6 CCR 1007-3. 265.93	Collected data to be evaluated with regard to monitoring GW in uppermost aquifer.
Survey Plat	6 CCR 1007-3.265.116	At completion of closure activities, a survey plat showing the location and dimensions of HW disposal units with respect to survey benchmarks will be submitted.
Post Closure	6 CCR 1007-3.265.117,-120, .228, .258 and .310	Basin F complies with post closure care outlined under these requirements. Post-closure is a 30 year period unless Army requests reduction.
Notation in the Deed	6 CCR 1007-3.265.119(a)	The post-closure certification is to also include a copy of the survey plat deed recordation. A record of the type, quantity of HW disposed in Basin F will also be submitted within 60-days after certification of closure of Basin F.
Certification of Post-Closure	6 CCR 1007-3 Section 265.120	Within 60 days after post-closure care of Basin F is completed, post-closure monitoring results to be reviewed by the Army and an independent Professional Engineer and a certification report is to be submitted (by registered mail).

Table 9.6-1 Community Involvement Activities Conducted at RMA Pertinent to the Lime Basins and Basin F Remediation

Public Comment Period or Date of Public Meeting	Document Provided or Topic Discussed
March 27, 2003 to April 26, 2003	Lime Basins Soil Remediation 30 Percent Design
April 24, 2003	Public Availability Session on the Lime Basins, RAB meeting, Discussion on Lime Basins history, site characterization, and 30 percent design package
May 22, 2003	Provided feedback to RAB based on questions from the April 24, 2003 meeting
July 31, 2003	Released Fact Sheet for the Basin F boundary change (RVO 2003)
November 4, 2003	Public Availability Session on the Lime Basins, RAB meeting, Discussion on Lime Basins 60 percent design package
July 29, 2004	RAB meeting, presentation and discussion on the Lime Basins/Former Basin F Solidification proposed remedy changes
August 17, 2004	SSAB meeting, presentation and discussion on the Lime Basins/Former Basin F Solidification proposed remedy changes
August 26, 2004	RAB meeting, answered additional RAB questions concerning the Lime Basins/Former Basin F Solidification proposed remedy changes
October 19, 2004	Mailed responses to questions raised by the SSAB at the August 17, 2004 SSAB meeting
April 20, 2005 to June 20, 2005	Revised Proposed Plan for the Rocky Mountain Arsenal On-Post Operable Unit, Section 36 Lime Basins and Former Basin F (PMRMA 2005)
April 21, 2005	Citizens Improvement Area Committee presentation and discussion on the Lime Basins/Former Basin F Solidification proposed remedy changes
May 12, 2005	Public Meeting at the Commerce City Recreational Center for the Revised Proposed Plan for the Rocky Mountain Arsenal On-Post Operable Unit, Section 36 Lime Basins and Former Basin F. The presentation included information about the original ROD remedies, design issues, proposed alternatives and the public comment period information.
June 6, 2005	Responses to SSAB questions raised at the May 12, 2005 public meeting were mailed to SSAB members
June 7, 2005	SSAB meeting, follow-up presentation on groundwater questions raised at the public meeting
July 25, 2005	Mailed responses to questions raised by the SSAB at the June 7, 2005 SSAB meeting

FIGURES



ROCKY MOUNTAIN ARSENAL
Project Location Reference

Off-post Operable Unit

On-post Operable Unit
(Remedy complete in hatched area)

Implementation Project

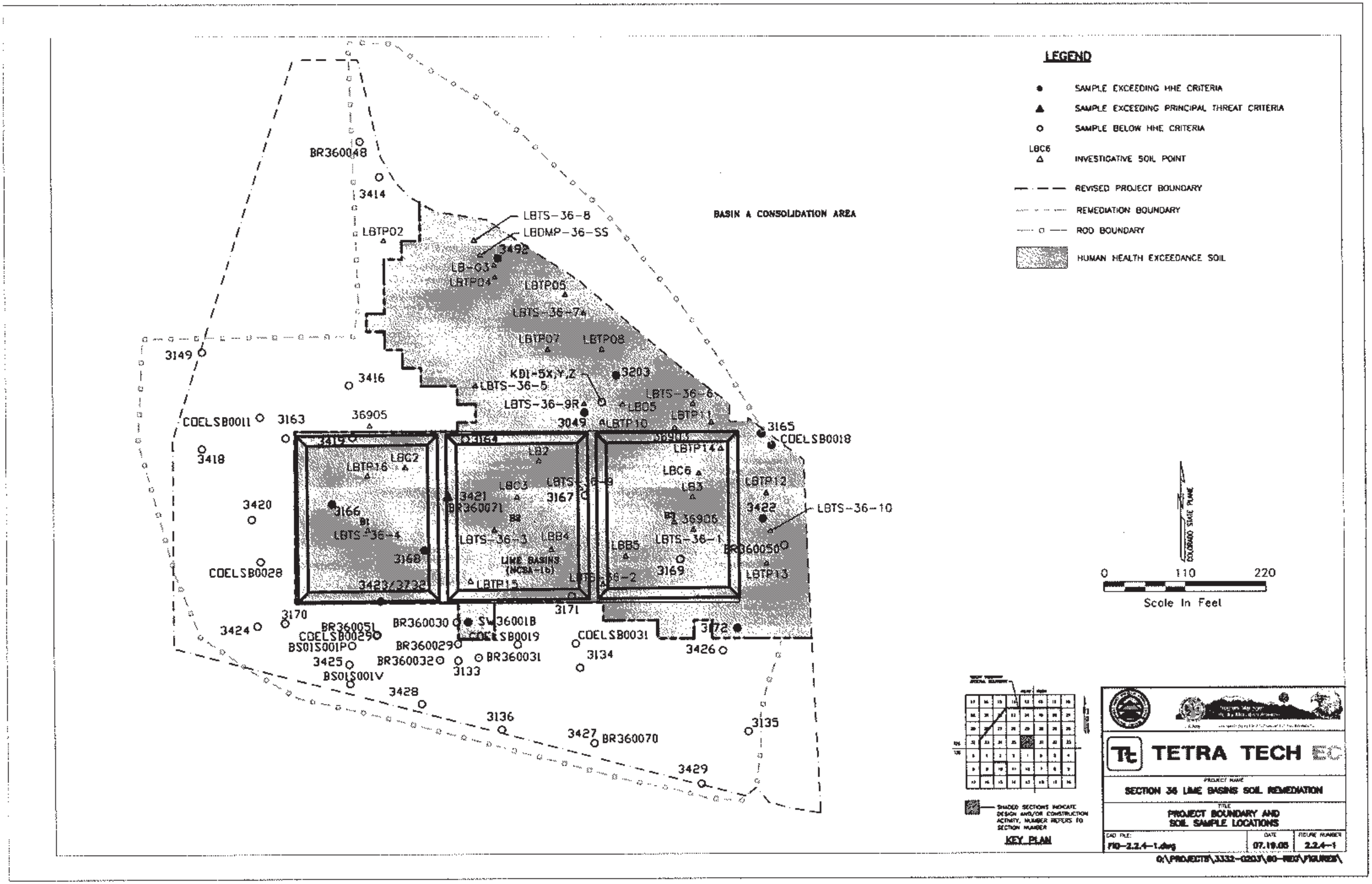
Rocky Mountain Arsenal
National Wildlife Refuge

N

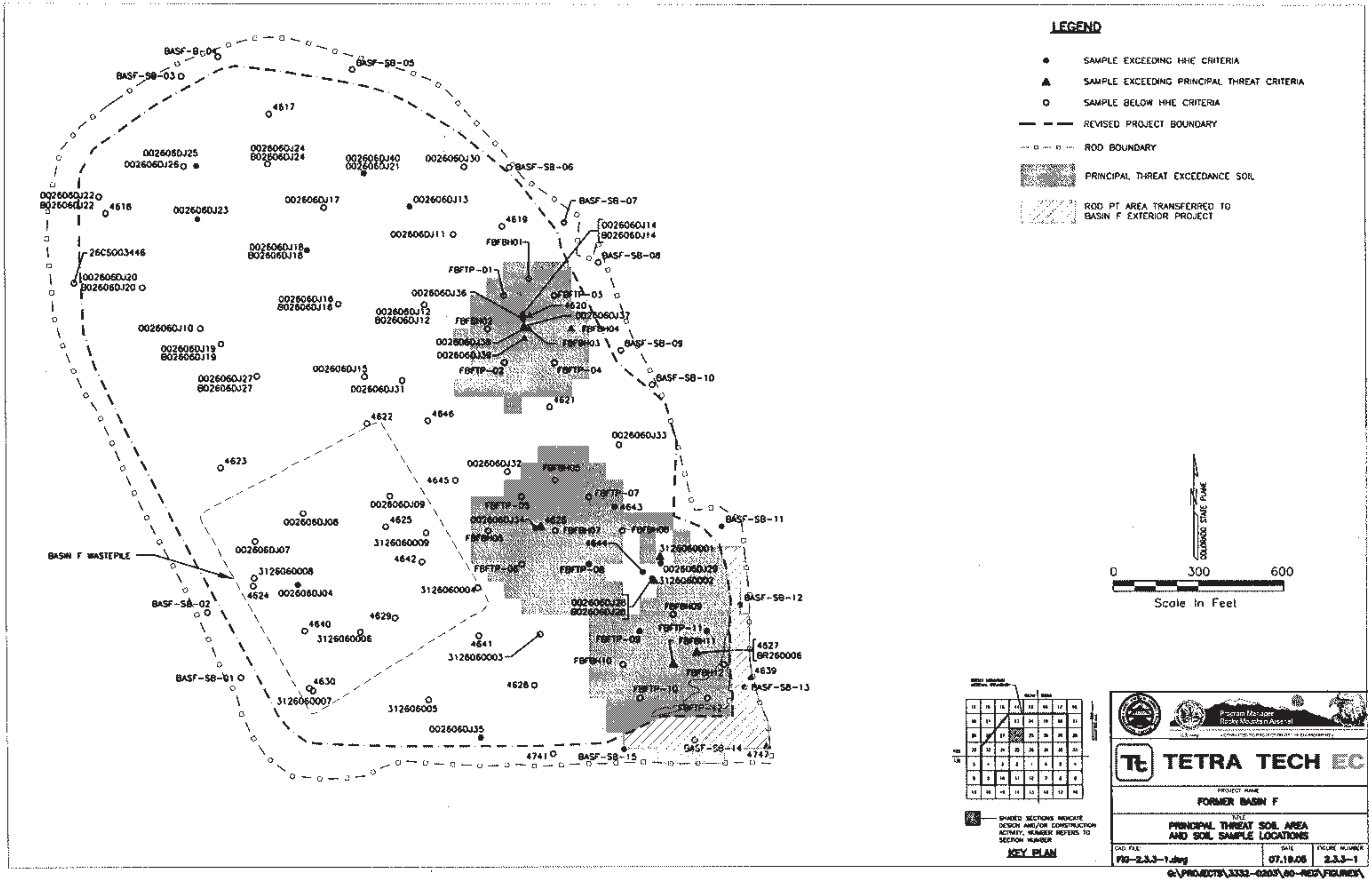
0 0.5 1
Miles

FIGURE 1.0-1

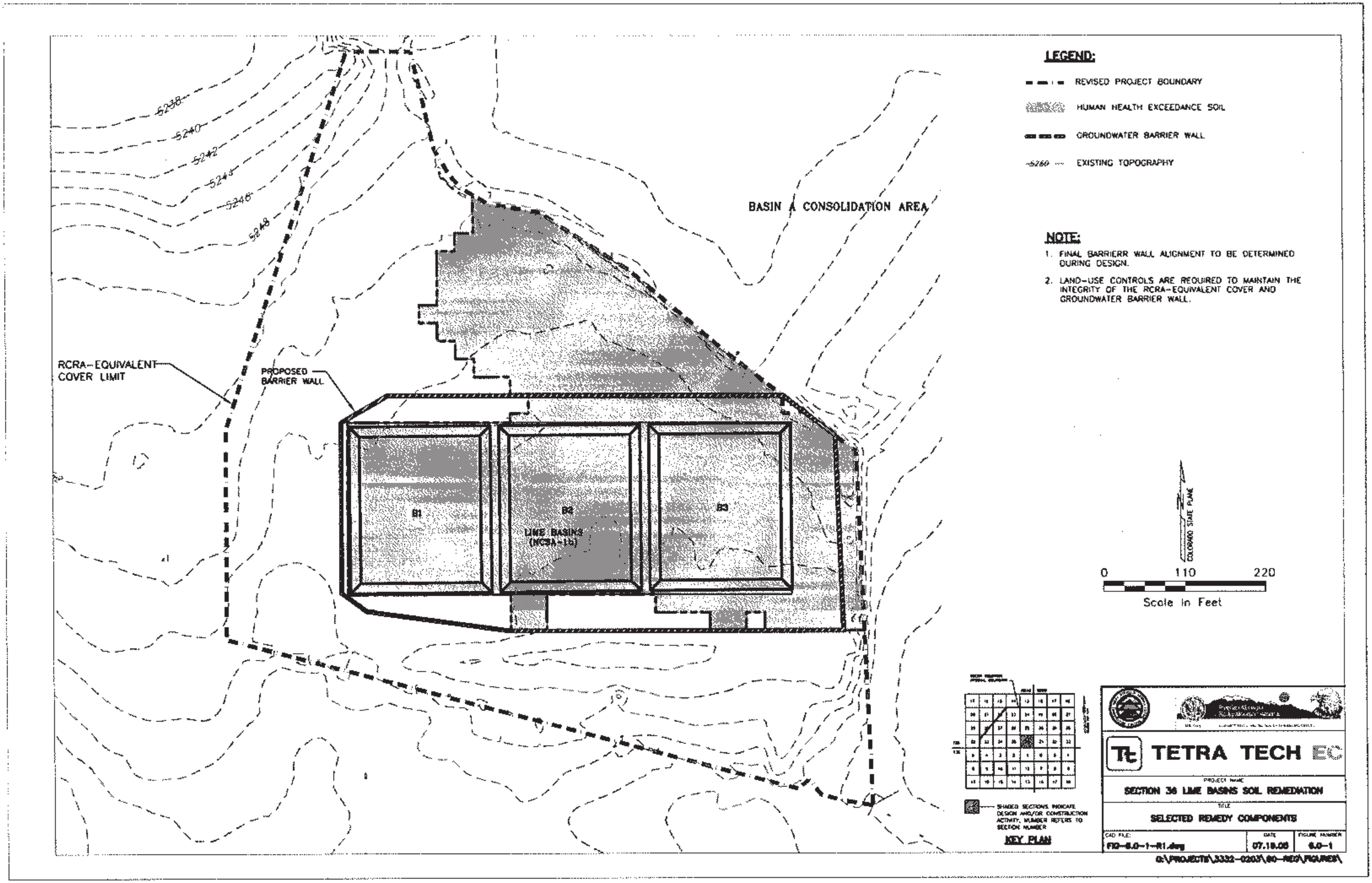
Map Document: D:\Map Documents\ESD_BasinF_1.0.mxd

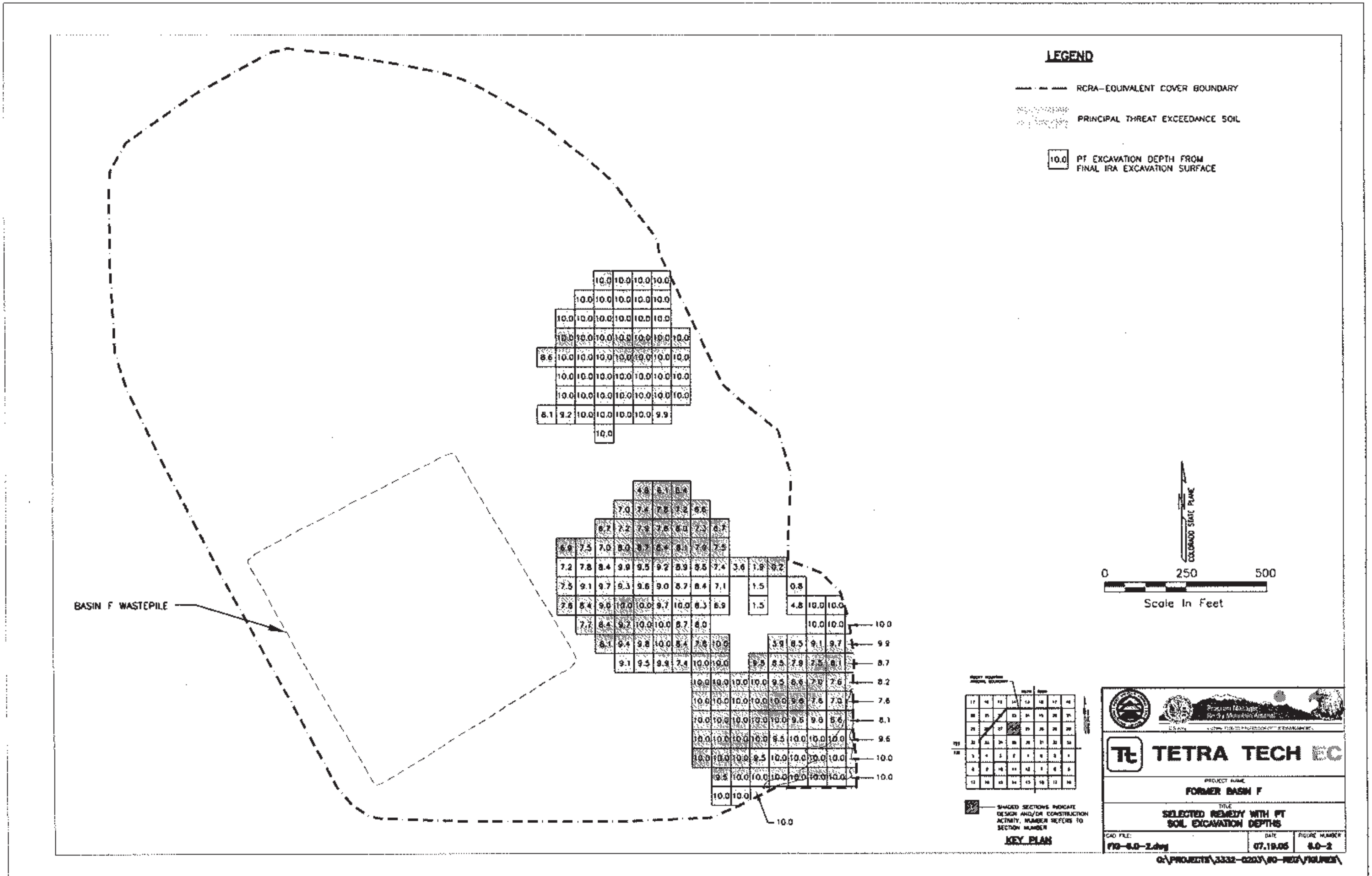


LEGEND
SAMPLE EXCEEDING HHE CRITERIA
SAMPLE EXCEEDING PRINCIPAL THREAT CRITERIA
SAMPLE BELOW HHE CRITERIA
LBC6
INVESTIGATIVE SOIL POINT
REVISED PROJECT BOUNDARY
REMEDIATION BOUNDARY
ROD BOUNDARY
HUMAN HEALTH EXCEEDANCE SOIL
BASIN A CONSOLIDATION AREA
LIME BASINS (NCSA-1b)
COLORADO STATE PLANE
0
110
220
Scale In Feet
KEY PLAN
TETRA TECH EC
SECTION 36 LIME BASINS SOIL REMEDIATION
PROJECT BOUNDARY AND SOIL SAMPLE LOCATIONS
FIG-2.2.4-1.dwg
07.19.05
2.2.4-1



LEGEND
SAMPLE EXCEEDING HHE CRITERIA
SAMPLE EXCEEDING PRINCIPAL THREAT CRITERIA
SAMPLE BELOW HHE CRITERIA
REVISED PROJECT BOUNDARY
ROD BOUNDARY
PRINCIPAL THREAT EXCEEDANCE SOIL
ROD PT AREA TRANSFERRED TO BASIN F EXTERIOR PROJECT
BASIN F WASTEPILE
COLORADO STATE PLANE
0 300 600
Scale In Feet
KEY PLAN
SHADED SECTIONS INDICATE DESIGN AND/OR CONSTRUCTION ACTIVITY. NUMBER REFERS TO SECTION NUMBER
Program Manager Rocky Mountain Arsenal
TETRA TECH EC
PROJECT NAME
FORMER BASIN F
TITLE
PRINCIPAL THREAT SOIL AREA AND SOIL SAMPLE LOCATIONS
CAD FILE
FIG-2.3.3-1.dwg
DATE
07.19.05
FIGURE NUMBER
2.3.3-1
G:\PROJECTS\3332-0203\60-REG\FIGURES\


LEGEND:
REVISED PROJECT BOUNDARY
HUMAN HEALTH EXCEEDANCE SOIL
GROUNDWATER BARRIER WALL
5260 EXISTING TOPOGRAPHY
NOTE:
1. FINAL BARRIERR WALL ALIGNMENT TO BE DETERMINED DURING DESIGN.
2. LAND-USE CONTROLS ARE REQUIRED TO MAINTAIN THE INTEGRITY OF THE RCRA-EQUIVALENT COVER AND GROUNDWATER BARRIER WALL.
BASIN A CONSOLIDATION AREA
5238
5240
5242
5244
5246
5248
RCRA-EQUIVALENT COVER LIMIT
PROPOSED BARRIER WALL
B1
B2
B3
LIME BASINS (NCSA-1b)
COLORADO STATE PLANE
0
110
220
Scale in Feet
SHADED SECTIONS INDICATE DESIGN AND/OR CONSTRUCTION ACTIVITY. NUMBER REFERS TO SECTION NUMBER
KEY PLAN
TETRA TECH EC
PROJECT NAME
SECTION 36 LIME BASINS SOIL REMEDIATION
TITLE
SELECTED REMEDY COMPONENTS
CAD FILE:
DATE
FIGURE NUMBER


LEGEND
RCRA-EQUIVALENT COVER BOUNDARY
PRINCIPAL THREAT EXCEEDANCE SOIL
PT EXCAVATION DEPTH FROM FINAL IRA EXCAVATION SURFACE
BASIN F WASTEPILE
COLORADO STATE PLANE
0
250
500
Scale In Feet
SHADED SECTIONS INDICATE DESIGN AND/OR CONSTRUCTION ACTIVITY, NUMBER REFERS TO SECTION NUMBER
KEY PLAN
TETRA TECH EC
PROJECT NAME
FORMER BASIN F
TITLE
SELECTED REMEDY WITH PT SOIL EXCAVATION DEPTHS
CAD FILE:
DATE
07.19.05
FIGURE NUMBER
6.0-2

APPENDIX A

WRITTEN COMMENTS RECEIVED DURING PUBLIC COMMENT PERIOD

SITE SPECIFIC ADVISORY BOARD OF THE ROCKY MOUNTAIN ARSENAL, INC.
844 Downing Street * Denver, Colorado 80218
(303) 832-3707 * Fax (303) 832-3708

June 20, 2005

Mr. Charles Scharmann
Rocky Mountain Arsenal
Project Manager
Commerce City, Colorado 80022

SSAB Public Comments Re: The Revised Proposed Plan for the Rocky Mountain Arsenal On-Post Operable Unit, Section 36 Lime Basins and Former Basin E

Dear Mr. Scharmann:

The Site Specific Advisory Board was founded in 1994 under the auspicious of the Governors Office of the State of Colorado, with the support of the US Environmental Protection Agency, for the purpose of providing community involvement and information in decision making and planning for the environmental "clean-up" at the Rocky Mountain Arsenal. Since that time we have maintained open membership of the interested public and stakeholders and, as such, have provided comments to the Army and regulators in all aspects of the "clean-up". We are currently the recipients of an EPA Technical
Assistance Grant (TAG) to provide the public with access to independent, high-level technical expertise.

We thank you for the opportunity that you have provided the public to comment on the current, proposed ROD amendments, and specifically the extra steps you have taken to make knowledgeable consultants available to us, not only in public meetings but for private conversations, many times of a highly technical nature. We have discussed the proposal with you at these meetings and among ourselves, and we appreciate the written responses that you have subsequent to the public meeting.

On behalf of the Site Specific Advisory Board of the Rocky Mountain Arsenal, the following comments are submitted regarding the proposed changes to the Record of Decision (ROD), the Revised Proposed Plan for the Rocky Mountain Arsenal On-Post Operable Unit, Section 3 6 Lime Basins and Former Basin F.

Basin F Soils

The preferred alternative to the proposed changes to the ROD recommend that the Basin F soils be dug up and deposited in the Enhanced Land Fill (ELF) instead of leaving the soil in place and solidifying the top ten feet of contaminated soils. The Basin F Soils represent some of the most contaminated soils at the Rocky Mountain Arsenal and we have long argued that these soils should be treated and de-contaminated or, at the least, stored in a monitored landfill.

We agree with the preferred alternative. Moving and storing the contaminated soils from Basin F to the ELF is far more protective of long-term health and environmental protection than leaving and storing the soils in place. The contaminated soils in Basin F extend below the ten feet level and in a least three places the contaminated soils go all the way to ground water, approximately forty feet below surface. The removal of Basin F soils should include all contaminated soils. The decision to solidify only the top ten feet of the Basin F soils was political and arbitrary, and is not fully protective of human health and the environment. Removing and storing only the top ten feet of soil is not justified under the proposed ROD change. To be fully protective of human health and the environment, all contaminated soils must be moved.

Lime Basins

The preferred alternative in the proposed changes to the ROD recommend that, instead of being dug up and moved to the ELF, that the Lime Basins be left in place, with a soil cap and a slurry wall, and then de-watered with treatment to the removed liquid.

We find that the preferred alternative is substantially less protective than the original remedy included in the ROD.

First, the permanent placement of these wastes violates the Congressional Land Ban by inappropriately siting contaminated waste outside of a certified, designated hazardous waste landfill. Even though some parts of the RMA remedy were exempted from the Congressional Land Ban under the Corrective Action Management Unit (CAMU), a regulation promulgated by EPA, this CAMU regulation was successfully contested and, as a significant change to the remedy at RMA, the proposal to leave waste is subject to current laws and regulations.

Second, the assumptions as to the soundness and impermeability of the underlying geological formation are not adequately substantiated. Along with the historical data providing geological composition of the bedrock, there is inadequate supporting data for justifying the structural integrity the formation. Such assurance to the public would consist of comprehensive assays such as Three-D Seismic Imaging or Ground Penetrating Radar (GPR), and other technologies readily and locally available. More information is required to assure the public of the absence of vertical cracks and lenses which would
allow for contaminate migration to underlying groundwater.

Third, prior to permanent placement or land disposal of these wastes in-situ, comprehensive analysis and characterization of these wastes needs to be performed in order to provide posterity with the greatest amount of information.

Fourth, in the event that the proposed remedy is performed, in addition to the de-watering at the Lime Basin, down stream of the alluvial flow at the low point of bedrock in Basin A should be similarly de-watered and monitored. This additional well would provide the public and the regulators with needed long-term information related to the correctness of the underlying assumptions and the long-term remedy effectiveness.

Costs

It is very disappointing that the proposed changes to the ROD do not include adequate information regarding the costs of the proposed changes, making it impossible to compare these proposed remedy changes relative to cost. Since cost is one of the nine criteria set forth in the NCP, and has become the determinative criteria at DOD contamination sites, the lack of adequate cost information makes full comment on the proposed changes impossible for us at this time.

Thank you again for the opportunity to provide public comment on the proposed amendment to the ROD, and for the extension of time which we found to be beneficial and informative. We look forward to cooperative communication in regards to the proposed plan and wish be informed and involved in further decision, designs, and refinements, especially those related to these comments and recommendations.

Yours truly,

Sandra Jaquith
On behalf of the Site Specific Advisory Board (SSAB) of the Rocky Mountain Arsenal

LIGHT5683@aol.com
06/14/2005 07:56 PM

To pao@rma-army.mil
cc
bcc
Subject Re: proposed change to ROD

Attn: Peggy Machamer
Public Relations Office
Building 111
Commerce City, CO 80022

To Whom It May Concern:

This is my comment regarding the requested change to the ROD signed June 11, 1996.

I live five blocks from the RMA and am a thirty plus years resident.

In 1996 the ROD was signed in good faith that the remedy was the most protective for human health and safety of the community.

Now to save money the Army wants to change the agreement. Not only that they are suggesting the use of a remedy (the slurry wall) that has failed in the past. In my opinion that solution is not protective enough. There is a lack of information regarding the risk to the ground water and the aquifer under the lime basin. Leaving a 500 pound anomaly in place with unknown consequences to the aquifer and surrounding community in the future is totally unacceptable. Furthermore there has not been enough research as to what other remedies exist and what new technologies have been developed. The Army and
Shell made this mess and now they are looking for short cuts to cleaning it up. I want the ROD to stand and if a change must be made it needs to be newer technology and more protective of health and safety of the surrounding community.

6/1/05

Comments on Proposal to Change ROD

I live 5 blocks West of the RMA. Health and Safety of the surrounding Community is my primary concern.

Regarding the proposed changes to the ROD for lime pit and Basin F, I would like to see the agreements in the existing ROD kept the same.

There has not been enough research done to prove these proposed changes would be more protective for Human Health and Safety.

Thank You
Nancy Christian
Commerce City Resident