DRAFT FINAL (REVISION 1)

VOLUME 2A

REMEDIAL INVESTIGATION / FEASIBILITY STUDY

FIELD SAMPLING PLAN

SITE-WIDE GROUNDWATER (OPERABLE UNIT 03)

WEST LAKE LANDFILL SITE

BRIDGETON, MISSOURI

April 22, 2020

Project #: 63N-001-002

SUBMITTED BY: Trihydro Corporation

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List of Acronyms

ARAR	Applicable or Relevant and Appropriate Requirement
ASAOC	Administrative Settlement Agreement and Order on Consent
bgs	below ground surface
BL	Barometric pressure logger
C&D	Construction & Demolition
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CH_4	methane
CoC	chain of custody
COPC	Constituent of Potential Concern
CPT	cone penetrometer test
CSR	Code of State Regulations
DL	Data Logger
DO	Dissolved Oxygen
DOE	United States Department of Energy
EM	electromagnetic
EMSI	Engineering Management Support, Inc
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
ESRI	Environmental Systems Research Institute
°F	degrees Fahrenheit
FS	Feasibility Study
FSP	Field Sampling Plan
ft	feet

List of Acronyms (cont.)

FTL	Field Team Leader
GPS	Global Positioning System
H_2S	hydrogen sulfide
HASP	Health and Safety Plan
ID	inner diameter
IDW	Investigation Derived Waste
L	liter
LCS	Leachate Collection Sump
LCS/LCSD	Laboratory Control Sample/Laboratory Control Sample Duplicate
LEL	lower explosive limit
MCLI	Materials & Chemistry Laboratory, Inc.
MDNR	Missouri Department of Natural Resources
mg/L	milligram per liter
ml/min	milliliter per minute
mm	millimeter
MS/MSD	Matrix Spike/Matrix Spike Duplicate
msl	mean sea level
mS/m	millisiemens per meter
mV	millivolts
NAD83	North American Datum 1983
NAVD88	North American Vertical Datum 1988
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NOAA	National Oceanic and Atmospheric Administration

List of Acronyms (cont.)

NPL	National Priorities List
Cotter	Cotter Corporation (N.S.L)
NTU	Nephelometric Turbidity Units
O_2	oxygen
OERR	Office of Emergency and Remedial Response
ohm-m	ohm-meters
ORP	oxidation reduction potential
OSWER	Office of Solid Waste and Emergency Response
OU	Operable Unit
%	percent
PDF	portable document format
P.E.	Professional Engineer
P.G.	Professional Geologist
PID	Photoionization Detector
PPE	Personal Protective Equipment
psi	pounds per square inch
PSQ	Principal Study Question
PVC	Polyvinyl Chloride
QA	Quality Assurance
QAD	Quality Assurance Director
QAPP	Quality Assurance Project Plan
QC	Quality Control
RCRA	Resource Conservation and Recovery Act

List of Acronyms (cont.)

RCS	Radiation Control Supervisor
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RIM	radiologically impacted materials
ROW	Right of Way
RQD	Rock Quality Designation
RSP	Radiation Safety Plan
SAP	Sampling and Analysis Plan
scfm	standard cubic feet per minute
SLERA	Screening Level Ecological Risk Assessment
SOP	Standard Operating Procedure
SOW	Scope of Work
SP	Spontaneous Potential
SSR	Subsurface Reaction
TDS	Total Dissolved Solids
TPH	Total Petroleum Hydrocarbons
µm	micrometer
UPS	United Parcel Service
USCS	Unified Soil Classification System
USACE	United States Army Corps of Engineers
VOC	Volatile Organic Compound

1.0 INTRODUCTION

This Remedial Investigation/Feasibility Study (RI/FS) Field Sampling Plan (FSP) has been prepared by Trihydro Corporation (Trihydro) on behalf of Bridgeton Landfill, LLC, Cotter Corporation (N.S.L.) (Cotter), and the United States Department of Energy (DOE) (collectively Respondents), for site-wide groundwater (Operable Unit 3 or OU-3) at the West Lake Landfill Site (site). The site is located at 13570 St. Charles Rock Road, Bridgeton, Missouri (Figure 1-1). The FSP was prepared at the request of the United States Environmental Protection Agency (USEPA) in accordance with requirements outlined in the Final RI/FS OU-3 Statement of Work (SOW), dated September 21, 2018, included as Appendix B in the Administrative Settlement Agreement and Order on Consent (ASAOC), dated February 6, 2019 (USEPA 2019). This FSP and the Quality Assurance Project Plan (QAPP) are being submitted as the Sampling and Analysis Plan (SAP), included as Volume 2 of the RI/FS Work Plan. The Health and Safety Plan is Volume 3 of the RI/FS Work Plan.

The site was added to the Superfund National Priorities List (NPL) in 1990 and consists of three Operable Units (OUs) including former industrial and municipal waste cells and groundwater. The site layout is shown on Figure 1-2. Operable Unit 1 (OU-1) includes former waste disposal areas Radiological Area 1 (Area 1) and Radiological Area 2 (Area 2) where radiologically impacted materials (RIM) have been identified (USEPA ID#MOD079900932). Operable Unit 2 (OU-2) has no known areas identified as having been impacted with RIM and includes the Closed Demolition Landfill, Inactive Sanitary Landfill, and the North and South Quarry portions of the Bridgeton Landfill (also referred to as the Former Active Sanitary Landfill). The Missouri Department of Natural Resources (MDNR) is responsible for overseeing activities at the Bridgeton Landfill and the Closed Demolition Landfill portions of OU-2, while the remedial actions for the Inactive Sanitary Landfill are being addressed under USEPA's Superfund authority. OU-3 includes the groundwater beneath, and associated with the entire approximately 200-acre site and is the focus of this RI/FS.

1.1 SITE BACKGROUND AND SETTING

Section 2.0 of the Work Plan presents a brief description of the site, including the location, an overview of past and current operations, and a discussion of other activities near the site. Detailed descriptions of the site were included in documents submitted to USEPA under the OU-1 and OU-2 RI/FS process. Numerous investigations were previously conducted by Radiation Management Corporation (RMC), Burns & McDonnell (B&M), the U.S. Nuclear Regulatory Commission (NRC), Golder Associates (Golder), McLaren/Hart Environmental Engineering Corporation (McLaren/Hart), Water Management Consultants, Inc. (WMC), Engineering Management Support, Inc (EMSI), Herst & Associates, Inc. (H&A), and Feezor Engineering, Inc. (Feezor). The relevant data from each effort pertinent to OU-3 is summarized in this Section.

The site is 212 acres and is on the east side of the Missouri River within the western portion of the St. Louis metropolitan area in northwestern St. Louis County (Figure 1-1 and Figure 1-2). The site address is 13570 St. Charles Rock Road, which is approximately one mile north of the intersection of Interstate 70 and Interstate 270, within the City of Bridgeton, Missouri. The site includes six historical waste disposal areas (units), including Area 1, Area 2, the Closed Demolition Landfill, the Inactive Sanitary Landfill, and the North Quarry and South Quarry Portions of the Bridgeton Landfill. A solid waste transfer station and an asphalt batch plant currently operate on the site (Figure 1-3). There is a six-foot-high chain-link fence with a three-strand barbed wire canopy enclosing most of the property. The main access gate is on the northeastern boundary and a secondary access gate is on the southwestern boundary of the landfill property.

Current ownership of the properties included in the definition of the site is depicted on Figure 1-4. The landfill property is bordered by Crossroads Industrial Park to the northwest and St. Charles Rock Road (State Highway 180) to the north and east; Taussig Road, commercial facilities (including the Bridgeton Transfer Station, LLC hauling company facility), and agricultural land are to the southeast; and Old St. Charles Rock Road and the Earth City Industrial Park (Earth City) stormwater/ flood control pond are to the south, west, and north. The Earth City commercial/industrial complex continues to the west and north of the flood control pond and extends to the Missouri River. Earth City is separated from the river by an engineered levee system that is owned and maintained by the Earth City Flood Control District. Terrisan Reste mobile home park is the nearest residential area to the site, which is located to the southeast, approximately 0.7 miles from Area 1 and 1.1 miles from Area 2. The Spanish Village residential subdivision is located to the south of the site near the intersection of St. Charles Rock Road and I-270, approximately 1 mile from Area 1 and 1.25 miles from Area 2.

The property on the west side of Area 2 was previously referred to as the Ford Property in the OU-1 RI (EMSI 2000) because it was previously owned by Ford Motor Credit, Inc (Ford). Most of the Ford Property was sold to Crossroad Properties, LLC in 1998 and has since been developed into the Crossroads Industrial Park. Ford initially retained ownership of a 1.78-acre parcel located immediately adjacent to the west of Area 2 (Figure 1-3). Ownership of this 1.78-acre parcel was subsequently transferred to Rock Road Industries, Inc., now Bridgeton Landfill, LLC, to provide a buffer between the landfill and adjacent property, and therefore, this parcel has been identified as the "Buffer Zone." Crossroad Properties, LLC initially developed all of the former Ford property with the exception of Lot 2A2, a 3.58-acre parcel immediately north of the Buffer Zone. Lot 2A2 was subsequently developed by AAA Trailer, the owner of much of the property immediately to the north of the Buffer Zone and Area 2, although Lot 2A2 is still owned by Crossroad Properties, LLC. Property to the north and northeast of the landfill, across St. Charles Rock Road, is moderately developed with commercial, retail and manufacturing operations. Zoning for the parcels that make up the landfill property and surrounding parcels is depicted on Figure 1-5.

The West Lake Landfill Superfund NPL site consists of the various parcels that comprise the landfill property (on-property) and adjacent properties (off-property). OU-1 includes on-property Areas 1 and 2, the adjacent off-property Buffer Zone, and the adjacent off-property Parcels B and C of Lot 2A2 of the Crossroads Industrial Park (Figure 1-3). The Buffer Zone and the Lot 2A2 were not used for waste disposal, but have been identified as containing radionuclides in soil as a result of transport by surficial runoff from OU-1. OU-2 consists of the remaining portions of the landfill property. These areas are shown on Figure 1-3 and discussed in more detail in Section 2.2 of the Work Plan.

The West Lake Landfill is approximately 1.75 miles to the east-southeast of the Missouri River with portions of the site ranging from 1.4 to 2.0 miles from the river. The Earth City Industrial Park is located on the Missouri River floodplain to the west of the site. The Earth City Industrial Park is protected from flooding by a levee (Figure 1-2) and stormwater management system operated and maintained by the Earth City Flood Control and Levee District. The stormwater management system includes a series of stormwater detention ponds, one of which is along the west side of the landfill property (Figure 1-2). There is another stormwater detention pond is located across St. Charles Rock Road to the north of Area 2.

There is an area that occasionally accumulates stormwater near the northern portion of Area 2, on the south side of St. Charles Rock Road (Figure 1-2). Although this low area consisted of a pond during the time frame when the original OU-1 field investigations were conducted (1995-1997), and therefore was identified as the North Surface Water Body, over the years this area has become overgrown and silted in, and only contains water after storm events. In addition to overland flow from the north slope of Area 2, stormwater runoff from much of the West Lake Landfill area is conveyed to this area by the internal stormwater conveyance ditches and the perimeter stormwater conveyance structures and ditch along the southwest side of St. Charles Rock Road. Inspection of the North Surface Water Body has not identified any outlet, or pathway for discharge of the water, and therefore, the surface water that accumulates in this area appears to dissipate over time by evaporation and infiltration.

The site, at its closest point, is within approximately 8,450 ft of the end of runway 11 of Lambert St. Louis International Airport. The site is situated within the takeoff and approach routes for the airport. As discussed in Section 2.3 of the Work Plan, the landfill is subject to a Negative Easement and Declaration of Restrictive Covenants Agreement between the City of St. Louis and Bridgeton Landfill, LLC (among other entities) that prohibits depositing or dumping of new or additional putrescible waste on the entirety of the Bridgeton Landfill after August 1, 2005 (City of St. Louis 2005).

The preliminary extent of the OU-3 study area includes the area proposed for investigation as part of the OU-3 RI work plan as shown on Figure 1-6. This initial estimate of the study area will be refined during site characterization and as the OU-3 investigation progresses.

1.2 SITE DESCRIPTION AND STUDY AREA HISTORY

Historically, the on-property portions of the site have been divided into five areas:

- Area 1
- Area 2
- Closed Demolition Landfill
- Inactive Sanitary Landfill
- Former Active Sanitary Landfills (North and South Quarry) or the Bridgeton Landfill

These areas are discussed in further detail in Section 2.2 of the Work Plan. OU-1 includes Area 1, Area 2, the Buffer Zone, and Crossroads Properties LLC Lot 2A2. The Bridgeton Landfill, the Closed Demolition Landfill, and the Inactive Sanitary Landfill are all part of OU-2 (Figure 1-3). Historical aerial photographs are included as Appendix A of the Work Plan.

The West Lake Landfill was originally used for agriculture until a limestone quarrying and crushing operation began in 1939. The quarrying operation continued until 1988 and resulted in two excavation areas and two quarry pits, the North Quarry Pit and the South Quarry Pit. Both quarries were excavated to a maximum depth of approximately 240 feet below ground surface (ft bgs) and had a bottom elevation of approximately 240 ft above mean sea level (msl) (H&A 2005; Golder 1996).

The site contains six areas where solid wastes have been disposed. The date that landfilling activities started at the West Lake Landfill is not known with certainty and has been variously cited as beginning, in or around the early 1950s (EMSI 2000), or as starting in 1952 or possibly 1962 (H&A 2005). The landfill was authorized by the county to accept sanitary waste in 1952. USEPA has reported that “from 1941 through 1953 it appeared that limestone extraction was the prime activity at the facility; however, as time passed, the focus of the activity appeared to shift from mining to waste disposal” (USEPA 1989). USEPA has reported that historical aerial photography from 1953 indicates use as a landfill had commenced . Mine spoils from quarrying operations were deposited on adjacent land immediately to the west of the quarry (H&A 2005). Portions of the quarried areas and adjacent areas were subsequently used to landfill municipal refuse, industrial solid wastes, and construction and demolition (C&D) debris. USEPA has reported that liquid wastes and sludges were also disposed of at the landfill (USEPA 1989). These operations, which predated state and federal laws and regulations that govern such operations, occurred in areas that subsequently have been identified as Area 1, Area 2, the Closed Demolition Landfill, and the Inactive Sanitary Landfill (Figure 1-3).

Due in part to the fact that the disposal of solid and liquid waste at the site predated state and federal regulations for landfills, there is uncertainty regarding the specific site activities and disposal practices. Specifically, based upon a review of historical aerial photographs as documented in the Aerial Photographic Analysis of the West Lake Landfill Site (USEPA 1989), "deep" pits, lagoons, and other features related to past on-site disposal practices have been identified in several historical aerial photographs for the years pre-dating the arrival of radionuclides from the Latty Avenue Site (EMSI 2018).

1.3 ALIGNMENT WITH OU-3 RI/FS WORK PLAN AND DATA QUALITY OBJECTIVES

The OU-3 RI/FS Work Plan documents include the Work Plan (Volume 1), a SAP composed of this FSP (Volume 2a) and the QAPP (Volume 2b), and a Health and Safety Plan (HASP) (Volume 3). The OU-3 RI/FS Work Plan provides a description of what data will be collected and the rationale for the RI/FS, including a project description, a summary of site historical information, site setting overview, and general technical approach. The QAPP outlines the data quality objectives (DQOs) for the project that will be used to ensure the data collected during the RI/FS program are of acceptable quality. This FSP outlines how the data will be collected, including detailed field methodology descriptions.

Data from the OU-3 RI/FS will be used to refine the conceptual site model (CSM), address principal study questions (PSQs) associated with the DQOs in Table 3-1 of the QAPP, and inform decision making for the Feasibility Study. For consistency across the documents, a document directory has been included as Table 1-1, which maps where each major topic or task is addressed within each document.

1.4 RI FIELD WORK

Trihydro will perform the following field activities on behalf of the Respondents as part of the OU-3 RI/FS to help achieve these objectives. Each of these field activities, their description, and use is described in this FSP. The FSP will be revised to include any additional activities proposed as part of the OU-3 RI/FS.

The following major field activities are anticipated as part of the initial OU-3 RI scope of work:

- Mobilize and set up temporary facilities
- Perform utility clearances
- Perform a well inventory

- Repair and redevelopment wells, as necessary
- Plug and abandon boreholes, as necessary
- Drill pilot test boreholes with a cone penetrometer test (CPT) drill rig with a hydraulic profiling tool (HPT) for a continuous hydrostratigraphic log
- Drill and continuously core boreholes with a sonic drill rig
- Field screen borehole cores using a photoionization detector (PID)
- Log boreholes using geophysical tools to provide a more complete characterization of the bedrock formations
- Packer test the bedrock formations
- Collect borehole alluvial aquifer matrix samples
- Collect bedrock aquifer matrix samples
- Install bedrock aquifer groundwater monitoring wells
- Install shallow, intermediate, and deep alluvial aquifer monitoring wells
- Develop groundwater monitoring wells
- Conduct slug testing
- Conduct aquifer pump testing
- Install bladder pumps and collect groundwater samples
- Collect leachate samples
- Install flow meters on leachate collection sumps, if needed
- Gauge fluid levels in monitoring wells, surface water, and leachate sumps
- Record leachate collection sump flow rates and volumes
- Install pressure transducers in a subset of monitoring wells
- Install barometric pressure loggers (BLs)
- Install staff gauges with continuously recording monitoring stations
- Perform a vapor intrusion investigation including indoor air and ambient air testing in and around on-site buildings
- Survey wells, staff gauges, leachate riser elevations, and other site features, as necessary

- Perform a bathymetric survey of surface water bodies where staff gauges are installed
- Perform an ecological survey

Other tasks associated with the OU-3 field activities include:

- Document third-party data sources
- Document sample collection
- Preserve, package, and ship sample containers
- Assure quality control (QC)
- Perform calibration procedures
- Perform decontamination procedures
- Manage, sample, and dispose of investigation derived waste (IDW)

1.5 PROJECT ORGANIZATION AND FIELD TEAM RESPONSIBILITIES

The Respondents will direct this project. The OU-3 Project Coordinator has the responsibility for overall project completion and communication between the regulators, Respondents and contractors. Trihydro will function as the primary contractor. Relevant roles outlined below include Project Principal, Project Manager and Assistant Project Manager, Field Team Leader, Field Team Members, Site Quality Control Officer, Quality Assurance Director, Site Health and Safety Officer, Radiation Safety Officer, Radiological Control Supervisor, and Geospatial Director.

Gary Risse will serve as the Project Principal for Trihydro. Trihydro will provide project management, with the following personnel supporting the project at this time: Allison Riffel, Professional Engineer (P.E.) (PM or Project Manager), Michael Sweetenham, Professional Geologist (P.G.) (APM or Assistant Project Manager), Kelly Birkenhauer, P.G. (FTL or Field Team Lead and Project Geologist), and Christina Hiegel, P.E. (QAD or Quality Assurance Director). The expanded project Organization Chart with project personnel is included as Figure 1-7. The Organization Chart includes the proposed subcontractors: Chad Drummond, P.E. – Drummond Carpenter, LLC, Ameriphysics LLC, Feezor Engineering, Pace Analytical Services, LLC (Pace), Materials and Chemistry Laboratory, Inc. (MCLInc), Advanced Terra Testing, ALS Environmental Laboratories, and EMSL Analytical, Inc (EMSL). A qualified drilling contractor will be determined prior to RI/FS implementation.

Section 2.0 of the QAPP contains detailed descriptions of the complete roles for the PM, APM, FTL, QAD, and specific field team members such as the Site Quality Control Officer, Site Health and Safety Officer, Radiation Safety Officer, and Radiological Control Supervisor.

1.6 HEALTH AND SAFETY PLAN

A HASP, which includes the most current OU-1 Radiation Safety Plan (RSP) and OU-1 Emergency Response Plan for work conducted within the boundaries of OU-1 Areas 1 and 2, is included as Volume 3. The HASP provides a summary of personnel responsibilities, protective equipment, health and safety procedures and protocols, decontamination procedures, personnel training, and type and extent of medical surveillance. The plan identifies problems or hazards that may be encountered during performance of the RI and how these are to be addressed. Additionally, procedures for protecting third parties, such as site visitors, vehicular or pedestrian traffic near drilling locations or sampling crews, and for the surrounding community, in general, is also described in the HASP.

2.0 SAMPLING PLAN DESIGN AND RATIONALE

The sampling plan for the OU-3 RI/FS has been designed to obtain the additional data required to adequately characterize subsurface conditions including, but not limited to, vertical/lateral flow, extent of constituents of potential concern (COPCs), background levels of constituents, and naturally-occurring materials. The additional data will support evaluations conducted in the OU-3 Baseline Risk Assessment and support the evaluation of remedial technologies and alternatives. In order to collect the additional data, the following series of field activities are proposed as part of the OU-3 RI/FS:

- Site Reconnaissance, Well Inventory, and Well Repair
- Field Surveying and Mapping
- Drilling
- Aquifer Matrix Sampling
- Geophysical Logging
- Packer Testing
- Monitoring Well Construction
- Plugging and Abandoning Boreholes and Monitoring Wells
- Monitoring Well Development
- Slug Testing
- Aquifer Pumping Tests
- Groundwater Sampling
- Leachate Sampling
- Monitoring Well and Leachate Riser Gauging
- Surface Water Gauge Installation and Monitoring
- Vapor Intrusion Investigation
- Ecological Survey
- Field Documentation

The field investigation is proposed to be completed using a phased, iterative, flexible, and collaborative approach with USEPA that supports changes in scope as new data become available to inform decisions on the placement of additional monitoring wells as discussed in Section 5.0 of the Work Plan. Field activities will be prioritized and sequenced based on the PSQs they are intended to answer as described in Section 4.3 of the Work Plan. Monitoring well installation is proposed to be completed using a phased approach. Data will be continuously evaluated as they are collected and presented to USEPA, so further phases of work can be implemented efficiently in general accordance with the Work Plan, QAPP, and FSP without unnecessary pauses. Proposed phasing for monitoring well installation is discussed in further detail in Work Plan Section 4.3.

Samples collected for laboratory analysis during the OU-3 RI/FS include alluvial aquifer matrix samples, bedrock aquifer matrix samples, groundwater samples, leachate samples, and vapor samples. Table 2-1 presents a summary of the analytical sampling plan. Boreholes will be advanced at nine individual well locations utilizing a sonic drill rig for collection of alluvial aquifer matrix and/or bedrock aquifer matrix samples. Groundwater samples will be collected quarterly for two years from the 158 monitoring wells, piezometers, and leachate risers. Leachate samples will be collected at the same frequency from the leachate collection sumps (LCSs) available for sampling at the time. The first two groundwater sampling events will include the existing wells in the proposed monitoring well network, as well as new wells which will be phased into the routine sampling as they are constructed. Vapor samples will be collected from four buildings onsite. The proposed analytical suite by media type and a sample summary count by media type are presented in Tables 2-2 and 2-3, respectively. Additional activities will be completed as appropriate, which are contingent on results of the initial OU-3 RI/FS activities and will be outlined in addenda as presented in Work Plan Section 9.2.

2.1 SAMPLING RATIONALE AND LABORATORY ANALYSIS

The media sampled and associated laboratory analyses were selected to meet the objectives of the OU-3 RI/FS PSQs and the data quality objectives outlined in Table 3-1 of the QAPP. Groundwater/leachate, alluvial aquifer matrix, bedrock aquifer matrix, and vapor samples will be collected for the analytes listed in Tables 2-4a, 2-4b, 2-4c, and 2-4d, respectively. Information on analyte, analyte method, preservation requirements, and container requirements is also included. A detailed discussion of the analytical narrative, the analytical test methods, and the detection limits are included in the QAPP.

2.2 SAMPLE COLLECTION ORDER

The recommended collection order for the water samples is presented in Table 2-5. The collection order protocol is designed to prevent cross-contamination and sample agitation, with the most volatile analyses collected first.

2.3 SAMPLE HANDLING AND CUSTODY

Sampling handling field activities include sample collection, preservation of the samples, packing, transportation, and handling of the samples prior to receipt by the laboratory. The following sections outline the sample naming conventions by sample type, and protocols for sample collection documentation, container labeling, and packing and shipping. Field quality assurance (QA)/quality control (QC) procedures are summarized in Section 2.4, and in Section 5.1 of the QAPP. Appendix A-1 includes Trihydro's Field Documentation SOP. Appendix B-1 includes Trihydro's Shipping SOP.

2.3.1 SAMPLE NAMING CONVENTIONS

All field measurement locations, sample locations, and samples, including those collected for QA/QC purposes, will be assigned a unique identification number. The unique identification number will be used to track field-screening data and laboratory analytical results in the project database, as well as presentation of the data in reports. During field work, the unique identification numbers will be recorded in the field logbook, on field datasheets, on sample collection logs, on the sample jars, and on the Chain of Custody (CoC) paperwork.

The following name conventions will be utilized for alluvial aquifer matrix and bedrock aquifer matrix samples:

- Location: Monitoring Well (MW)
- Location Series Identification: 100, 200, 300, 400, 500, or 600. This is unique to each well identification
- Hydrogeological Zone: Shallow Alluvium (AS), Intermediate Alluvium (AI), Deep Alluvium (AD), Upper St. Louis/Upper Salem Formation (SS), Salem Formation (SD), Keokuk Formation (KS)
- Sample Type: Alluvial Aquifer Matrix (AAM), Bedrock Aquifer Matrix (BAM)
- Sample Depth Interval (ft bgs): (0-10'), (10-20'), (20-30'), etc.
- Sample Date: Month-Day-Year
- Final Sample Time: 00:00:00

The following name conventions will be utilized for groundwater samples:

- Location[1]: Monitoring Well (MW), Piezometer (PZ), Leachate Riser (LR), Shallow (S), Intermediate (I), Deep (D), Missouri (MO)

[1] Existing monitoring wells have included naming conventions other than MW for monitoring well such as piezometer, Shallow, Immediate, and Deep. Samples collected from existing wells will continue to use their historical naming conventions.

- Location Series Identification: 100, 200, 300, 400, 500,600, or applicable number. This is unique to each well identification
- Hydrogeological Zone: Shallow Alluvium (AS), Intermediate Alluvium (AI), Deep Alluvium (AD), Upper St. Louis/Upper Salem Formation (SS), Salem Formation (SD), Keokuk Formation (KS), Leachate Riser (LR)
- Sample Type: Groundwater (GW)
- Sample Date: Month-Day-Year
- Final Sample Time: 00:00:00

The following name conventions will be utilized for leachate samples:

- Location: Leachate Collection Sump (LCS)
- Location Series Identification Number: This is unique to each LCS.
- Sample Type: Leachate (L)
- Sample Date: Month-Day-Year
- Final Sample Time: 00:00:00

The following name conventions will be utilized for vapor samples:

- Building Identification: Asphalt Plant Building (APB), Pump House (PH), Scale House (SH), and the Engineering Office (EO)
- Sample Type: Indoor Air (IA), Ambient Air (AA)
- Sample Date: Month-Day-Year
- Sample Time (Start): 00:00:00
- Sample Time (Final): 00:00:00

Field QA/QC samples will include blind duplicates, equipment blanks, field blanks, trip blanks, matrix spike/matrix spike duplicate, and ambient blank samples as described in Section 5.1.3.1 of the QAPP.

For QA/QC samples, blind duplicate naming conventions for samples will include:

- Sample Type: Groundwater (GW), Leachate Collection Sump (LCS), Vapor (V)
- Sample Type: Blind Duplicate (BD)

- Sample Date: Month-Day-Year
- Sample Time: 00:00:00

The following naming conventions will be utilized for equipment blanks:

- Sample Type: Equipment Blank (EB)
- Sample Date: Month-Day-Year
- Sample Time: 00:00:00

The equipment from which the equipment blank was collected will be noted on a Sample Collection Log and in the field logbook.

Field blank naming conventions will include:

- Sample Type: Field Blank (FB)
- Sample Date: Month-Day-Year
- Sample Time: 00:00:00

Trip Blank naming conventions will include:

- Sample Type: Trip Blank (TB)
- Trip Blank Number: 1, 2, 3, (kept sequentially in the field logbook with reference to associated CoC)
- Sample Date: Month-Day-Year
- Sample Time: 00:00:00

Matrix Spike/Matrix Spike Duplicate (MS/MSD) naming conventions will include:

- Location: Monitoring Well (MW), Piezometer (PZ), Shallow (S), Intermediate (I), Deep (D), Leachate Riser (LR), Missouri (MO), Leachate Collection Sump (LCS)
- Location Series Identification: 100, 200, 300, 400, 500, or 600. This is unique to each well identification
- Hydrological Zone (applicable for equipment used on AAM and BAM samples only): Alluvial Shallow (AS), Alluvial Intermediate (AI), Alluvial Deep (AD), Upper Salem/St. Louis Formation (SS), Salem Formation (SD), Keokuk Formation (KS)

- Sample Type: Groundwater (GW), Leachate (L), Alluvial Aquifer Matrix (AAM), Bedrock Aquifer Matrix (BAM)
- Sample Type: Matrix Spike/Matrix Spike Duplicate (MS/MSD)
- Sample Depth Interval (ft bgs) (applicable for equipment used on AAM and BAM samples only): (0-10'), (10-20'), (20-30'), etc.

2.3.2 SAMPLE DOCUMENTATION

A Sample Collection Log (Appendix A-2) will be completed for each individual sample submitted to an analytical laboratory. The Sample Collection Log will include the sample's unique identification number, sample type, sample location, sample time, field personnel, and analytical parameters and container counts for the sample. Associated QA/QC samples such as duplicates, trip blanks, equipment blanks, etc. will be noted.

2.3.3 SAMPLE CONTAINERS AND LABELING

For sample collection, each sample container is identified with a label. The labels will be pre-printed, where possible, and use indelible ink. Sample container labels will include:

- Sample's unique identification number
- Project number
- Date and time of collection
- Personnel collecting the sample
- Preservative
- Analyses requested

For applicable vapor sampling, Summa® canisters are identified with a provided sample tag. The sample tag should include the sample ID and date of collection recorded on the CoC. Other information on the tag may include the canister start and stop vacuum and sample collection time. Electret samplers used for collection of vapor samples for radon analysis will be placed in double-bagged, labeled bags which will contain the sample's unique identification number, project, date and time of collection, personnel collecting the sample, and analysis requested.

2.3.4 SAMPLE PRESERVATION, PACKAGING, AND SHIPPING

The type of sample containers, volumes, and preservatives are listed in Tables 2-4a, 2-4b, 2-4c, and 2-4d for groundwater and leachate; alluvial aquifer matrix; bedrock aquifer matrix; and indoor air samples, respectively. The containers are pre-cleaned and will not be rinsed prior to sample collection. Sample containers requiring preservatives will be provided by the contract laboratories. Sample containers will be placed on ice, if required, in opaque coolers and shipped per the details outlined in the Shipping SOP included in Appendix B-1. Samples will be shipped via FedEx and/or United Parcel Service (UPS) either overnight or ground (or by laboratory courier), as required by sample type, to the laboratories such that the laboratory has sufficient time to meet the USEPA-recommended holding times prior to analysis. After analyses, samples will be disposed of by the laboratory.

2.3.5 SAMPLE CHAIN-OF-CUSTODY FORMS AND CUSTODY SEALS

Samples will be delivered or shipped to the analytical laboratory under CoC protocol (Appendix C) and sent with the samples for each laboratory and each shipment. If multiple coolers are sent to a single laboratory during a single day, CoCs will be completed and sent with the samples for each cooler. A copy of the CoC is kept in the project files. The CoC part of the form provides documentation necessary to trace sample possession continuously from the time of collection until the time of receipt in the laboratory, and the condition of the samples and sample container upon receipt.

When the samples leave custody of the sampling team, the shipping container will be sealed with a custody seal to ensure that the samples have not been disturbed during transportation to the laboratory. The laboratory personnel receiving the coolers will note the condition of the seal and the sample containers within the cooler on the CoC. The laboratory will notify the Trihydro QAD of any deficiencies. If samples are transferred directly from sampling personnel to laboratory personnel, custody seals are not required, but CoCs must be completed to document the transfer. In the event of an incomplete CoC form (with regard to the receipt signature), a signed affidavit will be required from the laboratory. The Trihydro QAD will be contacted should any uncertainty arise regarding the identification of the samples. In the event of indication of sample tampering, the Trihydro QAD will be contacted immediately.

2.4 QUALITY ASSURANCE/QUALITY CONTROL SAMPLES

The QA objectives provide quantitative and qualitative measures of the ability to produce high quality results through a properly designed sampling and analysis program. The objectives of the overall QA/QC program are to:

- Ensure that procedures are documented, including any changes from the RI/FS Work Plan protocol, FSP, or QAPP requirements.
- Ensure that sampling and analytical procedures are conducted according to sound scientific principles.
- Monitor the performance of the field sampling team and laboratory with a systematic audit program and provide for corrective action necessary to assure quality.

- Evaluate the quality of the analytical data through a system of quantitative and qualitative criteria.
- Ensure that data and observations are recorded and archived, as specified in Section 3.11.2 of the QAPP.

A description of the proposed field quality control samples and laboratory quality control samples is included below.

2.4.1 FIELD QUALITY CONTROL SAMPLES

Accuracy in the field is assessed through the use of field, equipment, and trip blanks and through the adherence to protocols and requirements regarding sample handling, preservation, and holding times. Trip blanks are collected to identify and measure cross contamination from transit between the field and the laboratory. Equipment blanks are collected to identify and measure cross contamination from equipment sources not properly decontaminated. Field blanks are collected to identify and measure cross contamination from ambient sources. Accuracy for field measurements will be maintained through adherence to the calibration procedures for the field instruments as outlined in their respective SOPs and Section 4.0.

The number/frequency for each QA sample type is summarized below as outlined in Section 5.1.3.1 of the QAPP and specified in Tables 2-6a through 2-6e:

<u>Blind Duplicate Samples</u>:

1. Groundwater: 1 blind aqueous duplicate per 10 groundwater samples will be collected for the same analytical suite as the parent samples as shown in Table 2-6a.
2. Leachate: 1 aqueous blind duplicate sample per 10 leachate samples will be collected for the same analytical suite as the parent samples as shown in Table 2-6b.
3. Solid matrices (alluvium and bedrock): Blind duplicate samples will not be collected for solid matrix (alluvium and bedrock) samples as they are inherently non-homogenous.
4. Vapor: 1 vapor blind duplicate sample per 10 vapor samples will be collected for the same analytical suite as the parent samples as shown in Table 2-6e.

<u>Equipment Blanks</u>:

1. Groundwater: 1 aqueous equipment blank sample per day of groundwater sampling per sample crew (or 1 equipment blank per 20 groundwater samples, whichever is greater) will be collected for the same analytical suite as the parent samples as shown in Table 2-6a. Non-dedicated sampling equipment will be used for groundwater equipment blanks (e.g., water level probes).

2. Leachate: Dedicated equipment is used for leachate sampling and gauging; no equipment blanks for leachate sampling are proposed.
3. Alluvium: Equipment blanks will not be collected for alluvium samples.
4. Bedrock: Equipment blanks will not be collected for bedrock samples.
5. Vapor: Equipment blanks will not be collected for vapor samples. Vapor sampling equipment will be dedicated to each sample location.

Field Blanks:

1. Groundwater: 1 aqueous field blank per day of groundwater sampling per sample crew (or 1 field blank per 20 groundwater samples, whichever is greater) will be collected at the same time and location as the parent sample is collected. Groundwater field blanks will be collected for potential airborne particulate or vapor-forming compounds as shown in Table 2-6a.
2. Leachate: 1 aqueous field blank per day of leachate sampling per sample crew (or 1 field blank per 20 leachate samples, whichever is greater) will be collected at the same time and location as the parent sample is collected. Leachate field blanks will be collected for potential airborne particulate or vapor-forming compounds as shown in Table 2-6b.
3. Alluvium: Field blanks will not be collected for alluvium samples.
4. Bedrock: Field blanks will not be collected for bedrock samples.
5. Vapor: 1 ambient air sample will be collected for each day of vapor sampling to determine background air quality. The ambient air sample will be collected from an up-wind location for the sample analytical suite as the parent samples (VOCs, methane, radon, and polonium). The ambient air sample will be collected over the same time period used for collection of the parent vapor sample. Both long-term and short-term radon measurements will be collected from the ambient air location.

Trip Blanks:

1. Groundwater: 1 aqueous trip blank will be shipped with each cooler containing groundwater sample jars for analysis of volatile parameters, including samples for analysis of VOCs and total petroleum hydrocarbons (TPH) (low range).
2. Leachate: 1 aqueous trip blank will be shipped with each cooler containing leachate sample jars for analysis of volatile parameters, including samples for analysis of VOCs and total petroleum hydrocarbons (TPH) (low range).

Matrix Spike and Matrix Spike Duplicate:

1. Groundwater: 1 MS/MSD duplicate pair for groundwater will be collected for every 20 groundwater samples (or 1 per event, whichever is greater) for analysis of the analyte suite shown in Table 2-6a.
2. Leachate: 1 MS/MSD duplicate pair for leachate will be collected for every 20 leachate samples (or 1 per event, whichever is greater) for analysis of the analyte suite shown in Table 2-6b.
3. Alluvium: 1 MS/MSD duplicate pair for alluvium will be collected for every 20 alluvium samples for analysis of total metals and radiochemistry
4. Bedrock: MS/MSD samples for bedrock are not proposed since sufficient sample is not expected to be available.
5. Vapor: MS/MSD samples are not required for vapor analyses.

For radiochemical analyses, some methods do not use MS/MSDs; instead the method utilizes a stable carrier or radiotracer for sample-specific yield determination and for gamma spectroscopy.

In order to minimize the chance of cross-contamination, field and equipment blanks will be stored and shipped separately from source area samples, to the extent practicable.

2.4.2 LABORATORY QUALITY CONTROL SAMPLES

Analytical accuracy is expressed as the percent recovery (%R) of a spiked constituent such as a surrogate standard, laboratory control sample/laboratory control sample duplicate (LCS/LCSD), or MS/MSD. Surrogate percent recoveries measure system performance and efficiency during organic analyses. Comparisons of results from LCS/LCSD pairs in conjunction with the MS/MSD pairs can be used to provide evidence that the laboratory methods resulted in data that is within acceptance criteria and, if applicable, the extent of matrix interference. Quality control recovery limits are calculated by the laboratory and are established based on statistical evaluation of previous laboratory analytical results for organic and inorganic analyses. Laboratory QC checks are detailed in Section 5.1.3.2 of the QAPP.

3.0 FIELD METHODS, EQUIPMENT, AND PROCEDURES

This section describes the procedures for sample collection including field sampling methods, equipment, and sample preservation requirements. Procedures for the collection of alluvial aquifer matrix, bedrock aquifer matrix, groundwater, leachate, and indoor air samples have been developed in accordance with industry standard practices and current United States Army Corps of Engineers (USACE) relevant regulatory guidance (USACE 2001). These procedures are intended to provide for the collection of consistent, comprehensive, and representative samples. The sample collection procedures described in this section will be used to ensure the quality of the data and support the OU-3 RI/FS data collection activities.

A list of equipment that is anticipated to be used on this project, associated SOPs, user manuals, and other references are shown in Table 3-1. Calibration procedures for field equipment are outlined in Section 4.0. Decontamination procedures for field equipment are outlined in Section 5.0. IDW management, handling, sampling, and documentation are outlined in Section 6.0.

3.1 PREPARATORY ACTIVITIES

Off-site activities proposed for the OU-3 RI/FS will require access agreements to private properties, notifications to USEPA, utility clearances, and permits. A description of the procedures for each preparatory activity is included below.

3.1.1 SITE ACCESS

Access agreement requests will be prepared for the OU-3 RI/FS off-site activities. For the OU-3 RI/FS, access will be requested from property owners of proposed off-site monitoring well and staff gauge locations. Should additional well locations be identified during the radius search for off-site wells, access agreement requests will be prepared.

3.1.2 NOTIFICATIONS

Required notifications to the USEPA during implementation of the OU-3 RI/FS will be completed as outlined in the ASAOC:

- Contractor Selection – USEPA will be notified within 21 days prior to commencement of any work by additional contractors or subcontractors. Notification will include the names, titles, addresses, telephone numbers, email addresses, and qualifications of personnel.

- Unanticipated Site Changes – USEPA will be notified within 24 hours of discovery of any unanticipated or changed circumstances at the site.
- Sample Collection Activity – USEPA and the MDNR will be notified no less than seven days prior to any sample collection activity to allow for the coordination of the collection of split duplicate samples.

The following notification will be made as outlined in the ASAOC related to emergency response and release reporting:

- Emergency Response – USEPA will be notified should any event occur during performance of the work that causes or threatens to cause a release of Waste Material on, at, or from the site that either constitutes an emergency situation or that may present an immediate threat to public health, welfare, or the environment. Respondents shall take all appropriate action to prevent, abate, or minimize such release or threat of release. Respondents shall immediately notify USEPA's Remedial Project Manager of the incident, or in the event of his/her unavailability, the Regional Duty Officer at (913) 281-0991.
- Release Reporting – USEPA will be notified of any release requiring reporting pursuant to Section 103 of Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. 9603, or Section 304 of the Emergency Planning and Community Right-to-Know Act, 42 U.S.C. 11004. Respondents shall immediately orally notify USEPA's Remedial Project Manager or the Reginal Duty Officer.
- Written Report – A written report will be submitted to USEPA within seven days of any Emergency Response or Release Reporting event describing the event, measures taken to mitigate any release or threat of release, and measurements taken to prevent the reoccurrence of a release.

3.1.3 UTILITY CLEARANCE

The proposed drilling locations include areas within public ROW which may have considerable buried utilities present. As part of the site reconnaissance step, public utility locate requests will be submitted to refine drilling locations prior to mobilization. The public utility clearance process will be repeated prior to commencement of drilling activities. Public utility clearances will be coordinated with the drilling subcontractor (to be determined). The Missouri One Call System (MOCS) will be contacted at least three, but not more than ten working days prior to beginning subsurface activities.

Additionally, a private utility locator will be used to clear buried utilities at each proposed drilling location. Trihydro's Site Clearance and Excavation SOP and Excavation Checklist Form (Appendix D) will be utilized for each well cluster, piezometer, and staff gauge location, or where any other intrusive field activities occur.

3.1.4 PERMITS AND LICENSES

Prior to any monitoring well or vapor well installation activities, Trihydro, or its subcontractor, will obtain the necessary permits required to perform the work scope. Permit requirements will depend on the excavation location. Trihydro will confirm the ownership information and appropriate regulating entity to determine the permitting requirements prior to any field work. Referenced permits are included in Appendix E. Anticipated permits include the following:

1. St. Louis County – St. Louis County will require a Special Use Permit for work proposed within public ROWs designated as part of the St. Louis County Arterial Road System (ARS), dedicated public ROWs in unincorporated St. Louis County, and certain easements for sidewalk and drainage projects. St. Louis County requires at least 48 hours advanced notification. Procedures for obtaining the Special Use Permit include:
    a. Submittal of a Special Use Permit application(s) and required fee(s) of $208 per application and $43 each for Core Drilling and Extraction. The application can be found on the County's website https://www.stlouisco.com/Portals/8/docs/document%20library/highways/sup/SUP_Application_and_Conditions.pdf.
    b. Submittal of proof of liability insurance as outlined in the Special Use Permit.
    c. Confirmation that work will be conducted in accordance with the Manual of Uniform Traffic Control Devices.
2. City of Bridgeton – The City of Bridgeton will require an Excavation Permit for drilling activities. Procedures for obtaining the City of Bridgeton Excavation Permit include:
    a. Submittal of an Excavation Permit application(s) and required fee(s) of $100 per application. The application can be found on the City's website www.bridgetonmo.com under Public Works/Engineering Department.
    b. Submittal of three sets of detailed construction drawings for each application showing the location of the work and what it will entail.
    c. Submittal of proof of liability insurance that meets Section 530.060 of the City's Excavation Permit ordinances ($100,000 for bodily injury to each person, $300,000 for bodily injury to all persons in one occurrence, and $25,000 for all property damage in one occurrence).
    d. Submittal of a performance bond or escrow check in the amount of $2,000 to cover work in the ROW. If the work involves working in the street, the bond amount goes up to $4,000.
3. City of Maryland Heights – The City of Maryland Heights will require a ROW Use Permit for drilling activities. Procedures for obtaining the City of Maryland Heights Permit include:

a. Submittal of a ROW Use Permit application(s) and required fee(s) of $116.00 per unit. Permits will be charged on a unit basis and units applicable to the proposed permit activity will be determined by the Director of Public Works. The application can be found on the City's website http://www.marylandheights.com/ under Public Works.

b. Submittal of two sets of plans showing the extent of the proposed work. Applicants will receive one copy of the approved plans with the permit.

c. Submittal of either a cash deposit of not less than $100 or a surety bond of not less than $1,000. The type of deposit and amount will be determined by the Director of Public Works or their designee based upon the nature and extent of the proposed work.

d. All work must be in accordance with Maryland Heights Municipal Code requirements or, where not defined, in accordance with the St. Louis County Department of Highways and Traffic and Metropolitan St. Louis Sewer District design criteria and standards.

4. Missouri Department of Transportation (MoDOT) – The MoDOT requires a Permit for Work on ROW for any excavations occurring on MoDOT-controlled ROWs or streets. The procedures for obtaining the ROW permit include the following steps subject to a determination by the MoDOT Local Traffic Specialist.

   a. Submittal of an initial on-line permit application on MoDOT's website: https://www6.modot.mo.gov/Permitting/PermitRequest.aspx.

   b. Submittal of engineering drawings or plans (to be determined by MoDOT specialist).

   c. Submittal of a traffic study, if required (to be determined by MoDOT specialist).

   d. Submittal of a traffic control plan, if required to be determined by MoDOT specialist).

   e. Submittal of a surety deposit.

   f. Submittal of a performance bond.

5. MDNR – All monitoring wells and boreholes will be installed, constructed, and abandoned according to MDNR's Code of State Regulations (CSR) Title 10 – Department of Natural Resources Division 23 – Well Installation Regulations (Missouri 2019). For monitoring well and borehole installation, the following information will be submitted to the MDNR:

   a. A monitoring well contractor's permit to construct, repair, or properly plug a monitoring well.

   b. A restricted monitoring well contractor's permit is required for environmental or engineering entities to contract these activities or to act as the primary contractor on-site supervisor.

c. Well certification and registration forms will be prepared as needed either prior to installation for items requiring a variance, such as nested wells, or following installation and abandonment:

   i. MDNR Form 780-1415 – Monitoring Well Certification Report

   ii. MDNR Form 780-2161 – Monitoring Well/Test Hole/Soil and Geotechnical Boring Plugging Registration Report

   iii. MDNR Form 780-2169 – Nested Monitoring Well Certification Report

   iv. MDNR Form 780-1422 – Variance Request Form

   v. Other forms will be prepared if applicable

3.2 WELL INVENTORY AND WELL REPAIR

The first field task to be completed as part of the OU-3 RI/FS will be the completion of a well inventory of the existing wells included in the proposed well network. During the well inventory, wells in need of repair, redevelopment, replacement, or abandonment will be identified, and the necessary well repairs will be completed prior to sampling. A description of the procedures to be used during implementation of the well inventory and repair task is summarized in this section.

3.2.1 MONITORING WELL INVENTORY

Field personnel and subcontractors will inspect and photo-document the site, proposed and existing monitoring well locations, and proposed staff gauge locations. Existing off-site wells such as industrial wells, municipal wells, and water intake structures may be identified during the radius search, which may also be inventoried. This initial site reconnaissance information will be recorded on the Fluid Level and Well Inspection Form (Appendix A-3). A daily record of events for inventoried wells including the site address, location name, and well identification (if available) will be kept in the field logbook. Photograph identification numbers associated with each location will be recorded in the field logbook. The records will be kept as outlined in Trihydro's Field Documentation SOP (Appendix A-1).

The full monitoring well inventory will be conducted during the OU-3 RI/FS to review the existing monitoring well network (Figure 3-1) and other offsite well locations where access has been granted. The Fluid Level and Well Inspection Form documents the following:

- Well Identification Number (if applicable)
- Water Level

- Total Well Depth
- Condition of Bolts, Gaskets, J-Plug, Lid, Well Pad, and Casing
- Issues with Site Access and/or Control

Total well depth will be measured for on-site monitoring wells from the surveyed top of casing by lowering the weighted probe to the bottom of the well. If pumps, tubing, or grab sampling devices are present and an obstacle to total well depth measurements, they will be removed prior to collecting total depth measurements. The well depth will be recorded to the nearest 0.1 foot. To eliminate the potential for any contamination of a drinking water source, a sonic water level meter will be utilized for gauging water levels from any non-monitoring well or off-site well. Their total well depths will not be measured, nor will any equipment be put down these wells during this inventory.

Water level measurements will be conducted in accordance with Trihydro's Fluid Level Measurements SOP (Appendix F-1) and recorded on the Fluid Level and Well Inspection Form (Appendix A-3) during site reconnaissance. The information gathered during the well inventory will be compared to the existing monitoring well survey and construction data summary (Table 3-2) to evaluate monitoring well integrity. Based on the survey, wells will be slated for redevelopment, repair, abandonment and/or replacement.

During the well inventory, a downhole camera will be utilized in each existing well to evaluate to the extent possible whether the well screen or riser pipe are compromised to the extent possible. The downhole camera images will be correlated to the top of casing elevation. The camera will be lowered from the top of casing, and the depths of findings will be noted in the logbook. This will allow for comparison to the well construction logs. Video of the inspection will be recorded. Appendix A-5 includes the downhole camera user manual.

3.2.2 MONITORING WELL REPAIR, REPLACEMENT, AND ABANDONMENT

During the site reconnaissance and well inventory, the monitoring wells with identified issues will be evaluated for redevelopment, repair, replacement, or abandonment. All monitoring well repairs, replacement, or abandonment activities will be performed in accordance with the MDNR 10 CSR 23-4 (Missouri 2019).

Well parts (bolts, gaskets, lids, J-plugs) will be replaced in kind, if necessary. Cracked well pads will be filled (minor cracks) or replaced if major cracks are present. If a well casing has a constriction which limits pump deployment, the well will be evaluated to determine whether the casing can be repaired (for shallow casing issues) or will need to be replaced. For monitoring wells identified in need of major repairs, a scope of work will be prepared for a drilling subcontractor detailing the repairs required for each location.

Monitoring wells with greater than 10 nephelometric turbidity units (NTU) or more than 10% well screen occlusion will be redeveloped according to the same procedures for monitoring well development in Section 3.10. The need for redevelopment will be evaluated and completed during the monitoring well inventory.

All abandonment activities will be conducted according to 10 CSR 23-4. A Monitoring Well/Test Hole/Soil and Geotechnical Boring Plugging Registration Report (MDNR Form 780-2161, Appendix E-4) will be prepared for each location by the drilling subcontractor and reviewed by Trihydro.

For monitoring wells slated for replacement, the existing monitoring wells will first be abandoned. Monitoring well replacement activities will be performing following the same procedures in Sections 3.5 and 3.9 outlining drilling and monitoring well installation activities, respectively.

3.3 AMBIENT AIR AND SAMPLE FIELD SCREENING

Ambient air and sample field screening will be performed using handheld instruments during specific OU-3 RI/FS field activities, including measurements collected using PIDs, multi-gas meters, and fixed gas meters. Below is a summary of the proposed field screening instruments, a description of when readings will be collected, documentation, safety-related triggers, and field procedures for each device. Calibration procedures are outlined in Section 4.0.

3.3.1 PHOTOIONIZATION DETECTOR

A PID equipped with 10.6 electron volt (eV) lamp will be used as a field screening tool for semi-quantitative measurement total organic volatile concentrations in ambient air and sample headspace. The PID uses an ultraviolet lamp to ionize organic vapors (USEPA 1997). The 10.6 eV lamp was selected due to its ability to detect a broad range of compounds, including aromatics, ketones and aldehydes, amines and amides, chlorinated hydrocarbons, sulfur compounds, unsaturated hydrocarbons, alcohols, and saturated hydrocarbons. The known VOCs present in on-site groundwater include benzene and chlorobenzene based on the ASAOC SOW. The ionization potential for these two compounds is 9.25 eV and 9.06 eV, respectively, as published by the manufacturer (RAE Technical Note TN-106, 2010). The PID will be fitted with a moisture filter to reduce false moisture interference. Appendix G includes the PID SOP and user manual.

<u>Applicability</u>

The PID will be used during any field activities to monitor ambient air quality pursuant to the OU-3 RI/FS HASP. Additionally, soil and bedrock samples will be field screened with the PID to estimate VOC headspace concentrations. Vapor samples will also be field screened with the PID.

Documentation

PID readings will be recorded in the field logbook and on applicable field forms depending on the scope of work for the day.

Safety

Ambient air measurements will be collected during all field work where environmental exposure may occur. If ambient air PID readings are noted above levels in the HASP, Draeger Tubes will be used for further evaluating breathing zone air quality and for making decisions regarding respiratory protection (See OU-3 RI/FS HASP for more details).

Field Screening Procedures

During drilling, an aliquot of the alluvial aquifer matrix from each two-foot interval to the water table will be collected directly from the core and placed in a small ziploc-style bag for headspace readings in accordance with Trihydro's Field Screening of Soil Samples Using a PID SOP (Appendix G-1). The bag will be filled halfway with solids and sealed. The soil particles will be manually broken within the bag, and the bag will be allowed to equilibrate for several minutes out of direct sunlight in a 60-80 degrees Fahrenheit (°F) temperature environment (i.e. automobile or field office location). The PID will then be inserted into the bag without opening the bag significantly to collect vapor measurements. The alluvial aquifer matrix from the water table through the bedrock core will be field screened by running the PID along each ten-foot core interval 0.5 to 1-inch above the core. The highest PID results from the ten-foot interval, in parts per billion, will be recorded on field forms for each sample depth and location.

3.3.2 MULTI-GAS METER

A 4-gas or multi-gas meter, such as a BW Gas Alert Microclip or similar meter, will be utilized when working inside the landfill property for ambient air monitoring as outlined in the HASP. The BW Gas Alert Microclip is a clip-on meter that measures the concentration of combustible or toxic gases and vapors as well as oxygen concentrations. The instrument sounds an audible alarm when concentrations exceed preset limits as outlined in Section 6.1.4.2 of the HASP. The meter will be configured to report hydrogen sulfide (H_2S), methane (CH_4) percentage (%), the lower explosive limit (LEL), and the percent oxygen (O_2%). The BW Gas Alert Microclip collects continuous readings.

Documentation

Any alarm conditions will be noted in the logbook.

Safety

Pursuant to the HASP, personnel will evacuate if alarm conditions are detected using the 4-gas meter.

3.3.3 FIXED GAS METER

A fixed gas meter, such as the Landtec GEM™ 2000, or equivalent, will be utilized as a field screening tool when conducting vapor sampling. The fixed gas meter monitors methane, carbon dioxide, and oxygen concentrations. Appendix M-8 includes the Landtec GEM™ 2000 user manual.

Documentation

Field screening readings from the fixed gas meter will be recorded on the Vapor Sampling Field Forms in Appendix M-4.

Field Screening

During indoor air sampling, the fixed gas meter will be utilized by walking through the structure and taking note of areas of elevated fixed gas readings that do not match atmospheric concentrations of 0% methane, 0% carbon dioxide, and 20.9% oxygen. Fixed gas readings will also be recorded when a Summa® canister is placed for indoor air, ambient air, subslab and nearslab sampling. Detailed field procedures for using the fixed gas meter during vapor sampling are included in Appendix M-3.

3.4 FIELD SURVEYING AND MAPPING

Field surveying will consist of land surveying existing monitoring wells, leachate risers, leachate collection sumps, new monitoring wells, staff gauges, and vapor sampling locations. Bathymetric surveying will be conducted on the surface water bodies where staff gauges are installed. The surveying will be scheduled in phases based on the expected timeframes for the installation of new monitoring wells and staff gauges.

3.4.1 LAND SURVEY

For the surveying of the monitoring wells and staff gauges, a State of Missouri registered professional land surveyor will complete the surveys in accordance with the following United States Geological Survey (USGS) guidelines from the USGS Techniques and Methods Book: *The National Map Seamless Digital Elevation Model Specifications, U.S. Geological Survey Techniques and Methods* (USGS 2017) and *Methods of Practice and Guidelines for Using Survey-Grade Global Navigation Satellite Systems (GNSS) to establish Vertical Datum* (USGS 2012) and in accordance with the *Standards and Procedures for Referencing Project Elevation Grades to Nationwide Vertical Datums* (USACE 2010).

Collected well and staff gauge survey data will be input into Trihydro's Project Direct database and exported into the USEPA-accessible database. Spatial information requirements for each surveyed location are as follows:

- Northing and Easting, reported to 0.5-ft, US Survey Feet.
- Coordinates reported in decimal degrees, North American Datum of 1983 (NAD 83).
- North-side top of well casing, reported to 0.01-ft, North American Vertical Datum of 1988 (NAVD 88). The north-side top of well casing will be notched for all later groundwater level measurements to reference.
- Ground surface elevation, reported to 0.01-ft, NAVD 88.
- All coordinates reported in NAD 83, Missouri East State Plane Zone.

Collected survey data will be submitted in Environmental Systems Research Institute (ESRI)-compatible format as either a shapefile or geodatabase. The survey will include installation of two permanent on-site control points and horizontal and vertical control of the locations. The survey will be based on National Geodetic Survey monuments located near the site.

3.4.2 BATHYMETRIC SURVEY

Bathymetric surveys will be performed to collect total depth readings on the four offsite private ponds (SG-501, SG-502, SG-503, SG-600), the onsite stormwater pond (SG-200), and the Earth City ponds (SG-500, SG-504) pending access agreements with third-parties. Bathymetric surveys will not be performed if existing data are available on the construction of the surface water feature. The bathymetric survey data will be utilized as part of the evaluation of potential exposure pathways in conjunction with the screening level ecological risk assessment and sediment/sediment pore water/surface water addenda (Work Plan Section 9.2). A single-beam survey will be performed. With a single-beam survey, the single-beam echosounder emission and pulse are recorded which is used to determine the depth of water along with the speed of sound in the water at the time of the measurement. Specific-site conditions for each water body will determine the exact survey procedures which will be performed by a licensed Missouri professional land surveyor. The surveyor will follow bathymetric survey methods as from *Chapter 2 – Bathymetry: Methodologies Employed by Bathymetric Mapping and Sediment Characterization as Part of the Upper Mississippi River System Navigation Feasibility Study* (Rogala 1999). Appendix A-9 includes information on the bathymetric survey equipment including the single-beam echosounder.

Collected bathymetric data will be input into Trihydro's Project Direct database and exported into the USEPA-accessible database. Spatial information requirements for each surveyed location are as follows:

- Ground surface elevation, reported to 0.01-ft, NAVD 88
- All coordinates reported in NAD 83, Missouri East State Plane Zone

3.5 DRILLING

The following section describes the methods and procedures for drilling. Drilling activities will be conducted in accordance with Trihydro's Drilling Procedures (Appendix H). All lithology will be logged on Trihydro's Lithology Log (Appendix H-3). All rock coring will be performed in accordance with Trihydro's Rock Coring SOP (Appendix I-1). All rock cores will be logged on Trihydro Rock Core Log (Appendix I-2). Borehole advancement will be performed by an MDNR-certified well installation contractor and drilling company. Asbestos training may also be required for on-site soil boring advancement within waste disposal areas.

Boreholes will be advanced to further define the stratigraphy of the site and to identify transmissive units in alluvium and bedrock for well screening and installation. A total of 25 individual clusters (i.e., groups of boreholes/wells) and 4 piezometers will be installed. Drilling activities will be phased as outlined in Section 5.3 of the Work Plan. Phase I will include installation of 65 high priority wells, beginning with the 500-series off-site alluvial wells (AS, AI, AD) (18 wells), then the 200-, 300-, and 400-series on-site wells along the perimeter of the site (30 wells), and then the 600-series off-site background wells (17 wells). Phase II will include 8 off-site bedrock, 5 select on-site wells, and 4 off-site piezometers. The scope of work for Phase II will be reevaluated based on initial results obtained from the Phase I monitoring wells, but is currently anticipated to include the 500-series bedrock wells (SS and SD) (8 wells), wells MW-111 (AS, AI, AD), well MW-113-SD, and well MW-205-SD. The location of these wells may change based on the initial Phase I well sampling. Phase II will also include the installation of four piezometers (PZ-700-series).

As noted in Section 2.0, the OU-3 RI/FS scope of work will be phased and iterative. Table 3-3 presents the proposed monitoring well network and their well installation phase. The majority of the monitoring wells proposed in the OU-3 RI/FS Work Plan will be installed during Phase I of drilling activities:

<u>Phase I Off-site Alluvial Wells</u>:

- MW-500-AS, MW-500-AI, and MW-500-AD
- MW-501-AS, MW-501-AI, and MW-501-AD
- MW-502-AS, MW-502-AI, and MW-502-AD
- MW-503-AS, MW-503-AI, and MW-503-AD

- MW-504-AS, MW-504-AI, and MW-504-AD
- MW-505-AS, MW-505-AI, and MW-505-AD

Phase I On-site/Near-site Alluvial and Bedrock Wells:

- MW-213-AS and MW-213-AD
- MW-302-AD
- MW-303-AI and MW-303-AD
- MW-304-AD, MW-304-SS, and MW-304-SD
- MW-306-AI and MW-306-AD
- MW-400-AS, MW-400-AI, MW-400-AD, MW-400-SS, and MW-400-SD
- MW-401-AS, MW-401-AI, MW-401-AD, MW-401-SS, and MW-401-SD
- MW-402-AS, MW-402-AI, MW-402-AD, MW-402-SS, and MW-402-SD
- MW-403-AS, MW-403-AI, and MW-403-AD
- MW-404-SS and MW-404SD

Phase I Background Alluvial and Bedrock Wells:

- MW-600-AS, MW-600-AI, and MW-600-AD
- MW-601-AS, MW-601-AI, and MW-601-AD
- MW-602-AS, MW-602-AI, MW-602-AD, MW-602-SS, and MW-602-SD
- MW-603-SS and MW-603-SD
- MW-604-SS and MW-604-SD
- MW-605-SS and MW-605-SD

The Phase II wells include on-site/near-site alluvial and bedrock wells, off-site bedrock wells, and alluvial piezometers:

Phase II Off-site Bedrock Wells:

- MW-500-SS and MW-500-SD
- MW-501-SS and MW-501-SD
- MW-502-SS and MW-502-SD
- MW-505-SS and MW-505-SD

Phase II On-site/Near-site Alluvial and Bedrock Wells:

- MW-111-AS, MW-111-AI, and MW-111-AD
- MW-113-SD
- MW-205-SD

Phase II Alluvial Piezometers:

- PZ-700-AS
- PZ-701-AS
- PZ-702-AS
- PZ-703-AS

Approximate locations of the proposed on-site and near-site, off-site, and background monitoring well locations, as well as the piezometer locations, are shown on Figures 3-3, 3-4, 3-5, and 3-6, respectively. These locations are pending access agreements and utility clearances. Section 3.5.2 outlines borehole drilling and logging procedures for each type of drill rig. Section 3.6 outlines aquifer matrix sampling (e.g., alluvium and bedrock), Section 3.7 outlines geologic logging, and Section 3.8 outlines packer testing of the bedrock at new monitoring well locations.

3.5.1 MOBILIZATION AND TEMPORARY FACILITIES

Prior to drilling, Trihydro and the drilling subcontractor will coordinate mobilization of field crews and equipment to the site. Temporary facilities will be designated for storage of field equipment, sample coolers, and well construction materials. A decontamination area will be established. Site control for access to the field equipment and sample coolers will be maintained with dedicated locks on the temporary facilities.

3.5.2 BOREHOLE DRILLING AND LOGGING PROCEDURES

The following section describes the drilling methods proposed for use during the OU-3 RI/FS, including CPT drilling and sonic drilling. Drill rig selection is discussed in more detail in Section 5.4.6 of the Work Plan. Sonic drilling is the preferred drilling method for monitoring well installation for the site due to the nature of the alluvial materials (i.e., grading to coarse gravels with depth) which may impede advancement of a CPT drill rig. However, the CPT rig will be used to advance an HPT within the alluvium to collect in situ hydraulic conductivity data. Details on both CPT with HPT drilling and sonic drilling procedures are included below.

3.5.2.1 CONE PENETROMETER TEST WITH HYDRAULIC PROFILING TOOL

CPT drilling includes advancement of tooling into the subsurface by displacing soil to provide a near-continuous electronic log of site stratigraphy. Soil is displaced, primarily laterally, as the tooling is forced vertically downward. Advantages to using CPT include its continuous logging capabilities, real-time data collection, and the multiple modules and tooling that it can accommodate. Additionally, CPT rigs are generally heavier than traditional direct-push technology units. CPT drilling is typically conducted at depths of less than 100 feet in unconsolidated formations consisting primarily of sand, silt, and clay with some gravel; therefore, the fine to coarse gravels present at the site may impede drilling to total depth. The following procedures will be followed as outlined in Trihydro's Drilling Procedures (Appendix H). CPT drilling will be performed by a subcontractor in accordance with ASTM D5778-12 *Standard Test Method for Electronic Friction Cone and Piezocone Penetration Testing of Soils*.

The CPT drilling rig uses an electronic piezocone soil logging tool to determine soil stratigraphy from relative density and strength and equilibrium groundwater pressures (Appendix H-1). A cone, placed at the advancing tip of the tooling, records tip resistance, sleeve resistance, and pore water pressure. The CPT drilling rig also has variable capacity friction sleeves and pore pressure measurement capabilities. The pore pressure dissipation is recorded either on the face of the cone tip or behind the cone tip. Data are displayed in real time.

The CPT drilling rig will also be equipped with an HPT manufactured by Geoprobe Systems® or similar (Appendix H-1). The HPT measures the pressure in pounds per square inch (psi) required to inject a flow of water into the soil as the probe is advanced into the subsurface, which is an indicator of formation permeability. The flow rate of the injection of water is also recorded. In addition to measuring injection pressure and flow rate in relation to depth below ground surface, the HPT measures electrical conductivity in millisiemens per meter (mS/m). Electrical conductivity will increase where higher ionic fluids, such as leachate, are encountered. The HPT logs are used to calculate absolute piezometric pressure and estimate hydraulic conductivity. The HPT logs are displayed in graphical form. The HPT logging will be performed by a subcontractor in accordance with ASTM D8037 *Standard Practice for Direct Push Hydraulic Logging for Profiling Variations of Permeability in Soils.*

A pilot test will be conducted to evaluate the feasibility of CPT drilling with HPT. The pilot test will consist of a transect of soil borings advanced utilizing a CPT rig in the Buffer Zone near well D-6 (Figure 3-2). Following pilot testing near monitoring well location D-6, CPT with HPT is planned to be installed in the alluvial material at each of the 19 well locations where alluvial wells will be installed. HPT logging will be evaluated to determine the zones with the highest hydraulic conductivities in the alluvium. This information will be used to determine the interval to screen the shallow, intermediate, and deep alluvial wells. If the CPT with HPT cannot advance into the alluvium due to refusal if gravels are encountered, the screened interval of the deep alluvial will be determined from the field geologist's log during sonic drilling.

3.5.2.2 SONIC DRILLING

The sonic drilling method is a type of rotary vibratory drilling that includes rotary motion and oscillation, which causes a high frequency force to be superimposed on the drill string. The sonic drilling technique involves advancing a core barrel and an override casing to prevent the borehole from collapse when the core is retrieved. The technique utilizes the rotating and vibrating core barrel and override casing simultaneously to drill a clean borehole minimizing the amount of drill cuttings and maximizing the amount of cored material retrieved for sampling. The sonic drilling technique allows for continuous casing of the borehole to prevent downhole migration of constituents of concern, continuous coring of 10-foot intervals, ample core material for sampling, and retention of minimally-disturbed cores following sampling.

While there are concerns regarding the use of sonic drilling and short-term vaporization of VOCs in the immediate area of a well during installation, soil sampling for VOC analysis is not proposed. The number of groundwater samples proposed over an extended period of time from sonic-drilled wells should not be affected by short-term vaporization in the immediate area of a well during installation. The proposed monitoring wells for the OU-3 RI/FS will be installed using sonic drilling techniques and the following procedure will be followed:

- The core barrel and override casing size will be selected such that the diameter of the borehole and override casing will be a minimum of 4 inches greater than the diameter of the installed well casing and screen, thus a minimum of 6-inch core barrel and 7-inch override casing size will be used for a non-nested, single-cased 2-inch well.[2]
- The core barrel is advanced at 10-foot intervals telescoping from below the override casing.
- The core barrel will be withdrawn to the surface.
- The core barrel will be replaced with the Shelby tube adaptor.[3]
- The Shelby tube (approximately 3-inch diameter, 2-5 ft long) will be advanced into the first approximately 30-inches of each 10-foot interval.
- The Shelby tube will be withdrawn to the surface.
- The Shelby tube adaptor will be replaced with the core barrel.
- The core barrel will be advanced through the rest of the 10-foot interval for sampling.
- The core barrel will be withdrawn from the surface.
- The core barrel plastic sleeve will be removed from the barrel for field observation and logging.
- This process will be repeated until the entire interval of interest is sampled, which will take several core sections to span.
- The addition of potable water during sonic drilling will be kept to a minimum during the drilling. Potable water added during drilling will be logged in the field logbook.
- Each cored interval will be viewed first through the plastic sleeve, and then by cutting through the plastic sleeve.
- Field team personnel wearing clean gloves will extract the samples from the plastic sleeve. The samples will be inspected, prepared for screening, and logged.

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[2] Nested wells will be constructed in the alluvial aquifer. Double-cased wells will be constructed in the bedrock aquifers to prevent the potential contamination of the lower bedrock units by upper alluvial aquifer zones. The appropriate core barrel and override casing size will be selected for the double-nested wells and for the double-cased wells to meet 10 CSR 23-4. Well construction details are described in Section 3.9.

[3] Shelby tubes will only be collected at specific locations where specialty geotechnical samples are required. See Table 2-4b and Figure 3-7.

- A representative aliquot of the soil from each two-foot section of the sampler in the unsaturated zone will have its headspace measured with a PID.
- A representative aliquot of the alluvial aquifer matrix from each two-foot section of the sampler in the saturated zone will be field screened with a PID.

Alluvial descriptions will include the Unified Soil Classification System (USCS), color, grain size, stiffness or density, moisture content, sorting, angularity, mineralogy, and plasticity as applicable. The alluvial descriptions will be logged according to Trihydro's Drilling and USCS Classification SOPs (Appendix H-1, H-2) and recorded on Trihydro Lithology Log (Appendix H-3). Field screening with the PID will be recorded on the Lithology Log. The Shelby tubes will be collected in accordance with ASTM D1587 *Standard Practice for Thin-Walled Tube Sampling of Fine-Grained Soils for Geotechnical Purposes.* The undisturbed soil cores will be maintained, placed in core boxes, labeled, and stored at a designated location for further testing, if required.

3.5.2.3 ROCK CORING

Bedrock coring will be conducted after alluvium has been drilled through to rock by first advancing a 12-inch core barrel and setting an 8-inch steel isolation casing at least two feet below the bedrock contact.[4] The bedrock coring will be performed using a wireline coring system with a diamond impregnated coring bit. The core barrel assembly consists of core barrel and an overshot component. The core barrel assembly will be a split barrel, 5- to 10- feet in length, either 96-mm OD, 63.5-mm ID (HQ™) or 122.6-mm OD, 85-mm ID (PQ™) cores will be utilized, advanced in 5- to 10-foot intervals with rotation from the drill head and the borehole cleared using an air compressor. After advancement of the rock core barrel in 5- to 10-foot intervals, a 7-inch OD override casing will follow.[5] The final borehole OD will be dependent upon MDNR permitting for the bedrock aquifer monitoring wells. Upon completion of the 5- to 10-foot interval, the wireline attached to the overshot assembly will be used to retrieve the core barrel assembly. This process will continue until between approximately 100 to 200 feet of core is retrieved, and the borehole is cleared to total depth with a 7-inch diameter override casing. Table 3-4 details the total depth and rock coring length for the bedrock monitoring wells. If, during coring a highly transmissive fracture is encountered, field personnel will stop drilling and notify the FTL and APM to discuss procedures for minimizing potential cross-contamination. Procedures may include installing a packer or telescoping during rock coring and extending the core barrel to continuously isolate the bedrock

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[4] The isolation casing will be set and grouted prior to rock coring to ensure the well is double-cased between the alluvium and bedrock.
[5] The core barrel assembly diameter will be dependent on driller availability and will be either HQ™, PQ™, or equivalent.

aquifer. If it is determined that the bedrock aquifers need to be isolated, isolation casing will be extended and installed as needed.

Recovered cores will be retained and inspected by a field geologist. Bedrock descriptions will include weathering, bedding, color, grain/crystal size, strength, lithologic description, and geologic formation. Bedrock borehole logs will also include core recovery, rock quality designation (RQD), fractures per foot, weathering index, strength index, and discontinuity data. The bedrock cores will be logged according to Trihydro's Rock Coring SOP (Appendix I-1) and on the Rock Coring Log (Appendix I-2). Bedrock cores will be placed in core boxes, labeled, and stored at a designated location for further testing as needed.

3.6 AQUIFER MATRIX SAMPLING

A tally of the number of estimated samples is included in Table 2-3. The sections below outline the sampling process for each material based on the phased monitoring well installation.

3.6.1 ALLUVIAL AQUIFER MATRIX SAMPLING

The alluvial aquifer matrix samples will be collected from the deepest borehole at nine well locations (Figure 3-7a). The following list shows the nine locations for alluvial aquifer matrix sampling in the order of installation:

Phase I Off-site Alluvial Wells:

- MW-502-AD
- MW-503-AD

Phase I On-site/Near-site Alluvial Wells:

- MW-304-AD
- MW-400-AD
- MW-401-AD
- MW-402-AD

Phase I Background Alluvial Wells:

- MW-600-AD
- MW-601-AD
- MW-602-AD

Saturated alluvial aquifer matrix samples will be collected every 20 feet to bedrock. Upon reaching each 20-foot interval, the core barrel will be replaced with the Shelby tube adaptor to drive the Shelby tube into the sampled interval. Once the Shelby tube is retrieved, the adaptor will be replaced by the core barrel, which will be driven to the final sample depth for the 20-foot interval.

Sample nomenclature will follow protocols outlined in Section 2.3.1.[6] Within each 20-ft interval, a 2 to 4 ft length of alluvial sample will be collected to provide an overall random unbiased and representative dataset. If the 20-ft interval intersects the vertical interval which has been selected for the well screen based the criteria is Section 3.9.1, then the sample will be preferentially selected from within the 10-ft well screen interval. Samples are anticipated to be collected from clays, silts, and fine-grained sands in the shallow alluvial aquifer; medium-grained sand, coarse-grained sand, and fine gravel in the intermediate aquifer; and fine, medium, and coarse gravel in the deep alluvial aquifer. In general, vertical gradients are negligible between clustered wells screened in the shallow, intermediate, and deep alluvial zones. This indicates these zones are in hydraulic communication and are part of a connected hydrostratigraphic zone.

Alluvium from the intervals selected by the field geologist will be placed in the laboratory provided sample container according to preservation requirements as outlined in Table 2-4b. The samples will be collected in the field and preserved as required with either wet or dry ice in coolers as outlined in Trihydro's Shipping Procedures (Appendix B). A Sample Collection Form (Appendix A-2) will be pre-prepared (i.e., the sample name, sample type, analytical methods, and QA/QC required will be prepopulated on the form) to aid in the sampling effort and then completed in the field for each individual sample collected.

Depending on the depth to bedrock, a total of up to five alluvial aquifer matrix samples from nine boreholes will be sampled for analysis, resulting in approximately 45 alluvial aquifer matrix samples. The alluvial aquifer matrix samples from each well site will be analyzed for the parameters as outlined in Section 2.0 and on Table 2-6c.

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[6] For example, a sample from the 0-10' interval from MW-213-AD will be MW-213-AD-AAM-(0-10').

A subset of well locations will also be analyzed for mineralogy (XRD and SEM-EDS), sequential extraction, and select geotechnical analyses as shown in Figure 3-7b. The goal of these specialty analyses is outlined in Section 5.4.8 of the Work Plan. These specialty samples will be submitted from the same vertical intervals as the proposed alluvial well screen intervals. Based on the assumption that three alluvial wells will be screened at each of the three locations, it is anticipated that a total of nine alluvial samples will be collected for the specialty analyses.[7]

3.6.2 BEDROCK AQUIFER MATRIX SAMPLING

Bedrock aquifer matrix samples will be collected from nine well locations where bedrock wells will be installed (Figure 3-7a). The following list shows the nine locations for bedrock sampling at the Phase I and II well locations in the order of installation:

Phase I On-site/Near-site Bedrock Wells:

- MW-304-SD
- MW-400-SD
- MW-401-SD
- MW-402-SD

Phase I Background Bedrock Wells:

- MW-602-SD
- MW-603-SD
- MW-604-SD

Phase II Off-site Bedrock Wells:

- MW-502-SD

Phase II On-site/Near-site Bedrock Wells:

- MW-205-SD

[7] Specialty analysis samples will be collected from MW-400-AD, MW-503-AD, and MW-602-AD.

The bedrock aquifer matrix samples will be analyzed for the parameters as outlined in Section 2.0 and on Table 2-6d. Bedrock aquifer matrix samples will be collected every 20 feet based on rock core logs targeting fractured zones. Approximately seven samples are anticipated for the bedrock aquifer wells with the exception of the MW-603-series and MW-604-series wells. Approximately 12 samples are anticipated for the bedrock aquifer wells from MW-603-SD and MW-604-SD due to their location east of the edge of the alluvium. A total of 73 bedrock aquifer matrix samples will be submitted for laboratory analysis.

The bedrock intervals selected for sampling will be containerized and preserved as outlined in Table 2-4c. The samples will be collected in the field and preserved as required with either wet or dry ice in coolers as outlined in Trihydro's Shipping Procedure (Appendix B). A Sample Collection Form (Appendix A-2) will be completed for each sample collected.

A subset of bedrock samples will be submitted for analysis of the mineralogical parameters (XRD and SEM). Sampling intervals for the specialty analyses will correspond with the 10-foot interval selected for screening the SS and SD bedrock monitoring wells following geophysical logging and packer testing. These samples will be collected from the rock core which is retained following drilling. Based on the assumption that two bedrock wells will be screened at each location shown on Figure 3-7b, a total of nine bedrock samples are anticipated to be submitted for specialty analysis.[8]

3.7 GEOPHYSICAL LOGGING

3.7.1 PURPOSE

Geophysical logging using down-hole tooling will be conducted to evaluate data gaps by correlating lithology, rock structure, hydraulic properties, and other borehole parameters across the site primarily in the bedrock. Geophysical tools are deployed in open boreholes. Due to the presence of sands and gravels in the alluvium, an open borehole is anticipated to collapse. Therefore, proposed geophysical logging in the alluvium is limited to the instrumentation that can provide data through the isolation casing. This includes the spectral gamma tool as described in Section 3.7.2.5. Note that the spectral gamma measurements through the isolation casing will be muted.

In bedrock, viable geophysical tools for the open borehole include the acoustic televiewer, spontaneous potential (SP)/resistivity, induction/conductivity, heat pulse flow meter, fluid temperature and resistivity, gamma-gamma-density, natural gamma, spectral gamma, and caliper tools as described in Section 3.7.2.

[8] Specialty analysis samples will be collected from MW-205-SD, MW-304-SD, MW-400-SD, MW-602-SD, MW-603-SD.

Table 3-5 summarizes the proposed tools for each of the monitoring well location slated for geophysical logging. It will be performed in accordance with Trihydro's Geophysics SOP (Appendix H-4). The types of tooling will vary depending on the driller(s) selected for the work. It is anticipated at least one tool from each of the three categories (i.e., lithology and rock structure, hydraulic parameters, and radionuclide information) will be deployed as part of the OU-3 RI/FS geophysical logging scope of work. Information on potential fractures and cavities will be obtained from acoustic televiewer logs and caliper logs prior to deploying other geophysical tools to confirm the stability of the borehole.

1. Lithologic information is available from SP/resistivity, induction/conductivity electromagnetic (EM) logs, and gamma-gamma logs.
2. Hydrogeologic information is available from induction/conductivity EM logs, heat pulse flow meter logs, and fluid temperature and electrical resistivity logs.
3. Radionuclide information is available from natural gamma and spectral gamma logs.

Downhole geophysical logging will be conducted after the borehole is advanced to total depth following grouting isolation casing in the alluvial material and within the open borehole in bedrock prior to installing the monitoring well. Geophysical logging will be performed at the 15 well site locations where bedrock wells will be installed within the deepest borehole at each site for the Phase I and II wells:

<u>Phase I On-site/Near-site Wells</u>:

- MW-304-SD
- MW-400-SD
- MW-401-SD
- MW-402-SD
- MW-404-SD

<u>Phase I Background Wells</u>:

- MW-602-SD
- MW-603-SD
- MW-604-SD
- MW-605-SD

Phase II Off-site Wells:

- MW-500-SD

Phase II On-site/Near-site Wells:

- MW-113-SD
- MW-205-SD
- MW-501-SD
- MW-502-SD
- MW-505-SD

The downhole geophysical work will be subcontracted to a qualified firm. The geophysical subcontractor and their tooling will be selected based on ability to record and report these geophysical parameters. Reports will include digital files such as Log ASCII Standard, or other equivalent common format, adjusted for tool depth and length. The results of the geophysical logging will be used to aid well screen placement, along with rock coring logs and results of packer testing. The geophysical logging results will be utilized to determine the locations within the bedrock borehole to packer test as described in Section 3.8.

The borehole logs will be correlated to the ground surface elevation, which will be surveyed following monitoring well location. The camera lens will be lowered to the ground surface, and the depth of the camera lens will be adjusted to give a depth of 0'0" on the monitor. This will allow for conversion of the logs to surveyed ground surface elevation points and comparison across the investigation area.

3.7.2 GEOLOGIC LOGGING TOOLS

The following sections describe the various potential geophysical logging tools which will be considered for evaluating data gaps. Since the type of information provided by the tools listed below can be duplicative, a subset of these tools will ultimately be selected for deployment depending on driller selection. Available tooling will be evaluated, and the geophysical logging tools selected such that at least one tool within each category (i.e., lithology and rock structure, hydraulic parameters, and radionuclide information) is utilized.

3.7.2.1 ACOUSTIC TELEVIEWER

The acoustic televiewer is used to collect a continuous image of the borehole wall. The image can be analyzed to determine lithology, characterize voids (or core loss zones), and calculate strike and dip of planar features that intersect the boring such as bedding planes, fractures, joints, and foliation. The images are constructed by recording the arrival times and amplitudes of ultrasonic pulses generated from a source located in the borehole. The source is oriented towards the borehole wall and spinning 360 degrees. The borehole must be filled with water or drilling fluid and the hole should be uncased. However, some material behind casing may be imaged by analyzing secondary arrivals (echo from the casing). This tool requires an open borehole for utilization.

3.7.2.2 SPONTANEOUS POTENTIAL/RESISTIVITY PROBE

The spontaneous potential (SP)/resistivity probe contains electrodes at various separations, each producing a different lateral distance for penetration of the electric field into the formation. In general, the borehole resistivity probes respond to the conductivity/resistivity variations within geologic materials that are often related to mineralogy, water content, and porosity, and are used to resolve conductive materials such as clay and shale within resistive units such as dense limestone or dry, non-cohesive soils. SP is reported in units of millivolts (mV) and resistivity is reported in units of ohm-meters (ohm-m). The cased borehole in alluvium or open borehole in rock must be filled with water or drilling fluid. This tool requires an open borehole for utilization.

3.7.2.3 INDUCTION/CONDUCTIVITY

Electromagnetic (EM) induction logs include induction resistivity and formation conductivity, both of which are based on porosity, hydraulic conductivity, water content, total dissolved solids within the interstitial water and clay content. Data are collected by generating a primary field within the measurement volume. The primary field induces a secondary magnetic field. The strength of the secondary field is related to the formation conductivity. The formation conductivity is reported in units of mS/m and is used to resolve details within conductive materials such as clay and shale. The induction resistivity is reported in units of ohm-m and is used to resolve details within resistive units such as dense limestone or dry, non-cohesive soils. Therefore, the formation conductivity is good for detecting clay-rich zones within epikarst, and the induction resistivity is useful for detecting top of competent bedrock. This tool requires an open borehole for utilization.

3.7.2.4 HEAT PULSE FLOW METER

The heat pulse flow meter utilizes a pulse of heat to measure the time required for water, at a specific location in the water column, to flow through a known area. The test can be conducted under both static and pumping conditions. This tool requires an open borehole for utilization.

3.7.2.5 FLUID TEMPERATURE AND RESISTIVITY

Fluid temperature logs and resistivity logs provide variations in temperature and electrical resistivity of the borehole fluid with depth, respectively. Fluid resistivity changes reflect changes in the dissolved-solids concentration of the water. The temperature and resistivity variations assist in determining water-producing and water-receiving zones in addition to zones of vertical borehole flow. Vertical borehole flow is characterized by zones for which the borehole fluid temperature and resistivity have little or no vertical variation. This tool requires an open borehole for utilization.

3.7.2.6 GAMMA-GAMMA DENSITY

Gamma-gamma density logging involves measuring the intensity of radiation from a down-hole source after the radiation has attenuated due to back-scattering of materials in and around the borehole. The attenuation of the back-scattered radiation is attributed to the bulk density of the surrounding geologic materials. Therefore, the gamma-gamma log can assist in assigning lithologic variations with depth. This tool requires an open borehole for utilization.

3.7.2.7 NATURAL GAMMA

Natural gamma logging involves measuring the natural gamma radiation emitted by material surrounding the borehole. The primary radioactive elements within geologic materials are potassium-40, thorium-232, uranium-238, and the daughter products in their decay series. These elements typically reside in clays and shales and are not prevalent in clean sands and limestone. Therefore, natural gamma data are useful for identifying clay-rich zones or shale partings within limestone. Natural gamma data represent total gamma ray emissions in units of counts per second (cps). This tool requires an open borehole for utilization.

3.7.2.8 SPECTRAL GAMMA

Spectral gamma logging involves measuring the natural-gamma energy spectra, which are caused by the decay of uranium, thorium, potassium-40, and anthropogenic radioactive isotopes. Spectral gamma logging can be used to identify and quantify the amount of uranium, thorium, and potassium-40 isotopes detected in an open borehole, and to a lesser extent through a cased borehole. This tool may be utilized in an open or cased borehole. Readings may be muted in a cased borehole.

3.7.2.9 CALIPER

Changes in borehole diameter are logged using a 3-arm caliper probe. These data provide generalized information regarding hole condition such as the presence of voids, vugs, or solution-widened joints or bedding planes. Since borehole diameter often affects log response, the caliper log provides useful information for geophysical logs. This tool requires an open borehole for utilization.

3.8 PACKER TESTING

Packer testing will be conducted to evaluate aquifer properties of the bedrock and to identify higher transmissivity zones for screen placement. Packer testing will be conducted at the 15 deepest bedrock boreholes in each well cluster where a bedrock monitoring well will be installed, as shown in Table 3-5. Results from the geophysical logging will be utilized to determine intervals within the bedrock to packer test. Intervals with the highest potential hydraulic conductivities based on the geophysical logs will be selected. Packer testing will be performed in accordance with ASTM D 4630-96 *Standard Test Method for Determining Transmissivity and Storage Coefficient of Low-Permeability Rocks by In Situ Measurements Using the Constant Head Injection Test* (ASTM 2002).

3.8.1 PROCEDURES

Following drilling operations and geophysical logging, constant rate of flow injection packer tests will be conducted in all open bedrock holes on select intervals identified during continuous coring based on fracture frequency and porosity, and intervals identified during borehole geophysical logging. Double (straddle) and single downhole packer assemblies will be lowered to the desired depth using the sonic drilling rig. Straddle packer tests will generally isolate 5 to 10 feet of borehole length using pneumatic straddle packers.

Downhole packer testing equipment will be supplied by the selected drilling contractor and connected via the drilling rods to a surface assembly consisting of a variable rate water pump, a flow meter manifold, a pressure gauge, valving, and hoses. Step tests will be conducted where feasible.

3.9 MONITORING WELL CONSTRUCTION

The OU-3 RI/FS monitoring well network will consist of 78 new monitoring wells and 4 piezometers (Table 3-3). The monitoring wells are grouped by location series either immediately adjacent to the perimeter of the active sanitary landfill (100-series), on-site (200, 300, and 400-series), off-site (500-series), and as off-site background (600-series) monitoring wells. The monitoring wells will be installed in clusters (i.e. a group of monitoring wells), with exception of wells MW-113-SD, MW-205-SD, and MW-302-SD, for a total of 25 monitoring well locations. Table 3-4 shows the new monitoring wells, their location series, their tentative installation depths which will be field-verified, and their proposed well construction.

Figures 3-8a, 3-8b, and 3-8c show the proposed monitoring well construction types for the single alluvial wells, the nested alluvial wells, and the bedrock wells, respectively. Both flush-mount and stick-up well completions are shown for each well type proposed for off-site and on-site wells, respectively. Well installation will follow the MDNR Well Construction Code 10 CSR 23-4 (Missouri 2019) and the Trihydro Well Installation Procedures (Appendix J). Well construction information will be recorded on the appropriate Trihydro Well Construction Log for either Single- or Double-Cased Monitoring Wells (Appendix J-2 and J-3, respectively).

Trihydro will work with the subcontractor to specify sourcing of the well construction materials from one source and will require certificates, where possible, from the manufacturer or supplier to certify the materials are clean.

3.9.1 MONITORING WELL DESIGN

The most transmissive zones within the shallow, intermediate, and deep portions of the alluvial aquifer will be determined from HPT results and field logging for alluvial wells. The monitoring well's screen depth will target the interval with the highest hydraulic conductivity. It is anticipated that the most transmissive zones in the alluvial aquifer matrix will consist of medium-grained sand in the shallow alluvial aquifer, coarse-grained sand and fine gravel in the intermediate alluvial aquifer, and coarse gravel in the deep alluvial aquifer.

Results of field logging, geophysical logging, and packer testing from the deepest bedrock well in each well cluster will be used to determine bedrock monitoring well screen intervals. The monitoring well's screen depth will target the interval with the highest hydraulic conductivity.

3.9.1.1 BEDROCK WELL INSTALLATION

Bedrock monitoring well installation will follow MDNR procedures with additional precautions taken to prevent vertical migration of groundwater from the alluvial deposits above (Missouri 2019). Wells advanced beyond the bedrock/alluvium interface will be double-cased to minimize the chance of downward migration of potentially impacted groundwater of the boreholes advanced into bedrock. The boring will be over-drilled through the alluvium, into competent bedrock, with a 12-inch core barrel. An 8-inch outer casing will then be installed and seated at least 2 feet into competent bedrock. Monitoring well design will also be in accordance with ASTM *Standard Practice for Design and Installation of Groundwater Monitoring Wells* D5092 (ASTM 2010). The borings logs for previously installed monitoring wells at and around the site have been reviewed to determine appropriate screen slot sizes and filter pack sand sizes such that the sand is fine enough to retain the formation, but coarse enough to allow for unrestricted movement of groundwater into and through the monitoring well for representative sample collection and aquifer testing. Bedrock monitoring wells will not be installed as open borehole construction wells. They will be constructed with 10-foot screens and appropriate sand in order to isolate the 10-foot interval with the highest hydraulic conductivity for sampling.

The isolation casing will be grouted by pressure grouting from the bottom of the borehole at approximately 2 feet below the competent bedrock surface to the surface outside the outer casing to minimize the chance of alluvial formation groundwater transport pathways. Competent bedrock depth will be confirmed during rock coring and geophysical logging. The isolation casing will be extended if needed. The isolation casing will be allowed a minimum of 48 hours to cure. Following grouting and allowing the isolation casing to set for 48 hours, an inner boring will then be advanced for rock coring to the final depth of the monitoring well. Next, geophysical logging will be completed on the deepest of the bedrock monitoring well locations, followed by packer testing. Once these tests have been completed, an approximately 7-inch diameter sonic core barrel will be advanced to final depth, and well installation will commence with setting the well materials. If needed for geophysical logging tooling, the borehole may be reamed out with the approximately 7-inch diameter sonic core barrel prior to logging.

The bedrock monitoring wells will be constructed of 2-inch, Schedule 80 flush-threaded polyvinyl chloride (PVC) pipe with 0.010-inch factory-slotted Schedule 80 PVC screen. The screen length for the bedrock wells will be 10 feet. A flush-threaded, Schedule 80 PVC end cap will be placed on the bottom of the monitoring well screen. A Schedule 80, flush-threaded, PVC riser will be placed above the screen to a height of approximately 3 feet above grade. The riser will be cut down during installation of the flush-mount well box for off-site wells. Each well will be capped with a waterproof cap with penetrations for sample tubing and water level gauging.

Surrounding the screen, the filter pack sand will consist of 10/20 or equivalent mesh silica sand, depending upon market availability. The 10/20 or equivalent mesh silica sand is fine enough to filter out coarse to fine-grained materials but is not so fine as to potentially occlude the well screen or introduce fines from the sand pack into the well. The top of the filter pack will extend at least 2 feet above the top of the well screen. The filter pack will be capped with approximately 2 feet of bentonite (chips for a dry hole or coated pellets if constructed in water) used to form a hydraulic seal. Bentonite chips, if used, will be hydrated with potable water and allowed to hydrate a minimum of 1 hour before applying grout to the annular space. The surface of the bentonite seal will be measured with a clean measuring tape to document the thickness of the seal. The remaining annulus above the seal will be filled with cement-bentonite grout; a slurry of cement, bentonite, and potable water. Powdered bentonite from two to six percent (2-6%) by weight shall be added. The cement bentonite grout will be tremie-grouted into the annular space to within approximately 2 to 5 feet of ground surface. The tremie pipe shall be placed to the bottom of the annular space and have a side discharge which directs the grout away from the bentonite seal, reducing the potential for infiltration. The grouting will be completed in continual, lifting operation. After the grout has been allowed to settle, additional grout will be placed to approximately 2 ft bgs. The remaining annular space beneath the concrete surface completion will be filled with sand to allow for surface water entering into the well to infiltrate into the ground surface instead of potentially flooding the well and entering the monitoring well.

3.9.1.2 ALLUVIAL WELL AND PIEZOMETER INSTALLATION

Alluvial wells will be installed as either single-cased monitoring wells or double-nested, single-cased monitoring wells. Piezometers will be installed as single-cased wells. As required in 10 CSR 23-4, prior approval will be obtained from MDNR for any proposed nested well construction (Missouri 2019). Monitoring well design for the alluvial wells will follow the applicable ASTM guidance and procedures noted above in Section 3.9.1.1.

The shallow and intermediate alluvial wells will be nested within an approximately 11-inch diameter borehole. The 11-inch diameter borehole will be advanced via sonic drilling to total depth for the well cluster. The nested wells will be assembled simultaneously while being lowered into the borehole; centralizers and spacers between the well casings will be utilized as appropriate to ensure the wells are separated by a minimum of 2 inches of annular materials between each other.

Deep alluvial monitoring wells will be constructed within a single borehole approximately 7-inches in diameter. However, if HPT results indicate that less than 13 ft of vertical space exists between proposed screened intervals for the shallow and intermediate wells, the intermediate alluvial well will be nested with the deep alluvial well within a single borehole approximately 11-inches in diameter. After the wells are lowered and bottom depth of each well is confirmed to be at the target depths, annular materials will be placed in the borehole using a tremie pipe inserted to the bottom of the borehole.

The alluvial aquifer monitoring wells will generally be constructed of 2-inch, Schedule 40 flush-threaded PVC pipe with 0.010-inch factory-slotted Schedule 40 PVC screen. If the total well depth is greater than 100 feet, then Schedule 80 PVC pipe and screen will be utilized as per Missouri State Well Code. The screen length will be 10 feet in the alluvial aquifer wells. The annular space around the screened intervals for the shallow and intermediate alluvial wells will be filled with 16/35 or equivalent sand; the annular space around the screened intervals for the deep alluvial wells will be filled with 10/20, or equivalent sand. The sand will be placed to a minimum of 2 feet above the top of the screen. Groundwater will be surged in each screened interval location prior to completing the filter pack placement to minimize future settlement of the filter pack.

The filter pack will be capped with at least 2 feet of bentonite (chips for a dry hole or coated pellets if constructed in water) used to form a hydraulic seal in the single wells. In the double nested wells, coated, time-released, bentonite chips will be placed for the annual seal between or above the screened intervals. Per 10 CSR 23-4, the chips will be hydrated after each three foot lift to help ensure proper hydration and a minimum of three times as much water as bentonite will be used. Alternatively, a bentonite-slurry grout, as described above, may be tremie-grouted from the bottom to the top of the annular space. The surface of the bentonite seal will be measured with a clean measuring tape to document the thickness of the seal. The annular seal between the nested well screens will be a minimum depth of 13 feet between the well screens. The grouting will be completed in continual, lifting operation. After the grout has been allowed to settle, additional grout will be placed to approximately 2 ft bgs. The remaining annular space beneath the concrete surface completion will be filled with sand to allow for surface water entering into the well to infiltrate into the ground surface instead of potentially flooding the well and entering the monitoring well.

Piezometers will be constructed similarly to the single, shallow alluvial wells in an approximately 7-inch diameter borehole. The piezometers will be constructed of 2-inch ID, Schedule 40 flush-threaded PVC pipe with 0.010-inch factory-slotted Schedule 40 PVC screen. The annular space around the screened intervals will be filled with 16/35 or equivalent sand. The sand will be placed to a minimum of 2 feet above the top of the screen. The filter pack will be capped with at least 2 feet of bentonite (chips for a dry hole or coated pellets if constructed in water) used to form a hydraulic seal then the annular space will be grouted to the surface in continual, lifts.

3.9.2 MONITORING WELL COMPLETION

Following monitoring well installation, the monitoring wells well be completed with either stick up wells with protective casing and bollards or flush-mounts with well vaults depending on their location onsite or offsite. The following sections describe their completions based on the monitoring well type and location.

3.9.2.1 ON-SITE MONITORING WELLS

The on-site well completions will be constructed with a target riser height of approximately 3 feet. After well construction is complete, a protective outer casing will be added. For bedrock aquifer monitoring wells, protective outer metal casings will include a 6-inch diameter, or 6-inch square well protective casing buried at least 18 inches into the ground with the top of the protective casing located approximately 36 inches above the top of the cement pad. For nested, alluvial aquifer matrix monitoring wells, protective metal vaults will be installed with the protective casing buried at least 18-inches into the ground. Accurate placement of the protective casing is important to ensure ease of access and compatibility with sampling equipment. The steel casings will be equipped with a locking cap and rust resistant locks. All well locks will be keyed alike, to the extent practicable. Surface well pads will be constructed of concrete reinforced with steel mesh, 4 inches thick (approximately 2 inches below ground surface and 2 inches above ground surface), with a surface dimension of 2 by 2 feet for single wells and 3 by 3 feet for double-nested wells. The concrete pads will be sloped slightly away from the protective outer metal casings to the edge of the pad to drain precipitation. Well pads will be oriented with one edge parallel with surrounding roads or fences, or with one edge of the pad trending north. If vehicle traffic may be nearby, bollards will be used to help protect above-ground well casings. For on-site wells, bollards will be painted yellow and protective outer casing is blue.

3.9.2.2 OFF-SITE MONITORING WELLS

Most off-site wells will be completed with a flush-mount, well box with a cover set in a concrete apron. For nested wells, an in-ground well vault box will be installed. Both completions will include flush covers with specialized bolts to limit access and reduce the potential for entry of fluids from the ground surface into the monitoring well. The well box or vault will be placed above the existing ground surface with the concrete apron sloping from the well box for efficient drainage. Runoff will be prevented from accumulating in the flush mount vault. The annular space will be filled with sand inside and will extend a short distance below the base of the vault to allow any runoff entering the vault to seep out. The well box for monitoring wells that may be installed in sidewalks, street or drive/parking areas subject to snow removal shall be flush with or slightly below (up to ½ inch) the ground surface, depending on City of Bridgeton or Earth City requirements. Monitoring wells will be identified with the well number marked on the well cover, when possible, and metal labels of the well ID will also be included in the vault. In areas not subject to vehicle or pedestrian traffic, above-ground well protectors may be used.

3.10 MONITORING WELL DEVELOPMENT

The objectives of monitoring well development are to:

- Allow groundwater to enter the well screen freely, thus yielding a representative groundwater sample and water level measurements.
- Remove water that may have been introduced or disturbed during drilling, downhole testing (e.g. packer testing), or well installation activities.
- Remove fine-grained sediment in the filter pack to minimize the turbidity of the groundwater sample turbidity and decrease the likelihood of silting of the well.
- Maximize the efficiency of the filter pack.

The new monitoring wells will be developed, no sooner than 48 hours after grouting is completed, by mechanically surging the well, followed by pumping, as detailed Trihydro’s Well Development and Sampling Procedures

(Appendix K) and in accordance with the *Monitoring Well Development Guidelines for Superfund Project Managers* (USEPA 1992). At least 10 well casing volumes will be removed from the new wells during development.

Casing volumes will be calculated based on total well depth, standing water level, and casing diameter. One casing volume will be calculated as:

$$\mathbf{V = \pi d^2\, h / 77.01}$$

where: **V** is the volume of one well casing of water ($1 ft^3$ = 7.48 gallons);
d is the ID of the well casing (in inches);
h is the total depth of water in the well (in feet).

The wells will be developed by mechanically surging the well, followed by pumping. Surging will consist of forcing water into and out of the formation using a surge block. The surging action will be relatively gentle to avoid slumping formation material into the screen. Surging will be concentrated over 5-foot intervals, starting at the top of the screen, to avoid sand locking the surge block.

Immediately following surging activities, groundwater and any sediment in the bottom of the well will be evacuated using a bailer or pump. The volume evacuated from each well and physical characteristics of the purge water (color, relative turbidity, sediments, etc.) will be recorded during regular intervals during development activities. If natural recharge rates are adequate, development activities will continue until the extracted water is visibly free of sediment, or until parameters (pH, temperature, and turbidity) are stable. If natural recharge rates are insufficient to attain the well development objectives, the rational for discontinuing well development activities will be documented. The addition of water to aid in well development is not anticipated but may be necessary if water is limited. If water should need to be added, potable water will be used and removed during the development process with a bailer or pump. Water levels and total depths will be measured before and after well development in accordance with Trihydro’s Water Level Measurement Procedures (Appendix F) and documented on the Monitoring Well Development and Groundwater Sampling Field Form (Appendix K-3).

During the well inventory, should existing wells that are included in the proposed monitoring well network be found to require redevelopment due to sediment collection in the bottom of the well, these wells will be redeveloped following the same above-described procedures. If dedicated bladder pumps are in the wells, they will be removed and stored within clean plastic sheeting. Once the well has been redeveloped, the dedicated pump will be placed back in the well.

If the well contains a Waterra valve and tubing, it will be removed and replaced with a new, dedicated bladder pump. The Waterra valve and tubing will be handled as IDW per Section 6.0.

3.11 PLUGGING AND ABANDONING BOREHOLES

None of the boreholes installed during the monitoring network expansions are currently anticipated to need to be plugged or abandoned except for the CPT boreholes near well D-6. The boreholes will be abandoned following 10 CSR 23-4-080. The boreholes will be abandoned with a neat cement grout comprised of a mixture of 96-pounds of Portland cement to no more than 6 gallons of water. The boreholes will be pressure grouted from the bottom of the borehole to the surface. Prior to abandonment, well construction, total depth, and depth to water will be confirmed. The field geologist will calculate the anticipated amount of grout required before plugging the borehole and record the amount of grout used during plugging in the logbook. If other boreholes are identified for abandonment, they will be handled in the same manner.

3.12 SLUG TESTING

Slug testing will be conducted to determine the hydraulic conductivity of the formation materials near each well and performed in accordance with Trihydro's Slug Test and Aquifer Pumping Test Procedures (Appendix L). Slug testing will be conducted on a subset of 40 new wells, 4 new piezometers, and 32 of the 86 existing monitoring wells which were not previously tested (Table 3-7). Slug testing will be conducted at the new wells at least 10 days after well development is completed. Additional slug testing may be performed on other wells as necessary for development of the groundwater model and refinement of the CSM.

Pneumatic slug testing, using compressed air, will be conducted on the subset of wells shown in Table 3-7. Traditional slug testing, using a solid slug, will also be conducted on the shallow alluvial wells if the screened interval intersects the water table. Two rising head tests will be performed at each monitoring well. Slug testing will be performed in accordance with Trihydro's Conventional and Pneumatic Slug Testing SOP (Appendix L-1) and in accordance with USEPA's *Suggested Operating Procedures for Aquifer Pumping Tests* (USEPA/540/S-93/503, February 1993). Slug testing data will be evaluated in AQTESOLV software; the Bouwer-Rice method will be used to calculate hydraulic conductivity, which is appropriate for an unconfined aquifer. A description of the pneumatic and manual slug testing procedures is included below.

3.12.1 PNEUMATIC SLUG TESTING

The pneumatic slug test method uses air pressure to provide the slug test groundwater displacement. For wells where pneumatic slug testing with compressed air is conducted, groundwater monitoring will not be conducted within a one-month period to allow for any changes in the dissolved oxygen (DO) and redox conditions to re-equilibrate. The procedure for conducting pneumatic slug tests includes:

1. Deploy water level transducer in the well and fix an air-tight cap with a pressure relief valve to the top of the well.
2. Use an air pump to increase pressure inside the well casing to cause the water level to decrease a maximum water level of 4 feet.
3. Confirm that positive air pressure is maintained with an integral air pressure gauge at the well head assembly.
4. Allow water levels to equilibrate and the air pressure at the well head assembly to stabilize.
5. Open the valve allowing the water level to rise.

Once the water level has returned to 90% of the per-test level, the slug-out test can be terminated, and the transducer recording stopped. Two rising head tests will be conducted for each well in accordance with USEPA's *Suggested Operating Procedures for Aquifer Pumping Tests* (USEPA/540/S-93/503, February 1993. Transducer use and placement will be in accordance with Trihydro's Transducer SOP (Appendix F-2).

3.12.2 CONVENTIONAL SLUG TESTING

Conventional slug testing involves the instantaneous injection or withdrawal of a volume or slug of water or a solid cylinder of a known volume. The procedure for conducing conventional slug test includes:

1. Connect the pressure transducer to the data cable and install it in the well in a manner that it does not interfere with the insertion and removal of the slug.
2. Calculate the height of the water column in the well and confirm that it is sufficient to completely submerge the slug.
3. Set the frequency of the transducer for the slug-in test. Lower the slug into the well to a depth just above the water level. Begin recording measurements with the transducer and lower slug so it is completely submerged. Record the start time.
4. Monitor the water level decline with the transducer and take periodic depth to water measurements with the water level meter.
5. Once the water level has returned to 90% of the pre-test level, the test can be terminated.
6. Prepare for the slug-out test and record the depth to water measurement and time with the water level meter. Change recording frequency of the transducer if needed.

7. Immediately raise the slug out of the water column above static-water level. Record the start time.
8. Monitor the water level rise with the transducer and take periodic depth to water measurements with the water level meter.
9. Once the water level has returned to 90% of the pre-test level, the test can be terminated.
10. Repeat testing sequence as necessary.

All conventional slug testing start time, stop time, and depth to water measurements will be recorded on the Slug Test Data Form (Appendix L-2).

3.13 AQUIFER PUMPING TEST

In order to estimate storativity of the water-bearing zones, a multi-well aquifer pumping test will be conducted as part of the OU-3 RI activities in accordance with Trihydro's Aquifer Pumping Test SOP (Appendix L-3) and in accordance with USEPA's *Suggested Operating Procedures for Aquifer Pumping Tests* (USEPA/540/S-93/503, February 1993). The aquifer pumping test will be conducted at one of the proposed OU-3 RI well locations which has all five vertical intervals represented. The well location will be selected based on the representativeness of the geology and hydrogeology relative to the groundwater model, and at a location that is unimpacted to avoid the generation of impacted purge water. Therefore, the proposed aquifer pumping test will occur after the initial water quality data and water level information are collected at the new monitoring wells. The proposed aquifer pumping test procedures will include a constant rate of flow test and step drawdown test for each water-bearing zone. Additional details on the aquifer pumping test location and procedures will be submitted as an addendum to the Work Plan.

3.14 GROUNDWATER SAMPLING

This section presents the groundwater sample collection, handling, and reporting procedures when conducting groundwater sampling monitoring events. Quarterly groundwater monitoring is proposed for eight consecutive quarters as part of the OU-3 RI/FS, though additional monitoring may be necessary until a remedial action is selected and implemented at the site. Two monitoring events will be conducted during drilling activities to provide interim groundwater data for the existing wells plus any proposed wells that have been drilled, developed, and are ready to be sampled. A total of 158 wells will be sampled during the OU-3 RI/FS for six consecutive quarters. The proposed OU-3 monitoring well network is listed on Table 3-6 and shown on Figure 3-9. The groundwater samples will be submitted for analysis of the analytes presented in Section 2.0. Data from multiple events will be evaluated per Work Plan Section 6.2.5 to determine if a modification to the analytical suite is warranted. Recommendations will be submitted to the USEPA for review and approval.

Groundwater sampling will be performed in accordance with the monitoring well development and sampling procedures (Appendix K), and specifically Trihydro's Bladder Pump Low-Flow Purging and Sampling SOP (Appendix K-2). The USEPA's *Groundwater Sampling Guidelines for Superfund and Resource Conservation and Recovery Act (RCRA) Project Managers* (USEPA 2002) were used for reference in this SOP and for determining stabilization criteria. A detailed description of the groundwater sampling methods is included below.

3.14.1 BLADDER PUMP INSTALLATION

Following completion of slug tests, a dedicated bladder pump will be installed in each of the 78 new wells. Bladder pumps are currently installed in all of the active Bridgeton Landfill monitoring wells. New bladder pumps will be installed in existing wells identified for the OU-3 well network as necessary based on the condition of the existing pumps determined by the well inventory. The bladder pump depth will be specifically configured for each well, based on the total depth, the depth to static groundwater, and the well screen interval. The bladder pumps will be purchased from the same manufacturer (similar model) as those used in the Bridgeton Landfill monitoring well network. Trihydro anticipates installing QED Environmental Systems' Well Wizard® pumps Model Numbers P1101M and P1150 (or similar), which are currently utilized for other on-site groundwater sampling programs.

Bladder pump intakes will be placed at the most transmissive zone or impacted zone identified during well installation. If there are concerns with the well pumping dry, pumps will be placed 2 to 3 ft from the bottom of the well to permit reasonable draw down while preventing cascading conditions. For most of the monitored groundwater zones, the pump will be set within the well's screened interval. The exception is within wells with very deep screened intervals (e.g., the Keokuk Zone wells) where drop tubes are set within the screened interval. Pumping rates will be regulated or controlled to minimize turbulent flow, prevent damage to the monitoring well components, and minimize the introduction of sediment into the well.

3.14.2 MONITORING WELL PURGING

Purging of monitoring wells prior to sampling is necessary to remove stagnant from the bladder pump and bladder pump tubing, and to ensure that representative groundwater from the aquifer is collected for sampling. Purging will be performed at a rate at, or below, the well's recovery rate to minimize the migration of groundwater above the well screen. The flow rate should be a low flow rate (0.2 to 0.5 L/min) while maintaining a drawdown of less than 0.33 foot. Purged water will be considered IDW, containerized, and stored onsite within a temporary tank pending waste characterization analytical results as described in Section 6.0.

Initial water quality readings will be collected only after stagnant water has been purged from the sampling apparatus. This will be accomplished at each well by determining the volume of resident water inside the pump body, tubing, and flow-through cell and dividing this volume by the observed flow rate. For example, if the resident volume is 3 liters (L), and the pump is producing groundwater at 0.4 L/minute, readings should be collected after 7.5 minutes (3L / 0.4L/min. = 7.5 minutes). One full resident volume will be purged to remove stagnant water while adjusting the pump flow rate to operate between 0.2 and 0.5 milliliters per minute (mL/min). Once water levels have stabilized, subsequent water quality parameters will be recorded continuing to use a volume-based interval that accounts for the turnover of one-half resident volume. The flow rate will be adjusted until water levels have stabilized. Water levels are considered stable when there is minimal to no water level draw down of less than 0.33 foot. Readings will be recorded until stabilization criteria have been met.

All wells will be purged prior to sampling utilizing a dedicated bladder pump and as detailed in the Bladder Pump Low-Flow Purging and Sampling SOP (Appendix K-2). Pumping rates will be regulated between 0.2 to 0.5 mL/min, or controlled to minimize turbulent flow, prevent damage to the monitoring well components, and minimize the introduction of sediment into the well.

A flow-through cell will be used for all field parameter measurements to ensure that the water quality meter's sensors are in contact with flowing water. After purging stagnant water in the dedicated bladder pumps tubing from the well, purging will continue until field parameter stabilization is achieved in accordance with the stabilization criteria presented in USEPA's *Groundwater Sampling Guidelines for Superfund and RCRA Project Managers* (USEPA 2002).

Throughout the purging process, groundwater will be monitored for the following field parameters: pH, specific conductance, temperature, turbidity, DO, and oxidation-reduction potential (ORP). Field parameter values will be monitored and recorded at regular intervals as noted above. Stabilization criteria for pH is +/- 0.1 Standard Units; for specific conductance is +/- 3%; for ORP is +/- 10 mV; for turbidity is <10 NTU if possible; and for DO is +/- 0.3 mg/L. Temperature will be monitored but is not considered a stabilization parameter. Equilibrium is achieved when parameters independently exhibit variation equal to or less than the above-reference USEPA criteria for stabilization for a minimum of three consecutive field parameter readings. The three consecutive readings should not all be trending in the same direction, otherwise stability may not have been reached; purging will continue until directional trending of parameter readings discontinues. If during sampling stabilization to <10 NTU is not possible, then the monitoring well may be redeveloped as described in Section 3.10. If during redevelopment, the monitoring well cannot achieve <10 NTU, then an evaluation will be conducted to determine whether the full analyte suite should be sampled or everything except totals metals. The evaluation will be performed in coordination with the USEPA.

Approximate pumping rates and the approximate volume of groundwater removed from the well will be recorded on the Monitoring Well Development and Sampling Log (Appendix K-3). If allowances are made regarding the definition of equilibrium based on the aquifer's characteristics at individual wells, they will be documented on the field form. If a well is purged dry prior to the achievement of field parameter equilibrium, the well will be purged to the lowest reasonable groundwater elevation, permitted to recover, and then sampled within 24 hours of completion of purging.

3.14.3 MONITORING WELL SAMPLING

A groundwater monitoring well may be sampled as soon as the field parameters have stabilized, or if purged to dry, as soon as it has recovered sufficiently, but typically no more than 24 hours after purging. The same methods used for well purging will be utilized for sample collection, as per the Bladder Pump Low-Flow Purging and Sampling SOP (Appendix K-2). Once the tubing is disconnected from the flow-through cell, sample bottles will be filled directly from the pump's discharge tube to minimize agitation and aeration. The final set of parameter values will be recorded on the sampling record.

RAD7 H2O Radon/Polonium Groundwater Screening

Prior to filling any sample containers for laboratory analysis, radon will be measured in groundwater collected from shallow alluvial wells in real-time in the field with the RAD7 radon meter with H2O accessory. Shallow alluvial groundwater will be analyzed for radon to determine the potential for volatilization to indoor air at off-site locations. Due to the ubiquitous nature of radon in the St. Louis area (a Level 2 radon area as designated by the USEPA), the groundwater radon concentrations will be evaluated relative to the extent of radium in groundwater prior to making decisions regarding the risk to off-site indoor air. Due to the different behaviors of radium and radon in the environment, the radium isotope 226 (226Ra) to radon (222Rn) activity ratio in the natural water is not constant. Radon gas can leak and diffuse from the rocks and sediment to the water, while the dissolution of Ra in the rock/sediment to the water is a slower process. This causes higher 222Rn concentration than that of 226Ra in the natural water. Additional factors also contribute to secular disequilbria between radium and radon, notably differences in the isotopes' half-lives and differences in the chemical behavior of multiple parent isotopes. While it is difficult to quantitatively predict radon activity concentrations in groundwater from radium, it is common for radon activity to exceed radium activity by multiple orders of magnitude (King et al. 1982, Moloney et al. 2011).

The first 500 ml of groundwater purged following stabilization will be collected for radon screening using the RAD7 with H2O accessary in accordance with the user's manual (Appendix K-6) for closed loop sampling. Both filtered and unfiltered samples will be collected and analyzed. Filtered samples will be filtered through a disposable 0.45 micrometer (µm) filter. Specifications for the proposed filters are included in Appendix K-5. Clean, unused filters will be used for each filtered sample collected. The 250 ml vial will be placed in a decontaminated stainless-steel bowl. The sample discharge tubing will be placed in the bottom of the vial, and the vial will be allowed to fill and overflow until it is completed submerged in the bowl. Once submerged, the vial will be capped ensuring there are no bubbles in the vial. The vial will be dried and labeled.

https://durridge.com/products/rad-h2o/

The RAD7 with H2O closed loop system will be set up in the temporary facilities to ensure that it remains dry. It will be confirmed dry and ready for sampling in accordance with the user's manual. RAD7 samples will be run for a minimum of 30 minutes. Samples collected through the day will be analyzed in batches within 24 hours. If samples are held longer than 24 hours, a decay correction factor will be applied as described in the RAD7 user manual. The RAD7 will be purged for a minimum of 12 minutes between samples. Relative humidity will be confirmed on the equipment monitoring prior to beginning the next sample run. Results will be stored within the RAD7 device and downloaded in between each sample run. Stored results will also include counts of polonium isotopes 214 (214Po) and 218 (218Po).

After collection of the radon/polonium sample, individual sample containers for laboratory analysis will be filled in the order described in Section 2.2 and on Table 2-4. Sample containers for VOCs and TPH (low carbon range) will be filled in such a manner to eliminate head space within the container. At each sampling location, all bottles designated for a particular analysis (e.g., VOCs) will be filled sequentially before bottles designated for the next analysis are filled. If a duplicate sample is collected, all bottles designated for a particular analysis for both sample designations will be filled sequentially before bottles for another analysis are filled. In the filling sequence for duplicate samples, bottles with the two different sample designations will alternate.

Groundwater and leachate samples will be collected for both filtered and unfiltered metals and isotopic thorium, uranium, and radium. The laboratory will filter samples submitted for dissolved organic carbon and total suspended solids.

Field test kit samples will be run on both unfiltered and filtered samples for ferrous and ferric iron and ammonium. The field test kit samples will be field filtered with an in-line 0.45-µm filter to remove particles that have been entrained in the water sample such that the bladder pump generates sufficient pressure to force water through the filter. Specifications for the proposed filters are included in Appendix K-5. Clean, unused filters will be used for each filtered sample collected. Groundwater samples will be transferred from the filter directly into the appropriate sample containers with a preservative and processed for shipment to the laboratory. Depending on the viability of the proposed filtration process, this methodology may be altered as necessary in the field. Multiple filters may be required for sampling. Filters will be changed out as required to collect samples in the appropriate sample collection order. Proposed alterations will be discussed with project stakeholders prior to implementation. When transferring samples, care will be taken not to touch the filter to the sample container. Groundwater samples will be transferred directly into the appropriate sample containers with preservative, if required, chilled if appropriate, and processed for shipment to the laboratory. See Table 2-4 and Section 2.3.4 for preservation and shipping procedures.

Ferrous and Ferric Iron

After filling bottles for laboratory analysis, sample volume will be collected for field analysis of ferrous and ferric iron concentrations. Ferrous and ferric iron concentrations will be measured with Hach test kits according to their user's manuals (Appendix K-7). For the Hach test kits, the test procedure outlined in the user's manuals will be followed in the field. This procedure will be performed on both filtered and unfiltered samples following the same above-described filtering method. First, total iron will be measured using the following procedures:

1. Fill provided two tubes with 5 ml of sampled groundwater from the discharge tubing.
2. Place one tube in the color comparator box.
3. Add one FerroVer Iron Reagent Powder Pillow to the other tube. Swirl to mix and watch an orange color develop.
4. Place the second tube into the color comparator box.
5. Hold the color comparator box in front of a light source.

6. Turn the color disc to find the color match.
7. Record the result shown in the scale window in milligram per liter (mg/l) in the field logbook. Note the sample date, time, and location.

For the ferrous iron test, the following procedures apply:

1. Fill the provided tube with 5 ml of sampled groundwater from the discharge tubing.
2. Place the tube in the left opening of the color comparator box.
3. Fill the vial to the 25 ml mark with the sample.
4. Add one Ferrous Iron Reagent Powder Pillow to the vial. Swirl to mix and watch an orange color develop (if ferrous iron is present).
5. Wait 3 minutes.
6. Fill a second tube with 5 ml of prepared sample from the 25 ml vial.
7. Place the second tube in the color comparator box.
8. Hold the color comparator box in front of a light source.
9. Turn the color disc to find the color match.
10. Record the result shown in the scale window in mg/l in the field logbook. Note the sample date, time, and location.

The ferric iron concentration is determined by subtracting the ferrous iron concentration from the total iron concentration.

<u>Ammonium</u>

After filling bottles for laboratory analysis and sampling for ferrous and ferric iron, sample volume will be collected for field analysis of total ammonium (i.e., concentrations of both ammonium ions and free ammonia). This procedure will be performed on both unfiltered and filtered samples following the same above-described filtering method. Ammonium ions (NH_4-N) and free ammonia (NH_4+) concentrations will be measured with MQuant® test kits according to their user's manuals (Appendix K-8). For the test kits, the test procedure outlined in the user's manuals will be followed in the field using the following procedures:

1. Measure pH of sample. Record in field logbook, along with sample date, time, and location.

   Note: the pH range must be between 2 – 12 to complete the test.

2. Rinse the provided two tubes, the blank and the measurement tube, with the sample water.
3. Fill both rinsed tubes 5 ml of sampled groundwater from the discharge tubing.
4. Place the blank tube in the sliding color comparator box.
5. Hold bottle vertically. Add 3 drops of Reagent NH_4-1 to the measurement tube and mix.
6. Hold bottle vertically. Add 3 drops of Reagent NH_4-2 to the measurement tube and mix.
7. Hold bottle vertically. Add 3 drops of Reagent NH_4-3 to the measurement tube and mix.
8. Place the measurement tube into the sliding color comparator box.
9. Hold the color comparator box in front of a light source.
10. Slide the color disc to find the closest possible color match between the two open tubes when viewed from above.
11. Record the result shown as indicated by the pointed end of the slide in mg/l as NH_4+ or NH_4-N in the field logbook. Note the sample date, time, and location.
12. Refer to the user manual for notes on the measurement in relation to pH readings.

The measured value indicates the content of total ammonium. The percentage of ammonium ions (NH_4-N) and free ammonia (NH_4+) is pH dependent. In acidic waters, primarily only ammonium ions are present.

3.15 LEACHATE COLLECTION SYSTEM SAMPLING

The current leachate collection system is comprised of leachate collection sumps (LCSs) within the North Quarry (LCS-5A, LCS-5B, and LCS-6A) and South Quarry (LCS-1D, LCS-2D, LCS-3D, LCS-4B, LCS-4C) as documented in the March 2019 Operation, Maintenance and Monitoring Plan (CECI 2019). Each sump has been installed towards the base of the quarry floor, approximately 270 ft bgs, with screens that range in length from 60 to 150 ft. Dedicated pumps were installed in each LCS point. Due to the subsurface reaction (SSR) described in Work Plan Section 2.2.5, some of the South Quarry sump pumps are no longer operational. As part of the first phase of site characterization, leachate samples will be collected from approximately six LCS points which are safe to access, and which produce fluid. Eight quarters of leachate sampling will be conducted.

If the dedicated LCS pump is not operational, the LCS point will not be sampled unless it is still identified as a data gap after the first phase of site characterization and does not present a health and safety concern. LCS samples will be collected for the same analytical suite of COPCs using the same sample order as groundwater samples.

At the time of the OU-3 RI field activities, information will be obtained on operational status of the leachate collection and treatment system, including LCS points with fluid available for sampling without access issues, construction, operational history, frequency of use, pumping rates from each LCS point, pump configuration, and influent and effluent concentrations. Trihydro will monitor the weekly leachate levels and pump rates on the MDNR website where weekly leachate levels and pumping rates are recorded from the Bridgeton Landfill in order to determine and ideal time to collect LCS samples.[9] Ground temperature, vadose zone pressure, and gas extraction data from Bridgeton Landfill will also be compiled.

3.16 MONITORING WELL AND LEACHATE RISER GAUGING

3.16.1 WATER LEVEL MEASUREMENTS

Each month, the depth to static groundwater will be measured, within a 24-hour timeframe, at each groundwater monitoring well in the network for a period of 24 consecutive months, as well as prior to purging for groundwater sampling events, in accordance with Trihydro's Water Level Measurement Procedures (Appendix F). Monitoring wells are gauged prior to groundwater sampling to establish the depth-to-water measurement which must be followed per low-flow sampling protocol. An electronic sounder, accurate to the nearest +/- 0.01 foot, will be used to measure depth to water in each well. When using an electronic sounder, the probe is lowered down the casing to the top of the water column. The graduated markings on the probe wire or tape are used to measure the depth to water from the surveyed point on the rim of the well casing. Typically, the measuring device emits a constant tone when the probe is submerged in standing water, and most electronic water level sounders have a visual indicator consisting of a small light bulb or diode that turns on when the probe encounters water. See Section 4.0 for calibration of the water level sounders prior to use.

In general, water levels will be measured first in wells which have the least amount of known contamination. Wells with known or suspected contamination will generally be measured last. The order will be estimated based off of known information and well location for the first sampling event. The order will be evaluated and adjusted following receipt of analytical results from the first sampling event.

The need to collect total depth measurements will be determined at least annually based on multiple lines of evidence, including anomalous field parameter readings, analytical results, and turbidity readings. If it is determined that substantial sediment has accumulated in a well, the well will be redeveloped as described in Section 3.10. The specific

[9] https://dnr.mo.gov/env/swmp/facilities/BridgetonSanitaryLandfill-RCP.htm#weeklyreportOCT11

methods used to redevelop a well will be determined on a case by case basis, based in part on well design, sediment character and quantity, aquifer properties, and other factors.

3.16.2 PRESSURE TRANSDUCERS

After completing the initial round of water level measurements, absolute pressure transducers/data loggers (DLs) will be placed in select wells in accordance with Trihydro's Transducer SOP (Appendix F-2). Table 3-8 identifies the 88 proposed wells in which DLs will be placed. Two barometric pressure loggers (BLs) will be placed onsite in a secure and ventilated location. The Solinst Model 3001 Leveloggers and Barologger (or similar) will be deployed. The DLs measure and record groundwater levels and temperature. Water levels are displayed as temperature compensated pressure readings and are barometrically compensated with the aid of the BL. The BL uses algorithms based on the air pressure; it measures and logs changes in the atmospheric pressure, which are then used to compensate water levels recorded by the DL. Potential sources of error with the equipment are addressed in the QAPP.

The DLs will be placed with direct read cables and will be hung from specialized well caps. Prior to use, the pressure transducers will be allowed to equilibrate to groundwater temperature to alleviate potential erroneous readings. The DLs will be placed approximately 10 feet below the static water level in each well. The DLs will remain within the wells for approximately 2 years, while the quarterly groundwater monitoring occurs. The DLs will be programmed to collect readings every hour. During each quarterly groundwater monitoring event, the data will be downloaded from the transducers and saved within the project files. The DL deployment form and the manufacturers guides are included in Appendix F-6.

3.17 SURFACE WATER GAUGE INSTALLATION AND MONITORING

Staff gauges will be installed at eight locations as shown on Table 3-9 and Figure 3-10. In order to monitor the surface water bodies in real time, integrated data logging systems will be installed. Integrated data logging systems consist of a monitoring station which houses the DL, telemetry module, and integrated solar panels for power supply. The monitoring station connects to a deployment pipe which houses the submersible pressure transducer. The pressure transducer measures the combined pressure exerted on it by the atmosphere and head of water. A vendor has not yet been selected for this equipment; however, a typical staff gauge station setup, as shown in Appendix F-7, is proposed.

During site reconnaissance, suitable locations for the staff gauges will be identified. Permitting will be completed as required prior to installation with the City of Bridgeton, St. Louis County, and MDNR. The preferred locations will accommodate a range of flow conditions, where turbulence is minimal, and where equipment will be submerged during low water levels. Sites with extensive vegetation or unstable banks will be avoided. For installation, the pressure transducer is housed in a 2-inch PVC pipe with an attached, perforated PVC pipe. The perforated portion of the pipe is submerged in the surface water body and should remain submerged. The pressure transducer cable exits the top of the locked, capped PVC pipe and should remain above the water surface. It is connected to the monitoring station. The monitoring station is constructed as a 2-inch pole (PVC or metal) set in concrete. The DL and power pack are both connected to the monitoring station pole which should be installed to a sufficient height to avoid surface water and ease of access in the field. The DL and solar power pack will be installed to withstand potential weather conditions and be appropriately housed and locked.

Two staff gauges equipped with transducers and telemetry already exist in the Earth City ponds and are used to operate pumps that maintain a constant elevation in the ponds. These will be evaluated as replacements to the staff gauges proposed in the Earth City ponds if access to the data is granted and they meet the requirements in the QAPP.

3.18 VAPOR INTRUSION INVESTIGATION

As part of the OU-3 RI activities, a vapor intrusion investigation will be performed to determine the potential for vapor-forming compounds, including organic compounds, radon, polonium, and methane, to migrate into indoor air. Vapor sampling will be conducted at four buildings located onsite. The buildings included in the investigation are depicted on Figure 3-11 and Table 3-10 and include: the Asphalt Plant Building (APB;~680 square feet [sf]), Pump House (PH;~660 sf), Scale House (SH;~240 sf), and the Engineering Office (EO; ~5,240 sf). Four rounds of indoor air testing will be conducted. One indoor air sample will be collected per 2,000 sf of building area during the initial indoor air testing. Table 2-4d shows the analytes, holding time and preservation, and container requirements for the vapor samples. Table 2-6e shows the sampling plan and QA samples for vapor analyses.

Additional vapor sampling, including subslab, or nearslab vadose zone vapor sampling, may be conducted. However, further assessment will be performed after the first round of indoor air sampling to determine if additional sampling activities are warranted, and if there is potential for a completed vapor intrusion pathway resulting in unacceptable risk in on-site or off-site occupied structures. Once review of historical vapor intrusion activities has been performed, Trihydro will determine the path forward for future activities that may include, but are not limited to, passive soil gas vapor sampling, installation of soil gas vapor wells, soil gas vapor sampling, subslab vapor sampling, additional indoor air quality sampling, or installation of mitigation systems. If required, additional vapor intrusion assessment activities will be completed as part of the OU-3 RI/FS. The following sections describe the field procedures for the proposed indoor air testing, as well as the procedures for future potential subslab and nearslab vapor sampling should they be warranted.

3.18.1 INDOOR AIR SAMPLING

The indoor air samples will be collected in general accordance with Trihydro's Vapor Sampling SOP (Appendix M-1), the standard operating procedures and protocols described in *Environmental Response Team (ERT) Standard Operating Procedure (SOP) #1701: Summa Canister Sampling* (USEPA 1995), and Office of Solid Waste and Emergency Response (OSWER) *Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air* (OSWER Publication 9200.2-154, USEPA, June 2015), and the Interstate Technology and Regulatory Council (ITRC) Guidance, *Vapor Intrusion Pathway: A Practical Guideline, Technical and Regulatory Guidance* (ITRC 2007).

3.18.1.1 TESTING LOCATIONS

Per USEPA guidance (OSWER Publication 9200.2-154, USEPA, June 2015), monitoring/testing locations for indoor air sampling will be selected based on the following recommendations:

- Measurement should be made in ground contact spaces that are occupied on a regular basis.
- In general, measurements should not be made in kitchens, laundry rooms, or bathrooms.
- A position should be selected where the detector will not be disturbed during the measurement period and where there is adequate room for the device.
- The measurement should not be made near drafts caused by heating, ventilating and air conditioning vents, doors, fans, and windows. Locations near heat sources (such as on appliances,) near fireplaces or in direct sunlight, and areas of high humidity should also be avoided.
- Fans should not be operated in the test area. Forced air heating or cooling systems should not have the fan operating continuously unless it is a permanent setting.
- The measurement location should not be within three feet of doors and windows or other potential openings to the outdoors. If there are no doors or windows to the outdoors, the measurement should not be within one foot of the exterior wall of the building.
- The monitoring device should be at least 20 inches from the floor, not closer than 24 inches to the ceiling, and at least 4 inches from other objects.
- Sound judgment is required as to what space constitutes a room. Measurements made in closets, cupboards, sumps, crawl spaces, or nooks within the foundation should not be used as a representative measurement.

Sampling/monitoring will be performed at a density of approximately one sample per 2,000 square feet of occupied building footprint space.

3.18.1.2 INDOOR AIR SAMPLING FOR VOCS AND METHANE

For indoor air samples collected for VOC and methane analysis, the samples will be collected using a 6-liter Summa® canister connected to a flow-controller calibrated to collect the sample over a 24-hour period, which is representative of facility operations (24 hours). The canisters will be suspended five feet above ground.

Prior to initiating indoor air monitoring and sampling, Trihydro will:

1. Utilize the Vapor Intrusion Interior Building Survey Form (Appendix M-2) to gather information from the building tenant on VOC sources within the building.
2. Complete a review of the questionnaire and follow-up interview of the building tenant to insure completeness of the questionnaire.
3. Conduct an inspection of the premises to identify and document any VOC sources (if any) not listed on the questionnaire. A detailed description of the chemical or material will be documented in field notes for that building. On-site buildings at the site are used for storage of gasoline and other vapor-forming products will be accounted for during the assessment.

Identified VOC sources will be removed from buildings, if possible, at least 24 hours prior to sample collection. As outlined in the Vapor Sampling SOP, ambient air will be monitoring for total organic vapor concentrations using a PID (ppbRae, or equivalent), as well as fixed gases including oxygen, methane, and carbon dioxide using a landfill gas meter (Landtec GEM™ 2000, or equivalent). Readings will be collected prior to Summa® canister placement and recorded on the Vapor Sampling Field Form (Appendix M-4).

3.18.1.3 INDOOR AIR SAMPLING FOR RADON AND POLONIUM

Radon and polonium samples will be collected from the indoor air in each of the four buildings included in the OU-3 RI/FS investigation. Both short-term and long-term radon measurements will be performed at the four buildings (see Sections 3.18.1.4 and 3.18.1.5 below) in general accordance with Trihydro's Vapor Sampling Procedures (Appendix M) and the standard operating procedures and protocols described in *Indoor Radon and Radon Decay Product Measurement Device Protocols* (USEPA 402-R-92-004; USEPA 1992) and *Protocols For Radon And Radon Decay Product Measurements In Homes* (USEPA 402-R-92-003; USEPA 1993). Short-term polonium measurements will be collected at the four buildings with the RAD7 meter.

3.18.1.4 SHORT-TERM RADON AND POLONIUM TESTING

The purpose of the short-term radon testing is to provide a preliminary indicator as to whether there is a potential need for interim action to reduce radon levels in indoor air prior to acquiring results from the more accurate long-term radon testing. Short-term radon testing will be performed using a continuous radon monitor device with a solid-state alpha detector such as the RAD7, or equivalent. The short-term monitoring will be conducted as outlined in the Short-Term Radon Sampling SOP and Section 4.4 of the RAD7 User Manual for Continuous Monitoring (Appendix M-5 and Appendix M-7). As discussed in the RAD7 User Manual, polonium isotope counts will be included in the downloadable data file. The data file will contain total counts, percentage counts, and livetime (i.e., the duration of active data collection) in various windows of the data capture system. The short-term polonium testing will provide the only measurement of polonium isotopes due to the inability to obtain laboratory testing results following a standard operating procedure.

Typical short-term testing consists of continuous radon monitoring over a 48-hour period within a closed building with no air exchange system or ventilation fans running. As this is not possible at the on-site facility with 24-hour operations, a modified short-term radon test will be conducted where occupants can enter/exit the building based on normal site operations. Long-term radon testing will also be conducted, and the results will serve as a more accurate representation of the average worker exposure. Results of the long-term radon testing will also be used for any risk calculations or comparison to risk-based screening levels.

3.18.1.5 LONG-TERM RADON TESTING

Long-term radon testing will be performed using long-term electret ion chambers for a period of 90 days, deployed per USEPA protocols and per Trihydro's Radon Testing Using Long-Term Electret Ion Chambers SOP (Appendix M-6). These devices consist of a special plastic canister (ion chamber) containing an electrostatically charged disk detector (electret). The electrets start with a known voltage that is decreased by the ionization and decay of radioactive gas. The change in voltage is proportional to the amount of radon gas that has entered the chamber containing the electret. The initial and final voltages are measured at the analytical laboratory, and a calculation performed using the instrument manufacturer's formula or software, including a minor regional correction factor for background-level gamma radiation. As indicated above, long-term radon testing results serve as a more accurate representation of average worker exposure and will be used for any risk calculations or comparison to risk-based screening levels. These procedures are in general accordance with the standard operating procedures and protocols described in *Indoor Radon and Radon Decay Product Measurement Device Protocols* (USEPA 402-R-92-004; USEPA 1992) and *Protocols For Radon And Radon Decay Product Measurements In Homes* (USEPA 402-R-92-003; USEPA 1993).

3.18.2 SUBSLAB VAPOR SAMPLING

Vadose zone soil gas sampling may be proposed to provide multiple lines of evidence to evaluate whether the vapor intrusion pathway is complete and poses a current or future risk to human health. The following sections outline subslab probe installation, subslab probe vapor sampling, nested vapor well construction, and vapor well sampling methodologies for future reference. The scope of work for vadose zone sampling (if necessary) will be presented in an addendum based on the results of the initial indoor air testing.

3.18.2.1 SUBSLAB PROBE INSTALLATION

Prior to probe placement and installation, the locations of subslab utilities will be identified and assessed using the USEPA guidance, as outlined in Section 3.18.1.3. Locations will be screened to identify potential buried utilities and rebar using a handheld scanner (Bosch D-TECT150 Wall/Floor Scanner with UWB Radar Technology or similar). The subslab probe consists of a ¼-inch, outer diameter, chromatography-grade, 316 stainless steel tubing approximately 4 inches in length, with a compression-fit coupling to a female National Pipe Thread Tapered (NPT) thread at the top. A stainless-steel ball valve with a ¼-inch compression fitting will be attached to the top of the probe. The subslab probes are installed by drilling a ½-inch diameter hole through the floor slab, reaming the upper inch to a $^{5}/_{8}$-inch diameter, clearing concrete dust, placing the probe into the hole, and sealing the upper inch with fast-setting, hydrating (swelling) cement. The seal will generally set within 10 minutes. The seal integrity will be verified using a helium tracer methodology (ITRC 2007), which is also described below. After sampling, the probes will be removed, and the hole will be sealed with cement and smoothed with a trowel to a flush finish.

3.18.2.2 SUBSLAB PROBE SAMPLE COLLECTION

Prior to soil gas monitoring activities, probes will be connected to a micro-manometer to measure the static pressure differential between the subslab and indoor air. Measurements will be recorded on the appropriate vapor sampling field forms (Appendix M-4). The gas permeability of granular fill beneath each structure will be determined using pneumatic test results (similar to that of a traditional aquifer step-test). The gas permeability is a measure of the ease to which soil gas moves through the coarse fill beneath the slab and can provide information regarding barriers to vapor movement. Pneumatic testing consists of measuring the differential pressure within the probe over increasing soil vapor extraction rates. A vacuum is imposed upon the probe inducing a flow of approximately 0.1 L/min. Following wellhead vacuum stabilization, the flow and vacuum are recorded. The same process is then repeated at 0.2 and 0.5 L/min. In some cases, additional flow rates may be tested. The gas permeability will be calculated from these data using equations provided in Johnson et al. (1990).

Prior to soil gas sample collection, the subslab probe will be purged and field-screened to ensure that representative soil gas is collected within a Summa® canister. Purging will be accomplished using a 3-L Tedlar bag and lung box. A vacuum will be applied to the lung box to induce soil gas to the surface. A minimum of three purge volumes will be removed and screened to confirm that soil gas conditions are stable prior to collecting a sample in the Summa® canister. A typical purge volume is approximately 1 to 1.5 L. The soil gas collected during each purge interval will be field-screened for total organic vapors using a PID, and for fixed gases (oxygen, carbon dioxide, and methane) using a multi-gas meter. The PID and multi-gas meter will be calibrated prior to conducting measurements in accordance with the manufacturer's guidance.

Helium will be used as a tracer gas during purging to identify potential leaks in the sample fitting and Summa® canister and/or the building slab with an acceptable leak threshold of 5%. A plastic shroud will be placed over the probe, fittings, and Summa® canister(s), and a steady supply of helium (approximately 10% to 30%) will be maintained under the shroud during purging and sampling. A Dielectric MGD-2002™ portable helium detector or equivalent will be used to monitor the shroud concentration and to screen the soil gas collected during each purge interval. If the helium concentration in purge gas is less than 5% of the helium concentration in the shroud (i.e., purge gas consists of at least 95% soil gas), then the seals and fittings will be deemed acceptable and a sample will be collected for laboratory analysis. If the purge gas helium concentration exceeds 5% of the shroud concentration, this will indicate an unacceptable leak and the equipment will be evaluated to resolve the source of the leak. Soil gas samples will also be analyzed for helium by the laboratory. The soil vapor samples will be collected in 6-L Summa® canisters connected to a flow-controller calibrated to collect the sample at a rate of 0.2 L/min.

Following subslab sample collection as described above, the radon and polonium activity concentration in subslab gas will be measured. Using manufacturer supplied desiccant and tubing, a RAD7 radon detector will be connected to the subslab probe operated in "sniff" mode, collecting readings approximately every 5 minutes for approximately 30 minutes. Subslab radon activity readings, including polonium isotopes, will be collected until adequate precision and stabilization is observed. Adequate stabilization is defined as <10% change in radon activity concentration from the previous measurement, and precision is considered adequate when the standard deviation is <10% of the radon activity concentration measurement.

3.18.3 NEARSLAB NESTED WELL VAPOR SAMPLING

Currently, sub-floor ventilation is being performed at the SH building to interrupt the VI pathway and protect existing occupants. The active movement of air/vapors beneath the slab/floor of this building perturbs the subsurface soil gas concentration profile in the immediate vicinity of the building such that subslab/sub-floor sample analytical results would not inform risk under a future use scenario in which a sub-floor ventilation system were not present. Additional details regarding the system evaluation will be included with the vapor intrusion addendum., if necessary. In lieu of a subslab vapor sample at the SH building, a nearslab vapor well nest with a shallow probe (approximately 5 ft bgs) and deep (aka, “near-source”, approximately 15 ft bgs) probe close to the water table may be installed adjacent (but beyond the influence of advective flow caused by the sub-floor ventilation). The deep probe will be installed close to the water table but above the capillary fringe to reduce the likelihood of collecting soil gas sample with elevated moisture content.

3.18.3.1 NESTED VAPOR MONITORING WELL CONSTRUCTION

The design and installation of nearslab nested vapor monitoring wells will be in accordance with USEPA guidance for soil gas assessment (USEPA 2015). Nested vapor monitoring wells will be installed to terminal depth as follows: a hand auger will be used to advance the boring from 0 - 5 ft bgs, and the remainder of the boring will be installed using a direct-push drilling technique, such as CPT. Soil gas probes in nested vapor monitoring wells will consist of stainless-steel screens connected to the surface with Nylaflow® tubing or equivalent. A compression fit ball valve (or similar) will be attached to the top of each probe. The ball valve for each probe will be labeled with the associated well name and depth. Certified VOC-free silica sand will be placed around the screen to approximately 6-inches (in) above the top of the screen. Approximate 1-foot lifts of granular bentonite and water will then be added to approximately 6 inches below the bottom of the next probe screen. Six inches of silica sand will be placed on top of the seal prior to placing the next probe. The top foot of the boring will be capped with hydraulic cement. Typical nested vapor monitoring well construction detail is provided as Appendix M-1.

Upon reaching the designated depth at each well, the direct push drive rods will be removed. The silica sand pack will be placed around the screen and bentonite seal constructed (as described above). A weighted fiberglass measuring tape or similar will be used to confirm the depth intervals of seals and sand-packs. Surface completions will consist of an 8-in diameter, lockable casing with sufficient space to securely coil tubes/valves inside.

Nested vapor monitoring wells have multiple probes within a single borehole making it critical to confirm the competence of the seal between probes. Seal tests will be conducted on newly installed wells by drawing a vacuum of approximately 5 in of water (in-H_2O) on a selected probe and measuring the vacuum response at the probe immediately above or below. This test will be repeated for each probe in sequence to check for significant vacuum response in the adjacent probe which indicates a potentially leaky seal.

3.18.3.2 NEARSLAB SOIL GAS SAMPLING PROCEDURES

Nearslab soil gas sampling procedures will begin a minimum of 48 hours following well installation to allow subsurface conditions to equilibrate. To ensure that a representative soil gas sample is collected, and the sample is not diluted with ambient air, multiple reliability checks are included in the soil gas sampling procedure. These checks include: performing shut-in tests, purging and field screening with a helium shroud, and collecting canister vacuum reading before and after transport. The procedures outlined below will be documented on the Vapor Sampling Field Forms shown in Appendix M-4.

Following nested-well soil gas sample collection for VOCs, methane, fixed gases, and helium, radon and polonium activity levels in subsurface soil gas will be measured. Using manufacturer supplied desiccant and tubing, a RAD7 radon detector will be connected to the nested well probe and operated in “sniff” mode collecting readings approximately every 5 minutes. Soil gas radon activity concentration readings will be collected until adequate precision and stabilization is observed, approximately 30 minutes. Adequate stabilization is defined as <10% change in radon activity concentration from the previous measurement, and precision is considered adequate when the standard deviation is <10% of the radon activity concentration measurement.

3.18.3.2.1 SHUT-IN TESTING

Shut-in testing is conducted to confirm the integrity of the sample train prior to conducting pneumatic testing, soil gas purging, and collecting the final sample for laboratory analysis. Shut-in testing is performed by closing the ball valve to the soil gas probe and inducing a vacuum on the sample equipment, then closing valves at both ends and observing the vacuum to assess that it does not dissipate. If the vacuum dissipates, the leaky component in the sample train is identified and repaired or replaced (if necessary), and the shut-in test is performed again until the sample train holds a constant vacuum. These steps are recorded on the Soil Vapor Field Form (Appendix M-4).

3.18.3.2.2 PURGING AND FIELD SCREENING

To begin sampling procedures, nested vapor probes are purged using a 200 mL/min flow controller, vacuum pump, 3-L Tedlar bag, and lung box. Soil gas is extracted over a 5-minute interval (approximately 1 L of soil gas per interval) for three successive purging intervals prior to sample collection.

Helium will be used as a tracer gas for measuring the potential for leakage of ambient air through the annular seal of the vapor probe or connections within the sampling equipment. A shroud is placed around the nested well or subslab probe, flow controller, Summa® canister, and fittings during purging. Helium gas is added to the shroud through a small port. The concentration of helium is recorded using a Radiodetection/Dielectric Technologies MGD-2002™

multi-gas detector, or similar, to confirm that a helium content of about 10 to 20% is maintained beneath the shroud during purging. The range of helium maintained in the shroud is recorded during each purge interval. The concentration of helium in the soil gas samples recovered in the Tedlar bag during each purge interval are screened using the portable meter. This concentration should be less than 5% of the helium concentration under the shroud. If the helium concentration in the soil gas sample exceeds 5% of the shroud concentration, the probe and sampling equipment should be isolated at points along the sample train and inspected for leaks and repaired or replaced as needed. Additional purging should be conducted to ensure collection of a representative soil gas sample.

3.18.3.2.3 SOIL GAS SAMPLE COLLECTION, SHIPPING, AND ANALYSIS

Upon stabilization of PID readings and fixed gas concentrations over three successive intervals and confirmation of the integrity of the vapor probe and sampling equipment using helium as a tracer gas, the soil gas sample can be collected. The soil gas sample is collected in a pre-evacuated, individually certified, 6-L Summa® canister with a 5 µm in-line filter and flow controller (maximum rate of 200 mL/min). The Summa® canister, in-line filter, and flow controller are placed beneath the shroud and a helium content of about 10 to 20% is maintained during collection of the final soil gas sample. A residual vacuum should be maintained in the Summa® canister (typically 3 inches of mercury). Following collection of the soil gas samples, the Summa® canisters are labeled with the following information:

- Facility Name
- Date/Time
- Unique Summa® Canister Identification
- Unique Sample Identification
- Sampler Name
- Requested Laboratory Analyses
- Initial Summa® Canister Vacuum Upon Receipt from the Laboratory
- Final Summa® Canister Vacuum Following Collection of the Soil Gas Sample

A chain-of-custody form will accompany the samples to the analytical laboratory. Table 2-6e shows the nearslab sample summary.

3.18.4 AMBIENT AIR MONITORING

On days when indoor air, subslab, and/or nearslab samples are collected, one outdoor ambient air sample will be collected using a 6-L Summa® canister connected to a flow-controller calibrated to collect the sample over the designated time period. For outdoor air samples, the flow-controller will be calibrated to collect the sample over a 24-hour period. Outdoor ambient air canisters will be placed approximately 3 to 5 feet at a location upwind of the building(s) in which sampling activities are being conducted. A RAD7 Radon Detector will be placed adjacent to any Summa® canister collecting ambient air and operated using the built-in 24-hour protocol on a comparable timeframe as the ambient air canister sample collection period.

3.19 ECOLOGICAL SURVEY

An ecological survey will occur in two steps that will result in the baseline characterization of existing ecological and biological conditions within and adjacent to the site. A desktop assessment will be conducted first to characterize current habitat types, overall quality, and regional/landscape position by evaluating the existing OU-1 and OU-2 data, as well as publicly available information at the regional, local, and site-specific scale. The desktop assessment will identify the anticipated ecological communities and habitat types, and biota likely to occur within those habitats. The bathymetric surveys of the surface water bodies will be conducted where staff gauges will be installed (Section 3.5.2). The surface water depths will be reviewed as part of the desktop assessment to determine potential littoral and limnetic habitats.

Following the desktop assessment, an ecological survey of the flora and fauna onsite and surrounding the site will be conducted by a biologist. The survey will build upon the results of the desktop assessment, by verifying the existing vegetation communities; the nature, location, and extent of aquatic resources surrounding the site (focusing on the general area that has the potential to be connected to site-impacted groundwater and/or receives site runoff) and the identification of potential ecological receptors that use these general habitats. Data collection will include photographs, field notes, and global positioning system (GPS) coordinates delineating notable points or boundaries.

It is anticipated that a Screening Level Ecological Risk Assessment (SLERA) will need to be completed, and the ecological receptor evaluation will provide the basis for this. A work plan for the SLERA will be developed as an addendum to the Work Plan after the groundwater and surface water evaluations are completed and potential exposure pathways have been elucidated. At present, it is assumed that potential ecological exposure points for OU-3 include 1) the vadose zone and 2) off-site surface water bodies that are hydrologically connected to groundwater or receive surface water runoff that originates within the site. Information from OU-1 and OU-2 will be considered in the development of the CSM for the SLERA, and any remaining data gaps will be identified at that time. Additional site-specific information may be obtained (as needed) through the design and implementation of potential targeted sampling events (e.g. vegetation surveys, wildlife inventories, characterization of benthic macroinvertebrate assemblages, plant or animal tissue sampling, etc.).

Photographs, field notes, and GPS coordinates will be collected according to Trihydro's Field Documentation Procedures (Appendix A). Any GPS unit used during the OU-3 RI/FS will be capable of sub-meter accuracy data. Estimated accuracy will be recorded in the field logbook during data collection activities. The GPS data are post-processed and differentially corrected against the nearest base station.

3.20 THIRD-PARTY DATA COLLECTION

As part of the OU-3 RI/FS, third-party data will be collected for evaluation. Ground temperature, vadose zone pressure, and gas extraction data collected by Bridgeton Landfill, reported to MDNR, and publicly available online will be compiled for evaluation of the potential effects from the landfill and SSR. Meteorological data, primarily precipitation data, will be compiled from the National Oceanic and Atmospheric Administration's (NOAA) National Climatic Data Center's (NCDC) and the on-site meteorological (MET) station. Daily Missouri River stage data will be evaluated from the USGS stream gauge 06935965 at St. Charles Missouri.

3.20.1 MDNR – BRIDGETON SANITARY LANDFILL DATA

Bridgeton Landfill reports temperature monitoring probe (TMP) data in a Weekly Data Submittal to MDNR.[10] The TMP data show temperature (°F) by depth (ft). TMP locations are shown in the Weekly Data Submittal. The Weekly Data Submittal also include leachate levels in the LCSs. Depending on the LCS, the level is recorded as height above the quarry floor in feet or depth below grade in feet.

Bridgeton Landfill reports daily flare monitoring data in a Monthly Data Submittal to MDNR. The flare data includes average device flow in standard cubic feet per minute (scfm) from flares FL-100, FL-120, and FL-140. Data reported from the flares also include inlet gas composition (%) of oxygen, carbon dioxide, methane, hydrogen, and nitrogen, as well as temperature (°F). The combined inlet concentrations are of carbon monoxide in parts per million (ppm), methane as % volume, and oxygen as % volume.

Quarterly Landfill Gas Corrective Action Plan Updates reported by Bridgeton Landfill to MDNR will be evaluated for weekly gas monitoring probe (GMP) data which includes methane, carbon dioxide, oxygen, and balance gas

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[10] https://dnr.mo.gov/env/swmp/facilities/BridgetonSanitaryLandfill-RCP.htm

percentages. Barometric pressure and relative pressure are also reported weekly from each GMP. GMP locations are also shown in this report.

3.20.2 PRECIPITATION DATA

Precipitation data will be collected from NOAA's NCDC St. Louis Lambert Airport International Station (USW00013994).[11] Daily records of precipitation showing the 24-hour amount of rain and snow are reported in inches. Monthly datasets will be downloaded as ASCII text files and include the station, station name, geographic location, date, measurement, quality flag, source flag, and time of observation. The Lambert Airport Station is shown on Figure 3-12.

Precipitation data will also be collected from the on-site MET station. The on-site station records precipitation every minute to the nearest hundredth of an inch. The MET station is located near the neck of the South Quarry (Figure 3-12).

3.20.3 USGS DATA

The USGS stream gauge 06935965 at St. Charles Missouri is located approximately 1.5 miles northwest of the northwest corner of Area 2 and has a surveyed elevation of 413.47 ft msl NAVD 88 and a drainage area of approximately 524,000 square miles. Data from USGS stream gauge 06935965 at St. Charlies, Missouri, will be downloaded for evaluation.[12] Downloaded data will include the gauge height data reported in feet. The gauge height data will be corrected to determine the water level in feet above sea level in NAVD 88 datum by adding 413.47 feet to gauge height. The USGS stream gauge is shown on Figure 3-12.

3.21 DOCUMENTATION

Field logbooks and field forms will provide the means of recording the data collection activities. All field logbooks and field forms will be scanned to create portable document format (PDF) files for electronic archiving with the central project file. Field data recorded on field forms will not be duplicated in the field logbook, and vice versa. Field documentation will be submitted to the FTL and reviewed by the PM. Original field forms will be stored in the project files. See Appendix A for Field Documentation Procedures.

[11] https://www.ncdc.noaa.gov/cdo-web/datasets/GHCND/stations/GHCND:USW00013994/detail
[12] https://waterdata.usgs.gov/usa/nwis/uv?06935965

3.21.1 FIELD LOGBOOKS

Field logbooks will be used to document field observations and activities. The field notes will be clear, with sufficient detail, so that events can be reconstructed later, if necessary. Field logbooks will document deviations from the RI/FS Work Plan and/or FSP, as well as the reason for the changes. Requirements for logbook entries will include the following:

- Separate field activity logbooks will be kept for each task.
- Logbooks will be bound, with consecutively numbered pages.
- Entries will be made legibly with dark, indelible ink.
- Unbiased, accurate language will be used.
- Entries will be made while activities are in progress, or as soon afterward as possible, with the date and time that the notation is made.
- Samples collected and sample collection times will be noted. Sample container counts and other sample collection activities will be recorded on the Sample Collection Log (Appendix A-2).
- The weather and any precipitation events will be noted at the beginning of each day, including temperature, cloud cover, wind speed and direction, barometric pressure, and current or recent precipitation.
- A single stroke with the field personnel's initials shall be used to manage unused space left on a page.
- Each consecutive day's first entry will begin on a new, blank page.
- The date and time, based on military time, will be recorded on each page.
- When a field activity is complete, the logbook will be entered into the permanent project file.
- The person recording the information will print and sign each page of the logbook. If more than one individual makes entries on the same page, each recorder will print and sign the entry.
- Logbook corrections will be made by drawing a single line through the original entry, initialed, and dated.

3.21.2 FIELD DATASHEETS/FORMS

Field datasheets/forms will be utilized when appropriate to achieve efficient and standardized recording of field measurements and observations. The type of field data sheet and the information recorded on it may vary by activity. At a minimum, field datasheets will be completed for each sample to document the unique sample identifier assigned, to provide information on whether the sample is representative of a primary sample or a quality control sample (i.e. field blank, field duplicate, etc.), and to provide information regarding the sample media, sample date, sample location, and sampling team members. Information from the field datasheets will be entered into the database as needed. Datasheets may also be used to document information such as habitat descriptions, water level gauging data, sample field observations and measurements, soil sample characteristics, well construction details, etc. A reference date and activity will be entered in the field logbook to refer to the field datasheets being generated. The field datasheets will be scanned into a PDF and become a permanent record within the project file. Hard copies will be maintained in a 3-ring spiral notebook. Data from the forms will be transferred to the USEPA-accessible database. The following field data sheets and forms will be used for the OU-3 RI/FS:

- Sample Collection Log (Appendix A-2)
- Fluid Level and Well Inspection Form (Appendix A-3)
- Daily Calibration Log (Appendix A-4)
- Daily Calibration Forms – PID, Multi-Rae, Fixed Gas Meter, Water Quality Meter (Appendix A-4)
- Shipping Checklist (Appendix B-2)
- Excavation and Site Clearance Checklist (Appendix D-2)
- Depth to Groundwater Measurements Form (Appendix F-3)
- DL Deployment Form (Appendix F-6)
- Lithology Log Form (Appendix H-3)
- Rock Core Log (Appendix I-2)
- Monitoring Well Construction Detail Log – Single-Cased Wells (Appendix J-2)
- Monitoring Well Construction Detail Log – Double-Cased Wells (Appendix J-3)
- Monitoring Well Development and Groundwater Sampling Field Form (Appendix K-3)
- Slug Test Data Form (Appendix L-2)
- Vapor Sampling Field Form (Appendix M-4)

3.21.3 PHOTOGRAPHIC DOCUMENTATION

Photographs will be taken at the sampling locations and at other areas of interest on the site or sampling area. They will serve to verify information entered in the field logbook. When photographs are taken, the following information will be written in in the field logbook:

- Time, date, location, and weather conditions
- Description of the subject photographed
- Name of person taking the photograph
- Camera used to take photographs
- Direction the photo is facing (north, south, east, west)
- When possible and appropriate, rulers or other items will be placed in the photograph for scale

Field personnel will upload digital photographs daily. Photograph file names will be assigned as follows: Date-Location-Orientation-Initials. For example, photo file name 20200312_MW-213_N_JFG would indicate the photograph was taken on March 12, 2020 at well MW-213 looking north, and that the photograph was taken by field personnel with initials J.F.G. Representative photographic logs will be prepared for reports as appropriate. The photographic log will indicate the photograph date, location, photographer, orientation of the photograph, and any other descriptive information.

4.0 CALIBRATION PROCEDURES

This section describes the calibration procedures and the frequency at which these procedures will be performed for field instruments. The calibration procedures listed in this section are specific to the field instruments currently proposed during the OU-3 RI/FS. If calibration of any instrument or meter is not described herein, it will follow the manufacturer specified calibration procedures.

4.1 FIELD INSTRUMENTS

Field instruments will be used during the OU-3 RI/FS to assess soils, bedrock, vapor, and groundwater conditions. Field equipment and instruments used during this project organized by task are outlined in Table 3-1. The instruments will be calibrated in accordance with the general schedule and procedures prescribed by the equipment manufacturer. Calibration will be repeated at prescribed intervals according to the manufacturer's requirements. The calibration frequency depends on the type and stability of equipment, the intended use of the equipment, and the recommendation of the manufacturer. A daily calibration log will be maintained (Appendix A-4). Individual equipment requiring calibration to a standard, including the PID, field parameter meter, water quality meter, fixed gas meter, methane meter, helium detector, and radon detector, will be recorded on their respective calibration forms (Appendix A-4).

Field instruments used during this project and their general calibration procedures are described below and in their respective SOPs and user's manuals included in the appendices:

1. Electric water level/interface probe (Solinst 102, or similar) – Prior to first use, the water level probes will be calibrated. Each probe will be unraveled and measured to confirm the probe's length. Additionally, the water level probes all be used to record a water level in one shallow and one deep well to confirm any differences in recorded depths to groundwater. The probes' lengths and recorded measurements will be compared between each probe used on the site. If there are any differences between the probes, they will be recorded in the field logbook with relation to the probe's serial number so that any necessary adjustments to groundwater levels can be made. When groundwater measurements are collected, the probe's serial number will be noted. The probes will be re-calibrated quarterly prior to the groundwater sampling events. The probes will be decontaminated following calibration. Refer to Appendix F-4 for the user manual.

2. Sonic water level meter (Global Water WL650, or equivalent) – The sonic water level is factory calibrated. Accuracy can be assessed in the field by comparing sonic readings to electric water level interface probes. Prior to using the sonic water level meter in an off-site well where electric water level probes will not be used during the initial inventory, the accuracy of the sonic water level meter will be assessed against the electric water level meter with an on-site well. The readings will be recorded in the field logbook. The temperature at the time of collection will be noted. Refer to Appendix F-4 for the sonic water level user's manual.

3. Multi-gas meter (BW Gas Alert Microclip, or equivalent) - Routine periodic calibration along with bump tests will be conducted to verify that the monitoring equipment is operating within its acceptable calibration settings. The multi-gas meter will be inspected and calibrated according to the manufacture's recommendations. Refer to HASP for the user manual.
4. PID (ppbRae 3000 with 10.6 eV lamp, or equivalent) - The PID will be calibrated daily using a 100-ppm isobutylene standard. Calibration procedures and the user manual are included in Appendix G.
5. Fixed Gas Meter (Landtec GEM™ 2000, or equivalent) – The fixed gas meter will be calibrated daily against a standard reference gas for methane, carbon dioxide and oxygen. Calibration procedures and the user manual are included in Appendix M-8.
6. Geophysical tools (i.e., acoustic televiewer, caliper probe, EM induction probe, fluid temperature and resistivity probe, gamma-gamma density probe, heat pulse flow meter, natural gamma probe, spontaneous potential/resistivity probe) – Calibration certificates for geophysical tooling will be requested from the geophysics subcontractor prior to use.
7. Water quality meter (In-Situ AquaTroll, or equivalent) – The water quality meter will be calibrated daily prior to use and at the end of the day. Calibration procedures and the user manual are described in Appendix K-4.
8. Water pressure transducer and barometric compensation probe (Solinst Levelogger Model 3001 and Solinst Barologger Model 3001, or equivalent) – The transducer is factory calibrated. As long as the transducer is used within its specified range, it should be calibrated for the lifetime of the instrument.
9. Electronic radon detector (RAD7) with H2O accessory – The RAD7 is factory calibrated. It is recommended to be returned to the manufacturer annually for recalibration. Refer to Appendix M-7 for the RAD7 user manual and Appendix K-6 for the RAD7 H2O user manual.
10. Helium detector (Dielectric Technologies MGD-2002 Multi-Gas Detector) - The MGD-2002 is factory calibrated. It is recommended to be returned to the manufacturer annually for recalibration. Refer to Appendix M-9 for the MGD-2002 user manual.

4.2 DOCUMENTATION

Calibration procedures will be documented on the daily calibration log and on their respective calibration field forms and will include the date and time of calibration, name of person performing the calibration, reference standards used, and the calibration results (Appendix A-4). Multiple readings on one sample or standard, as well as readings on replicate samples when applicable, will also be documented.

5.0 DECONTAMINATION PROCEDURES

The decontamination procedures that will be followed are in general accordance with the Equipment Decontamination SOP included in Appendix N. Decontamination will occur prior to and after each use of a piece of equipment. Decontamination of sampling equipment must be conducted consistently as to assure the quality of samples collected. Drilling and monitoring well installation equipment will be decontaminated upon arrival onsite and between drilling locations. Downhole tooling will be decontaminated with high-pressure steam cleaning within a designated area onsite. Disposable equipment intended for one-time use will not be decontaminated but will be packaged for appropriate disposal. Sampling equipment will be decontaminated with a six-step process in accordance with *Sampling Equipment Decontamination SOP# 206* (USEPA 1994).

5.1 DRILLING EQUIPMENT, DOWNHOLE TOOLS, AND WELL INSTALLATION EQUIPMENT

Before arriving at the site, the drill rig, tools, and accessories will be thoroughly decontaminated with a pressure washer/steam cleaner. Downhole drilling tools and sampling equipment, such as bits, augers, rods, and split spoons will be decontaminated before advancing each boring. The drilling equipment will be inspected daily.

Decontamination of the rig, vehicles, and other equipment will be accomplished with a steam cleaner and/or a high pressure hot water washer or similar within a designated area onsite. Prior to steam cleaning, equipment will be disassembled to the extent possible and dirt will be removed with hand tools or brush.

Decontamination of non-disposable tools and equipment will consist of a phosphate-free detergent (Alconox or similar), tap water rinse and a distilled water rinse. PVC risers, well screens and end caps will be contained within the manufacturers' packaging until use. Workers shall wear clean gloves when handling the riser and well screen.

Decontamination water generated during well installation will be collected and either stored onsite within a temporary tank pending analytical data for waste characterization or transferred to the on-site leachate water treatment system.

5.2 SAMPLING EQUIPMENT

Equipment and tools used for the collection of samples will be decontaminated prior to and following collection of samples at each location in accordance with *Sampling Equipment Decontamination SOP# 206* (USEPA 1994). Generally, field sampling equipment will be decontaminated using a six-step process including (1) submersion in a phosphate-free detergent soapy water, (2) tap water rinse, (3) acidic solution application, (4) spray with deionized water, (5) solvent application and dry, and (6) final spray with deionized water and dry. The dedicated or disposable equipment will not be decontaminated prior to and following use. Table 3-1 outlines field equipment and decontamination procedures.

Equipment will be decontaminated in a predesignated area on pallets or plastic sheeting, and clean bulky equipment will be stored on plastic sheeting in uncontaminated areas. Cleaned small equipment will be stored in aluminum foil. Materials to be stored for more than a few hours will also be covered.

Pressure transducers will be decontaminated using a distilled water rinse only.

Decontamination of solid slug testing equipment will consist of submerging the equipment in phosphate-free detergent soapy water, a tap water rinse, applying an acidic solution, spraying equipment with deionized water, applying solvent and drying, and a final spray with deionized water and letting the equipment dry.

For well development, the submersible pump and lead will be decontaminated prior to purging each well in the following manner:

- External surfaces will be brushed free of loose material.
- Internal surfaces will be decontaminated by placing the pump into a clean bucket containing a phosphate-free detergent solution and by allowing the pump to operate for several minutes while submerged in the phosphate free detergent solution to circulate the decontamination solution through the impellers and pump housing. The pump will then be rinsed by circulating while pump is submerged in tap water, followed by cycling through a distilled water rinse.

Pump tubing and discharge hose used for purging and collecting groundwater samples will be dedicated to each monitoring well or discarded after use. Dedicated bladder pumps are located in each monitoring well and do not require decontamination.

Water level meters and interface probes will be decontaminated by placing the tape into a clean bucket containing a phosphate-free detergent. The tape will be allowed to sit in the solution for a few minutes. The tape will then be rinsed with tap water thoroughly followed by an acidic solution application, spraying equipment with distilled water, applying a solvent and drying, a final spray with deionized water and letting the equipment dry.

Wastewater fluids generated during decontamination efforts will be collected and either stored onsite within a temporary tank pending analytical data or transferred to the on-site leachate water treatment system. Acidic and solvent solutions will be consolidated into separate containers for waste characterization and disposal purposes.

5.3 DOCUMENTATION

Decontamination procedures for equipment will be logged as performed in the field logbook.

6.0 INVESTIGATION DERIVED WASTE MANAGEMENT

In the process of collecting environmental samples, the sampling team will generate different types of potentially contaminated IDW that include the following:

- Used personal protective equipment (PPE)
- Disposable sampling equipment
- Decontamination fluids
- Soil cuttings
- Purged groundwater and excess groundwater collected for sample container filling

The USEPA's National Oil and Hazardous Substances Pollution Contingency Plan (NCP) requires that management of IDW generated during sampling comply with all applicable or relevant and appropriate requirements (ARARs) to the extent practicable. The sampling plan will follow the *Office of Emergency and Remedial Response (OERR) Directive 9345.3-02* (May 1991), which provides the guidance for the management of IDW. In addition, other legal and practical considerations that may affect the handling of IDW will be considered.

- Used PPE and disposable equipment will be double bagged and placed in a municipal refuse dumpster. These wastes are not considered hazardous and can be sent to a municipal landfill. Any PPE and disposable equipment that is to be disposed of which can still be reused will be rendered inoperable before disposal in the refuse dumpster. Any PPE generated within OU-1 Areas 1 and 2 will be frisked to verify the absence of radionuclides and predisposed of as municipal solid waste as per the most recent OU-1 Radiation Safety Plan (Ameriphysics 2020).
- Decontamination fluids that will be generated in the sampling event will consist of distilled water, residual constituents of concerns, water with non-phosphate detergent, acidic rinse water, and spent solvent rinse solution. Water-based decontamination fluid will be containerized and either stored onsite within a temporary tank pending characterization for off-site disposal or transferred to the on-site leachate water treatment system for discharge pending approval from MSD. Acidic rinse waters and spent solvent liquids will be containerized separately in drums or totes, characterized, profiled, and shipped offsite for disposal by a licensed waste management facility. Any decontamination fluids generated within OU-1 Areas 1 and 2 will be managed per the OU-1 site protocols and in accordance with the OU-1 Radiological Safety Plan.
- Soil cuttings generated during the subsurface sampling will be containerized and disposed of pending waste characterization and profiling. It is anticipated that the proposed analytical suite will be sufficient for waste

characterization purposes. Any soil cuttings generated within OU-1 Areas 1 and 2 will be managed per the OU-1 site protocols and in accordance with the OU-1 Radiological Safety Plan.

- Purged groundwater will be containerized and stored onsite within a temporary tank pending waste characterization and profiling. It is anticipated that the proposed analytical suite will be sufficient for waste characterization purposes. Any purged groundwater generated within OU-1 Areas 1 and 2 will be managed per the OU-1 site protocols and in accordance with the OU-1 Radiological Safety Plan.

All off-site shipments will be managed as required by the ASAOC and will comply with USEPA's *Guide to Management of Investigation Derived Waste 9345.3-03FS* (January 1992).

7.0 FIELD EVENTS SCHEDULE

A detailed OU-3 RI/FS Work Plan is included as Figure 10-2 of the Work Plan. It is anticipated that the schedule will be updated monthly during the project. Milestones for the major project tasks are currently estimated as follows based on the assumption that the OU-3 RI/FS Work Plan will be approved by July 1, 2020:

- Initial Tasks (Well Inventory, Staff Gauge Installation, Access Agreements, Permitting, Fluid Level Monitoring) – Spring 2020 pending USEPA approval to expedite tasks
- Well Inventory Summary Report – Summer 2020
- Interim Groundwater Sampling – Summer 2020 and Early 2021*
- Quarterly Groundwater Sampling – Spring 2021 through Summer 2022*
- Phase I and II Well Installation – Summer 2020 – Spring 2021*
- Addendum to RI Work Plan – Late 2020
- Additional RI Well Installation – Spring 2021*
- Groundwater Modeling Work Plan – Late 2021
- Groundwater Modeling Report – Early 2023
- Baseline Risk Assessment Work Plan – Fall 2022
- RI Report – Late 2023
- Baseline Risk Assessment Report – Late 2023
- Feasibility Study – Spring 2025

**Major field events denoted with an asterisk.*

8.0 REFERENCES

ASTM. 2002. Standard Test Method for Determining Transmissivity and Storage Coefficient of Low-Permeability Rocks by In Situ Measurements Using the Constant Head Injection Test. D 4630-96.

ASTM. 2010. Standard Practice for Design and Installation of Groundwater Monitoring Wells. D 5092.

ASTM. 2016. Standard Practice for Direct Push Hydraulic Logging for Profiling Variations of Permeability in Soils. D 8037.

ASTM. 2012. Standard Test Method for Electronic Friction Cone and Piezocone Penetration Testing of Soils. D 5778-12.

ASTM. 2015. Standard Practice for Thin-Walled Tube sampling of Fine-Grained Soils for Geotechnical Purposes. D 1587.

CECI. 2019. Operation, Maintenance and Monitoring Plan, Bridgeton Landfill, LLC. Civil & Environmental Consultants, Inc. March 2019.

City of St. Louis. 2005. Negative Easement and Declaration of Restrictive Covenants Agreement. April 6, 2005.

EMSI. 2000. Remedial Investigation Report. West Lake Landfill, Operable Unit 1. April 10, 2000.

EMSI. 2018. Remedial Investigation Addendum, West Lake Landfill, Operable Unit 1. January 25, 2018.

Golder Associates, Inc. (Golder). 1996. Physical Characterization Technical Memorandum for the West Lake Landfill Operable Unit 2, Bridgeton, Missouri. August 15, 1996.

Herst & Associates, Inc. 2005. Remedial Investigation Report, West Lake Landfill Operable Unit 2, Bridgeton, Missouri. September 2005.

Interstate Technical and Regulatory Council (ITRC). 2007. Vapor Intrusion Pathway: A Practical Guideline, Technical and Regulatory Guidance. Prepared by The ITRC Vapor Intrusion Team. January 2007.

Johnson, P.C., Kemblowski, M.W., and Colthart, J.D. 1990. Quantitative Analysis for the Cleanup of Hydrocarbon-Contaminated Soils by In-Situ Soil Venting. Groundwater. 1990. 28 (3).

King, P.T., Michel, J., and Moore W.S. 1982. Ground water geochemistry of 228Ra, 226Ra and 222Rn. Geochimica et Cosmochimica Acta, v. 46, p. 1173– 1182.

Moloney, T. P. Sims, K.W., and Kaszuba, J.P. 2011. Uranium and Thorium Decay Series Isotopic Contraints on the Source and Residence Time of Solutes in the Yellowstone Hydrothermal System. University of Wyoming National Park Service Research Center Annual Report: Vol. 33, Article 26. Available at: https://repository.uwyo.edu/uwnpsrc_reports/vol33/iss1/26

Rogala, J.T. (1999), Bathymetry – Chapter 2 extracted from James T. Rogala, 1999. Methodologies employed for bathymetric mapping and sediment characterization as part of the Upper Mississippi River System Navigation Feasibility Study, ENV Rep. 13, Interim Report for the Upper Mississippi River – Illinois Waterway System Navigation Study; prepared for U.S. Geological Survey, U.S. Army Eng. Dist., Rock Isl., St. Louis.

State of Missouri (Missouri). 2019. Missouri Monitoring Well Construction Code. Available from: https://dnr.mo.gov/geology/geosrv/wellhd/wellsanddrilling.htm.

USACE. 2001. Requirements for the Preparation of Sampling and Analysis Plans, Appendix C, Section C.2, EM200-1-3. Washington, DC.

USACE. 2010. Standards and Procedures for Referencing Project Elevation Grades to Nationwide Vertical Datums https://www.publications.usace.army.mil/Portals/76/Publications/EngineerManuals/EM_1110-2-6056.pdf.

USEPA. 1989. Aerial Photographic Analysis of the Westlake Landfill Site. October 1989.

USEPA. 1991. Management of Investigation-Derived Wastes During Site Inspections. Office of Emergency and Remedial Response (OERR) Directive 9345.3-02. EPA/540/G-91/009. May 1991.

USEPA. 1992. Guide to Management of Investigation Derived Waste 9345.3-03FS. (January 1992).

USEPA. 1992. Indoor Radon and Radon Decay Product Measurement Device Protocols (EPA 402-R-92-004.

USEPA. 1993. Protocols For Radon And Radon Decay Product Measurements In Homes (EPA 402-R-92-003.

USEPA. 1993. Suggested Operating Procedures For Aquifer Pumping Tests. U.S. Environmental Protection Agency, Washington, DC, EPA/540/S-93/503.

USEPA. 1994. Standard Operating Procedures for Sampling Equipment Decontamination. SOP #2006. (August 11, 1994).

USEPA. 1995. Environmental Response Team (ERT) Standard Operating Procedure (SOP) #1701: Summa Canister Sampling.

USEPA. 2002. Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers. Yeskis, Douglas and Bernard Zavala.

USEPA. 2005. National Geospatial Data Policy (CIO 05-002, Reviewed 2008). August 2005. Available from: https://www.epa.gov/sites/production/files/2014-08/documents/national_geospatial_data_policy_0.pdf.

USEPA. 2015. OSWER Technical Guidance for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air, OSWER Publication No. 9200.2-154. June.

USEPA. 2018. Statement of Work, Remedial Investigation and Feasibility Study, Site Wide Groundwater (Operable Unit 3), West Lake Landfill Site, Bridgeton, Missouri. September 21, 2018.

USEPA. 2019. West Lake Landfill OU-3 Administrative Settlement Agreement and Order on Consent for Remedial Investigation/Feasibility Study. CERCLA-07-2018-0259. February 2019.

USGS. 2012. Rydlund, P.H., Jr., and Densmore, B.K., 2012, Methods of practice and guidelines for using survey-grade global navigation satellite systems (GNSS) to establish vertical datum in the United States Geological Survey: U.S. Geological Survey Techniques and Methods, book 11, chap. D1, 102 p. with appendices. https://pubs.usgs.gov/tm/11d1/.

USGS. 2017. Archuleta, C.M., Constance, E.W., Arundel, S.T., Lowe, A.J., Mantey, K.S., and Phillips, L.A., 2017, The National Map seamless digital elevation model specifications: U.S. Geological Survey Techniques and Methods, book 11, chap. B9, 39 p., https://pubs.er.usgs.gov/publication/tm11B9.

TABLES

TABLE 1-1. DOCUMENT DIRECTORY
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION/FEASIBILITY STUDY
FIELD SAMPLING PLAN

Scope of Work	WP Section	FSP Section	QAPP Section
Project Background and Setting	2.1, 2.2, 2.3, 2.4	1.1, 1.2	--
Project Personnel and Team Responsibilities	10.1, Figure 10-1	1.5, Figure 1-7	2.0, Figure 2-1, Table 3-1
Project Schedule	10.3, Figure 10-2	7.0	Table 3-1
Historical Datasets	2.5	--	Table 3-1
Conceptual Site Model	3.0	--	3.1.2, Table 3-1
Data Quality Objectives	4.1, 4.2	1.3	3.0, Table 3-1
Field Instrument Calibration	5.1.2	4.0	5.1.5.1
Compile Existing Data	5.2	3.20	4.2, Table 3-1
Existing Monitoring Well Network	5.3.1, Figure 5-1, Appendix B	3.2	Table 3-1
Proposed Monitoring Well Network	5.3, 5.3.2, 5.3.3, 5.3.4, and Figures 5-2 through 5-5	3.5	5.0, 6.0, and 7.0[1]
Phased Approach	1.1, 4.0, 4.3, 5.0, 5.3.2.1, 5.4.1	1.3	1.2
Site Reconnaissance, Well Inventory, Repair, Replacement, and Abandonment	5.4.3, 5.4.4, 9.1	3.2, 3.11	--
Hydraulic Profiling Tool Pilot Test	5.4.5	3.5.2.1, Appendix H	5.0, 6.0, and 7.0[1], Table 3-1
Drill Rig Selection	5.4.6	3.5.2	--
Continuous Coring and Field Logging	5.4.7	3.5.2.2, 3.5.2.3, Appendix H and I	Table 3-1
Alluvium and Bedrock Aquifer Matrix Sampling	5.4.8	3.6, Appendix I	5.1.2.1.2, Table 3-1
Borehole Geophysical Logging	5.4.9	3.7, Appendix H	Table 3-1
Packer Testing	5.4.10	3.8	Table 3-1
Monitoring Well Installation	5.4.11	3.9, Appendix K	Table 3-1
Monitoring Well Development	5.4.12	3.10, Appendix K	Table 3-1
Slug Testing	5.4.13	3.12, Appendix L	Table 3-1
Aquifer Pumping Test	5.4.14	3.13, Appendix L	Table 3-1
Water-level Measurements	5.4.15.1	3.16, Appendix F	Table 3-1
Monitoring Well Purging	5.4.15.2	3.14.1, 3.14.2, Appendix K	Table 3-1
Monitoring Well Sampling	5.4.15.3	3.14.3, Appendix K	5.1.2.1.1, Table 3-1
Staff Gauge Installation	5.4.16, Figure 5-6	3.17	Table 3-1
Leachate Collection System Sampling	5.4.17	3.15	5.1.2.1.1, Table 3-1
On-site Vapor Intrusion Assessment	5.4.18, Figure 5-10	3.18, Appendix M	5.1.2.1.3, Table 3-1
Ecological Survey	5.4.19	3.19	--
Surveying and Mapping of the Investigation Areas	5.4.20	3.4	5.1.2.1.4, 5.3.3, 6.1.4, 6.2.3, 7.1.2.5

TABLE 1-1. DOCUMENT DIRECTORY
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION/FEASIBILITY STUDY
FIELD SAMPLING PLAN

Scope of Work	WP Section	FSP Section	QAPP Section
Investigation Derived Waste	5.4.21	6.0	--
Decontamination Procedures	5.4.21	5.0, Appendix N	6.1.1
Additional Site Characterization	5.4.22	--	Table 3-1
Groundwater Modeling and Fate and Transport	5.5, 6.2.1	--	Table 3-1
Health and Safety (see Health and Safety Plan)	5.7	--	--
Data Management	6.1	--	5.3
Data Validation	6.1.1	--	4.1, 4.2, 7.0
Project Database	6.1.2, 6.2.2	--	5.3
Spatial Data	6.1.3	--	5.1.2.1.4, 5.3.3, 6.1.4, 6.2.3, 7.1.2.5
Field Logbooks	6.1.4.1	3.21.1, Appendix A	3.11
Field Datasheets	6.1.4.2	3.21.2, Appendix A	3.11
Data Evaluation	6.2	--	4.0, Table 3-1
Baseline Risk Assessment and RI Report	7.0	--	4.0, Table 3-1
Feasibility Study	8.0	--	--
RI/FS Report	9.0	--	--

Notes:

This table is not meant to be all inclusive but as a guide to help find the major components of these Scope of Work Items. Tables, Appendices, and Figures were only referenced if they contained a large portion of the information for that component.

1: Section 5.0, 6.0, and 7.0 of the QAPP addresses groundwater, leachate, alluvium, bedrock and vapor in the following sections:

5.1.1 - Sample Handling and Custody, 5.1.2 - Analytical Methods, 5.1.3 - Quality Control, 5.1.4/5.1.5 - Field Instrument/Equipment Procedures. 5.1.6 - Supplies and Consumables, 5.3 - Data Management, 6.1.1 - Field Audits, 6.2.1 - Field Data Reporting, 7.1.1 - Field Data Validation

Highlighted column indicates where the majority of information for that topic is discussed.

Abbreviations:

FSP: Field Sampling Plan
QAPP: Quality Assurance Project Plan
WP: Work Plan
RI: Remedial Investigation
FS: Feasibility Study

TABLE 2-1. ANALYTICAL SAMPLING PLAN
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Samples Type	Sample Locations	Sample Plan
Alluvial Aquifer Matrix Samples	9 proposed well sites	Collect samples every 20 ft (estimated 5 samples per well site)
Bedrock Aquifer Matrix Samples	9 proposed well sites	Collect samples every 20 ft (estimated 7 to 12 samples per well site, depending on bedrock thickness)
Specialty Analysis[1]	9 alluvial and 9 bedrock well sites	One sample collected per well from within the interval in which the well is screened
Radionuclide Speciation Samples	9 alluvial samples	One sample collected per well from within the interval in which the well is screened
Groundwater Samples	80 existing wells, piezometers, and leachate risers	Collect samples quarterly for 2 years from 158 locations[2]
	78 proposed wells	
Leachate Samples	Up to 6 LCS sumps depending on accessibility, presence of leachate, and working pumps (4 currently accessible)	Collect samples quarterly for 2 years from each sump
Air Samples	6 indoor air samples collected from 4 buildings	6 indoor air samples will be collected from 4 buildings for 4 events

Notes:

1: Specialty analysis includes X-Ray Diffraction (XRD), SEM-EDS, sequential extraction (alluvium only), and select geotechnical analysis (alluvium only).

2: The first and second events will consist of sampling the 80 existing wells with 20 proposed wells during the first event and 40 proposed wells in the second event as monitoring well installation allows.

TABLE 2-2. ANALYTE SUITE BY MEDIA
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Method Group	Sequential Extraction Analyses			Mineralogical			Geotechnical					Organic Chemistry					Gases				
Analyte:	Sequential Extraction Analysis, Dissolved Radium, Uranium, Thorium	Sequential Extraction Analysis, pH	Sequential Extraction Analysis, Total Metals (Barium, Calcium, Iron, Manganese, Sulfur)	X-Ray Diffraction	Scanning Electron Microscope with Energy Dispersive X-Ray Spectrometry (SEM/EDS)	Cation Exchange Capacity (CEC)	Grain Size Distribution by Sieve Analysis	Grain Size Distribution by Hydrometer Analysis	Porosity	Atterberg Limits	Density	Volatile Organic Compounds	Semi-volatile Organic Compounds	Poly-chlorinated Biphenyls (PCBs)	TPH - Aliphatic High, Medium & Low TPH - Aromatic High, Medium & Low	Chlorinated Herbicides	Methane	Carbon Dioxide	Oxygen	Hydrogen	Helium
Alluvial Soil	X	X	X	X	X	X	X	X	X	X	X	-	-	-	-	-	-	-	-	-	-
Bedrock	-	-	-	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Groundwater	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	-	-	-
Leachate	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	-	-	-
Vapor	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	#, X	#, X[2]	#, X[2]	X[2]	#, X[2]

Method Group	Metals								Radiological Chemistry										
Analyte:	Chromium (III)	Chromium (VI)	Dissolved Mercury	Total Mercury	Ferric Iron	Ferrous Iron	Dissolved Metals	Total Metals	Radon	Polonium Isotopes	Total Isotopic Thorium (Th-228, Th-230, Th-232)	Total Isotopic Uranium (U-234, U-235, U-238)	Total Isotopic Radium-226	Total Isotopic Radium-228	Dissolved Isotopic Thorium (Th-228, Th-230, Th-232)	Dissolved Isotopic Uranium (U-234, U-235, U-238)	Dissolved Isotopic Radium-226	Dissolved Isotopic Radium-228	Tritium
Alluvial Soil	-	-	-	X	X	X	-	X	-	-	X	X	X	X	-	-	-	-	-
Bedrock	-	-	-	X	X	X	-	X	-	-	X	X	X	X	-	-	-	-	-
Groundwater	X	X	X	X	#[1]	#	X	X	**#**	**#**	X	X	X	X	X	X	X	X	X
Leachate	X	X	X	X	#[1]	#	X	X	**#**	**#**	X	X	X	X	X	X	X	X	X
Vapor	-	-	-	-	-	-	-	-	**# , X**	**#**	-	-	-	-	-	-	-	-	-

TABLE 2-2. ANALYTE SUITE BY MEDIA
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Method Group	Geochemistry																						
Analyte:	**pH**	**Cyanide**	**Dissolved Organic Carbon**	**Total Organic Carbon**	**Alkalinity**	**Bromide**	**Carbonate**	**Cations + Anions**	**Total Dissolved Solids**	**Total Suspended Solids**	**Total Hardness**	**Iodide**	**Chloride**	**Fluoride**	**Phosphate**	**Sulfate**	**Sulfide**	**Chemical Oxygen Demand**	**Nitrogen, Ammonia**	**Nitrogen, Nitrate**	**Nitrogen, Nitrate + Nitrite**	**Nitrogen, Nitrite**	**Ammonium**
Alluvial Soil	X	-	-	X	X	X	X	X	-	-	-	X	X	X	-	X	-	-	-	-	-	-	-
Bedrock	X	-	-	X	X	X	X	X	-	-	-	X	X	X	-	X	-	-	-	-	-	-	-
Groundwater	# , X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	#
Leachate	# , X	x	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	#
Vapor	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes:

X: Sample will be collected for this analysis.
--: Sample will not be collected for this analysis.
#: Samples collected through field measurement.
1: Ferric Iron will be calculated from the Total Iron and Ferrous Iron field tests.
2: Contingent upon results of indoor air samples.

Dissolved and Total Metals: Arsenic, Barium, Beryllium, Cadmium, Calcium, Cobalt, Copper, Iron, Lead, Lithium, Magnesium, Manganese, Molybdenum, Potassium, Selenium, Silicon, Sodium, Strontium, Vanadium, Zinc, Aluminum, Antimony, Boron, Chromium, Nickel, Silver, Thallium, Thorium, Tin, Titanium, Uranium

Polonium isotope count data and radon will be recorded with the Rad7 meters and downloaded through the CAPTURE software.

TABLE 2-3. ESTIMATED NUMBER OF SAMPLES
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Media Type	Number of Sample Locations	Estimated Number of Samples per Location	Number of Events	Estimated Number of Samples
Alluvial Soil	9	5	1	45
Bedrock	9	7/12*	1	73
Groundwater	100[a]	1	1	100
	120[a]	1	1	120
	158[a]	1	6	948
Leachate	6	1	8	48
Vapor	4[b]	1	6 Indoor Air	24

Notes:

Estimated number of samples does not include QA/QC sample counts.

* The 600-series wells will have approximately 12 samples per location. The remaining bedrock wells will have approximately 7 samples per location.

a: Assumes, Event 1: 80 existing and 20 new wells; Event 2: 80 existing and 40 new wells; Events 3-8: 80 existing and 78 new wells (6 events).

b: Vapor sample locations include 4 buildings (6 Indoor Air samples) for four events.

TABLE 2-4a. ANALYTES, HOLDING TIME AND PRESERVATION REQUIREMENTS FOR GROUNDWATER/LEACHATE
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Category	Analytical Group	Analytical Method	Containers (number, size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation / analysis)	Laboratory
Total Metals	Total Metals	USEPA 6010B	250mL in plastic container	Nitric Acid to pH <2* Ambient or Cool to ≤6°C	Must be analyzed within 6 months of the collection date.	Pace - I
	Total Metals	USEPA 6020	250mL in plastic container	Nitric Acid to pH <2* Ambient or Cool to ≤6°C	Must be analyzed within 6 months of the collection date.	Pace - I
	Total Mercury	USEPA 7470A	250mL in plastic container	Nitric Acid to pH <2* Cool to ≤6°C	Analysis must be completed within 28 days of collection date.	Pace - I
	Chromium (III)	Calculation	NA	NA	NA	Pace - I
	Chromium (VI) Use one of these two methods.	USEPA 7196A	250mL in plastic container	Cool to ≤6°C	Analysis must be completed within 24 hours of colelction date.	Pace - I
		USEPA 7199	Filterable syringe	Ammonium sulfate/Ammonium hydroxide Cool to ≤6°C	Analysis must be completed within 28 days of collection date.	Pace - I / Pace - N
Dissolved Metals	Dissolved Metals	USEPA 6020	250mL in plastic container	Field Filtration Nitric Acid to pH <2* Ambient or Cool to ≤6°C	Must be analyzed within 6 months of the collection date.	Pace - I
	Dissolved Metals	USEPA 6010B	250mL in plastic container	Field Filtration Nitric Acid to pH <2* Ambient or Cool to ≤6°C	Must be analyzed within 6 months of the collection date.	Pace - I
	Dissolved Mercury	USEPA 7470A	250mL in plastic container	Field Filtration Nitric Acid to pH <2* Ambient or Cool to ≤6°C	Analysis must be completed within 28 days of collection date.	Pace - I

TABLE 2-4a. ANALYTES, HOLDING TIME AND PRESERVATION REQUIREMENTS FOR GROUNDWATER/LEACHATE
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Category	Analytical Group	Analytical Method	Containers (number, size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation / analysis)	Laboratory
Semi-Volatile Organic Compounds	Semi-Volatile Organic Compounds	USEPA 8270C	2x100mL amber glass container with Teflon-lined lid, preferably wide mouth	Cool to ≤6°C	Sample must be extracted within 7 days of collection date and extract must be analyzed within 40 days of extraction date.	Pace - I
	Semi-Volatile Organic Compounds	USEPA 8270C SIM	2x100mL amber glass container with Teflon-lined lid, preferably wide mouth	Cool to ≤6°C	Sample must be extracted within 7 days of collection date and extract must be analyzed within 40 days of extraction date.	Pace - I
Volatile Organic Compounds	Volatile Organic Compounds	USEPA 8260C Low Level	Minimum 3 VOA vials. Additional sample is required if MS/MSD is required.	Acidified w/ 1:1 Hydrochloric Acid to pH<2, no headspace Cool to ≤6°C	pH>2: Analysis must be completed within 7 days of collection date. pH <2: Analysis must be completed within 14 days of collection date. (pH determined post analysis)	Pace - I
	Volatile Organic Compounds	USEPA 8011	Minimum 3 VOA amber vials. Additional sample is required if MS/MSD is required.	Preserved w/ sodium thiosulfate, no headspace Cool to ≤6°C	Analysis must be completed within 14 days of collection date.	Pace - I
PCBs	Polychlorinated Biphenyls (PCBs)	USEPA 8082A	2x100mL wide mouth amber glass bottle	Cool to ≤6°C	Extract within 6 months of collection and analyze within 40 days of extraction	Pace - I
Chlorinated Herbicides	Chlorinated Herbicides	USEPA 8151A	2x1000mL amber glass container with Teflon-lined lid, preferably wide mouth	Cool to ≤6°C	Sample must be extracted within 7 days of collection date and extract must be analyzed within 40 days of extraction date.	Pace - I
Hydrocarbons	TPH - Aliphatic and Aromatic	TX 1006	(2) 40 ml HCL vials	Cool to ≤6°C	Analysis must be completed within 7 days.	Pace - N
	Total TPH	TX 1005	(2) 40 ml HCL vials	Cool to ≤6°C	Analysis must be completed within 7 days.	Pace - N
Dissolved Gases	Methane	AM20GAX	2x40mL vials	BAK, Cool to ≤6°C	Analysis must be completed in 14 days within 14 days of collection date.	Pace - E
	Carbon Dioxide	AM20GAX	2x40mL vials	BAK, Cool to ≤6°C	Analysis must be completed in 14 days within 14 days of collection date.	Pace - E

TABLE 2-4a. ANALYTES, HOLDING TIME AND PRESERVATION REQUIREMENTS FOR GROUNDWATER/LEACHATE
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Category	Analytical Group	Analytical Method	Containers (number, size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation / analysis)	Laboratory
Radiological Chemistry	Isotopic Thorium (Th-228, Th-230, Th-232) Dissolved Isotopic Thorium (Th-228, Th-230, Th-232)	HASL-300 Method U-02	1L plastic or glass container	Nitric acid pH<2	Sample must be analyzed within 180 days	Pace - P
	Isotopic Uranium (U-234, U-235, U-238) Dissolved Isotopic Uranium (U-234, U-235, U-238)	HASL-300 Method U-02	1L plastic or glass container	Nitric acid pH<2	Sample must be analyzed within 180 days	Pace - P
	Isotopic Radium-226 Dissolved Isotopic Radium-226	USEPA 903.1	1L plastic or glass container	Nitric acid pH<2	Sample must be analyzed within 180 days	Pace - P
	Isotopic Radium-228 Dissolved Isotopic Radium-228	USEPA 904.0	1L plastic or glass container	Nitric acid pH<2	Sample must be analyzed within 180 days	Pace - P
	Tritium	USEPA 906.0	500mL amber glass	Cool to ≤6°C	Sample must be analyzed within 180 days	Pace - P

TABLE 2-4a. ANALYTES, HOLDING TIME AND PRESERVATION REQUIREMENTS FOR GROUNDWATER/LEACHATE
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Category	Analytical Group	Analytical Method	Containers (number, size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation / analysis)	Laboratory
Geochemistry	Alkalinity	SM 2320B	250mL minimum in plastic container	Cool to ≤6°C	Sample must be analyzed within 14 days of collection date.	Pace - I
	Bromide	USEPA 9056A	250mL minimum in plastic container	Cool to ≤6°C	Sample must be analyzed within 28 days of collection date.	Pace - I
	Carbonate	SM 2320B	250mL minimum in plastic container	Cool to ≤6°C	Sample must be analyzed within 14 days of collection date.	Pace - I
	Chemical Oxygen Demand	USEPA 410.4 Rev 2	One 250mL plastic or glass container	Sulfuric Acid to pH <2 Cool to ≤6°C	Sample must be analyzed within 28 days of collection date.	Pace - I
	Chloride, Fluoride, Sulfate, Iodide	USEPA 9056A	250mL in plastic container	Cool to ≤6°C	Analysis must be completed within 28 days of collection date.	Pace - I
	Cyanide	USEPA 9012A	250mL in plastic container	Preserved w/ sodium hydroxide to pH>10 Cool to ≤6°C	Sample must be analyzed within 14 days of collection date.	Pace - I
	Dissolved Organic Carbon	SM 5310C	250mL amber glass bottle	Field Filtered, Sulfuric Acid to pH <2 Cool to ≤6°C	Sample must be analyzed within 28 days of collection date.	Pace - I
	Nitrogen, Ammonia	SM 4500-NH_3 G/USEPA 350.1	250mL in plastic or glass container	Sulfuric Acid to pH <2 Cool to ≤6°C	Sample must be analyzed within 28 days of collection date.	Pace - I
	Nitrogen, Nitrate	USEPA 9056A	250mL in plastic container	Cool to ≤6°C	For unpreserved samples, analysis must be completed within 48 hours of collection.	Pace - I
	Nitrogen, Nitrate + Nitrite	USEPA 353.2 Rev 2	250mL in plastic container	For combined nitrate/nitrite analysis Sulfuric Acid to pH <2	For preserved samples, analysis must be completed within 28 days of collection date.	Pace - I

TABLE 2-4a. ANALYTES, HOLDING TIME AND PRESERVATION REQUIREMENTS FOR GROUNDWATER/LEACHATE
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Category	Analytical Group	Analytical Method	Containers (number, size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation / analysis)	Laboratory
Geochemistry	Nitrogen, Nitrite	USEPA 9056A	250mL in plastic container	Cool to ≤6°C	For unpreserved samples, analysis must be completed within 48 hours of collection.	Pace - I
	pH	SM 4500H+B	250mL minimum in plastic container	Cool to ≤6°C	Sample must be analyzed within 15 minutes of collection date.	Pace - I
	Phosphorous	USEPA 365.1	250mL in glass or plastic container	Preserved with H2SO4 to a pH<2, Cool to ≤6°C	Sample must be analyzed within 28 days of collection date.	Pace - I
	Sulfide	SM 4500-S^2-D	250mL in plastic container. Fill container completely without overflowing.	pH>9 with 1mL of 1:1 Sodium Hydroxide plus 0.5mL of 1N Zinc Acetate per 250mL sample. Cool to ≤6°C	Analysis must be completed within 7 days of collection.	Pace - I
	Total Dissolved Solids	SM 2540C	250mL minimum in plastic container	Cool to ≤6°C	Sample must be analyzed within 7 days of collection date.	Pace - I
	Total Hardness	USEPA 6010B/2340B Calculation	250mL in plastic container	Nitric Acid to pH <2* Ambient or Cool to ≤6°C	Must be analyzed within 6 months of the collection date.	Pace - I
	Total Organic Carbon	SM 5310C	250mL amber glass bottle	Sulfuric Acid to pH <2 Cool to ≤6°C	Sample must be analyzed within 28 days of collection date.	Pace - I
	Total Suspended Solids	SM 2540D	1L minimum in plastic container	Cool to ≤6°C	Sample must be analyzed within 7 days of collection date.	Pace - I

Notes:

* Samples received at pH >2 must be preserved to pH <2 with HNO3 and be allowed to equilibrate for 24 hours before being prepared for analysis. Acidification date and time are recorded in the Sample Preservation Logbook.

Abbreviations:

BAK: Benzalkonium Chloride
°C: degrees celsius
HASL: Health and Safety Laboratory
L: Liter
mL: milliliter
MS/MSD: Matrix Spike/Matrix Spike Duplicate
N: Normal
NA: Not Applicable
Pace - E: Pace Analytical Energy Services, LLC in Pittsburgh, Pennsylvania
Pace - I: Pace Analytical Services, LLC in Indianapolis, Indiana
Pace - K: Pace Analytical Services, LLC in Lenexa, Kansas
Pace - P: Pace Analytical Services, LLC in Pittsburgh, Pennsylvania
Pace - N: Pace Analytical National Center for Testing and Innovation in Mt. Juliet, Tennessee
PCBs: Polychlorinated biphenyl
SIM: Selective Ion Monitoring
SM: Standard Methods for the Examination of Water and Wastewater
TPH: Total Petroleum Hydrocarbons
USEPA: United States Environmental Protection Agency
VOA: Volatile Organic Analysis

TABLE 2-4b. ANALYTES, HOLDING TIME AND PRESERVATION REQUIREMENTS FOR ALLUVIAL AQUIFER MATRIX
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Category	Analytical Group	Analytical Method	Containers (number, size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation / analysis)	Laboratory
Total Metals	Total Metals	USEPA 6010B	4-oz glass with Teflon Lid	None	Must be analyzed within 6 months of the collection date.	Pace - I
	Total Metals	USEPA 6020	4-oz glass with Teflon Lid	None	Must be analyzed within 6 months of the collection date.	Pace - I
	Total Mercury	USEPA 7471A	4-oz glass with Teflon Lid	Cool to ≤6°C	28 days	Pace - I
	Ferrous Iron	HACH 8146, Modified	4-oz glass with Teflon Lid	Protect from Air before analysis	30 days	Pace - I
	Ferric Iron	Calculated Using SM 3500-Fe D, Modified	NA	Protect from Air before analysis	30 days	Pace - I
Radiological Chemistry	Total Isotopic Uranium (U-234, U-235, U-238)	HASL-300 Method U-02	4-oz glass with Teflon Lid	None	Sample must be analyzed within 180 days	Pace - P
	Total Isotopic Thorium (Th-228,Th-230, Th-232)	HASL-300 Method U-02	4-oz glass with Teflon Lid	None	Sample must be analyzed within 180 days	Pace - P
	Radium-226	USEPA 901.1M	16-oz glass with Teflon Lid	None	Sample must be analyzed within 180 days	Pace - P
	Radium-228	USEPA 901.1M	16-oz glass with Teflon Lid	None	Sample must be analyzed within 180 days	Pace - P
Major Minerals and Mineral Reactivity	X-Ray Diffraction	X-Ray Diffraction/Whole Pattern Fitting EMSL SOP MS- 01-1 Powder XRD	1 oz or larger, Plastic/glass	None	None	EMSL
	Scanning Electron Microscope with Energy Dispersive X-Ray Spectrometry (SEM/EDS)	Scanning Electron Microscope with Energy Dispersive X-Ray Spectrometry (SEM/EDS) EMSL SOPs.		None	None	EMSL
Mineralogical	Cation Exchange Capacity	USEPA 9081	4-oz glass with Teflon Lid	Cool to ≤6°C	Sample must be analyzed within 180 days	Pace - K

TABLE 2-4b. ANALYTES, HOLDING TIME AND PRESERVATION REQUIREMENTS FOR ALLUVIAL AQUIFER MATRIX
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Category	Analytical Group	Analytical Method	Containers (number, size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation / analysis)	Laboratory
Geochemistry	pH	USEPA 9045D	4-oz glass with Teflon Lid	Cool to ≤6°C	Immediately	Pace - I
	Total Organic Carbon	Walkley-Black Procedure	4-oz amber glass with Teflon Lid	Cool to ≤6°C	28 days	Pace - N
	Bromide, Iodide, Fluoride, Chloride, and Sulfate	USEPA 9056	4-oz amber glass with Teflon Lid	Cool to ≤6°C	28 days	Pace - I
	Total Alkalinity (carbonate and bicarbonate)	SM 2320B	4-oz glass with Teflon Lid	Cool to ≤6°C	14 days	Pace - I
Radionuclide Speciation	Following Sequential Extraction Analysis (Dissolved Radium and Dissolved Thorium)	USEPA 901.1M	(2) 1L Plastic**	HNO3	Sample must be analyzed within 180 days	MCLInc and Pace - P[3]
	Following Sequential Extraction Analysis (Total Uranium and Total Thorium)	HASL-300 Method U-02	250mL Plastic**	HNO3	Sample must be analyzed within 180 days	MCLInc and Pace - P[3]
	Following Sequential Extraction Analysis (Total Metals-Barium, Calcium, Iron, Manganese, Sulfur)	USEPA 6020	250mL Plastic	HNO3	Sample must be analyzed within 180 days	MCLInc and Pace - I[3]
	Following Sequential Extraction Analysis (pH)	USEPA 9045	250mL Plastic	Cool to ≤6°C	Sample must be analyzed within 15 minutes of collection date.	MCLInc

TABLE 2-4b. ANALYTES, HOLDING TIME AND PRESERVATION REQUIREMENTS FOR ALLUVIAL AQUIFER MATRIX
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Category	Analytical Group	Analytical Method	Containers (number, size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation / analysis)	Laboratory
Geotechnical Parameter	Grain Size (3" Maximum)	ASTM D6913	Bulk Sample	None	Sample must be analyzed within 180 days	Advanced Terra Testing
	Grain Size with Hydrometer	ASTM D6319 and D7928	Bulk Sample[1]	None	Sample must be analyzed within 180 days	Advanced Terra Testing
	Atterberg Limits (Method A)	ASTM D4318	Bulk Sample[1]	None	Sample must be analyzed within 180 days	Advanced Terra Testing
	Specific Gravity	ASTM D854	Core Sample[2]	None	Sample must be analyzed within 180 days	Advanced Terra Testing
	Porosity	ASTM D7263	Core Sample[2]	None	Sample must be analyzed within 180 days	Advanced Terra Testing
	Moisture Content and Density	ASTM D7263	Core Sample[2]	None	Sample must be analyzed within 180 days	Advanced Terra Testing

Notes:
* Samples received at pH >2 must be preserved to pH <2 with HNO3 and be allowed to equilibrate for 24 hours before being prepared for analysis. Acidification date and time are recorded in the Sample Preservation Logbook.
** Limited sample extract will be available from sequential extraction procedure
1: As for quantity of bulk material, to run the grain size with hydrometer and atterberg tests, 2000 grams minimum will suffice
2: Density, porosity, specific gravity, moisture content cannot be run on a bulk sample, and can only be completed if there is enough intact sample to complete the analysis
3: Samples will be shipped to MCLInc for extraction and then to Pace for analyses.

Abbreviations:
ASTM: American Society for Testing and Materials
°C: degrees celsius
EMSL: EMSL Analytical, Inc.
HASL: Health and Safety Laboratory
HNO3: Nitric acid
L: Liter
MCL: Materials and Chemistry Laboratory
MCLInc: Materials and Chemistry Laboratory, Inc.
mL: milliliter
NA: Not Applicable
oz: ounce
Pace - I: Pace Analytical Services, LLC in Indianapolis, Indiana
Pace - K: Pace Analytical Services, LLC in Lenexa, Kansas
Pace - P: Pace Analytical Services, LLC in Pittsburgh, Pennsylvania
Pace - N: Pace Analytical National Center for Testing and Innovation in Mt. Juliet, Tennessee
SM: Standard Methods for the Examination of Water and Wastewater
USEPA: United States Environmental Protection Agency
VOA: Volatile Organic Analysis

TABLE 2-4c. ANALYTES, HOLDING TIME AND PRESERVATION REQUIREMENTS FOR BEDROCK AQUIFER MATRIX
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Category	Analytical Group	Analytical Method	Containers[1] (number, size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation / analysis)	Laboratory
Total Metals	Total Metals	USEPA 6010B	NA	None	Must be analyzed within 6 months of the collection date.	Pace - I
	Total Metals	USEPA 6020	NA	None	Must be analyzed within 6 months of the collection date.	Pace - I
	Total Mercury	USEPA 7471A	NA	Cool to ≤6°C	28 days	Pace - I
	Ferrous Iron	HACH 8146, Modified	NA	Protect from Air before analysis	30 days	Pace - I
	Ferric Iron	Calculated Using SM 3500-Fe D, Modified	NA	Cool to ≤6°C	24 hours	Pace - I
Radiological Chemistry	Isotopic Uranium (U-234, U-235, U-238)	HASL-300 Method U-02	NA	None	Sample must be analyzed within 180 days	Pace - P
	Isotopic Thorium (Th-228,Th-230, Th-232)	HASL-300 Method U-02	NA	None	Sample must be analyzed within 180 days	Pace - P
	Radium-226	USEPA 901.1M	NA	None	Sample must be analyzed within 180 days	Pace - P
	Radium-228	USEPA 901.1M	NA	None	Sample must be analyzed within 180 days	Pace - P

TABLE 2-4c. ANALYTES, HOLDING TIME AND PRESERVATION REQUIREMENTS FOR BEDROCK AQUIFER MATRIX
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Category	Analytical Group	Analytical Method	Containers[1] (number, size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation / analysis)	Laboratory
Major Minerals and Mineral Reactivity	X-Ray Diffraction	X-Ray Diffraction/Whole Pattern Fitting EMSL SOP MS- 01-1 Powder XRD	NA	None	None	EMSL
	Scanning Electron Microscope with Energy Dispersive X-Ray Spectrometry (SEM/EDS)	Scanning Electron Microscope with Energy Dispersive X-Ray Spectrometry (SEM/EDS)	NA	None	None	EMSL
Mineralogical	Cation Exchange Capacity	USEPA 9081	NA	Cool to ≤6°C	Sample must be analyzed within 180 days	Pace - K
Geochemistry	pH	USEPA 9045C	NA	Cool to ≤6°C	Immediately	Pace - I
	Total Organic Carbon	Walkley-Black Procedure	NA	Cool to ≤6°C	28 days	Pace - N
	Total Alkalinity (carbonate and bicarbonate)	SM 2320B	NA	Cool to ≤6°C	14 days	Pace - I
	Bromide, Iodide, Fluoride, Chloride, and Sulfate	USEPA 9056	NA	Cool to ≤6°C	28 days	Pace - I

Notes:
1: Bedrock cores will be submitted to the laboratory for crushing and analysis. Approximately 1500g total are needed for the bedrock analytical suite. An approximately 6-inch core will be submitted to the laboratory.
* Samples received at pH >2 must be preserved to pH <2 with HNO3 and be allowed to equilibrate for 24 hours before being prepared for analysis. Acidification date and time are recorded in the Sample Preservation Logbook.

Abbreviations:
ASAP: As soon as possible
°C: degrees celsius
EMSL: EMSL Analytical, Inc.
HASL: Health and Safety Laboratory
HNO3: Nitric acid
L: Liter
M: Modified
MCL: Materials and Chemistry Laboratory
MCLInc: Materials and Chemistry Laboratory, Inc.
mL: milliliter
NA: Not Applicable
oz: ounce
Pace - I: Pace Analytical Services, LLC in Indianapolis, Indiana
Pace - K: Pace Analytical Services, LLC in Lenexa, Kansas
Pace - P: Pace Analytical Services, LLC in Pittsburgh, Pennsylvania
Pace - N: Pace Analytical National Center for Testing and Innovation in Mt. Juliet, Tennessee
SM: Standard Methods for the Examination of Water and Wastewater
USEPA: United States Environmental Protection Agency
VOA: Volatile Organic Analysis

TABLE 2-4d. ANALYTES, HOLDING TIME AND PRESERVATION, AND CONTAINER REQUIREMENTS FOR VAPOR
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Analytical Group	Analytical Method	Containers (number, size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation / analysis)	Laboratory
Volatile Organic Compounds	TO-15/TO-15 MOD[1]	1 – 6 Liter Summa Can[2]	NA	30 Days	ALS-S
Methane	TO-3 Modified	1 – 6 Liter Summa Can[2]	NA	30 Days	ALS-S
Radon	USEPA 402-R-92-004	Electret Ion Chamber	NA	NA	ALS-W
Helium and Fixed Gases[3]	*3C Modified*	*1 – 6 Liter Summa Can*[2]	*NA*	*30 Days*	*ALS-S*

Notes:
1: TO-15 Modified will be used for samples that also require methods 3c Modified and TO-3 Modified.
2: VOCs, Helium, fixed gases, and methane will be analyzed from the same canister.
3: Contingent upon results of indoor air samples.

Abbreviations:
ALS-S: ALS Simi Valley, CA
ALS-W: ALS Winnipeg, MB
SIM: Selective Ion Monitoring
MOD: Modified
NA: Not applicable
USEPA: United States Environmental Protection Agency

TABLE 2-5. SAMPLE COLLECTION ORDER
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Sample Order	
Order #	**Analyte**
1.	Radon Field Screening
2	VOCs
3.	TPH (Low-Carbon Range)
4.	SVOCs
5.	TPH (Mid-Carbon Range), TPH (High-Carbon Range)
6.	Radiochemistry
7.	Cations/Anions
8.	All Others

Note:
See Tables 2-4 and 2-6 for analyte lists associated with each sample type listed above.

TABLE 2-6a. SAMPLING PLAN AND QA SAMPLES FOR GROUNDWATER ANALYSES
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Category	Analytical Group	Analytical Method	Matrix	Number of Samples[1]	Number of Duplicates[2]	Number of Equipment Blanks[3]	Number of Field Blanks[3]	Number of Trip Blanks[3]	Number of MS/MSDs[4]	Total Number of Samples
Total Metals	Total Metals	USEPA 6010B	W	1168	118	59	59	0	59	1463
	Total Metals	USEPA 6020	W	1168	118	59	59	0	59	1463
	Total Mercury	USEPA 7470A	W	1168	118	59	59	0	59	1463
	Chromium (III)	Calculation	W	1168	118	59	59	0	59	1463
	Chromium (VI)	USEPA 7196A/USEPA 7199	W	1168	118	59	59	0	59	1463
Dissolved Metals	Dissolved Metals	USEPA 6020	W	1168	118	59	59	0	59	1463
	Dissolved Metals	USEPA 6010B	W	1168	118	59	59	0	59	1463
	Dissolved Mercury	USEPA 7470A	W	1168	118	59	59	0	59	1463
Semi-Volatile Organic Compounds	Semi-Volatile Organic Compounds	USEPA 8270C	W	1168	118	59	59	0	59	1463
	Semi-Volatile Organic Compounds	USEPA 8270C SIM*	W	1168	118	59	59	0	59	1463
Volatile Organic Compounds	Volatile Organic Compounds	USEPA 8260C Low Level	W	1168	118	59	59	59	59	1522
	Volatile Organic Compounds	USEPA 8011	W	1168	118	59	59	59	59	1522
PCBs	Polychlorinated Biphenyls (PCBs)	USEPA 8082A	W	1168	118	59	59	0	59	1463

TABLE 2-6a. SAMPLING PLAN AND QA SAMPLES FOR GROUNDWATER ANALYSES
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Category	Analytical Group	Analytical Method	Matrix	Number of Samples[1]	Number of Duplicates[2]	Number of Equipment Blanks[3]	Number of Field Blanks[3]	Number of Trip Blanks[3]	Number of MS/MSDs[4]	Total Number of Samples
Hydrocarbons[6]	C6 Aliphatics	TX 1006	W	1168	118	59	59	0	59	1463
	C6-C8 Aliphatics	TX 1006	W	1168	118	59	59	59	59	1522
	C8-C10 Aliphatics	TX 1006	W	1168	118	59	59	0	59	1463
	C10-C12 Aliphatics	TX 1006	W	1168	118	59	59	0	59	1463
	C12-C16 Aliphatics	TX 1006	W	1168	118	59	59	0	59	1463
	C16-C21 Aliphatics	TX 1006	W	1168	118	59	59	0	59	1463
	C21-C35 Aliphatics	TX 1006	W	1168	118	59	59	0	59	1463
	C7-C8 Aromatics	TX 1006	W	1168	118	59	59	59	59	1522
	C8-C10 Aromatics	TX 1006	W	1168	118	59	59	59	59	1522
	C10-C12 Aromatics	TX 1006	W	1168	118	59	59	0	59	1463
	C12-C16 Aromatics	TX 1006	W	1168	118	59	59	0	59	1463
	C16-C21 Aromatics	TX 1006	W	1168	118	59	59	0	59	1463
	C21-C35 Aromatics	TX 1006	W	1168	118	59	59	0	59	1463
	TPH C6-C35	TX 1006	W	1168	118	59	59	0	59	1463
	TPH C6-C12	TX 1005	W	1168	118	59	59	0	59	1463
	TPH C12-C28	TX 1005	W	1168	118	59	59	0	59	1463
	TPH C28-C35	TX 1005	W	1168	118	59	59	0	59	1463
	TPH C6-C35	TX 1005	W	1168	118	59	59	0	59	1463

TABLE 2-6a. SAMPLING PLAN AND QA SAMPLES FOR GROUNDWATER ANALYSES
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Category	Analytical Group	Analytical Method	Matrix	Number of Samples[1]	Number of Duplicates[2]	Number of Equipment Blanks[3]	Number of Field Blanks[3]	Number of Trip Blanks[3]	Number of MS/MSDs[4]	Total Number of Samples
Chlorinated Herbicides	Chlorinated Herbicides	USEPA 8151A	W	1168	118	59	59	0	59	1463
Radiological Chemistry	Total Isotopic Thorium (Th-228, Th-230, Th-232)	HASL-300 Method U-02	W	1168	118	59	59	0	59	1463
	Dissolved Isotopic Thorium (Th-228, Th-230, Th-232)	HASL-300 Method U-02	W	1168	118	59	59	0	59	1463
	Total Isotopic Uranium (U-234, U-235, U-238)	HASL-300 Method U-02	W	1168	118	59	59	0	59	1463
	Dissolved Isotopic Uranium (U-234, U-235, U-238)	HASL-300 Method U-02	W	1168	118	59	59	0	59	1463
	Radium-226	USEPA 903.1	W	1168	118	59	59	0	59	1463
	Radium-228	USEPA 904.0	W	1168	118	59	59	0	59	1463
Radiological Chemistry	Dissolved Isotopic Radium-226	USEPA 903.1	W	1168	118	59	59	0	59	1463
	Dissolved Isotopic Radium-228	USEPA 904.0	W	1168	118	59	59	0	59	1463
	Tritium	USEPA 906.0	W	1168	118	59	59	0	59	1463
Dissolved Gases	Methane	AM20GAX	W	1168	118	59	59	0	59	1463
	Carbon Dioxide	AM20GAX	W	1168	118	59	59	0	59	1463

TABLE 2-6a. SAMPLING PLAN AND QA SAMPLES FOR GROUNDWATER ANALYSES
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Category	Analytical Group	Analytical Method	Matrix	Number of Samples[1]	Number of Duplicates[2]	Number of Equipment Blanks[3]	Number of Field Blanks[3]	Number of Trip Blanks[3]	Number of MS/MSDs[4]	Total Number of Samples
Geochemistry	Alkalinity	SM 2320B	W	1168	118	59	0	0	0	1345
	Bromide	USEPA 9056A	W	1168	118	59	0	0	59	1404
	Carbonate (HC03-)	SM 2320B	W	1168	118	59	0	0	0	1345
	Cations + Anions[5]	Calculation	W	1168	118	59	0	0	0	1345
	Chemical Oxygen Demand	USEPA 410.4 Rev 2	W	1168	118	59	0	0	59	1404
	Chloride Fluoride Sulfate	USEPA 9056A	W	1168	118	59	0	0	59	1404
	Cyanide	USEPA 9012A	W	1168	118	59	0	0	59	1404
	Dissolved Organic Carbon	SM 5310C	W	1168	118	59	0	0	59	1404
	Nitrogen, Ammonia	SM 4500-NH_3 G USEPA 350.1	W	1168	118	59	0	0	59	1404
	Nitrogen, Nitrate	USEPA 9056A	W	1168	118	59	0	0	59	1404
	Nitrogen, Nitrate + Nitrite	USEPA 353.2 Rev 2	W	1168	118	59	0	0	59	1404
	Nitrogen, Nitrite	USEPA 9056A	W	1168	118	59	0	0	59	1404
	Iodide	USEPA 9056A	W	1168	118	59	0	0	59	1404
	pH	SM 4500H+B	W	1168	118	59	0	0	0	1345
	Phosphorous	USEPA 365.1	W	1168	118	59	0	0	59	1404
	Sulfide	SM 4500-S^{2}-D	W	1168	118	59	0	0	0	1345

TABLE 2-6a. SAMPLING PLAN AND QA SAMPLES FOR GROUNDWATER ANALYSES
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Category	Analytical Group	Analytical Method	Matrix	Number of Samples[1]	Number of Duplicates[2]	Number of Equipment Blanks[3]	Number of Field Blanks[3]	Number of Trip Blanks[3]	Number of MS/MSDs[4]	Total Number of Samples
Geochemistry	Total Dissolved Solids	SM 2540C	W	1168	118	59	0	0	0	1345
	Total Hardness	USEPA 6010B/2340B Calculation	W	1168	118	59	0	0	0	1345
	Total Organic Carbon	SM 5310C	W	1168	118	59	0	0	59	1404
	Total Suspended Solids	SM 2540D	W	1168	118	59	0	0	0	1345

Notes:

* - SVOC-SIM will be used to analyze PAHs.
1: Assumes: Event 1: 80 existing and 20 new wells; Event 2: 80 existing and 40 new wells; Events 3-8: 80 existing and 78 new wells (6 events)
2: One duplicate per 10 samples. The number was rounded to account for the separate sampling events.
3: Field blanks and equipment blanks collected at a rate of one per day of sampling per sampling crew or at a rate of one per 20 samples, whichever is larger.
4: Considers an MS and MSD as one sample on methods where the laboratory completes MS/MSDs in accordance with the SOPs.
5: Cations and Anions analytes are noted in Table 2-3a.
6: See Table 2-3a in the QAPP for hydrocarbon fractions related to Regional Screening Levels

Abbreviations:

MS/MSD: Matrix Spike/Matrix Spike Duplicate
PCBs: Polychlorinated biphenyl
SIM: Selective Ion Monitoring
SM: Standard Methods for the Examination of Water and Wastewater
SOP: Standard Operating Procedure
TPH: Total Petroleum Hydrocarbons
USEPA: United States Environmental Protection Agency
W: Water Matrix

TABLE 2-6b. SAMPLING PLAN AND QA SAMPLES FOR LEACHATE ANALYSES
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Category	Analytical Group	Analytical Method	Matrix	Number of Samples[1]	Number of Duplicates[2]	Number of Equipment Blanks[3]	Number of Field Blanks[3]	Number of Trip Blanks[3]	Number of MS/MSDS[4]	Total Number of Samples
Total Metals	Total Metals	USEPA 6010B	W	48	8	0	8	0	8	72
	Total Metals	USEPA 6020	W	48	8	0	8	0	8	72
	Total Mercury	USEPA 7470A	W	48	8	0	8	0	8	72
	Chromium (III)	Calculation	W	48	8	0	8	0	8	72
	Chromium (VI)	USEPA 7196A	W	48	8	0	8	0	8	72
Dissolved Metals	Dissolved Metals	USEPA 6020	W	48	8	0	8	0	8	72
	Dissolved Metals	USEPA 6010B	W	48	8	0	8	0	8	72
	Dissolved Mercury	USEPA 7470A	W	48	8	0	8	0	8	72
Semi-Volatile Organic Compounds	Semi-Volatile Organic Compounds	USEPA 8270C	W	48	8	0	8	0	8	72
	Semi-Volatile Organic Compounds	USEPA 8270C SIM*	W	48	8	0	8	0	8	72
Volatile Organic Compounds	Volatile Organic Compounds	USEPA 8260C Low Level	W	48	8	0	8	8	8	80
	Volatile Organic Compounds	USEPA 8011	W	48	8	0	8	8	8	80
PCBs	Polychlorinated Biphenyls (PCBs)	USEPA 8082A	W	48	8	0	8	0	8	72
Hydrocarbons[6]	C6 Aliphatics	TX 1006	W	48	8	0	8	0	8	72
	C6-C8 Aliphatics	TX 1006	W	48	8	0	8	8	8	80
	C8-C10 Aliphatics	TX 1006	W	48	8	0	8	0	8	72
	C10-C12 Aliphatics	TX 1006	W	48	8	0	8	0	8	72
	C12-C16 Aliphatics	TX 1006	W	48	8	0	8	0	8	72
	C16-C21 Aliphatics	TX 1006	W	48	8	0	8	0	8	72
	C21-C35 Aliphatics	TX 1006	W	48	8	0	8	0	8	72
	C7-C8 Aromatics	TX 1006	W	48	8	0	8	8	8	80
	C8-C10 Aromatics	TX 1006	W	48	8	0	8	8	8	80

TABLE 2-6b. SAMPLING PLAN AND QA SAMPLES FOR LEACHATE ANALYSES
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Category	Analytical Group	Analytical Method	Matrix	Number of Samples[1]	Number of Duplicates[2]	Number of Equipment Blanks[3]	Number of Field Blanks[3]	Number of Trip Blanks[3]	Number of MS/MSDS[4]	Total Number of Samples
Hydrocarbons[6]	C10-C12 Aromatics	TX 1006	W	48	8	0	8	0	8	72
	C12-C16 Aromatics	TX 1006	W	48	8	0	8	0	8	72
	C16-C21 Aromatics	TX 1006	W	48	8	0	8	0	8	72
	C21-C35 Aromatics	TX 1006	W	48	8	0	8	0	8	72
	TPH C6-C35	TX 1006	W	48	8	0	8	0	8	72
	TPH C6-C12	TX 1005	W	48	8	0	8	0	8	72
	TPH C12-C28	TX 1005	W	48	8	0	8	0	8	72
	TPH C28-C35	TX 1005	W	48	8	0	8	0	8	72
	TPH C6-C35	TX 1005	W	48	8	0	8	0	8	72
Chlorinated Herbicides	Chlorinated Herbicides	USEPA 8151	W	48	8	0	8	0	8	72
Radiological Chemistry	Total Isotopic Thorium (Th-228, Th-230, Th-232)	HASL-300 Method U-02	W	48	8	0	8	0	8	72
	Dissolved Isotopic Thorium (Th-228, Th-230, Th-232)	HASL-300 Method U-02	W	48	8	0	8	0	8	72
	Total Isotopic Uranium (U-234, U-235, U-238)	HASL-300 Method U-02	W	48	8	0	8	0	8	72
	Dissolved Isotopic Uranium (U-234, U-235, U-238)	HASL-300 Method U-02	W	48	8	0	8	0	8	72
	Radium-226	USEPA 903.1	W	48	8	0	8	0	8	72
	Radium-228	USEPA 904.0	W	48	8	0	8	0	8	72
	Dissolved Isotopic Radium-226	USEPA 903.1	W	48	8	0	8	0	8	72
	Dissolved Isotopic Radium-228	USEPA 904.0	W	48	8	0	8	0	8	64
	Tritium	USEPA 906.0	W	48	8	0	8	0	8	72
Dissolved Gases	Methane	AM20GAX	W	48	8	0	8	0	8	72
	Carbon Dioxide	AM20GAX	W	48	8	0	8	0	8	72

TABLE 2-6b. SAMPLING PLAN AND QA SAMPLES FOR LEACHATE ANALYSES
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Category	Analytical Group	Analytical Method	Matrix	Number of Samples[1]	Number of Duplicates[2]	Number of Equipment Blanks[3]	Number of Field Blanks[3]	Number of Trip Blanks[3]	Number of MS/MSDS[4]	Total Number of Samples
Geochemistry	Alkalinity	SM 2320B	W	48	8	0	8	0	8	72
	Bromide	USEPA 9056A	W	48	8	0	8	0	8	72
	Carbonate	USEPA 2320B	W	48	8	0	8	0	8	72
	Cations + Anions[5]	Calculation	W	48	8	0	8	0	8	72
	Chemical Oxygen Demand	USEPA 410.4 Rev 2	W	48	8	0	8	0	8	72
	Chloride Fluoride	USEPA 9056A	W	48	8	0	8	0	8	72
	Cyanide	USEPA 9012A	W	48	8	0	8	0	8	72
	Dissolved Organic Carbon	SM 5310C	W	48	8	0	8	0	8	72
	Iodide	USEPA 9056A	W	48	8	0	8	0	8	72
	Nitrogen, Ammonia	SM 4500-NH_3 G USEPA 350.1	W	48	8	0	8	0	8	72
	Nitrogen, Nitrate	USEPA 9056A	W	48	8	0	8	0	8	72
	Nitrogen, Nitrate + Nitrite	USEPA 353.2 Rev 2	W	48	8	0	8	0	8	72
	Nitrogen, Nitrite	USEPA 9056A	W	48	8	0	8	0	8	72
	pH	SM 4500H+B	W	48	8	0	8	0	8	72
	Phosphate	USEPA 365.1	W	48	8	0	8	0	8	72
	Sulfide	SM 4500-S^2-D	W	48	8	0	8	0	8	72
	Total Dissolved Solids	SM 2540C	W	48	8	0	8	0	8	72
	Total Hardness	USEPA 6010BCalc	W	48	8	0	8	0	8	72
	Total Organic Carbon	SM 5310C	W	48	8	0	8	0	8	72
	Total Suspended Solids	SM 2540D	W	48	8	0	8	0	8	72

Notes:

* - SVOC-SIM will be used to analyze PAHs.

1: Assumes 6 leachate collection sumps, sampled for 8 events = 48 samples

2: One duplicate per 10 samples. The number was rounded to account for the separate sampling events.

3: Field blanks will be collected at a rate of one per day of sampling per sampling crew or at a rate of one per 20 samples, whichever is larger. 8 leachate collection events are assumed, or 8 field blanks. No equipment blanks will be collected for leachate samples.

4: Considers an MS and MSD as one sample on methods where the laboratory completes MS/MSDs in accordance with the SOPs.

5: Cations and Anions analytes are noted in QAPP Table 2-3a.

6: See Table 2-3a in the QAPP for hydrocarbon fractions related to Regional Screening Levels

Abbreviations:

MS/MSD: Matrix Spike/Matrix Spike Duplicate
PCBs: Polychlorinated biphenyl
SIM: Selective Ion Monitoring
SM: Standard Methods for the Examination of Water and Wastewater
SOP: Standard Operating Procedure
TPH: Total Petroleum Hydrocarbons
USEPA: United States Environmental Protection Agency
W: Water Matrix

TABLE 2-6c. SAMPLING PLAN AND QA SAMPLES FOR ALLUVIAL AQUIFER MATRIX ANALYSES
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Category	Analytical Group	Analytical Method	Matrix	Number of Samples[1]	Number of Duplicates[2]	Number of Equipment Blanks[4]	Number of Field Blanks[4]	Number of Trip Blanks[4]	Number of MS/MSDs[5]	Total Number of Samples
Total Metals	Total Metals	USEPA 6010B	S	45	0	0	0	0	3	48
	Total Metals	USEPA 6020	S	45	0	0	0	0	3	48
	Total Mercury	USEPA 7471A	S	45	0	0	0	0	3	48
	Ferrous Iron	HACH 8146, Modified	S	45	0	0	0	0	0	45
	Ferric Iron	Calculation Using SM 3500-Fe D, Modified	S	45	0	0	0	0	0	45
Radiological Chemistry	Isotopic Uranium (U-234, U-235, U-238)	HASL-300 Method U-02	S	45	0	0	0	0	3	48
	Isotopic Thorium (Th-228,Th-230, Th-232)	HASL-300 Method U-02	S	45	0	0	0	0	3	48
	Radium-226	USEPA 901.1M	S	45	0	0	0	0	3	48
	Radium-228	USEPA 901.1M	S	45	0	0	0	0	3	48
Major Minerals and Mineral Reactivity[2]	X-Ray Diffraction	X-Ray Diffraction/Whole Pattern Fitting EMSL SOP MS- 01-1 Powder XRD	S	9	0	0	0	0	0	9
	Scanning Electron Microscope with Energy Dispersive X-Ray Spectrometry (SEM-EDS)	Scanning Electron Microscope with Energy Dispersive X-Ray Spectrometry	S	9	0	0	0	0	0	9
Mineralogical	Cation Exchange Capacity	USEPA 9081	S	45	0	0	0	0	0	45
Geochemistry	pH	USEPA 9045D	S	45	0	0	0	0	0	45
	Total Organic Carbon	Walkley-Black Procedure	S	45	0	0	0	0	0	45
	Total Alkalinity (carbonate and bicarb)	SM 2320B	S	45	0	0	0	0	0	45
	Bromide, Iodide, Fluoride, Chloride, and Sulfate	USEPA 9056A	S	45	0	0	0	0	0	45

TABLE 2-6c. SAMPLING PLAN AND QA SAMPLES FOR ALLUVIAL AQUIFER MATRIX ANALYSES
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Category	Analytical Group	Analytical Method	Matrix	Number of Samples[1]	Number of Duplicates[2]	Number of Equipment Blanks[4]	Number of Field Blanks[4]	Number of Trip Blanks[4]	Number of MS/MSDs[5]	Total Number of Samples
Radionuclide Speciation[3]	Following Sequential Extraction Analysis (Dissolved Radium)	USEPA 901.1M	S	9	0	0	0	0	0	9
	Following Sequential Extraction Analysis (Total Uranium and Total Thorium)	HASL-300 Method U-02	S	9	0	0	0	0	0	9
	Following Sequential Extraction Analysis (Total Metals-Barium, Calcium, Iron, Manganese, Sulfur)	USEPA 6020	S	9	0	0	0	0	0	9
	Following Sequential Extraction Analysis (pH)	USEPA 9045D	S	9	0	0	0	0	0	9
Geotechnical	Grain Size (3" Maximum)	ASTM D6913	S	45	0	0	0	0	0	45
	Grain Size with Hydrometer	ASTM D6319 and D7928	S	45	0	0	0	0	0	45
	Specific Gravity and Porosity	ASTM D854	S	9	0	0	0	0	0	9
	Atterberg Limits (Method A)	ASTM D4318	S	9	0	0	0	0	0	9
	Moisture Content and Density	ASTM D7263	S	9	0	0	0	0	0	9

Notes:

1: Assumes 45 alluvial samples based on collecting samples every 20 ft at 9 locations assuming 100 ft of alluvium.
2: Assumes 9 alluvial matrix samples for Sequential Extraction, XRD, SEM-EDS, and most geotechnical analyses based on locations shown on Work Plan Figure 5-8b.
3: Sequential Extraction will include a 7-point extraction completed by MCL,Inc.; extracts to be analyzed by Pace.
4: No Trip, Equipment, and Field Blanks proposed for alluvium samples.
5: Considers an MS and MSD as one sample on methods where the laboratory completes MS/MSDs in accordance with the SOPs.

Abbreviations:

ASTM: American Society for Testing and Materials
CEC: Cation Exchange Compacity
HASL: Health and Safety Laboratory
M: Modified
MS/MSD: Matrix Spike/Matrix Spike Duplicate
S: Solid Matrix
SM: Standard Methods for the Examination of Water and Wastewater
USEPA: United States Environmental Protection Agency

TABLE 2-6d. SAMPLING PLAN AND QA SAMPLES FOR BEDROCK AQUIFER MATRIX ANALYSES
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Category	Analytical Group	Analytical Method	Matrix	Number of Samples[1]	Number of Duplicates	Number of Equipment Blanks[3]	Number of Field Blanks[3]	Number of Trip Blanks[3]	Number of MS/MSDs[4]	Total Number of Samples
Total Metals	Total Metals	USEPA 6010B	S	73	0	0	0	0	0	73
	Total Metals	USEPA 6020	S	73	0	0	0	0	0	73
	Total Mercury	USEPA 7471A	S	73	0	0	0	0	0	73
	Ferrous Iron	HACH 8146, Modified	S	73	0	0	0	0	0	73
	Ferric Iron	Calculation Using SM 3500-Fe D, Modified	S	73	0	0	0	0	0	73
Radiological Chemistry	Isotopic Uranium (U-234, U-235, U-238)	HASL-300 Method U-02	S	73	0	0	0	0	0	73
	Isotopic Thorium (Th-228,Th-230, Th-232)	HASL-300 Method U-02	S	73	0	0	0	0	0	73
	Radium-226	USEPA 901.1 M	S	73	0	0	0	0	0	73
	Radium-228	USEPA 901.1 M	S	73	0	0	0	0	0	73
Major Minerals and Mineral Reactivity	X-Ray Diffraction	X-Ray Diffraction/Whole Pattern Fitting EMSL SOP MS- 01-1 Powder XRD	S	9	0	0	0	0	0	9
	Scanning Electron Microscope with Energy Dispersive X-Ray Spectrometry	Scanning Electron Microscope with Energy Dispersive X-Ray Spectrometry	S	9	0	0	0	0	0	9
Mineralogical	Cation Exchange Capacity	USEPA 9081	S	73	0	0	0	0	0	73
Geochemistry	pH	USEPA 9045D	S	73	0	0	0	0	0	73
	Total Organic Carbon	Walkley-Black Procedure	S	73	0	0	0	0	0	73
	Total Alkalinity (carbonate and bicarb)	SM 2320B	S	73	0	0	0	0	0	73
	Bromide, Iodide, Fluoride, Chloride, and Sulfate	USEPA 9056A	S	73	0	0	0	0	0	73

Notes:

1: Assumes 73 bedrock samples based on collecting samples every 20 ft at 9 locations assuming 140 ft of bedrock west of the edge of the alluvium and 240 ft of bedrock east of the edge of the alluvium.
2: Assumes 9 bedrock samples for XRD, SEM-EDS, and ferric and ferrous iron, based on locations shown on Work Plan Figure 5-8; sequential extraction is not possible for bedrock samples.
3: No Trip, Equipment, and Field Blanks proposed for bedrock samples.
4: Considers an MS and MSD as one sample. Due to the matrix, no extra sample will be able to be collected.

Abbreviations:

CEC: Cation Exchange Capacity
HASL: Health and Safety Laboratory
MCL: Materials and Chemistry Laboratory, Inc.
MS/MSD: Matrix Spike/Matrix Spike Duplicate
S: Soil Matrix
SM: Standard Methods for the Examination of Water and Wastewater
SOP: Standard Operating Procedure
USEPA: United States Environmental Protection Agency
XRD: X-Ray Diffraction

TABLE 2-6e. SAMPLING PLAN AND QA SAMPLES FOR VAPOR ANALYSES
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Category	Analytical Group	Analytical Method	Matrix	Number of Indoor Air Samples[1]	Number of Duplicate Indoor Air Samples	Number of Ambient Blanks[4]	Total Number of Samples
Volatiles	Volatile Organic Compounds	TO-15	Air	24	4	4	32
Methane	Methane	Method TO-3 Modified	Air	24	4	4	32
Radon	Long-Term Radon	USEPA 402-R-92-004	Air	24	4	4	32

Notes:
1: A total of 6 indoor air samples collected from four buildings for 4 events.
2: Duplicate samples collected at a rate of one per 10 vapor samples or 1 per event per sample type, whichever is greater.
3: A total of 1 ambient air sample will be collected up-wind of the site per event and will function as a blank sample.

Abbreviation:
USEPA: United States Environmental Protection Agency

TABLE 3-1. FIELD EQUIPMENT
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Field Task	Description	Model	Calibration Procedure	Decontamination Procedure	Associated FSP Appendices
Well Inspection and Well Inventory	Camera	Various models of cell phone cameras	NA	NA	Appendix A - Field Documentation Procedures
	Decontamination kit including phosphate-free detergent (Alconox or Liquinox), acidic solution, solvent solution, tap water, distilled water, 5-gallon buckets, spray bottles, pressure sprayer, paper towels, aluminum foil	NA	NA	NA	Appendix N - Equipment Decontamination Procedures
	Field notebook and field documentation forms	TBD	NA	NA	Appendix A - Field Documentation Procedures
	Permanent Markers	NA	NA	NA	Appendix A - Field Documentation Procedures
	Stakes and colored flagging tape	NA	NA	NA	Appendix A - Field Documentation Procedures
	Hand Tools	TBD	NA	Coolers will come pre-cleaned from the laboratory.	Appendix N - Equipment Decontamination Procedures
	Water Level Indicator of adequate length (300 feet)	Solinst 102, or equivalent	Use tape measure to determine if correction is needed.	6-Step Decontamination*	Appendix F - Water Level Measurement Procedures Appendix N - Decontamination Procedures
	4-Gas Meter	BW Gas Alert Microclip	A self-test will be performed daily, which includes a sensor test, power test, and auto-zero and oxygen calibration, upon startup of meter. The meter will be calibrated every 6 months or if necessary as part of troubleshooting.	NA	See HASP Appendix A - Field Documentation Procedures
	Photoionization Detector	ppbRae 3000 with 10.6 eV lamp, or equivalent	Perform manual bump test daily to verify displayed calibration value matches gas concentration. If sensor fails bump test, perform full calibration (fresh air and/or span calibrations). Daily calibration with isobutylene standard.	NA	Appendix G - Field Screening with a PID Appendix A - Field Documentation Procedures
	Downhole Inspection Camera	Heron Dipper, or equivalent	Use tape measure to determine if correction is needed.	6-Step Decontamination*	Appendix A - Field Documentation Procedures
	Sonic Water Level Meter	WL650	Manufacturer calibrated. Check accuracy daily against electric water level indicator.	NA	Appendix A - Field Documentation Procedures Appendix F - Water Level Measurement Procedures

TABLE 3-1. FIELD EQUIPMENT
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Field Task	Description	Model	Calibration Procedure	Decontamination Procedure	Associated FSP Appendices
Borehole Drilling and Sampling	Heat seal bags and labels	NA	NA	NA	Appendix H - Drilling Procedures
	Camera	Various models of cell phone cameras	NA	NA	Appendix A - Field Documentation Procedures
	CoC forms, custody seals	NA	NA	NA	Appendix C - Chain of Custody Procedures
	Coolers with bagged ice	NA	NA	Coolers will come pre-cleaned from the laboratory.	Appendix B - Shipping Procedures Appendix H - Drilling Procedures
	Core boxes	NA	NA	NA	Appendix B - Shipping Procedures Appendix H - Drilling Procedures Appendix I - Rock Coring Procedures
	Decontamination kit including phosphate-free detergent (Alconox or Liquinox), acidic solution, solvent, pressure sprayer, 5-gallon buckets, spray bottles, distilled water, paper towels, aluminum foil	NA	NA	NA	Appendix N - Equipment Decontamination Procedures
	Cone Penetrometer Test Drill Rig equipped with HPT.	TBD	TBD	See Appendix O	Appendix H - Drilling Procedures Appendix N - Decontamination Procedures
	Fiberglass tape of adequate length to measure the bottom of the well	TBD	NA	NA	Appendix H - Drilling Procedures Appendix N - Equipment Decontamination Procedures
	Field notebook and field documentation forms	TBD	NA	NA	Appendix A - Field Documentation Procedures
	Generator, steam cleaner, and related equipment	TBD	NA	NA	Appendix H - Drilling Procedures Appendix N - Decontamination Procedures
	Munsell Soil Color Chart	NA	NA	NA	Appendix H - Drilling Procedures
	Packaging tape	NA	NA	NA	Appendix H - Drilling Procedures
	Permanent Markers	NA	NA	NA	Appendix A - Field Documentation Procedures
	PPE	TBD	NA	NA	See HASP
	Sample containers and labels	NA	NA	NA	Appendix H - Drilling Procedures
	Stakes and colored flagging tape	NA	NA	NA	Appendix A - Field Documentation Procedures
	Sonic Drill Rig equipped with appropriate equipment and rock coring tooling.	Prosonic, PS 600T drill rig, or equivalent	NA	See Appendix O	Appendix H - Drilling Procedures Appendix I - Rock Coring Procedures
	Tap water	NA	NA	NA	Appendix H - Drilling Procedures Appendix I - Rock Coring Procedures

TABLE 3-1. FIELD EQUIPMENT
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Field Task	Description	Model	Calibration Procedure	Decontamination Procedure	Associated FSP Appendices
Borehole Drilling and Sampling (cont.)	Trash bags	NA	NA	NA	Appendix H - Drilling Procedures Appendix I - Rock Coring Procedures
	Vacuum sealer	NA	NA	NA	Appendix H - Drilling Procedures Appendix I - Rock Coring Procedures
	Water Level Indicator of adequate length (300 feet)	Solinst 102, or equivalent	Use tape measure to determine if correction is needed.	6-Step Decontamination*	Appendix F - Water Level Measurement Procedures Appendix H - Drilling Procedures Appendix N - Decontamination Procedures
	4-Gas Meter	BW Gas Alert Microclip	A self-test will be performed daily, which includes a sensor test, power test, and auto-zero and oxygen calibration, upon startup of meter. The meter will be calibrated every 6 months or if necessary as part of troubleshooting.	NA	See HASP
	Photoionization Detector	ppbRae 3000 with 10.6 eV lamp, or equivalent	Perform manual bump test daily to verify displayed calibration value matches gas concentration. If sensor fails bump test, perform full calibration (fresh air and/or span calibrations). Daily calibration with isobutylene standard.	NA	Appendix H - Drilling Procedures Appendix G - Field Screening with a PID
	Hydrochloric Acid	TBD	NA	NA	Appendix H - Drilling Procedures Appendix I - Rock Coring Procedures
Geophysical Logging	Logging vehicle equipped with downhole sondes, electric winch, and computerized processing equipment	To be determined pending subcontractor selection	To be determined pending subcontractor selection	To be determined pending subcontractor selection	Appendix H - Drilling Procedures
	Acoustic Televiewer	To be determined pending subcontractor selection	To be determined pending subcontractor selection	To be determined pending subcontractor selection	Appendix H - Drilling Procedures
	Caliper Probe	To be determined pending subcontractor selection	To be determined pending subcontractor selection	To be determined pending subcontractor selection	Appendix H - Drilling Procedures
	Electromagnetic Induction Probe	To be determined pending subcontractor selection	To be determined pending subcontractor selection	To be determined pending subcontractor selection	Appendix H - Drilling Procedures
	Fluid Temperature and Resistivity Probe	To be determined pending subcontractor selection	To be determined pending subcontractor selection	To be determined pending subcontractor selection	Appendix H - Drilling Procedures
	Gamma-Gamma- Density Probe	To be determined pending subcontractor selection	To be determined pending subcontractor selection	To be determined pending subcontractor selection	Appendix H - Drilling Procedures
	Heat Pulse Flow Meter	To be determined pending subcontractor selection	To be determined pending subcontractor selection	To be determined pending subcontractor selection	Appendix H - Drilling Procedures
	Natural Gamma Probe	To be determined pending subcontractor selection	To be determined pending subcontractor selection	To be determined pending subcontractor selection	Appendix H - Drilling Procedures
	Spectral Gamma Probe	To be determined pending subcontractor selection	To be determined pending subcontractor selection	To be determined pending subcontractor selection	Appendix H - Drilling Procedures
	Spontaneous Potential/Resistivity Probe	To be determined pending subcontractor selection	To be determined pending subcontractor selection	To be determined pending subcontractor selection	Appendix H - Drilling Procedures

TABLE 3-1. FIELD EQUIPMENT
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Field Task	Description	Model	Calibration Procedure	Decontamination Procedure	Associated FSP Appendices
Packer Testing	Flow Meter Manifold	TBD	NA	Wash with detergent and water solution.	Appendix I - Rock Coring Procedures
	Hoses	TBD	NA	Wash with detergent and water solution.	Appendix I - Rock Coring Procedures
	Inflatable Packers	TBD	NA	Wash with detergent and water solution.	Appendix I - Rock Coring Procedures
	Tap water	NA	NA	NA	Appendix I - Rock Coring Procedures Appendix N - Equipment Decontamination Procedures
	Pressure Gauge	TBD	NA	NA	Appendix I - Rock Coring Procedures
	Valving	TBD	NA	NA	Appendix I - Rock Coring Procedures
	Variable Rate Water Pump	TBD	NA	Wash with detergent and water solution.	Appendix I - Rock Coring Procedures
Monitoring Well Installation	Camera	Various models of cell phone cameras	NA	NA	Appendix A - Field Documentation Procedures
	Sonic Drill Rig	Prosonic, PS 600T drill rig, or equivalent	NA	See Appendix O	Appendix H - Drilling Procedures
	Water Level Indicator of adequate length (300 feet)	Solinst 102, or equivalent	Use tape measure to determine if correction is needed.	6-Step Decontamination*	Appendix F - Water Level Measurement Procedures Appendix N - Decontamination Procedures
	Fiberglass tape of adequate length to measure the bottom of the well	TBD	NA	NA	Appendix K - Well Installation Procedures
	Field notebook and field documentation forms	TBD	NA	NA	Appendix A - Field Documentation Procedures
	Generator, steam cleaner, and related equipment	TBD	NA	NA	Appendix K - Well Installation Procedures
	Tap water	NA	NA	NA	Appendix K - Well Installation Procedures Appendix N - Equipment Decontamination Procedures
	Well Construction Materials	TBD	NA	NA	Appendix K - Well Installation Procedures

TABLE 3-1. FIELD EQUIPMENT
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Field Task	Description	Model	Calibration Procedure	Decontamination Procedure	Associated FSP Appendices
Monitoring Well Development	Decontamination kit including phosphate-free detergent (Alconox or Liquinox), acidic solution, solvent, pressure sprayer, 5-gallon buckets, spray bottles, distilled water, paper towels, aluminum foil	NA	NA	NA	Appendix N - Equipment Decontamination Procedures
	Downrigger Truck	TBD	NA	NA	Appendix K - Well Development and Sampling Procedures
	Water Level Indicator of adequate length (300 feet)	Solinst 102, or equivalent	Use tape measure to determine if correction is needed.	6-Step Decontamination*	Appendix F - Water Level Measurement Procedures Appendix N - Decontamination Procedures
	Field notebook and field documentation forms	TBD	NA	NA	Appendix A - Field Documentation Procedures
	Generator, steam cleaner, and related equipment	TBD	NA	NA	Appendix K - Well Development and Sampling Procedures
	PPE	TBD	NA	NA	See HASP
	Submersible Pump	TBD	NA	6-Step Decontamination*	Appendix K - Well Development and Sampling Procedures
	Surge Block and Wireline	TBD	NA	6-Step Decontamination*	Appendix K - Well Development and Sampling Procedures
	Tap water	NA	NA	NA	Appendix K - Well Development and Sampling Procedures Appendix N - Equipment Decontamination Procedures
	Tubing	NA	NA	Dispose of disposable tubing.	Appendix K - Well Development and Sampling Procedures Appendix N - Equipment Decontamination Procedures
	Controller and generator	TBD	NA	NA	Appendix K - Well Development and Sampling Procedures
	Water Quality Meter with Flow Through Cell	Aqua TROLL® 600, or equivalent	Perform manual, daily calibration of each sensor using provided calibration solutions.	Wash sensors and cell with detergent and water solution. Rinse with distilled water.	Appendix K - Well Development and Sampling Procedures

TABLE 3-1. FIELD EQUIPMENT
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Field Task	Description	Model	Calibration Procedure	Decontamination Procedure	Associated FSP Appendices
Aquifer Testing	Calculator	NA	NA	NA	Appendix N - Slug Test and Aquifer Pump Testing Procedures
	Computer with software for transducer data downloading	Various models of laptop computers	NA	NA	Appendix N - Equipment Decontamination Procedures
	Decontamination kit including phosphate-free detergent (Alconox or Liquinox), acidic solution, solvent, pressure sprayer, 5-gallon buckets, spray bottles, distilled water, paper towels, aluminum foil	NA	NA	NA	Appendix N - Equipment Decontamination Procedures
	Water Level Indicator of adequate length (300 feet)	Solinst 102, or equivalent	Use tape measure to determine if correction is needed.	6-Step Decontamination*	Appendix F - Water Level Measurement Procedures Appendix N - Decontamination Procedures
	Electrical duct tape	NA	NA	NA	Appendix L - Slug Test and Aquifer Pump Testing Procedures
	Field notebook and field documentation forms	TBD	NA	NA	Appendix A - Field Documentation Procedures
	PPE	TBD	NA	NA	Appendix L - Slug Test and Aquifer Pump Testing Procedures
	Pneumatic slug assembly, valve assembly with a gauge, compression coupling assembly, pipe clamps, hand pump, screwdriver, and Teflon tape	NA	NA	6-Step Decontamination*	Appendix L - Slug Test and Aquifer Pump Testing Procedures
	Semi-log graph paper (if required)	NA	NA	NA	Appendix L - Slug Test and Aquifer Pump Testing Procedures
	Stainless steel or PVC slug of a known volume, for traditional slug testing	NA	NA	6-Step Decontamination*	Appendix L - Slug Test and Aquifer Pump Testing Procedures
	Steel tape (subdivided into tenths of feet)	NA	NA	NA	Appendix L - Slug Test and Aquifer Pump Testing Procedures
	Tape measure (subdivided into tenths of feet)	NA	NA	NA	Appendix L - Slug Test and Aquifer Pump Testing Procedures
	Thermometer	NA	NA	NA	Appendix L - Slug Test and Aquifer Pump Testing Procedures
	Watch or stopwatch with second hand	NA	NA	NA	Appendix L - Slug Test and Aquifer Pump Testing Procedures
	Pressure Transducer	Solinst Levelogger/Barologger Model 3001 Edge, or equivalent	NA	Distilled water only, if needed.	Appendix F - Water Level Measurement Procedures Appendix L - Slug Test and Aquifer Pump Testing Procedures
	Waterproof Ink Pens	NA	NA	NA	Appendix L - Slug Test and Aquifer Pump Testing Procedures

TABLE 3-1. FIELD EQUIPMENT
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Field Task	Description	Model	Calibration Procedure	Decontamination Procedure	Associated FSP Appendices
Groundwater and Leachate Monitoring	Calibration Solutions	pH 4, 6, 7 standard solution	NA	NA	Appendix K - Well Development and Sampling Procedures
	CoC forms, custody seals	NA	NA	NA	Appendix B - Shipping Procedures Appendix C - Chain of Custody Procedures Appendix K - Well Development and Sampling Procedures
	Coolers with bagged ice	NA	NA	Coolers will come pre-cleaned from the laboratory.	Appendix B - Shipping Procedures Appendix H - Drilling Procedures Appendix K- Well Development and Sampling Procedures
	Decontamination kit including phosphate-free detergent (Alconox or Liquinox), acidic solution, solvent, pressure sprayer, 5-gallon buckets, spray bottles, distilled water, paper towels, aluminum foil	NA	NA	NA	Appendix N - Equipment Decontamination Procedures
	Oil/Water Interface Probe of adequate length (300 feet)	Solinst 122, or equivalent	Use tape measure to determine if correction is needed.	6-Step Decontamination*	Appendix F - Water Level Measurement Procedures Appendix N - Decontamination Procedures
	Field notebook and field documentation forms	TBD	NA	NA	Appendix A - Field Documentation Procedures
	In-line filters (0.45 micron)	Waterra FHT-45, or equivalent	NA	NA	Appendix K - Well Development and Sampling Procedures
	Measuring Cup	TBD	NA	6-Step Decontamination*	Appendix K - Well Development and Sampling Procedures
	Air Compressor	Kobalt Quiet Tech 2-Gallon Single Stage Portable Electric Hot Dog Air Compressor, or equivalent	NA	NA	Appendix K - Well Development and Sampling Procedures
	Generator	Honda EB3000C, or equivalent	NA	NA	Appendix K - Well Development and Sampling Procedures
	Controller	MP-10H, or equivalent	NA	NA	Appendix K - Well Development and Sampling Procedures
	4-Gas Meter	BW Gas Alert Microclip	A self-test will be performed daily, which includes a sensor test, power test, and auto-zero and oxygen calibration, upon startup of meter. The meter will be calibrated every 6 months or if necessary as part of troubleshooting.	NA	See HASP
	Packaging tape	TBD	NA	NA	Appendix K - Well Development and Sampling Procedures
	PPE	TBD	NA	NA	Appendix K - Well Development and Sampling Procedures See HASP

TABLE 3-1. FIELD EQUIPMENT
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Field Task	Description	Model	Calibration Procedure	Decontamination Procedure	Associated FSP Appendices
Groundwater and Leachate Monitoring	Photoionization Detector	ppbRae 3000 with 10.6 eV lamp, or equivalent	Perform manual bump test daily to verify displayed calibration value matches gas concentration. If sensor fails bump test, perform full calibration (fresh air and/or span calibrations). Daily calibration with isobutylene standard.	NA	Appendix K - Well Development and Sampling Procedures Appendix G - Field Screening with a PID
	QED Bladder Pump	P1101M	NA		Appendix J - Well Installation Procedures Appendix K - Well Development and Sampling Procedures
	Sample containers and labels	TBD	NA	NA	Appendix K - Well Development and Sampling Procedures
	Stopwatch	TBD	NA	NA	Appendix K - Well Development and Sampling Procedures
	Trash bags	TBD	NA	NA	Appendix K - Well Development and Sampling Procedures
	Tubing	TBD	NA	Dedicated equipment	Appendix K - Well Development and Sampling Procedures
	Waterproof Ink Pens	NA	NA	NA	Appendix K - Well Development and Sampling Procedures
	Field Test Kits	Supelco MQuant® Ammonium Test (Model 11117)2, or equivalent, HACH Iron Test Kit (IR-18C), HACH Iron Test Kit (IR-18B)	Reagent/colorimetric tests, 1 sample blank is compared to 1 sample mixed with a reagent relative to a colorimetric disc	NA	Appendix K - Well Development and Sampling Procedures
	Electronic Radon Detector with In Water Accessory	RAD7 H2O	Return to manufacturer for factory calibration annually for RAD7 instrument, water accessory does not require calibration	Purge for 10 minutes	Appendix K - Well Development and Sampling Procedures
	Water Quality Meter with Flow Through Cell	Aqua TROLL® 600, or equivalent	Perform manual, daily calibration of each sensor using provided calibration solutions.	Wash sensors and cell with detergent and water solution. Rinse with distilled water.	Appendix K - Well Development and Sampling Procedures

TABLE 3-1. FIELD EQUIPMENT
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Field Task	Description	Model	Calibration Procedure	Decontamination Procedure	Associated FSP Appendices
Fluid Level Gauging	Decontamination kit including phosphate-free detergent (Alconox or Liquinox), acidic solution, solvent, pressure sprayer, 5-gallon buckets, spray bottles, distilled water, paper towels, aluminum foil	NA	NA	NA	Appendix N - Equipment Decontamination Procedures
	Water Level Indicator of adequate length (300 feet)	Solinst 102, or equivalent	Use tape measure to determine if correction is needed.	6-Step Decontamination*	Appendix F - Water Level Measurement Procedures Appendix N - Decontamination Procedures
	Hand Tools	TBD	NA	6-Step Decontamination*	Appendix F - Water Level Measurement Procedures
	Interface Probe of adequate length (300 feet)	Solinst 122, or equivalent	Use tape measure to determine if correction is needed.	6-Step Decontamination*	Appendix F - Water Level Measurement Procedures Appendix N - Decontamination Procedures
	Waterproof Ink Pens	NA	NA	NA	Appendix K - Well Development and Sampling Procedures
	4-Gas Meter	BW Gas Alert Microclip	A self-test will be performed daily, which includes a sensor test, power test, and auto-zero and oxygen calibration, upon startup of meter. The meter will be calibrated every 6 months or if necessary as part of troubleshooting.	NA	See HASP
	Photoionization Detector	ppbRae 3000 with 10.6 eV lamp, or equivalent	Perform manual bump test daily to verify displayed calibration value matches gas concentration. If sensor fails bump test, perform full calibration (fresh air and/or span calibrations). Daily calibration with isobutylene standard.	NA	Appendix F - Water Level Measurement Procedures Appendix G - Field Screening with a PID
Pressure Transducers/Dataloggers	Barometric Compensation Device	Solinst Barologger Model 3001 Edge, or equivalent	Factory calibrated	Distilled water only, if needed.	Appendix F - Water Level Measurement Procedures
	Braided monofilament line, minimum test weight of 25 pounds	NA	NA	NA	Appendix F - Water Level Measurement Procedures
	Decontamination kit including phosphate-free detergent (Alconox or Liquinox), acidic solution, solvent, pressure sprayer, 5-gallon buckets, spray bottles, distilled water, paper towels, aluminum foil	NA	NA	NA	Appendix N - Equipment Decontamination Procedures
	Field notebook and field documentation forms	TBD	NA	NA	Appendix A - Field Documentation Procedures Appendix F - Water Level Measurement Procedures
	Laptop computer with Solinst software installed	TBD	NA	NA	Appendix F - Water Level Measurement Procedures
	Specialized well caps (33 total)	TBD	NA	NA	Appendix F - Water Level Measurement Procedures
	Twine	TBD	NA	NA	Appendix F - Water Level Measurement Procedures
	Pressure Transducer	Solinst Levelogger Model 3001 Edge, or equivalent	NA	Distilled water only, if needed.	Appendix F - Water Level Measurement Procedures Appendix L - Slug Test and Aquifer Pump Testing Procedures
	Well Locks and Keys	Variable, Guarded Steel or Aluminum Padlocks	NA	NA	Appendix J - Well Installation Procedures

TABLE 3-1. FIELD EQUIPMENT
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Field Task	Description	Model	Calibration Procedure	Decontamination Procedure	Associated FSP Appendices
Staff Gauges	Pressure Transducer	Seametrics PT12 Submersible Pressure Sensor, or similar	NA	Distilled water only, if needed.	Appendix F - Water Level Measurement Procedures
	Staff Gauge	USGS Style A Staff Gauge	NA	NA	Appendix F - Water Level Measurement Procedures
	PPE	NA	NA	NA	See HASP
	PVC Piping	NA	NA	NA	Appendix F - Water Level Measurement Procedures
	Sledge hammer and/or post driver	NA	NA	NA	Appendix F - Water Level Measurement Procedures
	Waders/life preservers	NA	NA	NA	Appendix F - Water Level Measurement Procedures
	Field notebook and field documentation forms	TBD	NA	NA	Appendix A - Field Documentation Procedures
	Hand Tools	TBD	NA	6-Step Decontamination*	Appendix N - Equipment Decontamination Procedures
Surveying	Global Positioning System	Trimble R1	NA	NA	Appendix A - Field Documentation Procedures
	Robotic Total Station/GNSS Receiver	Trimble VX Spatial Station	Manufacturer (Seiler Instruments) calibrated.	NA	Appendix A - Field Documentation Procedures
	GNSS System	Trimble R8s GNSS System	Check into NGS Control Point Near Site	NA	Appendix A - Field Documentation Procedures
	Single Frequency Echosounder/Additional Global Positioning System	HydroLite-TM™	Check into NGS Control Point Near Site	NA	Appendix A - Field Documentation Procedures
	Survey Equipment (poles, tripod, etc.)	TBD	NA	NA	Appendix A - Field Documentation Procedures
	PPE	NA	NA	NA	See HASP
	Tape measure (subdivided into tenths of feet)	NA	NA	NA	SOP to be requested from subcontractor.

TABLE 3-1. FIELD EQUIPMENT
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Field Task	Description	Model	Calibration Procedure	Decontamination Procedure	Associated FSP Appendices
Vapor Sampling	Photoionization Detector	ppbRae 3000 with 10.6 eV lamp, or equivalent	Perform manual bump test daily to verify displayed calibration value matches gas concentration. If sensor fails bump test, perform full calibration (fresh air and/or span calibrations). Daily calibration with isobutylene standard.	NA	Appendix G - Field Screening with a PID Appendix M - Vapor Sampling Procedures
	Hand-held Utility Meter	D-Tech 150 Wall/Floor Scanner, or equivalent	Manufacturer calibrated.	NA	Appendix M - Vapor Sampling Procedures
	Concrete drill and drill bits	TBD	NA	6-Step Decontamination*	Appendix M - Vapor Sampling Procedures
	Subslab probe tooling	TBD	NA	6-Step Decontamination*	Appendix M - Vapor Sampling Procedures
	Cement	TBD	NA	NA	Appendix M - Vapor Sampling Procedures
	Trowel	TBD	NA	6-Step Decontamination*	Appendix M - Vapor Sampling Procedures
	CPT Drill Rig equipped with appropriate tooling	TBD	TBD	See Appendix O	Appendix H - Drilling Procedures Appendix N - Decontamination Procedures
	Vapor nest well supplies	Various Swagelok®, stainless steel & brass valves/fittings, Nylaflow Tubing	NA	NA	Appendix M - Vapor Sampling Procedures
	Micro-Manometer	TBD	Calibrated by manufacturer	NA	Appendix M - Vapor Sampling Procedures
	Tedlar Bags	3-Liter Tedlar Bag	Will be certified by the laboratory	NA	Appendix M - Vapor Sampling Procedures
	Lung Box	NA	NA	NA	Appendix M - Vapor Sampling Procedures
	Flow Controller	TBD	NA	NA	Appendix M - Vapor Sampling Procedures
	Helium	NA	NA	NA	Appendix M - Vapor Sampling Procedures

TABLE 3-1. FIELD EQUIPMENT
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Field Task	Description	Model	Calibration Procedure	Decontamination Procedure	Associated FSP Appendices
Vapor Sampling	Plastic Sheeting	TBD	NA	NA	Appendix M - Vapor Sampling Procedures
	Portable Helium Detector	Dielectric MGD2000	Calibrated by manufacturer		Appendix M - Vapor Sampling Procedures
	Weighted Fiberglass Measuring Tape	TBD	NA	NA	Appendix M - Vapor Sampling Procedures
	5-Micrometer In-line Filter	TBD	NA	NA	Appendix M - Vapor Sampling Procedures
	Real-Time Radon Sampling Device and Accessories	RAD7	Return to manufacturer for factory calibration annually	Purge for 10 minutes	Appendix M - Vapor Sampling Procedures
	Long-Term Electret Ion Chamber	S chamber model	Calibrated by manufacturer	NA	Appendix M - Vapor Sampling Procedures
	Landfill Gas Meter	Landtec GEM 2000, or equivalent	Daily calibration with standard.	NA	Appendix M - Vapor Sampling Procedures
	Hand Tools	NA	NA	NA	Appendix M - Vapor Sampling Procedures
	Pressure Gauge	NA	NA	NA	Appendix M - Vapor Sampling Procedures
	PPE	NA	NA	NA	See HASP
	Field notebook and field documentation forms	NA	NA	NA	Appendix M - Vapor Sampling Procedures
	Waterproof Ink Pens	NA	NA	NA	Appendix M - Vapor Sampling Procedures
	Summa Canisters, Flow Controller	6 Liter Summa Can	Will be certified by the laboratory	100% decon certification by the laboratory	Appendix M - Vapor Sampling Procedures

Note:
* 6-Step Decontamination includes (1) submersion in soapy water, (2) tap water rinse, (3) acidic solution application, (4) spray with deionized water, (5) solvent application, and (6) spray with deionized water

Abbreviations:
CoC: Chain-of-Custody
eV: electronvolt
HASP: Health and Safety Plan
NA: Not applicable for this equipment or instrumentation
NGS: National Geodetic Survey
FSP: Field Sampling Plan
GNSS: Global Navigation Satellite Systems
PID: Photoionization detector
PPE: Personal Protection Equipment
PVC: Polyvinyl Chloride
SOP: Standard Operating Procedure
TBD: To be determined once vendor is selected

TABLE 3-2. MONITORING WELL SURVEY AND CONSTRUCTION DATA SUMMARY
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Borehole ID	Env. Control Prefix	Env. Control Point Number	Hydro Zone	Monitoring Status	Alias	Install Date	Northing (ft)	Easting (ft)	MPE (ft msl)	GSE (ft msl)	Survey Source	2012 Cap Ht. Above Grade	Borehole Diameter (in)	Pipe Size (in)	Pipe Type	Perforation Detail	Surface Casing	Total Pipe Length (ft)	Boring Depth (ft)	Bottom Elev (ft MSL)	Cap Ht. Above Grade (ft)	Solid Length (ft)	Screen Length (ft)	Screen From	Screen To	Top Screen Elevation (msl)	Bottom Screen Elevation (msl)	Total Pipe Length (ft)	Construction Source
D-3	D	3	AD	I	WL-105A	8/1/1995	1069177.97	836047	468.34	465.12	EMSI 2012 Survey	3.22	8.25	2	Sch. 80 PVC	0.010 slotted	Locking steel protective cover	109.62	106.5	357.798	3.12	96.5	10	96.5	106.5	370.298	360.298	109.62	As-built
D-6	D	6	AD	I	WL-206	8/1/1995	1070235.1	834723.49	447.62	444.33	EMSI 2012 Survey	3.291	8.25	2	Sch. 40 PVC	0.010 slotted	Locking steel protective cover	109.7	106.5	334.998	3.2	96.5	10	96.5	106.5	347.498	337.498	109.7	As-built
D-12	D	12	AD	I	WL-216A	10/1/1995	1069877.23	835110.76	479.74	477.16	EMSI 2012 Survey	2.579	8.25	2	Sch. 80 PVC	0.010 slotted	Locking steel protective cover	146.21	143.7	330.798	2.51	133.7	10	133.7	143.7	343.298	333.298	146.21	As-built
D-13	D	13	AD	I	WL-224	10/1/1995	1070527.02	835776.56	470.25	467.73	EMSI 2012 Survey	2.5123	8.25	2	Sch. 80 PVC	0.010 slotted	Locking steel protective cover	135.7	133	334.998	2.7	123	10	123	133	344.998	334.998	135.7	As-built
D-14	D	14	LR	X	WL-109B	10/1/1995	1068988.87	836700.02	482.97	480.71	EMSI 2012 Survey	2.2604	8.25	2	Sch. 40 PVC	0.010 slotted	Locking steel protective cover	61.77	58.5	425.098	3.27	53.5	5	53.5	58.5	430.598	425.598	61.77	As-built
D-81	D	81	AD	I	NA	8/13/1984	1067378.73	834638.55	450.65	448.07	EMSI 2012 Survey	2.58	5" (0 - 15 ft), 4 1/2" (15 - 61.5 ft)	2	PVC	0.01 inch machine slot	NA	NA	61.5	385.898	3	48	15	45	60	402.398	387.398	60	RIA
D-83	D	83	AD	I	NA	8/16/1984	1070970.86	834807.79	448.21	444.84	EMSI 2012 Survey	3.369	5" (0-15 ft) 4 1/2" (15-115.3 ft)	2	PVC	0.01 inch machine slot	NA	NA	115.3	328.698	3.2	80.2	20	77	97	366.998	346.998	97	RIA
D-85	D	85	AD	A	NA	8/1/1984	1069667.27	836605.17	457.26	454.26	EMSI 2012 Survey	3.007	5" (0-10 ft) 4 1/2" (10-84.1 ft)	2	PVC	0.01 inch machine slot	NA	NA	84.1	372.648	3	65	20	62	82	390.698	370.698	82	RIA
D-87	D	87	AD	I	NA	8/1/1984	1069252.38	835579.37	464.47	461.22	EMSI 2012 Survey	3.251	5" (0 - 30 ft) 4 1/2" (30-111.7 ft)	2	PVC	0.01 inch machine slot	NA	NA	111.7	347.898	3	94	20	91	111	368.598	348.598	111	RIA
D-89	D	89	AI	I	NA	8/27/1984	1067010.97	835274.7	456.7	453.7	EMSI 2018 - Calculated	NA	5" (0-25 ft) 4 1/2" (25-49 ft)	2	PVC	0.01 inch machine slot	NA	NA	49	404.698	3	36	15	33	48	420.698	405.698	48	RIA
D-90	D	90	AI	X	NA	8/7/1985	1066200.97	834474.7	450.2	445.6	EMSI 2018 - Calculated	NA	4", 3 7/8"	2	PVC	0.01 inch machine slot	NA	NA	47	398.598	NA	NA	NA	37	47	408.598	398.598	47	RIA
D-91	D	91	AI	X	NA	8/1/1985	1065260.97	833944.7	452.97	447.6	EMSI 2018 - Calculated	NA	4", 3 7/8"	2	Sch 50 PVC Riser, Sch 20 PVC Screen	200 slots	NA	NA	45	402.598	5	40	10	35	45	412.598	402.598	45	RIA
D-92	D	92	AD	X	NA	4/9/1985	1069800.97	835264.7	474.97	475.1	EMSI 2018 - Calculated	NA	4" (0 - 40 ft), 3 7/8" (40 -143.6 ft)	2	PVC	0.01 inch machine slot	NA	NA	143.6	331.498	-0.2	122.8	20	123	143	352.098	332.098	143	RIA
D-93	D	93	AD	I	NA	4/18/1985	1069369.76	834443.56	450.84	448.28	EMSI 2012 Survey	2.556	6" (0-8 ft) 4 7/8" (8-119.2ft)	2	PVC	0.01 inch machine slot	NA	NA	119.2	337.798	3.3	95.3	20	92	112	358.298	338.298	112	RIA
D-94	D	94	AD	X	NA	4/1/1985	1070685.97	835994.7	442.28	438.1	EMSI 2018 - Calculated	NA	3 7/8"	2	PVC	0.01 inch machine slot	NA	NA	109	329.098	2.6	91.6	20	86	106	352.098	332.098	106	RIA
D-95	D	95	AD	X	NA	4/1/1985	1070861.54	836524.52	452.69	449.6	Georeferenced/ Calculated	NA	3 7/8"	2	PVC	0.01 inch machine slot	NA	NA	101	348.598	3.3	84.3	20	81	101	368.598	348.598	101	RIA
F-1-D	F	1	AD	X	NA	8/1/1990	1068649.65	836034.74	461.23	458.38	McLaren Hart 1996	NA	8"	2	Sch 40 PVC	10 slot	Locking steel protective cover	NA	79.5	NA	2.85	76.95	5	NA	NA	NA	NA	79.1	RIA
F-1-S	F	1	AS	X	NA	8/1/1990	1068643.97	836040.05	460.95	458.7	McLaren Hart 1996	NA	8"	2	Sch 40 PVC	10 slot	Locking steel protective cover	34.9	32.9	NA	2.4	22.5	10	22.5	32.5	436.198	426.198	34.9	As-built
F-2	F	2	AS	X	NA	8/10/1990	1067725.97	834591.7	449.7	447.5	EMSI 2018	NA	8"	2	Sch 40 PVC	10 slot	Locking steel protective cover	27.55	25.7	NA	2.25	10.3	15	10.3	25.3	437.198	422.198	27.55	As-built
F-3	F	3	AS	X	NA	8/1/1990	1070530.77	835994.53	468.83	466.53	McLaren Hart 1996	NA	8"	2	Sch 40 PVC	10 slot	Locking steel protective cover	45.1	46	NA	2.3	32.8	10	32.8	42.8	433.728	423.728	45.1	As-built
I-2	I	2	AI	X	NA	Unknown	1069739.23	834386.88	446.01	442.8	McLaren Hart 1996	NA	8.25	2	Sch. 40 PVC	0.010 slotted	Locking steel protective cover	52.71	52	393.298	3.21	39.5	10	39.5	49.5	403.298	393.298	52.71	As-built
I-4	I	4	AI	I	WL-105B	8/1/1995	1069189.97	836064.6	465.74	462.95	EMSI 2012 Survey	2.789	8.25	2	Sch. 40 PVC	0.010 slotted	Locking steel protective cover	79.07	79	389.098	2.57	66.5	10	66.5	76.5	399.098	389.098	79.07	As-built
I-7	I	7	AI	U	WL-207	Unknown	1070784.02	834474.57	446.57	444.1	McLaren Hart 1996	NA	8.25	2	Sch. 40 PVC	0.010 slotted	Locking steel protective cover	49.97	50	396.598	2.47	37.5	10	37.5	47.5	406.598	396.598	49.97	As-built
I-9	I	9	AI	I	WL-229	9/1/1995	1069358.4	834444.23	449.88	447.92	EMSI 2012 Survey	1.964	8.25	2	Sch. 40 PVC	0.010 slotted	Locking steel protective cover	55.59	55.6	394.998	2.49	43.1	10	43.1	53.1	404.998	394.998	55.59	As-built
I-11	I	11	AI	I	WL-216C	8/1/1995	1069860.19	835099.74	480.11	477.58	EMSI 2012 Survey	2.526	8.25	2	Sch. 80 PVC	0.010 slotted	Locking steel protective cover	93.17	93	386.698	2.67	80.5	10	80.5	90.5	396.698	386.698	93.17	As-built

TABLE 3-2. MONITORING WELL SURVEY AND CONSTRUCTION DATA SUMMARY
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Borehole ID	Env. Control Prefix	Env. Control Point Number	Hydro Zone	Monitoring Status	Alias	Install Date	Northing (ft)	Easting (ft)	MPE (ft msl)	GSE (ft msl)	Survey Source	2012 Cap Ht. Above Grade	Borehole Diameter (in)	Pipe Size (in)	Pipe Type	Perforation Detail	Surface Casing	Total Pipe Length (ft)	Boring Depth (ft)	Bottom Elev (ft MSL)	Cap Ht. Above Grade (ft)	Solid Length (ft)	Screen Length (ft)	Screen From	Screen To	Top Screen Elevation (msl)	Bottom Screen Elevation (msl)	Total Pipe Length (ft)	Construction Source
I-50	I	50	AI	X	N-1	10/1/1983	1065231.29	834006.66	453.26	448.6	McLaren Hart 1996	NA	NA	0	0	0	NA	NA	40.6	407.998	4.48	35.08	10	30.6	40.6	417.998	407.998	40.6	RIA
I-55	I	55	AI	X	35	6/26/1978	1067827.97	834649.7	NA	471.5	EMSI 2018	NA	6"	2	PVC	NA	NA	NA	60	NA	NA	NA	NA	NA	NA	NA	NA	60	RIA
I-56	I	56	AI	X	34	6/27/1978	1068097.97	834661.7	NA	474.7	EMSI 2018	NA	6"	2	PVC	NA	NA	NA	60	NA	NA	NA	NA	NA	NA	NA	NA	60 (61.1 well schedule)	RIA
I-58	I	58	AI	X	40	6/28/1978	1068914.97	834632.7	NA	477.1	EMSI 2018	NA	6"	2	PVC	NA	NA	NA	60	NA	NA	NA	NA	NA	NA	NA	NA	60	RIA
I-59	I	59	AI	X	N-2	10/1/1983	1069372.97	834463.7	NA	444.5	EMSI 2018	NA	NA	NA	NA	NA	NA	NA	43.5	NA	NA	NA	NA	NA	NA	NA	NA	43.5	RIA
I-62	I	62	AI	I	N-3	10/1/1983	1070979.15	834821.33	446.14	444.34	EMSI 2012 Survey	1.7984	NA	NA	NA	NA	NA	NA	44	399.698	1.98	35.98	10	34	44	409.698	399.698	44	RIA
I-65	I	65	AI	I	N-4	10/1/1983	1070994.1	835507.99	441.26	438.93	EMSI 2012 Survey	2.3269	NA	NA	NA	NA	NA	NA	36	402.098	3.3	29.3	10	26	36	412.098	402.098	36	RIA
I-66	I	66	AI	I	N-5	10/1/1983	1070645.39	836025.96	441.7	438.96	EMSI 2012 Survey	2.7373	NA	NA	NA	NA	NA	NA	36.9	400.398	4.1	31	10	26.9	36.9	410.398	400.398	36.9	RIA
I-67	I	67	AI	I	N-6	10/1/1983	1070142.39	836418.55	441.68	439.34	EMSI 2012 Survey	2.342	NA	NA	NA	NA	NA	NA	35.4	400.698	2.58	27.98	10	25.4	35.4	410.698	400.698	35.4	RIA
I-68	I	68	AI	A	N-7	10/1/1983	1069612.97	836861.2	450.2	447.41	EMSI 2012 Survey	2.794	NA	NA	NA	NA	NA	NA	31.2	409.298	7.42	28.62	10	21.2	31.2	419.298	409.298	31.2	RIA
I-72	I	72	AI	X	39	6/1/1978	1067930.97	835519.7	465	462.3	EMSI 2018 - Calculated	NA	NA	NA	NA	NA	NA	NA	50	412.298	2.7	49.7	3	47	50	415.298	412.298	50	RIA
I-73	I	73	AI	A	38	6/1/1978	1067735.84	835745.29	461.08	457.98	EMSI 2012 Survey	3.1019	NA	NA	NA	NA	NA	NA	50	412.298	3.7	50.7	3	43.2	46.2	415.298	412.298	50	RIA
LR-100	LR	100	LR	I	NA	10/4/1995	1067334.45	835068.65	468.11	465.34	EMSI 2012 Survey	2.77	8 1/4"	2	Sch 80 PVC	0.01 inch machine slot	Locking steel protective cover	26.72	26	442.298	1.92	19.7	4.8	19.7	24.5	447.098	442.298	26.72	As-built
LR-101	LR	101	LR	X	NA	10/10/1995	1068443.22	834893.11	NA	NA	Golder 1996	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	RIA
LR-102	LR	102	LR	X	NA	10/8/1995	1068978.18	834962.83	513.12	511.6	Golder 1996	NA	8 1/4"	2	Sch 80 PVC	0.01 inch machine slot	Locking steel protective cover	61.52	76	451.898	1.52	54.9	4.8	54.9	59.7	456.698	451.898	61.52	As-built
LR-103	LR	103	LR	I	NA	10/20/1995	1068567.54	835392.18	470.24	466.87	EMSI 2012 Survey	3.371	8 1/4"	2	Sch 80 PVC	0.01 inch machine slot	Locking steel protective cover	39.8	40	420.998	1.1	28.6	9.8	28.6	38.4	431.098	421.298	39.8	As-built
LR-104	LR	104	LR	I	NA	10/18/1995	1068105.76	835808.49	459.65	457.79	EMSI 2012 Survey	1.8591	8 1/4"	2	Sch 80 PVC	0.01 inch machine slot	Locking steel protective cover	40.23	40	419.098	1.73	28.4	9.8	28.4	38.2	429.198	419.398	40.23	As-built
LR-105	LR	105	LR	I	NA	10/3/1995	1067750.35	834699.95	485.21	482.36	EMSI 2012 Survey	2.843	8 1/4"	2	Sch 80 PVC	0.01 inch machine slot	Locking steel protective cover	38.89	38	447.498	2.59	26.2	9.8	26.2	36	457.598	447.798	38.89	As-built
MO-3-SS	MO	3	SS	I	NA	8/12/2015	1066537.01	835641	461.69	461.89	MDNR	NA	5 7/8"	NA	NA	NA	NA	169.8	170	291.89	-0.2	149.8	20	150.4	170.4	311.49	291.49	169.8	MDNR
MO-3-SDR	MO	3	SD	I	NA	8/14/2015	1066547.22	835637	460.85	461.13	MDNR	NA	5 7/8"	NA	NA	NA	NA	209.8	210.08	251.05	-0.28	189.8	20	190.08	210.08	271.05	251.05	209.8	MDNR
MW-41	MW	41	NA	X	NA	6/1/1978	1069327.97	834551.7	NA	NA	EMSI 2018	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	RIA
MW-101	MW	101	AS	X	NA	4/1/1990	1070871.45	834598.7	446.43	444.96	McLaren Hart 1996	NA	8	2	PVC	0.010 slotted	Locking steel protective cover	29.6	25	NA	2.3	17.3	10	17.3	27.3	427.658	417.658	29.6	As-built
MW-102	MW	102	AS	X	NA	4/1/1990	1070135.68	834707.41	447.83	445.66	EMSI 2012 Survey	2.173	8	2	PVC	0.010 slotted	Locking steel protective cover	29.1	25	NA	2.3	16.8	10	16.8	26.8	428.86	418.86	29.1	As-built
MW-103	MW	103	AS	I	NA	4/1/1990	1068668.89	834508.8	438.92	437.07	EMSI 2012 Survey	1.85	8	2	PVC	0.010 slotted	Locking steel protective cover	21.1	18	NA	2.7	8.4	10	8.4	18.4	428.665	418.665	21.1	As-built
MW-104	MW	104	AS	I	NA	4/1/1990	1067565.65	834513.71	440.81	437.81	EMSI 2012 Survey	3.003	8	2	PVC	0.010 slotted	Locking steel protective cover	22.8	17	NA	2.9	9.9	10	9.9	19.9	427.909	417.909	22.8	As-built

TABLE 3-2. MONITORING WELL SURVEY AND CONSTRUCTION DATA SUMMARY
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Borehole ID	Env. Control Prefix	Env. Control Point Number	Hydro Zone	Monitoring Status	Alias	Install Date	Northing (ft)	Easting (ft)	MPE (ft msl)	GSE (ft msl)	Survey Source	2012 Cap Ht. Above Grade	Borehole Diameter (in)	Pipe Size (in)	Pipe Type	Perforation Detail	Surface Casing	Total Pipe Length (ft)	Boring Depth (ft)	Bottom Elev (ft MSL)	Cap Ht. Above Grade (ft)	Solid Length (ft)	Screen Length (ft)	Screen From	Screen To	Top Screen Elevation (msl)	Bottom Screen Elevation (msl)	Total Pipe Length (ft)	Construction Source
MW-105	MW	105	AS	X	NA	4/12/1990	1067565.65	833405.95	439.77	442.07	McLaren Hart 1996*	NA	8	2	PVC	0.010 slotted	Locking steel protective cover	17.3	15	15	2.3	7.3	10	5	15	437.068	427.068	NA	As-built
MW-106	MW	106	AS	X	NA	4/12/1990	1065996.72	833791.62	443.38	439.77	McLaren Hart 1996	NA	8	2	PVC	0.010 slotted	Locking steel protective cover	NA	15		NA	NA	10	5	15	434.768	424.768	NA	As-built
MW-107	MW	107	AS	X	NA	4/1/1990	1064711.71	833775.82	447.74	NA	McLaren Hart 1996	NA	8	2	PVC	0.010 slotted	Locking steel protective cover	NA	15	NA	NA	5	10	5	10	NA	NA	na	As-built
MW-1201	MW	1201	AS	I	PZ-1201-SS & 1201	3/1/1985	1067343.97	837077.7	482.44	480.2	EMSI 2018	NA	NA	NA	NA	NA	NA	NA	250	230.198	2.24	53	197	53	250	427.198	230.198	250	RIA
MW-1202	MW	1202	AS	X	NA	3/1/1985	1067383.97	837049.7	482.18	480.1	EMSI 2018	NA	NA	NA	NA	NA	NA	NA	250	230.098	2.08	NA	NA	NA	NA	NA	NA	250	RIA
MW-1203	MW	1203	AS	X	NA	7/1/1985	1067229.97	837129.7	483.61	480.7	EMSI 2018	NA	NA	NA	NA	NA	NA	NA	250	230.698	2.91	NA	NA	NA	NA	NA	NA	250	RIA
MW-1204	MW	1204	SD	A	NA	4/1/1991	1066461.15	835998.97	485.36	483.09	EMSI 2012 Survey	2.267	8	2	Sch. 80 PVC	0.010 slotted	Locking steel protective cover	225.8	227	NA	2.3	213.5	10	213.5	223.5	269.591	259.591	225.8	As-built
MW-1205	MW	1205	AS	X	NA	4/1/1991	1067428.36	835795.45	386.37	384.1	Foth & Van Dyke 1991	NA	11 and 6	2	Sch. 80 PVC	0.010 slotted	Locking steel protective cover	125.3	132	NA	2.3	113	10	113	123	271.098	261.098	125.3	As-built
MW-1206	MW	1206	AS	X	NA	3/1/1991	1067437.24	835799.07	388.08	385.8	Foth & Van Dyke 1991	NA	8	2	Sch. 80 PVC	0.010 slotted	Locking steel protective cover	75.3	73	NA	2.3	63	10	63	73	322.798	312.798	75.3	As-built
PZ-100-KS	PZ	100	KS	A	1209	2/17/1995	1068883.06	837386.27	485.95	484.82	EMSI 2012 Survey	1.134	10 1/4" (0-34 ft) 5 7/8" (34-391 ft)	2	Sch 80 PVC	0.01 inch machine slot	Locking steel protective cover	386.01	391.2	99.228	1.88	374	9.8	374	383.8	109.358	99.558	386.01	As-built
PZ-100-SD	PZ	100	SD	A	1208	2/23/1995	1068892.81	837369.99	486.08	484.49	EMSI 2012 Survey	1.592	10 1/4 "(0-51 ft) 5 7/8" (51-246 ft)	2	Sch 80 PVC	0.01 inch machine slot	Locking steel protective cover	246.4	246	239.018	1.47	234.8	9.8	234.8	244.6	249.148	239.348	246.4	As-built
PZ-100-SS	PZ	100	SS	A	1207	2/25/1995	1068908.76	837349.65	486.15	484.84	EMSI 2012 Survey	1.312	10 1/4 "(0-51 ft) 5 7/8" (51-94.5 ft)	2	Sch 80 PVC	0.01 inch machine slot	Locking steel protective cover	95.42	94.5	390.018	1.49	73.96	19.64	73.96	93.6	409.988	390.348	95.42	As-built
PZ-101-SS	PZ	101	SS	A	1210	3/6/1995	1068513.92	836797.32	491.16	488.95	EMSI 2012 Survey	2.214	10 1/4 "(0-14 ft) 5 7/8" (14-140 ft)	2	Sch 80 PVC	0.01 inch machine slot	Locking steel protective cover	141.4	140	334.878	1.79	129.48	9.8	129.48	139.28	345.008	335.208	141.4	As-built
PZ-102R-SS	PZ	102	SS	A	1211	6/18/1995	1068172.73	837033.55	486.05	484.18	EMSI 2012 Survey	1.874	10 1/4 "(0-35 ft) 5 7/8" (35-90.3 ft)	2	Sch 80 PVC	0.01 inch machine slot	Locking steel protective cover	91.08	90.3	394.138	1.12	79.83	9.8	79.83	89.63	404.268	394.468	91.08	As-built
PZ-102-SS	PZ	102	SS	A	NA	3/12/1995	1068128.68	837062.59	484.25	482.06	EMSI 2012 Survey	2.185	10 1/4 "(0-37 ft) 5 7/8" (37-90.4 ft)	2	Sch 80 PVC	0.01 inch machine slot	Locking steel protective cover	92.63	90.4	390.818	1.8	79.7	9.8	79.7	89.5	401.948	392.148	92.63	As-built
PZ-103-SS	PZ	103	SS	A	1212	2/26/1995	1067701.3	836897.82	483.8	479.9	EMSI 2012 Survey	3.899	10 1/4 "(0-51 ft) 5 7/8" (51-145.5 ft)	2	Sch 80 PVC	0.01 inch machine slot	Locking steel protective cover	147.22	145.5	332.548	2.39	134.7	9.8	134.7	144.5	342.678	332.878	147.22	As-built
PZ-104-KS	PZ	104	KS	A	1215	6/19/1995	1067034.02	836995.22	484.2	481.84	EMSI 2012 Survey	2.359	10 1/4 "(0-249 ft) 5 7/8" (249-408 ft)	2	Sch 80 PVC	0.01 inch machine slot	6 5/8" Steel Casing elev 483.3 - 233.32	409.22	408	74.418	1.72	397.37	9.8	397.37	407.17	84.548	74.748	409.22	As-built
PZ-104-SD	PZ	104	SD	A	1214	6/17/1995	1067054.14	837009.27	483.75	481.47	EMSI 2012 Survey	2.277	10 1/4 "(0-38 ft) 5 7/8" (38-252.5 ft)	2	Sch 80 PVC	0.01 inch machine slot	Locking steel protective cover	246.92	252.5	236.368	1.59	235.2	9.8	235.2	245	246.498	236.698	246.92	As-built
PZ-104-SS	PZ	104	SS	A	1213	6/4/1995	1067068.82	837021.99	483.6	481.65	EMSI 2012 Survey	1.948	10 1/4 "(0-37 ft) 5 7/8" (37-145 ft)	2	Sch 80 PVC	0.01 inch machine slot	Locking steel protective cover	146.7	145	336.528	2.07	134.5	9.8	134.5	144.3	346.658	336.858	146.7	As-built
PZ-105-SS	PZ	105	SS	A	1216	5/24/1995	1066462.14	836405.05	483.64	480.81	EMSI 2012 Survey	2.83	10 1/4 "(0-45 ft) 5 7/8" (45-149 ft)	2	Sch 80 PVC	0.01 inch machine slot	6 5/8" Steel Casing elev 482.7 - 436.22	151.02	149	332.188	2.39	138.5	9.8	138.5	148.3	342.318	332.518	151.02	As-built
PZ-106-KS	PZ	106	KS	A	1219	3/23/1995	1066744.65	835606.9	464.32	462.14	EMSI 2012 Survey	2.181	10 1/4 "(0-204 ft) 5 7/8" (204-375 ft)	2	Sch 80 PVC	0.01 inch machine slot	6 5/8" Steel Casing elev 463.3 - 257.77	376.39	375	87.468	2.49	363.75	9.8	363.75	373.57	97.618	87.798	376.39	As-built
PZ-106-SD	PZ	106	SD	A	1218	3/24/1995	1066755.69	835590.7	463.44	461.42	EMSI 2012 Survey	2.017	10 1/4 "(0-26 ft) 5 7/8" (26-201.1 ft)	2	Sch 80 PVC	0.01 inch machine slot	Locking steel protective cover	202.9	201.1	260.118	1.97	190.79	9.8	190.79	200.59	270.258	260.458	202.9	As-built
PZ-106-SS	PZ	106	SS	A	1217	4/5/1995	1066767.07	835574.64	462.7	460.95	EMSI 2012 Survey	1.752	10 1/4 "(0-23 ft) 5 7/8" (23-165.4 ft)	2	Sch 80 PVC	0.01 inch machine slot	Locking steel protective cover	297.2	165.4	295.118	1.75	155.3	9.8	155.3	165.1	305.248	295.448	297.2	As-built
PZ-107-SS	PZ	107	SS	A	1220	5/22/1995	1067204.04	835429.35	465	462.85	EMSI 2012 Survey	2.151	10 1/4 "(0-32ft) 5 7/8" (32-103 ft)	2	Sch 80 PVC	0.01 inch machine slot	6 5/8" Steel Casing elev 463.6 - 407.63	104.76	103	359.498	2.03	92.6	9.8	92.6	102.4	369.628	359.828	104.76	As-built
PZ-108-SS	PZ	108	SS	X	1221	3/29/1995	1067719.34	836147.31	455.8	453.7	Golder 1996	NA	10 1/4 "(0-20ft) 5 7/8" (20-143.9 ft)	2	Sch 80 PVC	0.01 inch machine slot	Locking steel protective cover	145.76	143.9	310.038	2.08	133.54	9.8	133.54	143.35	320.178	310.368	145.76	As-built

TABLE 3-2. MONITORING WELL SURVEY AND CONSTRUCTION DATA SUMMARY
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Borehole ID	Env. Control Prefix	Env. Control Point Number	Hydro Zone	Monitoring Status	Alias	Install Date	Northing (ft)	Easting (ft)	MPE (ft msl)	GSE (ft msl)	Survey Source	2012 Cap Ht. Above Grade	Borehole Diameter (in)	Pipe Size (in)	Pipe Type	Perforation Detail	Surface Casing	Total Pipe Length (ft)	Boring Depth (ft)	Bottom Elev (ft MSL)	Cap Ht. Above Grade (ft)	Solid Length (ft)	Screen Length (ft)	Screen From	Screen To	Top Screen Elevation (msl)	Bottom Screen Elevation (msl)	Total Pipe Length (ft)	Construction Source
PZ-109-SS	PZ	109	SS	A	1222	4/25/1995	1068052.31	836318.5	458.9	456.9	EMSI 2012 Survey	2.002	10 1/4 "(0-15ft) 5 7/8" (15-135.7 ft)	2	Sch 80 PVC	0.01 inch machine slot	Locking steel protective cover	137.56	135.7	320.538	1.73	125.7	9.8	125.7	135.5	330.668	320.868	137.56	As-built
PZ-110-SS	PZ	110	SS	I	1223	5/20/1995	1068376.97	836094.3	461.06	458.03	EMSI 2012 Survey	3.0292	10 1/4 "(0-61ft) 5 7/8" (61-111.5 ft)	2	Sch 80 PVC	0.01 inch machine slot	6 5/8" Steel Casing elev 457.3 - 395.84	113.37	111.5	345.138	2.07	100.9	9.8	100.9	110.7	355.538	345.738	113.37	As-built
PZ-111-KS	PZ	111	KS	A	1225	5/6/1995	1068661.96	836025.21	465.4	461.34	EMSI 2012 Survey	4.0621	14 3/4 "(0-84ft) 10" (84.0-215.5) 5 7/8" (215.5-368.8 ft)	2	Sch 80 PVC	0.01 inch machine slot	10 7/8" Steel Casing elev 459.9 - 375.38; 6 5/8" Steel Casing elev 460.2 - 243.88	368.99	368.8	91.478	1.69	357.15	9.8	357.15	366.96	101.628	91.818	368.99	As-built
PZ-111-SD	PZ	111	SD	A	1224	4/21/1995	1068678.17	836009	466.17	461.95	EMSI 2012 Survey	4.2226	10" (0-98 ft) 5 7/8" (98-210 ft)	2	Sch 80 PVC	0.01 inch machine slot	6 5/8" Steel Casing elev 459.7 - 361.22	211.83	210	249.318	2.33	199.4	9.8	199.4	209.2	259.418	249.618	211.83	As-built
PZ-111-SS	PZ	111	SS	A	NA	8/29/2017	1068631.93	835989.4	464.23	461.71	Feezor 2017	NA	8"	2	Sch 80 PVC	0.01 inch machine slot	6" Steel Casing 0 - 93 ft bgs	NA	0	0	0	0	0	462.11	462.11	0	0	0	RIA
PZ-112-AS	PZ	112	AS	A	1226	4/10/1995	1069042.85	835849.45	462.13	458.41	EMSI 2012 Survey	3.722	8 1/4"	2	Sch 80 PVC	0.01 inch machine slot	Locking steel protective cover	36.63	36	422.798	1.9	29.6	4.8	29.6	34.4	427.928	423.128	36.63	As-built
PZ-113-AD	PZ	113	AD	A	1228	5/3/1995	1069273.97	835934.5	461.84	459.47	EMSI 2012 Survey	2.368	10 1/4"	2	Sch 80 PVC	0.01 inch machine slot	Locking steel protective cover	110.33	108.7	350.728	1.6	98.6	9.8	98.6	108.4	360.858	351.058	110.33	As-built
PZ-113-AS	PZ	113	AS	A	1227	4/11/1995	1069264.97	835922.4	461.78	459.58	EMSI 2012 Survey	2.203	8 1/4"	2	Sch 80 PVC	0.01 inch machine slot	Locking steel protective cover	40.53	40	420.488	1.5	28.9	9.8	28.9	38.7	430.618	420.818	40.53	As-built
PZ-113-SS	PZ	113	SS	A	1229	5/20/1995	1069282.97	835951.3	462.26	459.65	EMSI 2012 Survey	2.601	9 3/4" (0-115 ft) 5 7/8" (115-159 ft)	2	Sch 80 PVC	0.01 inch machine slot	6 5/8" Steel Casing elev 460.4 - 344.96	160.51	159	300.858	1.81	148.57	9.8	148.57	158.37	310.988	301.188	160.51	As-built
PZ-114-AS	PZ	114	AS	A	1230	4/20/1995	1069460	836942.99	451.74	449.56	EMSI 2012 Survey	2.175	10 1/4"	2	Sch 80 PVC	0.01 inch machine slot	Locking steel protective cover	31.56	30.5	419.348	1.53	19.9	9.8	19.9	29.7	429.478	419.678	31.56	As-built
PZ-115-SS	PZ	115	SS	A	1231	5/21/1995	1069449.63	836929.87	452.5	450.21	EMSI 2012 Survey	2.284	9 7/8" (0-39ft) 5 7/8" (39-85ft)	2	Sch 80 PVC	0.01 inch machine slot	Locking steel protective cover	86.5	85	365.398	1.69	74.68	9.8	74.68	84.48	375.528	365.728	86.5	As-built
PZ-116-SS	PZ	116	SS	A	1232	6/20/1995	1066451.15	836018.58	486.04	483.55	EMSI 2012 Survey	2.49	10 1/4 "(0-33ft) 5 7/8" (33-162 ft)	2	Sch 80 PVC	0.01 inch machine slot	6 5/8" Steel Casing elev 451.6 - 411.61	163.13	162	321.338	1.8	151.4	9.8	151.4	161	331.268	331.668	163.13	As-built
PZ-200-SS	PZ	200	SS	A	NA	2/28/1995	1068537.09	837146.56	485.83	483.55	EMSI 2012 Survey	2.28	10 1/4 "(0-27.5ft) 5 7/8" (27.5-98.3 ft)	2	Sch 80 PVC	0.01 inch machine slot	Locking steel protective cover	99.99	98.7	385.238	2.02	9.62	88.02	9.62	97.64	473.588	385.568	99.99	As-built
PZ-201A-SS	PZ	201	SS	A	1223	4/23/1995	1067872.76	837021.16	481.93	479.87	EMSI 2012 Survey	2.058	10 1/4 "(0-33ft) 5 7/8" (33-90 ft)	2	Sch 80 PVC	0.01 inch machine slot	Locking steel protective cover	91.94	90	387.818	1.81	80	9.8	80	89.8	397.948	388.148	91.94	As-built
PZ-201-SS	PZ	201	SS	X	NA	3/6/1995	1067860.52	837036.76	479.93	477.6	Golder 1996	NA	10 1/4 "(0-33ft) 5 7/8" (33-39 ft)	2	Sch 80 PVC	0.01 inch machine slot	Locking steel protective cover	90.96	89	388.968	2.32	9.75	78.56	9.75	88.31	467.858	389.298	90.96	As-built
PZ-202-SS	PZ	202	SS	A	1234	3/12/1995	1067361.15	837276.12	481.42	479.47	EMSI 2012 Survey	1.942	10 1/4" (0-33.5 ft) 5 7/8" (33.5-90 ft)	2	Sch 80 PVC	0.01 inch machine slot	6 5/8" Steel Casing elev 480 - 445.01	91.59	90	389.178	2.16	40.2	48.9	40.2	89.1	438.408	389.508	91.59	As-built
PZ-203-SS	PZ	203	SS	A	1235	6/3/1995	1066702.37	836782.55	486.78	484.12	EMSI 2012 Survey	2.66	10 1/4" (0-56 ft) 5 7/8" (56-110 ft)	2	Sch 80 PVC	0.01 inch machine slot	6 5/8" Steel Casing elev 484.7 - 428.08	112.11	110	374.078	2.41	99.6	9.8	99.6	109.4	384.178	374.378	112.11	As-built
PZ-204A-SS	PZ	204A	SS	A	1236	8/21/1995	1066470.42	835731.27	464.88	464.88	EMSI 2012 Survey	0	10 1/4" (0.0-14 ft) 5 7/8" (14-90 ft)	2	Sch. 80 PVC	0.010 slotted	Locking steel protective cover	90.93	90	376.828	1.5	79.5	9.6	79.5	89.1	386.758	377.158	90.93	As-built
PZ-204-SS	PZ	204	SS	A	NA	3/10/1995	1066470.42	835731.27	464.88	464.88	EMSI 2012 Survey	0	10 1/4" (0-14 ft) 5 7/8" (14-90.3 ft)	2	Sch 80 PVC	0.01 inch machine slot	Locking steel protective cover	92.28	90.3	376.948	2.6	10.95	78.4	10.95	89.35	455.678	377.278	92.28	As-built
PZ-205-AS	PZ	205	AS	A	1237	5/5/1995	1067504.51	835637.88	460.48	458.54	EMSI 2012 Survey	1.944	14 3/4 "(0-29ft) 8 1/4" (29-49ft)	2	Sch 80 PVC	0.01 inch machine slot	6 5/8" Steel Casing elev 460 - 430.33	50.34	49	410.248	1.66	38.55	9.8	38.55	48.35	420.378	410.578	50.34	As-built
PZ-205-SS	PZ	205	SS	A	1238	5/21/1995	1067524.52	835652.19	461.87	459.62	EMSI 2012 Survey	2.256	9 3/4" (0-54 ft) 5 7/8" (54-90 ft)	2	Sch 80 PVC	0.01 inch machine slot	6 5/8" Steel Casing elev 460.5 - 405.53	100.36	99	360.428	1.66	88.57	9.8	88.57	98.37	370.558	360.758	100.36	As-built
PZ-206-SS	PZ	206	SS	A	1239	4/24/1995	1068071.82	835984.01	460.39	458.19	EMSI 2012 Survey	2.1958	10" (0-52 ft) 5 7/8" (52-125.5 ft)	2	Sch 80 PVC	0.01 inch machine slot	6 5/8" Steel Casing elev 459.1 - 406.38	126.82	125.5	332.978	1.82	115	9.8	115	124.8	342.978	333.178	126.82	As-built
PZ-207-AS	PZ	207	AS	A	1240	4/10/1995	1069685.45	836212.47	462.24	460.16	EMSI 2012 Survey	2.088	8 1/4"	2	Sch 80 PVC	0.01 inch machine slot	Locking steel protective cover	41.72	40	421.448	1.69	34.9	4.8	34.9	39.7	426.578	421.778	41.72	As-built
PZ-208-SS	PZ	208	SS	A	1241	6/18/1995	1069260.13	837344.08	474.79	472.48	EMSI 2012 Survey	2.311	10 1/4" (0-17 ft) 5 7/8" (17-99.2 ft)	2	Sch 80 PVC	0.01 inch machine slot	Locking steel protective cover	100.55	99.2	373.298	1.72	88.7	9.8	88.7	98.5	383.428	373.628	100.55	As-built

TABLE 3-2. MONITORING WELL SURVEY AND CONSTRUCTION DATA SUMMARY
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Borehole ID	Env. Control Prefix	Env. Control Point Number	Hydro Zone	Monitoring Status	Alias	Install Date	Northing (ft)	Easting (ft)	MPE (ft msl)	GSE (ft msl)	Survey Source	2012 Cap Ht. Above Grade	Borehole Diameter (in)	Pipe Size (in)	Pipe Type	Perforation Detail	Surface Casing	Total Pipe Length (ft)	Boring Depth (ft)	Bottom Elev (ft MSL)	Cap Ht. Above Grade (ft)	Solid Length (ft)	Screen Length (ft)	Screen From	Screen To	Top Screen Elevation (msl)	Bottom Screen Elevation (msl)	Total Pipe Length (ft)	Construction Source
PZ-209-SS	PZ	209	SS	A	NA	10/15/2013	1067112.51	837283.27	489.28	486.99	H&A As-Built	NA	9" for soil, 6" for rock	2	Sch. 80 PVC	0.010 slotted	Locking steel protective cover	152.29	150	336.988	2.29	140	10	140	150	346.988	336.988	152.29	As-built
PZ-209-SD	PZ	209	SD	A	NA	10/4/2013	1067116.71	837279.12	489.18	486.84	H&A As-Built	NA	9" for soil, 6" for rock	2	Sch. 80 PVC	0.010 slotted	Locking steel protective cover	252.34	250	236.838	2.34	240	10	240	250	246.838	236.838	252.34	As-built
PZ-210-SS	PZ	210	SS	A	NA	10/16/2013	1066869.35	836952.11	486.5	484.13	H&A As-Built	NA	9" for soil, 6" for rock	2	Sch. 80 PVC	0.010 slotted	Locking steel protective cover	150.37	148	336.128	2.37	138	10	138	148	346.128	336.128	150.37	As-built
PZ-210-SD	PZ	210	SD	A	NA	10/16/2013	1066865.01	836947.82	486.6	484.08	H&A As-Built	NA	9" for soil, 6" for rock	2	Sch. 80 PVC	0.010 slotted	Locking steel protective cover	250.52	248	236.078	2.52	238	10	238	248	246.078	236.078	250.52	As-built
PZ-211-SS	PZ	211	SS	A	NA	10/8/2013	1067101.76	837195.85	487.01	484.66	H&A As-Built	NA	9" for soil, 6" for rock	2	Sch. 80 PVC	0.010 slotted	Locking steel protective cover	149.35	147	337.658	2.35	137	10	137	147	347.658	337.658	149.35	As-built
PZ-211-SD	PZ	211	SD	A	NA	10/7/2013	1067097.67	837191.31	487.06	484.43	H&A As-Built	NA	9" for soil, 6" for rock	2	Sch. 80 PVC	0.010 slotted	Locking steel protective cover	240.46	247	237.428	2.63	237	10	237	247	347.428	237.428	240.46	As-built
PZ-212-SS	PZ	212	SS	A	NA	10/18/2013	1067531.96	838151.16	482.39	479.76	H&A As-Built	NA	9" for soil, 6" for rock	2	Sch. 80 PVC	0.010 slotted	Locking steel protective cover	146.63	150	329.758	2.63	134	10	134	144	345.758	335.758	146.63	As-built
PZ-212-SD	PZ	212	SD	A	NA	10/21/2013	1067536.66	838155.08	482.32	480.08	H&A As-Built	NA	7.25	2	Sch. 80 PVC	0.010 slotted	Locking steel protective cover	246.24	245	235.078	2.24	234	10	234	244	246.078	236.078	246.24	As-built
PZ-300-AD	PZ	300	AI	X	NA	9/24/1995	1065254.81	834002.76	449.22	447.7	Golder 1996	NA	8 1/4"	2	Sch 80 PVC	0.01 inch machine slot	Locking steel protective cover	43.72	42.2	405.498	1.52	37.1	4.8	37.1	41.9	410.598	405.798	43.72	As-built
PZ-300-AS	PZ	300	AS	X	NA	9/26/1995	1065539.41	834042.53	450.26	448.1	Golder 1996	NA	8 1/4"	2	Sch 80 PVC	0.01 inch machine slot	Locking steel protective cover	22.16	20	428.098	2.16	9.9	9.8	9.9	19.7	438.198	428.398	22.16	As-built
PZ-300-SS	PZ	300	SS	X	NA	9/26/1995	1065245.72	834024.51	449.2	448	Golder 1996	NA	9 7/8" (0-46ft) 5 7/8" (46-93ft)	2	Sch 80 PVC	0.01 inch machine slot	6 5/8" Steel Casing elev 447.6 - 402.4	95.2	94.5	353.998	1.2	83.88	9.8	83.88	93.7	364.118	354.298	95.2	As-built
PZ-301-SS	PZ	301	SS	X	NA	9/23/1995	1064842.65	835691.69	514.31	512.7	Golder 1996	NA	8 1/4" (0-19 ft) 5 7/8" (19-161.5 ft)	2	Sch 80 PVC	0.01 inch machine slot	Locking steel protective cover	162.61	161.5	351.698	1.61	150.9	9.8	150.9	160.7	361.798	351.998	162.61	As-built
PZ-302-AI	PZ	302	AI	I	NA	9/26/1995	1067250.87	834895.67	451.19	449.77	EMSI 2012 Survey	1.423	8 1/4"	2	Sch 80 PVC	0.01 inch machine slot	Locking steel protective cover	43.85	43	406.898	1.15	32.6	9.8	32.6	42.4	416.998	407.198	43.85	As-built
PZ-302-AS	PZ	302	AS	I	NA	9/25/1995	1067238.22	834912.69	451.57	449.36	EMSI 2012 Survey	2.217	8 1/4"	2	Sch 80 PVC	0.01 inch machine slot	Locking steel protective cover	24.22	22.3	426.798	1.92	12.2	9.8	12.2	22	436.898	427.098	24.22	As-built
PZ-303-AS	PZ	303	AS	I	NA	10/5/1995	1067703.94	834600.48	453.28	451.04	EMSI 2012 Survey	2.237	8 1/4"	2	Sch 80 PVC	0.01 inch machine slot	Locking steel protective cover	28.48	26.5	424.298	2.38	16	9.8	16	25.8	434.398	424.598	28.48	As-built
PZ-304-AI	PZ	304	AI	I	NA	10/2/1995	1068166.33	834609.4	454.15	451.76	EMSI 2012 Survey	2.395	8 1/4"	2	Sch 80 PVC	0.01 inch machine slot	Locking steel protective cover	51.52	50	402.098	2.42	39	9.8	39	48.8	412.198	402.398	51.52	As-built
PZ-304-AS	PZ	304	AS	I	NA	9/27/1995	1068187.02	834609.3	453.89	451.73	EMSI 2012 Survey	2.159	8 1/4"	2	Sch 80 PVC	0.01 inch machine slot	Locking steel protective cover	29.51	28	423.798	2.31	17.1	9.8	17.1	26.9	433.898	424.098	29.51	As-built
PZ-305-AI	PZ	305	AI	I	NA	10/19/1995	1068119.66	835797.89	459.98	458.09	EMSI 2012 Survey	1.8917	8 1/4"	2	Sch 80 PVC	0.01 inch machine slot	Locking steel protective cover	64.98	64	393.898	1.68	53.2	9.8	53.2	63	403.998	394.198	64.98	As-built
PZ-1201-SS	PZ	1201	SS	X	NA	7/7/1995	1067343.39	837078.26	482.02	480	Golder 1996	NA	Unknown (0-53 ft) 5 7/8" (53-250)	2	Sch 80 PVC	0.01 inch machine slot	6 5/8" Steel Casing elev 483-427.41	NA	250	229.998	2.01	139.71, 0.33	9.6	137.69	147.29	342.308	332.708	147.63	RIA
S-1	S	1	AS	X	NA	6/3/1905	1069726.8	834379.71	446.11	442.9	McLaren Hart 1996	NA	8.25	2	Sch. 40 PVC	0.010 slotted	Locking steel protective cover	25.71	25	417.898	3.21	2.5	20	2.5	22.5	440.398	420.398	25.71	As-built
S-5	S	5	AS	I	WL-105C	8/1/1995	1069196.97	836075.6	466.23	463.02	EMSI 2012 Survey	3.203	8.25	2	Sch. 40 PVC	0.010 slotted	Locking steel protective cover	42.95	49.3	415.998	2.95	30	10	30	40	435.298	425.298	42.95	As-built
S-8	S	8	AS	I	WI-228	9/1/1995	1071085.01	834898.67	443.93	441.55	EMSI 2012 Survey	2.3847	8.25	2	Sch. 40 PVC	0.010 slotted	Locking steel protective cover	29.23	29.3	411.898	2.43	6.8	20	6.8	26.8	434.398	414.398	29.23	As-built
S-10	S	10	AS	I	WL-216C; WL-232	9/1/1995	1069868.79	835106.24	480.1	477.6	EMSI 2012 Survey	2.497	8.25	2	Sch. 40 PVC	0.010 slotted	Locking steel protective cover	49.22	54.5	422.598	2.78	32	20	32	52	445.098	425.098	49.22	As-built
S-51	S	51	AS	X	HL-3	6/3/1905	1066202.28	834495.42	449.17	445.9	McLaren Hart 1996	NA	NA	NA	NA	NA	NA	NA	25.8	420.098	1.42	24.22	3	22.8	25.8	423.098	420.098	25.8	RIA
S-52	S	52	AS	X	HL-2	6/3/1905	1066510.97	834374.7	446.68	444.3	EMSI 2018 - Calculated	NA	NA	NA	NA	NA	NA	NA	25.2	419.098	2.38	24.58	3	22.2	25.2	422.098	419.098	25.2	RIA

TABLE 3-2. MONITORING WELL SURVEY AND CONSTRUCTION DATA SUMMARY
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Borehole ID	Env. Control Prefix	Env. Control Point Number	Hydro Zone	Monitoring Status	Alias	Install Date	Northing (ft)	Easting (ft)	MPE (ft msl)	GSE (ft msl)	Survey Source	2012 Cap Ht. Above Grade	Borehole Diameter (in)	Pipe Size (in)	Pipe Type	Perforation Detail	Surface Casing	Total Pipe Length (ft)	Boring Depth (ft)	Bottom Elev (ft MSL)	Cap Ht. Above Grade (ft)	Solid Length (ft)	Screen Length (ft)	Screen From	Screen To	Top Screen Elevation (msl)	Bottom Screen Elevation (msl)	Total Pipe Length (ft)	Construction Source
S-53	S	53	AS	I	HL-1	6/3/1905	1066911.17	834671.97	444.1	441.04	EMSI 2012 Survey	3.058	NA	NA	NA	NA	NA	NA	23.7	420.698	4.2	24.9	3	20.7	23.7	423.698	420.698	23.7	RIA
S-54	S	54	AS	X	36	Unknown	1067646.97	834642.7	NA	469.6	EMSI 2018	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	40.4	RIA
S-60	S	60	AS	X	S-2	7/1/1981	1069790.97	834484.7	446.53	442.7	EMSI 2018 - Calculated	NA	NA	NA	NA	NA	NA	NA	21	421.698	3.83	NA	NA	NA	21	NA	421.698	21	RIA
S-61	S	61	AS	X	S-1	7/1/1981	1070200.94	834754.56	449.2	445.5	EMSI 2012 Survey	3.706	NA	NA	NA	NA	NA	NA	21.5	423.698	4.57	NA	NA	NA	21.5	NA	423.698	21.5	RIA
S-75	S	75	AS	X	37	Unknown	1067291.38	834893.45	461.68	458.4	McLaren Hart 1996	NA	NA	NA	NA	NA	NA	NA	26	432.398	1.1	24.1	3	23	26	435.398	432.398	26	RIA
S-76	S	76	AS	X	37A	6/1/1978	1067446.97	834743.7	NA	474	EMSI 2018	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	50	RIA
S-80	S	80	AS	X	NA	8/28/1984	1065232.74	834033.05	452.71	448	McLaren Hart 1996	NA	5"	2	PVC	0.01 inch machine slot	NA	NA	22	425.998	5	15	10	10	20	437.998	427.998	20	RIA
S-82	S	82	AS	I	NA	8/27/1984	1069352.64	834447.5	450.11	448.17	EMSI 2012 Survey	1.941	5"	2	PVC	0.01 inch machine slot	NA	NA	26.5	420.798	3	18.5	10	15.5	25.5	431.798	421.798	25.5	RIA
S-84	S	84	AS	A	NA	8/1/1984	1069674.22	836614.27	457.04	454.24	EMSI 2012 Survey	2.804	5"	2	PVC	0.01 inch machine slot	NA	NA	31.5	420.998	4	24.9	10	20.9	30.9	431.598	421.598	30.9	RIA
S-88	S	88	AS	X	NA	8/1/1984	1068439.36	835408.73	462.36	459.6	McLaren Hart 1996	NA	5" (0-30 ft), 4 1/2" (30-41.5)	2	PVC	0.01 inch machine slot	NA	NA	41.5	418.098	2.7	33	10	30	40	429.598	419.598	40	RIA

Note:
Coordinate system updated to NAD83 State Plane Missouri East using conversion in Work Plan

Abbreviations:
EMSI: Environmental Management Support, Inc
RIA: Remedial Investigation Addendum
MPE: Measuring Point Elevation
GSE: Ground Surface Elevation
PVC: Polyvinyl Chloride
Sch: Schedule
MDNR: Missouri Department of Natural Resources
ft: feet
in: inches
msl: mean sea level
NA: Not available

Abbreviations:
Environmental Control Prefix
D: Deep
F: Foth
I: Intermediate
LR: Leachate Riser
MW: Monitoring Well
PZ: Piezometer
S: Shallow

Monitoring Status
A: Active
I: Inactive
U: Unknown
X: Abandoned

Abbreviations:
Hydrological Zone
AD: Deep Alluvial
AS: Shallow Alluvial
AI: Intermediate Alluvial
LR: Leachate Riser
KS: Keokuk Formation
SD: Salem Formation
SS: Upper Salem/St. Louis Formation

TABLE 3-3. PROPOSED MONITORING WELL NETWORK
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Location	Prefix	Series	Zone	Well ID	Phase
On-site	MW	111	AS	MW-111-AS	Phase II
	MW	111	AI	MW-111-AI	Phase II
	MW	111	AD	MW-111-AD	Phase II
	MW	113	SD	MW-113-SD	Phase II
	MW	205	SD	MW-205-SD	Phase II
	MW	213	AS	MW-213-AS	Phase I
	MW	213	AD	MW-213-AD	Phase I
	MW	302	AD	MW-302-AD	Phase I
	MW	303	AI	MW-303-AI	Phase I
	MW	303	AD	MW-303-AD	Phase I
	MW	304	AD	MW-304-AD	Phase I
	MW	304	SS	MW-304-SS	Phase I
	MW	304	SD	MW-304-SD	Phase I
	MW	306	AI	MW-306-AI	Phase I
	MW	306	AD	MW-306-AD	Phase I
On-site / Near-site	MW	400	AS	MW-400-AS	Phase I
	MW	400	AI	MW-400-AI	Phase I
	MW	400	AD	MW-400-AD	Phase I
	MW	400	SS*	MW-400-SS*	Phase I
	MW	400	SD	MW-400-SD	Phase I
	MW	401	AS	MW-401-AS	Phase I
	MW	401	AI	MW-401-AI	Phase I
	MW	401	AD	MW-401-AD	Phase I
	MW	401	SS*	MW-401-SS*	Phase I
	MW	401	SD	MW-401-SD	Phase I
	MW	402	AS	MW-402-AS	Phase I
	MW	402	AI	MW-402-AI	Phase I
	MW	402	AD	MW-402-AD	Phase I
	MW	402	SS*	MW-402-SS*	Phase I
	MW	402	SD	MW-402-SD	Phase I
	MW	403	AS	MW-403-AS	Phase I
	MW	403	AI	MW-403-AI	Phase I
	MW	403	AD	MW-403-AD	Phase I
	MW	404	SS	MW-404-SS	Phase I
	MW	404	SD	MW-404-SD	Phase I

TABLE 3-3. PROPOSED NEW MONITORING WELL LOCATIONS
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Location	Prefix	Series	Zone	Well ID	Phase
Off-site	MW	500	AS	MW-500-AS	Phase I
	MW	500	AI	MW-500-AI	Phase I
	MW	500	AD	MW-500-AD	Phase I
	MW	500	SS*	MW-500-SS*	Phase II
	MW	500	SD	MW-500-SD	Phase II
	MW	501	AS	MW-501-AS	Phase I
	MW	501	AI	MW-501-AI	Phase I
	MW	501	AD	MW-501-AD	Phase I
	MW	501	SS*	MW-501-SS*	Phase II
	MW	501	SD	MW-501-SD	Phase II
	MW	502	AS	MW-502-AS	Phase I
	MW	502	AI	MW-502-AI	Phase I
	MW	502	AD	MW-502-AD	Phase I
	MW	502	SS*	MW-502-SS*	Phase II
	MW	502	SD	MW-502-SD	Phase II
	MW	503	AS	MW-503-AS	Phase I
	MW	503	AI	MW-503-AI	Phase I
	MW	503	AD	MW-503-AD	Phase I
	MW	504	AS	MW-504-AS	Phase I
	MW	504	AI	MW-504-AI	Phase I
	MW	504	AD	MW-504-AD	Phase I
	MW	505	AS	MW-505-AS	Phase I
	MW	505	AI	MW-505-AI	Phase I
	MW	505	AD	MW-505-AD	Phase I
	MW	505	SS	MW-505-SS	Phase II
	MW	505	SD	MW-505-SD	Phase II

TABLE 3-3. PROPOSED MONITORING WELL NETWORK
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Location	Prefix	Series	Zone	Well ID	Phase
Background	MW	600	AS	MW-600-AS	Phase I
	MW	600	AI	MW-600-AI	Phase I
	MW	600	AD	MW-600-AD	Phase I
	MW	601	AS	MW-601-AS	Phase I
	MW	601	AI	MW-601-AI	Phase I
	MW	601	AD	MW-601-AD	Phase I
	MW	602	AS	MW-602-AS	Phase I
	MW	602	AI	MW-602-AI	Phase I
	MW	602	AD	MW-602-AD	Phase I
	MW	602	SS*	MW-602-SS*	Phase I
	MW	602	SD	MW-602-SD	Phase I
	MW	603	SS	MW-603-SS	Phase I
	MW	603	SD	MW-603-SD	Phase I
	MW	604	SS	MW-604-SS	Phase I
	MW	604	SD	MW-604-SD	Phase I
	MW	605	SS	MW-605-SS	Phase I
	MW	605	SD	MW-605-SD	Phase I
Piezometers	PZ	700	AS	PZ-700-AS	Phase II
	PZ	701	AS	PZ-701-AS	Phase II
	PZ	702	AS	PZ-702-AS	Phase II
	PZ	703	AS	PZ-703-AS	Phase II

Note:
* To be installed in formation if encountered in this location.

Abbreviations:

Environmental Control Prefix
MW: Monitoring Well
PZ: Piezometer

Hydrological Zone
AS: Shallow Alluvial
AI: Intermediate Alluvial
AD: Deep Alluvial
SS: Upper Salem/St. Louis Formation
SD: Salem Formation
KS: Keokuk Formation

TABLE 3-4. PROPOSED MONITORING WELL TOTAL DEPTHS AND CONSTRUCTION SUMMARY
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Phase	Prefix	Series	Zone	Borehole ID	Total Depth (ft bgs)	Ground Surface Elevation (ft msl)	Bottom Screen Elevation (ft msl)	Borehole Diameter (inches)	Proposed Well Construction	Nearby Wells/Piezometers/ Staff Gauges	Data Gaps Addressed	Additional Rationale	Drilling Method	Property Owner
Phase I	MW	213	AS	MW-213-AS	23	448	425	11	2-inch double nested Sch. 40 PVC	I-67	2, 3, 5, 6, 7, 9	No shallow alluvial well exists at this location	Sonic/Continuous Core	Bridgeton Landfill, LLC
	MW	213	AD	MW-213-AD	111	451	340	11	2-inch double nested Sch. 80 PVC	I-67	2, 3, 5, 6, 7, 9	No deep alluvial well exists at this location	Sonic/Continuous Core	Bridgeton Landfill, LLC
	MW	302	AD	MW-302-AD	111	451	340	7	2-inch Sch. 80 PVC	PZ-302-AS, PZ-302-AI	2, 3, 5, 6, 7, 9	No deep alluvial well exists at this location	Sonic/Continuous Core	Bridgeton Landfill, LLC
	MW	303	AI	MW-303-AI	53	448	395	11	2-inch double nested Sch. 40 PVC	MW-104, PZ-303-AS, LR-105	2, 3, 5, 6, 7, 9	No intermediate alluvial well exists at this location	Sonic/Continuous Core	Bridgeton Landfill, LLC
	MW	303	AD	MW-303-AD	111	451	340	11	2-inch double nested Sch. 80 PVC	MW-104, PZ-303-AS, LR-105	2, 3, 5, 6, 7, 9	No deep alluvial well exists at this location	Sonic/Continuous Core	Bridgeton Landfill, LLC
	MW	304	AD	MW-304-AD	111	451	340	7	2-inch Sch. 80 PVC	PZ-304 Cluster	2, 3, 5, 6, 7, 9	No deep or bedrock wells exist at PZ-304 cluster	Sonic/Continuous Core	Bridgeton Landfill, LLC
	MW	304	SS	MW-304-SS	151	451	300	12/7	2-inch Sch. 80 PVC	PZ-304 Cluster	2, 3, 5, 6, 7, 9	No deep or bedrock wells exist at PZ-304 cluster	Sonic/Continuous Core	Bridgeton Landfill, LLC
	MW	304	SD	MW-304-SD	211	451	240	12/7	2-inch Sch. 80 PVC	PZ-304 Cluster	2, 3, 5, 6, 7, 9	No deep or bedrock wells exist at PZ-304 cluster	Sonic/Continuous Core	Bridgeton Landfill, LLC
	MW	306	AI	MW-306-AI	53	448	395	11	2-inch double nested Sch. 40 PVC	MW-103	2, 3, 5, 6, 7, 9	No intermediate alluvial well exists at this location	Sonic/Continuous Core	Bridgeton Landfill, LLC
	MW	306	AD	MW-306-AD	109	451	342	11	2-inch double nested Sch. 80 PVC	MW-103	2, 3, 5, 6, 7, 9	No deep alluvial well exists at this location	Sonic/Continuous Core	Bridgeton Landfill, LLC
	MW	400	AS	MW-400-AS	26	446	420	11	2-inch double nested Sch. 40 PVC	S-61, MW-102, D-6	2, 3, 5, 6, 7, 9	S-61 and MW-102 abandoned, D-6 slated for abandonment	Sonic/Continuous Core	AAA Trailers
	MW	400	AI	MW-400-AI	51	446	395	11	2-inch double nested Sch. 40 PVC	S-61, MW-102, D-6	2, 3, 5, 6, 7, 9	S-61 and MW-102 abandoned, D-6 slated for abandonment	Sonic/Continuous Core	AAA Trailers
	MW	400	AD	MW-400-AD	106	446	340	7	2-inch Sch. 80 PVC	S-61, MW-102, D-6	2, 3, 5, 6, 7, 9	S-61 and MW-102 abandoned, D-6 slated for abandonment	Sonic/Continuous Core	AAA Trailers
	MW	400	SS*	MW-400-SS*	146	446	300	12/7	2-inch Sch. 80 PVC	S-61, MW-102, D-6	2, 3, 5, 6, 7, 9	S-61 and MW-102 abandoned, D-6 slated for abandonment	Sonic/Continuous Core	AAA Trailers
	MW	400	SD	MW-400-SD	206	446	240	12/7	2-inch Sch. 80 PVC	S-61, MW-102, D-6	2, 3, 5, 6, 7, 9	S-61 and MW-102 abandoned, D-6 slated for abandonment	Sonic/Continuous Core	AAA Trailers
	MW	401	AS	MW-401-AS	25	445	420	11	2-inch double nested Sch. 40 PVC	S-8, I-62, D-83	2, 3, 5, 6, 7, 9	Additional Area 2 perimeter well	Sonic/Continuous Core	AAA Trailers
	MW	401	AI	MW-401-AI	50	445	395	11	2-inch double nested Sch. 40 PVC	S-8, I-62, D-83	2, 3, 5, 6, 7, 9	Additional Area 2 perimeter well	Sonic/Continuous Core	AAA Trailers
	MW	401	AD	MW-401-AD	105	445	340	7	2-inch Sch. 80 PVC	S-8, I-62, D-83	2, 3, 5, 6, 7, 9	Additional Area 2 perimeter well	Sonic/Continuous Core	AAA Trailers
	MW	401	SS*	MW-401-SS*	145	445	300	12/7	2-inch Sch. 80 PVC	S-8, I-62, D-83	2, 3, 5, 6, 7, 9	No bedrock wells exist at this location	Sonic/Continuous Core	AAA Trailers
	MW	401	SD	MW-401-SD	205	445	240	12/7	2-inch Sch. 80 PVC	S-8, I-62, D-83	2, 3, 5, 6, 7, 9	No bedrock wells exist at this location	Sonic/Continuous Core	AAA Trailers
	MW	402	AS	MW-402-AS	34	454	420	11	2-inch double nested Sch. 40 PVC	I-66, D-13	2, 3, 5, 6, 7, 9, 10	No shallow alluvial well exists at this location	Sonic/Continuous Core	Bridgeton Landfill, LLC
	MW	402	AI	MW-402-AI	59	454	395	11	2-inch double nested Sch. 40 PVC	I-66, D-13	2, 3, 5, 6, 7, 9	Supplemental intermediate alluvial well to I-66	Sonic/Continuous Core	Bridgeton Landfill, LLC

TABLE 3-4. PROPOSED MONITORING WELL TOTAL DEPTHS AND CONSTRUCTION SUMMARY
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Phase	Prefix	Series	Zone	Borehole ID	Total Depth (ft bgs)	Ground Surface Elevation (ft msl)	Bottom Screen Elevation (ft msl)	Borehole Diameter (inches)	Proposed Well Construction	Nearby Wells/Piezometers/ Staff Gauges	Data Gaps Addressed	Additional Rationale	Drilling Method	Property Owner
Phase I	MW	402	AD	MW-402-AD	114	454	340	7	2-inch Sch. 80 PVC	I-66, D-13	2, 3, 5, 6, 7, 9	Supplemental deep alluvial well to D-13	Sonic/Continuous Core	Bridgeton Landfill, LLC
	MW	402	SS*	MW-402-SS*	154	454	300	12/7	2-inch Sch. 80 PVC	I-66, D-13	2, 3, 5, 6, 7, 9	No bedrock wells exist at this on-site location	Sonic/Continuous Core	Bridgeton Landfill, LLC
	MW	402	SD	MW-402-SD	214	454	240	12/7	2-inch Sch. 80 PVC	I-66, D-13	2, 3, 5, 6, 7, 9	No bedrock wells exist at this on-site location	Sonic/Continuous Core	Bridgeton Landfill, LLC
	MW	403	AS	MW-403-AS	21	440	419	11	2-inch double nested Sch. 40 PVC	I-65	2, 3, 5, 6, 7, 9	No shallow alluvial well exists at this location	Sonic/Continuous Core	City of Bridgeton Right of Way
	MW	403	AI	MW-403-AI	53	448	395	11	2-inch double nested Sch. 40 PVC	I-65	2, 3, 5, 6, 7, 9	Supplemental intermediate alluvial well to I-65	Sonic/Continuous Core	City of Bridgeton Right of Way
	MW	403	AD	MW-403-AD	109	448	339	7	2-inch Sch. 80 PVC	I-65	2, 3, 5, 6, 7, 9	No deep alluvial well exists at this location	Sonic/Continuous Core	City of Bridgeton Right of Way
	MW	404	SS	MW-404-SS	160	460	300	12/7	2-inch Sch. 80 PVC	S-82, I-9, D-93	2, 3, 5, 6, 7, 9	No bedrock wells exist at this on-site location	Sonic/Continuous Core	Bridgeton Landfill, LLC
	MW	404	SD	MW-404-SD	220	460	240	12/7	2-inch Sch. 80 PVC	S-82, I-9, D-93	2, 3, 5, 6, 7, 9	No bedrock wells exist at this on-site location	Sonic/Continuous Core	Bridgeton Landfill, LLC
	MW	500	AS	MW-500-AS	19	439	420	11	2-inch double nested Sch. 40 PVC	SG-500*	2, 3, 5, 6, 8, 9,10	Evaluate nature and extent of impacts and regional gradient	Sonic/Continuous Core	CLERC Properties Inc
	MW	500	AI	MW-500-AI	44	439	395	11	2-inch double nested Sch. 40 PVC	SG-500*	2, 3, 5, 6, 9,10	Evaluate nature and extent of impacts and regional gradient	Sonic/Continuous Core	CLERC Properties Inc
	MW	500	AD	MW-500-AD	99	439	340	7	2-inch Sch. 80 PVC	SG-500*	2, 3, 5, 6, 9,10	Evaluate nature and extent of impacts and regional gradient	Sonic/Continuous Core	CLERC Properties Inc
	MW	501	AS	MW-501-AS	18	438	420	11	2-inch double nested Sch. 40 PVC	SG-500*	2, 3, 5, 6, 8, 9,10	Evaluate nature and extent of impacts and regional gradient	Sonic/Continuous Core	Seventy Seventy LLC
	MW	501	AI	MW-501-AI	43	438	395	11	2-inch double nested Sch. 40 PVC	SG-500*	2, 3, 5, 6, 9,10	Evaluate nature and extent of impacts and regional gradient	Sonic/Continuous Core	Seventy Seventy LLC
	MW	501	AD	MW-501-AD	98	438	340	7	2-inch Sch. 80 PVC	SG-500*	2, 3, 5, 6, 9,10	Evaluate nature and extent of impacts and regional gradient	Sonic/Continuous Core	Seventy Seventy LLC
	MW	502	AS	MW-502-AS	25	445	420	11	2-inch double nested Sch. 40 PVC	USGS St. Charles Missouri River Gauge, SG-502*, SG-503*	2, 3, 5, 6, 8, 9,10	Evaluate nature and extent of impacts and regional gradient	Sonic/Continuous Core	R T Group II LLC
	MW	502	AI	MW-502-AI	50	445	395	11	2-inch double nested Sch. 40 PVC	USGS St. Charles Missouri River Gauge, SG-502*, SG-503*	2, 3, 5, 6, 9,10	Evaluate nature and extent of impacts and regional gradient	Sonic/Continuous Core	R T Group II LLC
	MW	502	AD	MW-502-AD	105	445	340	7	2-inch Sch. 80 PVC	USGS St. Charles Missouri River Gauge, SG-502*, SG-503*	2, 3, 5, 6, 9,10	Evaluate nature and extent of impacts and regional gradient	Sonic/Continuous Core	R T Group II LLC
	MW	503	AS	MW-503-AS	21	440	419	11	2-inch double nested Sch. 40 PVC	SG-503*	2, 3, 5, 6, 9,10	Evaluate nature and extent of impacts and regional gradient	Sonic/Continuous Core	Sensory Effects Flavor Co
	MW	503	AI	MW-503-AI	46	441	395	11	2-inch double nested Sch. 40 PVC	SG-503*	2, 3, 5, 6, 9,10	Evaluate nature and extent of impacts and regional gradient	Sonic/Continuous Core	Sensory Effects Flavor Co
	MW	503	AD	MW-503-AD	101	441	340	7	2-inch Sch. 80 PVC	SG-503*	2, 3, 5, 6, 9,10	Evaluate nature and extent of impacts and regional gradient	Sonic/Continuous Core	Sensory Effects Flavor Co
	MW	504	AS	MW-504-AS	21	440	419	11	2-inch double nested Sch. 40 PVC	SG-501*	2, 3, 5, 6, 9,10	Evaluate nature and extent of impacts and regional gradient	Sonic/Continuous Core	DST Systems Inc
	MW	504	AI	MW-504-AI	46	441	395	11	2-inch double nested Sch. 40 PVC	SG-501*	2, 3, 5, 6, 9,10	Evaluate nature and extent of impacts and regional gradient	Sonic/Continuous Core	DST Systems Inc

TABLE 3-4. PROPOSED MONITORING WELL TOTAL DEPTHS AND CONSTRUCTION SUMMARY
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Phase	Prefix	Series	Zone	Borehole ID	Total Depth (ft bgs)	Ground Surface Elevation (ft msl)	Bottom Screen Elevation (ft msl)	Borehole Diameter (inches)	Proposed Well Construction	Nearby Wells/Piezometers/ Staff Gauges	Data Gaps Addressed	Additional Rationale	Drilling Method	Property Owner
Phase I	MW	504	AD	MW-504-AD	101	441	340	7	2-inch Sch. 80 PVC	SG-501*	2, 3, 5, 6, 9,10	Evaluate nature and extent of impacts and regional gradient	Sonic/Continuous Core	DST Systems Inc
	MW	505	AS	MW-505-AS	22	447	425	11	2-inch double nested Sch. 40 PVC	S-53	2, 3, 5, 6, 9,10	Evaluate nature and extent of impacts and regional gradient	Sonic/Continuous Core	Bridgeton Landfill, LLC
	MW	505	AI	MW-505-AI	52	447	395	11	2-inch double nested Sch. 40 PVC	S-53	2, 3, 5, 6, 9,10	Evaluate nature and extent of impacts and regional gradient	Sonic/Continuous Core	Bridgeton Landfill, LLC
	MW	505	AD	MW-505-AD	107	447	340	7	2-inch Sch. 80 PVC	S-53	2, 3, 5, 6, 9,10	Evaluate nature and extent of impacts and regional gradient	Sonic/Continuous Core	Bridgeton Landfill, LLC
	MW	600	AS	MW-600-AS	25	445	420	11	2-inch double nested Sch. 40 PVC	SG-600*	2, 3, 4, 5, 6, 9	Evaluate background alluvial groundwater quality	Sonic/Continuous Core	State Highway
	MW	600	AI	MW-600-AI	50	445	395	11	2-inch double nested Sch. 40 PVC	SG-600*	2, 3, 4, 5, 6, 9	Evaluate background alluvial groundwater quality	Sonic/Continuous Core	Maryland Heights Right of Way
	MW	600	AD*	MW-600-AD*	105	445	340	7	2-inch Sch. 80 PVC	SG-600*	2, 3, 4, 5, 6, 9	Evaluate background alluvial groundwater quality	Sonic/Continuous Core	Maryland Heights Right of Way
	MW	601	AS	MW-601-AS	20	440	420	11	2-inch double nested Sch. 40 PVC	N/A	2, 3, 4, 5, 6, 9	Evaluate background alluvial groundwater quality	Sonic/Continuous Core	Unknown
	MW	601	AI	MW-601-AI	45	440	395	11	2-inch double nested Sch. 40 PVC	N/A	2, 3, 4, 5, 6, 9	Evaluate background alluvial groundwater quality	Sonic/Continuous Core	Unknown
	MW	601	AD	MW-601-AD	100	440	340	7	2-inch Sch. 80 PVC	N/A	2, 3, 4, 5, 6, 9	Evaluate background alluvial groundwater quality	Sonic/Continuous Core	Unknown
	MW	602	AS	MW-602-AS	14	434	420	11	2-inch double nested Sch. 40 PVC	N/A	2, 3, 5, 6, 8, 9,10	Evaluate background alluvial groundwater quality	Sonic/Continuous Core	Sensory Effects Flavor Co
	MW	602	AI	MW-602-AI	39	434	395	11	2-inch double nested Sch. 40 PVC	N/A	2, 3, 4, 5, 6, 9	Evaluate background alluvial groundwater quality	Sonic/Continuous Core	Sensory Effects Flavor Co
	MW	602	AD*	MW-602-AD*	94	434	340	7	2-inch Sch. 80 PVC	N/A	2, 3, 4, 5, 6, 9	Evaluate background alluvial groundwater quality	Sonic/Continuous Core	Sensory Effects Flavor Co
	MW	602	SS*	MW-602-SS*	134	434	300	12/7	2-inch Sch. 80 PVC	N/A	2, 3, 4, 5, 6, 9	Evaluate background bedrock groundwater quality	Sonic/Continuous Core	Sensory Effects Flavor Co
	MW	602	SD	MW-602-SD	194	434	240	12/7	2-inch Sch. 80 PVC	N/A	2, 3, 4, 5, 6, 9	Evaluate background bedrock groundwater quality	Sonic/Continuous Core	Sensory Effects Flavor Co
	MW	603	SS	MW-603-SS	232	532	300	12/7	2-inch Sch. 80 PVC	N/A	2, 3, 4, 5, 6, 9	Evaluate background bedrock groundwater quality	Sonic/Continuous Core	City of Bridgeton
	MW	603	SD	MW-603-SD	292	532	240	12/7	2-inch Sch. 80 PVC	N/A	2, 3, 4, 5, 6, 9	Evaluate background bedrock groundwater quality	Sonic/Continuous Core	City of Bridgeton
	MW	604	SS	MW-604-SS	214	514	300	12/7	2-inch Sch. 80 PVC	N/A	2, 3, 4, 5, 6, 9	Evaluate background bedrock groundwater quality	Sonic/Continuous Core	City of Bridgeton
	MW	604	SD	MW-604-SD	274	514	240	12/7	2-inch Sch. 80 PVC	N/A	2, 3, 4, 5, 6, 9	Evaluate background bedrock groundwater quality	Sonic/Continuous Core	City of Bridgeton
	MW	605	SS	MW-605-SS	170	470	300	12/7	2-inch Sch. 80 PVC	N/A	2, 3, 4, 5, 6, 10	Evaluate background bedrock groundwater quality	Sonic/Continuous Core	Rolling Frito Lay Sales LP
	MW	605	SD	MW-605-SD	230	470	240	12/7	2-inch Sch. 80 PVC	N/A	2, 3, 4, 5, 6, 11	Evaluate background bedrock groundwater quality	Sonic/Continuous Core	Rolling Frito Lay Sales LP

TABLE 3-4. PROPOSED MONITORING WELL TOTAL DEPTHS AND CONSTRUCTION SUMMARY
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Phase	Prefix	Series	Zone	Borehole ID	Total Depth (ft bgs)	Ground Surface Elevation (ft msl)	Bottom Screen Elevation (ft msl)	Borehole Diameter (inches)	Proposed Well Construction	Nearby Wells/Piezometers/ Staff Gauges	Data Gaps Addressed	Additional Rationale	Drilling Method	Property Owner
Phase II	MW	111	AS	MW-111-AS	43	463	420	11	2-inch double nested Sch. 40 PVC	PZ-111-SS, PZ-111-SD, PZ-111-KS	2, 3, 5, 6, 9,10	No alluvial wells exist at this on-site location	Sonic/Continuous Core	Bridgeton Landfill, LLC
	MW	111	AI	MW-111-AI	68	463	395	11	2-inch double nested Sch. 40 PVC	PZ-111-SS, PZ-111-SD, PZ-111-KS	2, 3, 5, 6, 9,10	No alluvial wells exist at this on-site location	Sonic/Continuous Core	Bridgeton Landfill, LLC
	MW	111	AD	MW-111-AD	123	463	340	7	2-inch Sch. 80 PVC	PZ-111-SS, PZ-111-SD, PZ-111-KS	2, 3, 5, 6, 9,10	No alluvial wells exist at this on-site location	Sonic/Continuous Core	Bridgeton Landfill, LLC
	MW	113	SD	MW-113-SD	220	460	240	12/7	2-inch Sch. 80 PVC	PZ-113-AS, PZ-113-AD, PZ-113-SS	2, 3, 5, 6, 9,10	No Salem Formation well exists at this on-site location	Sonic/Continuous Core	Bridgeton Landfill, LLC
	MW	205	SD	MW-205-SD	220	460	240	12/7	2-inch Sch. 80 PVC	PZ-205-AS, PZ-205-SS	2, 3, 5, 6, 9,10	No Salem Formation well exists at this on-site location	Sonic/Continuous Core	Bridgeton Landfill, LLC
	MW	500	SS*	MW-500-SS*	139	439	300	12/7	2-inch Sch. 80 PVC	SG-500*	2, 3, 5, 6, 9,10	Evaluate nature and extent of impacts and regional gradient	Sonic/Continuous Core	CLERC Properties Inc
	MW	500	SD	MW-500-SD	199	439	240	12/7	2-inch Sch. 80 PVC	SG-500*	2, 3, 5, 6, 9,10	Evaluate nature and extent of impacts and regional gradient	Sonic/Continuous Core	CLERC Properties Inc
	MW	501	SS*	MW-501-SS*	138	438	300	12/7	2-inch Sch. 80 PVC	SG-400*	2, 3, 5, 6, 9,10	Evaluate nature and extent of impacts and regional gradient	Sonic/Continuous Core	Seventy Seventy LLC
	MW	501	SD	MW-501-SD	198	438	240	12/7	2-inch Sch. 80 PVC	SG-400*	2, 3, 5, 6, 9,10	Evaluate nature and extent of impacts and regional gradient	Sonic/Continuous Core	Seventy Seventy LLC
	MW	502	SS*	MW-502-SS*	145	445	300	12/7	2-inch Sch. 80 PVC	USGS St. Charles Missouri River Gauge, SG-502*, SG-503*	2, 3, 5, 6, 9,10	Evaluate nature and extent of impacts and regional gradient	Sonic/Continuous Core	R T GROUP II LLC
	MW	502	SD	MW-502-SD	205	445	240	12/7	2-inch Sch. 80 PVC	USGS St. Charles Missouri River Gauge, SG-502*, SG-503*	2, 3, 5, 6, 9,10	Evaluate nature and extent of impacts and regional gradient	Sonic/Continuous Core	R T GROUP II LLC
	MW	505	SS	MW-505-SS	147	447	300	12/7	2-inch Sch. 80 PVC	S-53	2, 3, 5, 6, 9,11	Evaluate nature and extent of impacts and regional gradient	Sonic/Continuous Core	Bridgeton Landfill, LLC
	MW	505	SD	MW-505-SD	207	447	240	12/7	2-inch Sch. 80 PVC	S-53	2, 3, 5, 6, 9,12	Evaluate nature and extent of impacts and regional gradient	Sonic/Continuous Core	Bridgeton Landfill, LLC

TABLE 3-4. PROPOSED MONITORING WELL TOTAL DEPTHS AND CONSTRUCTION SUMMARY
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Phase	Prefix	Series	Zone	Borehole ID	Total Depth (ft bgs)	Ground Surface Elevation (ft msl)	Bottom Screen Elevation (ft msl)	Borehole Diameter (inches)	Proposed Well Construction	Nearby Wells/Piezometers/ Staff Gauges	Data Gaps Addressed	Additional Rationale	Drilling Method	Property Owner
Phase II Piezometers	PZ	700	AS	PZ-700-AS	21	441	420	7	2-inch Sch. 40 PVC	North of 500 Series	9, 10	Model calibration	Sonic/Continuous Core	St. Louis County
	PZ	701	AS	PZ-701-AS	21	441	420	7	2-inch Sch. 40 PVC	North of 500 Series	9, 10	Model calibration	Sonic/Continuous Core	St. Louis County
	PZ	702	AS	PZ-702-AS	25	445	420	7	2-inch Sch. 40 PVC	South of 600 Series	9, 10	Model calibration	Sonic/Continuous Core	City of Maryland Heights
	PZ	703	AS	PZ-703-AS	25	445	420	7	2-inch Sch. 40 PVC	South of 600 Series	9, 10	Model calibration	Sonic/Continuous Core	City of Maryland Heights

Notes:
Data Gaps
1: Adequacy, usability, and status of existing and abandoned on-site and perimeter monitoring wells and associated data
2: Aquifer properties, including recharge/discharge rates and hydraulic conductivities
3: Regional and localized hydraulic gradients and flow directions within and between the alluvial aquifer and shallow and deep units (upper and lower intervals) of the bedrock aquifer system (Mississippian age)
4: Background groundwater quality of aquifers located at and near the Site
5: Occurrence and extent of groundwater impacts
6: Groundwater geochemistry parameters, redox couples, and organic content
7: Effects of the Bridgeton Landfill related infrastructure (leachate extraction system, EVOH cover, etc.) and hydraulic characteristics of landfill material on the groundwater system, and leachate chemistry/occurrence
8: Vapor intrusion
9: Temporal variability in groundwater levels and flow direction
10: Temporal and spatial water elevation effects from nearby surface water features (Missouri River) and storm events

Phase I: Proposed Phase I wells will be installed at the beginning of the drilling program based on the locations shown in Work Plan Figure 5-5a.
Phase II: Proposed Phase II wells will be installed at the end of the drilling program; locations may be shifted based on initial data from the Phase I wells;
Phase II piezometers will be installed in the locations shown in Work Plan Figure 5-5g if no shallow alluvial wells are identified during the Well Inventory.
* - To be installed in formation if encountered in this location.
All boreholes drilled using sonic drilling techniques and monitoring wells constructed using 0.010-inch factory slotted PVC screen
Alluvial samples will be collected from deepest alluvial hole at each location and submitted for laboratory analysis
Total depth is approximate
New wells subject to access agreement with property owner

Abbreviations:
MW: monitoring well
PZ: piezometer
PVC: polyvinyl chloride
Sch.: Schedule
N/A: not applicable
TBD: to be determined if deep alluvium present at this location
USGS: United States Geological Survey

Notes:
Zone Explanation
AS: Shallow Alluvial
AI: Intermediate Alluvial
AD: Deep Alluvial
SS: Deep St. Louis/Shallow Salem Formation
SD: Salem Formation
KS: Keokuk Formation

Series Explanation
100: Immediately adjacent to the perimeter of the active sanitary landfill
200: Within 500 feet of the active sanitary landfill
300: Adjacent to inactive landfill areas in western portion of site
400: Within 500 feet of Area 2
500: Offsite
600: Background

TABLE 3-5. PROPOSED GEOPHYSICAL LOGGING AND AQUIFER TESTING
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Location	Prefix	Series	Zone	Borehole ID	Spontaneous Potential / Resistivity	Induction/ Conductivity	Heat Pulse Flow Meter	Fluid Resistivity	Fluid Temp.	Gamma-Gamma-Density	Natural Gamma	Spectral Gamma	Caliper	Hydraulic Conductivity Test
On-site/ Near-site	MW	113	SD	MW-113-SD	X	X	X	X	X	X	X	X	X	Packer
	MW	205	SD	MW-205-SD	X	X	X	X	X	X	X	X	X	Packer
	MW	304	SD	MW-304-SD	X	X	X	X	X	X	X	X	X	Packer
	MW	400	SD	MW-400-SD	X	X	X	X	X	X	X	X	X	Packer
	MW	401	SD	MW-401-SD	X	X	X	X	X	X	X	X	X	Packer
	MW	402	SD	MW-402-SD	X	X	X	X	X	X	X	X	X	Packer
	MW	404	SD	MW-404-SD	X	X	X	X	X	X	X	X	X	Packer
Off-site	MW	500	SD	MW-500-SD	X	X	X	X	X	X	X	X	X	Packer
	MW	501	SD	MW-501-SD	X	X	X	X	X	X	X	X	X	Packer
	MW	502	SD	MW-502-SD	X	X	X	X	X	X	X	X	X	Packer
	MW	505	SD	MW-505-SD	X	X	X	X	X	X	X	X	X	Packer
Backgound	MW	602	SD	MW-602-SD	X	X	X	X	X	X	X	X	X	Packer
	MW	603	SD	MW-603-SD	X	X	X	X	X	X	X	X	X	Packer
	MW	604	SD	MW-604-SD	X	X	X	X	X	X	X	X	X	Packer
	MW	605	SD	MW-605-SD	X	X	X	X	X	X	X	X	X	Packer

Notes:
All boreholes drilled using sonic drilling techniques and monitoring wells constructed using 0.010-inch factory slotted PVC screen
Natural and spectral gamma tools will be used in cased portion of deep bedrock wells to qualify gamma in the alluvial interval of each location. Note, these values may be slightly muted due casing impediment.
Borehole geophysical tools dependent on subcontractor availability and equipment

Series Explanation
100: Immediately adjacent to the perimeter of the active sanitary landfill
200: Within 500 feet of the active sanitary landfill
300: Adjacent to inactive landfill areas in western portion of site
400: Within 500 feet of Area 2
500: Offsite
600: Background

Zone Explanation
AS: Shallow Alluvial
AI: Intermediate Alluvial
AD: Deep Alluvial
SS: Deep St. Louis/Shallow Salem Formation
SD: Salem Formation
KS: Keokuk Formation

TABLE 3-6. PROPOSED MONITORING WELL NETWORK
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

80 Existing Monitoring Wells					78 Proposed Monitoring Wells and 4 Piezometers				
Prefix	Series	Zone	Well ID	Current Monitoring Status	Location	Prefix	Series	Zone	Well ID
PZ	112	AS	PZ-112-AS	A	On-site	MW	111	AS	MW-111-AS
PZ	113	AS	PZ-113-AS	A		MW	111	AI	MW-111-AI
PZ	114	AS	PZ-114-AS	A		MW	111	AD	MW-111-AD
PZ	205	AS	PZ-205-AS	A		MW	113	SD	MW-113-SD
PZ	207	AS	PZ-207-AS	A		MW	205	SD	MW-205-SD
S	84	AS	S-84	A		MW	213	AS	MW-213-AS
MW	103	AS	MW-103	I		MW	213	AD	MW-213-AD
MW	104	AS	MW-104	I		MW	302	AD	MW-302-AD
PZ	302	AS	PZ-302-AS	I		MW	303	AI	MW-303-AI
PZ	303	AS	PZ-303-AS	I		MW	303	AD	MW-303-AD
PZ	304	AS	PZ-304-AS	I		MW	304	AD	MW-304-AD
S	5	AS	S-5**	I		MW	304	SS	MW-304-SS
S	8	AS	S-8	I		MW	304	SD	MW-304-SD
S	10	AS	S-10**	I		MW	306	AI	MW-306-AI
S	53	AS	S-53	I		MW	306	AD	MW-306-AD
S	82	AS	S-82	I	On-site / Near-site	MW	400	AS	MW-400-AS
I	68	AI	I-68	A		MW	400	AI	MW-400-AI
I	73	AI	I-73	A		MW	400	AD	MW-400-AD
D	89	AI	D-89	I		MW	400	SS*	MW-400-SS*
I	9	AI	I-9	I		MW	400	SD	MW-400-SD
I	11	AI	I-11**	I		MW	401	AS	MW-401-AS
I	62	AI	I-62**	I		MW	401	AI	MW-401-AI
I	65	AI	I-65	I		MW	401	AD	MW-401-AD
I	66	AI	I-66	I		MW	401	SS*	MW-401-SS*
I	67	AI	I-67	I		MW	401	SD	MW-401-SD
PZ	302	AI	PZ-302-AI	I		MW	402	AS	MW-402-AS
PZ	304	AI	PZ-304-AI	I		MW	402	AI	MW-402-AI
D	85	AD	D-85	A		MW	402	AD	MW-402-AD
PZ	113	AD	PZ-113-AD	A		MW	402	SS*	MW-402-SS*
D	3	AD	D-3**	I		MW	402	SD	MW-402-SD
D	6	AD	D-6**	I		MW	403	AS	MW-403-AS
D	12	AD	D-12**	I		MW	403	AI	MW-403-AI
D	13	AD	D-13**	I		MW	403	AD	MW-403-AD
D	81	AD	D-81	I		MW	404	SS	MW-404-SS
D	83	AD	D-83**	I		MW	404	SD	MW-404-SD
D	87	AD	D-87	I	Off-site	MW	500	AS	MW-500-AS
D	93	AD	D-93	I		MW	500	AI	MW-500-AI
LR	100	LR	LR-100	I		MW	500	AD	MW-500-AD
PZ	100	SS	PZ-100-SS	A		MW	500	SS*	MW-500-SS*
PZ	101	SS	PZ-101-SS	A		MW	500	SD	MW-500-SD
PZ	102	SS	PZ-102R-SS	A		MW	501	AS	MW-501-AS
PZ	102	SS	PZ-102-SS	A		MW	501	AI	MW-501-AI
PZ	103	SS	PZ-103-SS	A		MW	501	AD	MW-501-AD
PZ	104	SS	PZ-104-SS	A		MW	501	SS*	MW-501-SS*
PZ	105	SS	PZ-105-SS	A		MW	501	SD	MW-501-SD
PZ	106	SS	PZ-106-SS	A		MW	502	AS	MW-502-AS
PZ	107	SS	PZ-107-SS	A		MW	502	AI	MW-502-AI
PZ	109	SS	PZ-109-SS	A		MW	502	AD	MW-502-AD
PZ	111	SS	PZ-111-SS	A		MW	502	SS*	MW-502-SS*
PZ	113	SS	PZ-113-SS	A		MW	502	SD	MW-502-SD
PZ	115	SS	PZ-115-SS	A		MW	503	AS	MW-503-AS
PZ	116	SS	PZ-116-SS	A		MW	503	AI	MW-503-AI
PZ	200	SS	PZ-200-SS	A		MW	503	AD	MW-503-AD
PZ	201	SS	PZ-201A-SS	A		MW	504	AS	MW-504-AS
PZ	202	SS	PZ-202-SS	A		MW	504	AI	MW-504-AI
PZ	203	SS	PZ-203-SS	A		MW	504	AD	MW-504-AD
PZ	204A	SS	PZ-204A-SS	A		MW	505	AS	MW-505-AS
PZ	204	SS	PZ-204-SS	A		MW	505	AI	MW-505-AI
PZ	205	SS	PZ-205-SS	A		MW	505	AD	MW-505-AD
PZ	206	SS	PZ-206-SS	A		MW	505	SS	MW-505-SS
PZ	208	SS	PZ-208-SS	A		MW	505	SD	MW-505-SD

TABLE 3-6. PROPOSED MONITORING WELL NETWORK
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

80 Existing Monitoring Wells					78 Proposed Monitoring Wells and 4 Piezometers				
Prefix	Series	Zone	Well ID	Current Monitoring Status	Location	Prefix	Series	Zone	Well ID
PZ	209	SS	PZ-209-SS	A	Background	MW	600	AS	MW-600-AS
PZ	210	SS	PZ-210-SS	A		MW	600	AI	MW-600-AI
PZ	211	SS	PZ-211-SS	A		MW	600	AD	MW-600-AD
PZ	212	SS	PZ-212-SS	A		MW	601	AS	MW-601-AS
MO	3	SS	MO-3-SS	I		MW	601	AI	MW-601-AI
MW	1204	SD	MW-1204	A		MW	601	AD	MW-601-AD
PZ	100	SD	PZ-100-SD	A		MW	602	AS	MW-602-AS
PZ	104	SD	PZ-104-SD	A		MW	602	AI	MW-602-AI
PZ	106	SD	PZ-106-SD	A		MW	602	AD	MW-602-AD
PZ	111	SD	PZ-111-SD	A		MW	602	SS*	MW-602-SS*
PZ	209	SD	PZ-209-SD	A		MW	602	SD	MW-602-SD
PZ	210	SD	PZ-210-SD	A		MW	603	SS	MW-603-SS
PZ	211	SD	PZ-211-SD	A		MW	603	SD	MW-603-SD
PZ	212	SD	PZ-212-SD	A		MW	604	SS	MW-604-SS
MO	3	SD	MO-3-SD	I		MW	604	SD	MW-604-SD
PZ	100	KS	PZ-100-KS	A		MW	605	SS	MW-605-SS
PZ	104	KS	PZ-104-KS	A		MW	605	SD	MW-605-SD
PZ	106	KS	PZ-106-KS	A	Piezometers	PZ	700	AS	PZ-700-AS
PZ	111	KS	PZ-111-KS	A		PZ	701	AS	PZ-701-AS
						PZ	702	AS	PZ-702-AS
						PZ	703	AS	PZ-703-AS

Notes:
* Installed if zone encountered at proposed location
** Monitoring well may be in the footprint of OU-1 removal activities
Samples will not be collected from well I-4 due to compromised casing

Abbreviations:
S: Shallow
I: Intermediate
D: Deep
LR: Leachate Riser
MW: Monitoring Well
PZ: Piezometer
MO: Missouri
I: Inactive
U: Unknown
A: Abandoned

Abbreviations:
Hydrological Zone
AS: Shallow Alluvial
AI: Intermediate Alluvial
AD: Deep Alluvial
LR: Leachate Riser
SS: Upper Salem/St. Louis Formation
SD: Salem Formation
KS: Keokuk Formation

TABLE 3-7. WELLS PROPOSED FOR SLUG TESTING
WEST LAKE LAND FILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

40 Proposed Wells					32 Existing Wells				
Location	**Prefix**	**Series**	**Zone**	**Well ID**	**Prefix**	**Series**	**Zone**	**Well ID**	**Current Monitoring Status**
On-site/Near-site	MW	205	SD	MW-205-SD	S	84	AS	S-84	A
	MW	302	AD	MW-302-AD	I	73	AI	I-73	A
	MW	303	AI	MW-303-AI	PZ	102	SS	PZ-102-SS	A
	MW	303	AD	MW-303-AD	PZ	111	SS	PZ-111-SS	A
	MW	304	AD	MW-304-AD	PZ	203	SS	PZ-203-SS	A
	MW	304	SS	MW-304-SS	PZ	209	SS	PZ-209-SS	A
	MW	304	SD	MW-304-SD	PZ	210	SS	PZ-210-SS	A
	MW	400	SS	MW-400-SS	PZ	211	SS	PZ-211-SS	A
	MW	400	SD	MW-400-SD	p	212	SS	PZ-212-SS	A
	MW	401	SS	MW-401-SS	MW	1204	SD	MW-1204	A
	MW	401	SD	MW-401-SD	PZ	209	SD	PZ-209-SD	A
Off-site	MW	500	AS	MW-500-AS	PZ	210	SD	PZ-210-SD	A
	MW	500	AI	MW-500-AI	PZ	211	SD	PZ-211-SD	A
	MW	500	AD	MW-500-AD	PZ	212	SD	PZ-212-SD	A
	MW	501	AS	MW-501-AS	MO	3	SS	MO-3-SS	I
	MW	501	AI	MW-501-AI	MO	3	SDR	MO-3-SDR	I
	MW	501	AD	MW-501-AD	MW	103	AS	MW-103	I
	MW	502	AS	MW-502-AS	MW	104	AS	MW-104	I
	MW	502	AI	MW-502-AI	S	5	AS	S-5	I
	MW	502	AD	MW-502-AD	S	8	AS	S-8	I
	MW	503	AS	MW-503-AS	S	10	AS	S-10	I
	MW	503	AI	MW-503-AI	S	53	AS	S-53	I
	MW	503	AD	MW-503-AD	S	82	AS	S-82	I
Background	MW	600	AS	MW-600-AS	D	89	AI	D-89	I
	MW	600	AI	MW-600-AI	I	62	AI	I-62	I
	MW	600	AD	MW-600-AD	I	65	AI	I-65	I
	MW	601	AS	MW-601-AS	I	66	AI	I-66	I
	MW	601	AI	MW-601-AI	I	67	AI	I-67	I
	MW	601	AD	MW-601-AD	D	81	AD	D-81	I
	MW	602	AS	MW-602-AS	D	83	AD	D-83	I
	MW	602	AI	MW-602-AI	D	87	AD	D-87	I
	MW	602	AD	MW-602-AD	LR	100	LR	LR-100	I
	MW	602	SS*	MW-602-SS*					
	MW	602	SD	MW-602-SD					
	MW	604	SS	MW-604-SS					
	MW	604	SD	MW-604-SD					
Piezometers	PZ	700	AS	PZ-700-AS					
	PZ	701	AS	PZ-701-AS					
	PZ	702	AS	PZ-702-AS					
	PZ	703	AS	PZ-703-AS					

Note:

* slug tested if monitoring zone encountered during well installation

Abbreviations:

S: Shallow
I: Intermediate
D: Deep
LR: Leachate Riser
MW: Monitoring Well
PZ: Piezometer
MO: Missouri

Hydrological Zone
AS: Shallow Alluvial
AI: Intermediate Alluvial
AD: Deep Alluvial
LR: Leachate Riser
SS: Upper Salem/St. Louis Formation
SD: Salem Formation

TABLE 3-8. WELL LOCATIONS FOR DATALOGGERS
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

NEW ONSITE WELL LOCATIONS

	Aquifer Monitoring Intervals					
Well ID	**AS**	**AI**	**AD**	**SS**	**SD**	**KS**
MW-111	X	X	X			
MW-113					X	
MW-205					X	
MW-304			X	X	X	
MW-306		X	X			

NEW ONSITE / NEAR-SITE WELL LOCATIONS

	Aquifer Monitoring Intervals					
Well ID	**AS**	**AI**	**AD**	**SS**	**SD**	**KS**
MW-400	X	X	X	X	X	
MW-401	X	X	X	X	X	
MW-402	X	X	X	X	X	

NEW OFFSITE WELL LOCATIONS

	Aquifer Monitoring Intervals					
Well ID	**AS**	**AI**	**AD**	**SS**	**SD**	**KS**
MW-500	X	X	X	X*	X	
MW-501	X	X	X	X*	X	
MW-502	X	X	X	X*	X	
MW-503	X	X	X			
MW-504	X	X	X			
MW-505	X	X	X	X*	X	
MW-602	X	X	X	X	X	
MW-603				X	X	
MW-604				X	X	

TABLE 3-8. WELL LOCATIONS FOR DATALOGGERS
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

NEW OFFSITE PIEZOMETER LOCATIONS

	Aquifer Monitoring Intervals					
Well ID	**AS**	**AI**	**AD**	**SS**	**SD**	**KS**
MW-700	X					
MW-701	X					
MW-702	X					
MW-703	X					

EXISTING ONSITE WELL LOCATIONS

	Aquifer Monitoring Intervals					
Well ID	**AS**	**AI**	**AD**	**SS**	**SD**	**KS**
S-8	X					
I-62		X				
D-83			X			
S-82	X					
I-9		X				
D-93			X			
PZ-202				X		
PZ-209				X	X	
PZ-211				X	X	
PZ-113	X		X	X		
PZ-100				X	X	X
PZ-111				X	X	
PZ-205	X			X		
PZ-304	X	X				
MW-103	X					

Note:
* deployed if proposed zone encountered during well installation

Abbreviations:
AS: Shallow Alluvium
AI: Intermediate Alluvium
AD: Deep Alluvium
SS: St. Louis and Upper Salem Formations
SD: The base of the Salem Formation
KS: Keokuk Formation

TABLE 3-9. PROPOSED SURFACE WATER GAUGE LOCATIONS
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Location	Prefix	Series	Surface Gauge ID	Surface Water Body
On-Site	SG	200	SG-200	On-Site Stormwater Retention Basin
On-Site	SG	400	SG-400	North Surface Water Body
Off-Site	SG	500	SG-500	Earth City Industrial Park
	SG	501	SG-501	Northwest Industrial Park
	SG	502	SG-502	Retention Pond at Intersection of St. Charles Rock Rd. and Earth City Expresway.
	SG	503	SG-503	Crossroads Industrial Park
	SG	504	SG-504	Earth City Industrial Park
	SG	600	SG-600	Creve Couer

Notes:

Staff gauge placement dependent on access agreement with landowner.

Currently investigating whether a staff gauge already exists at the SG-400 location. If staff gauge exists and meets the DQO outlined in Table 3-1 of the QAPP, the existing staff gauge may be used.

Abbreviations:

DQO: data quality objective

QAPP: quality assurance project plan

TABLE 3-10. VAPOR INVESTIGATION SAMPLING PLAN
WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Building Name	Approximate Square Footage	Estimated Number of Indoor Air Sample Locations
Asphalt Plant Building	680	1
Pump House	660	1
Scale House	240	1
Engineering Office	5,240	3

Notes:

A minimum of one indoor air sample will be collected per proposed building and

one sample per 2,000 square feet.

See Table 2-6e for additional details on duplicates and ambient blank samples.

Abbreviations:

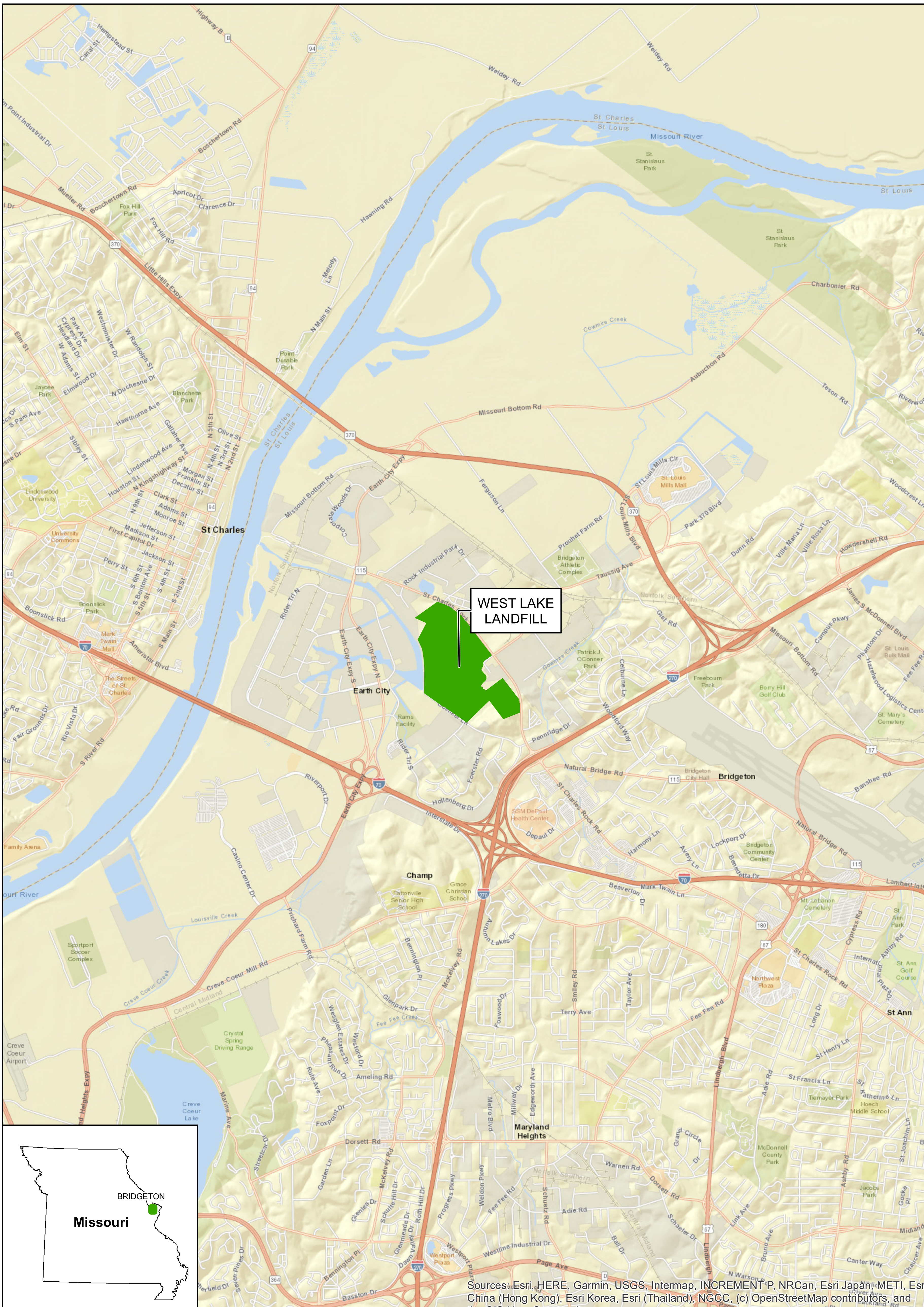
APB: Asphalt Plant Building

EO: Engineering Office

PH: Pump House

SH: Scale House

FIGURES



EXPLANATION

LANDFILL PROPERTY EXTENT

LATITUDE: 38.768106
LONGITUDE: -90.444574
LATITUDE AND LONGITUDE ARE IN NAD83

N

0 4,000 '

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FIGURE 1-1

SITE LOCATION MAP

WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Drawn By: KEJ	Checked By: MS	Scale: 1 " = 4,000 '	Date: 4/11/20	File: 1-1_SiteLocation_Fig1-1.mxd

M:\WTO\WESTLAKELANDFILL_ACP\GIS\MAPPING\202003_RIFS_WP\1-1_SITELOCATION_FIG1-1.MXD

EXPLANATION

- FORMER LEACHATE LAGOON
- LANDFILL PROPERTY BOUNDARY
- SUPERFUND SITE BOUNDARY
- OPERABLE UNIT 1

N

0 1,000 '

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FIGURE 1-2

SITE LAYOUT MAP

WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Drawn By: KEJ	Checked By: MS	Scale: 1 " = 1,000 '	Date: 4/21/20	File: 1-2_SiteLayout_Fig1-2.mxd

M:\WTO\WESTLAKELANDFILL_ACP\GIS\MAPPING\202003_RIFS_FSP\1-2_SITELAYOUT_FIG1-2.MXD

EXPLANATION

- SUPERFUND SITE BOUNDARY
- LANDFILL PROPERTY BOUNDARY
- FORMER LEACHATE LAGOON
- OPERABLE UNIT 1

N

0 500 '

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FIGURE 1-3

AREAS OF LANDFILL OPERATIONS

WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Drawn By: KEJ	Checked By: MS	Scale: 1 " = 500 '	Date: 4/21/20	File: 1-3_LandfillOperations_Fig1-3.mxd

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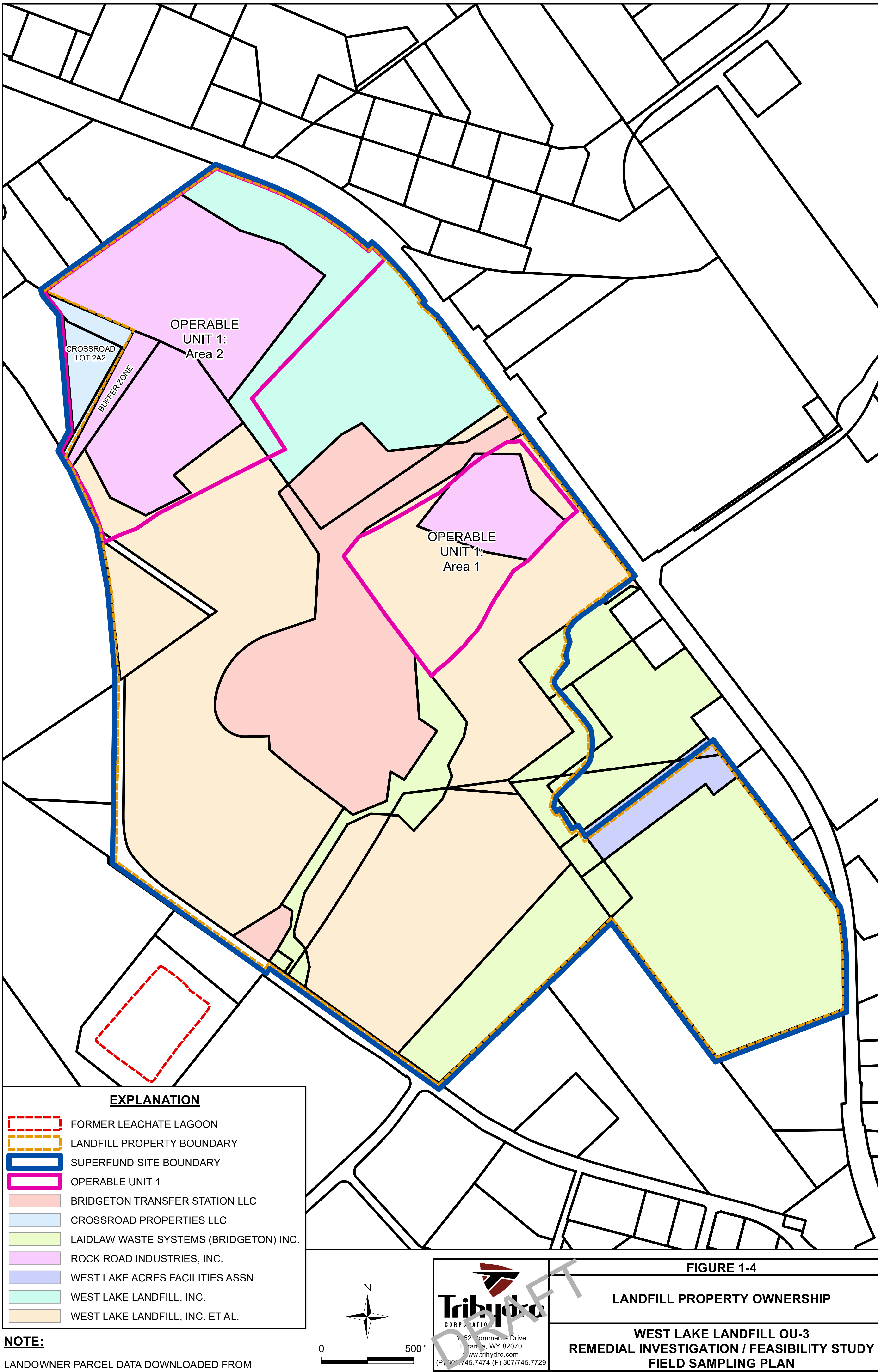

EXPLANATION

- FORMER LEACHATE LAGOON
- LANDFILL PROPERTY BOUNDARY
- SUPERFUND SITE BOUNDARY
- OPERABLE UNIT 1
- BRIDGETON TRANSFER STATION LLC
- CROSSROAD PROPERTIES LLC
- LAIDLAW WASTE SYSTEMS (BRIDGETON) INC.
- ROCK ROAD INDUSTRIES, INC.
- WEST LAKE ACRES FACILITIES ASSN.
- WEST LAKE LANDFILL, INC.
- WEST LAKE LANDFILL, INC. ET AL.

NOTE:

LANDOWNER PARCEL DATA DOWNLOADED FROM SAINT LOUIS COUNTY GIS SERVICE CENTER

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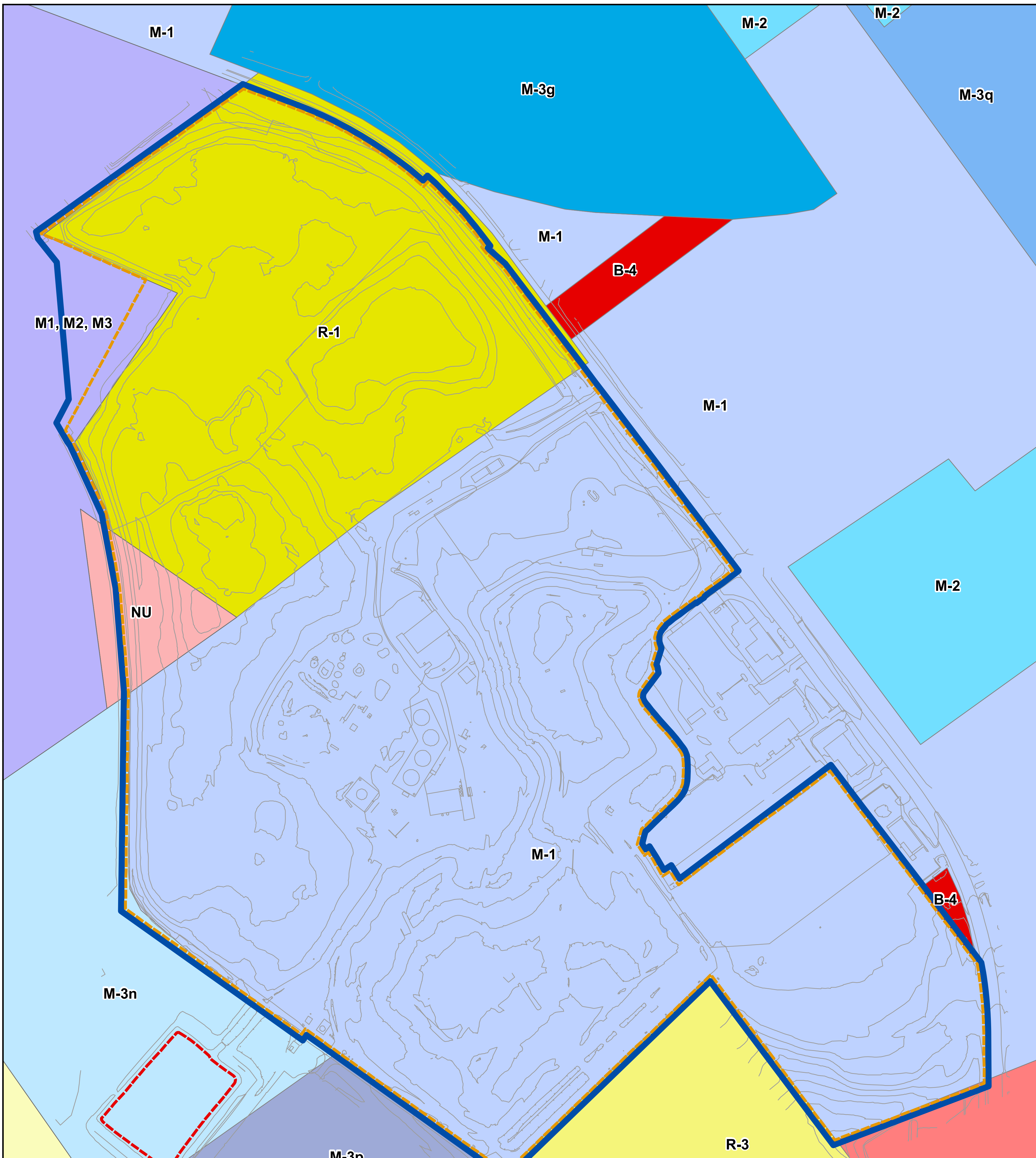
FIGURE 1-4

LANDFILL PROPERTY OWNERSHIP

WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Drawn By: KEJ	Checked By: MS	Scale: 1 " = 500 '	Date: 4/21/20	File: 1-4_LandfillPropertyOwnership_Fig1-4.mxd

M:\WTOZ\WESTLAKELANDFILL_ACP\GIS\MAPPING\202003_RIFS_FSP\1-4_LANDFILLPROPERTYOWNERSHIP_FIG1-4.MXD



EXPLANATION

- FORMER LEACHATE LAGOON
- LANDFILL PROPERTY BOUNDARY
- SUPERFUND SITE BOUNDARY
- B-3 = TRAVEL / ENTERTAINMENT SERVICES DISTRICT
- B-4 = GENERAL COMMERCIAL DISTRICT
- C1, C2, C3, C4, C8 = COMMERCIAL DISTRICT VAROUS (UNINCORPORATED)
- M-1 = MANUFACTURING DISTRICT, LIMITED
- M-2 = MANUFACTURING DISTRICT
- M-3A = PLANNED MANUFACTURING DISTRICT (HOLLENBERG BUSINESS PARK)
- M-3G = PLANNED MANUFACTURING DISTRICT (NORTHWEST INDUSTRIAL SUBDIVISION)
- M-3N = PLANNED MANUFACTURING DISTRICT (CORPORATE EXCHANGE PLAT)
- M-3O = PLANNED MANUFACTURING DISTRICT (CORPORATE EXCHANGE PLAT)
- M-3P = PLANNED MANUFACTURING DISTRICT (CORPORATE EXCHANGE PLAT)
- M-3Q = PLANNED MANUFACTURING DISTRICT (NORTHWEST INDUSTRIAL PARK)
- M1, M2, M3 = INDUSTRIAL DISTRICT VAROUS (UNINCORPORATED)
- NU = NON-URBAN DISTRICT (UNINCORPORATED)
- R-1 = SINGLE FAMILY DWELLING DISTRICT
- R-3 = SINGLE FAMILY DWELLING DISTRICT

NOTES:

1. LANDOWNER PARCEL DATA DOWNLOADED FROM SAINT LOUIS COUNTY GIS SERVICE CENTER
2. ZONING DATA FROM CITY OF BRIDGETON ZONING MAP AMENDED 9/20/2017 AND ZONING IN UNINCORPORATED AREA ST. LOUIS COUNTY, MISSOURI PREPARED JULY 2018

N

0 500 '

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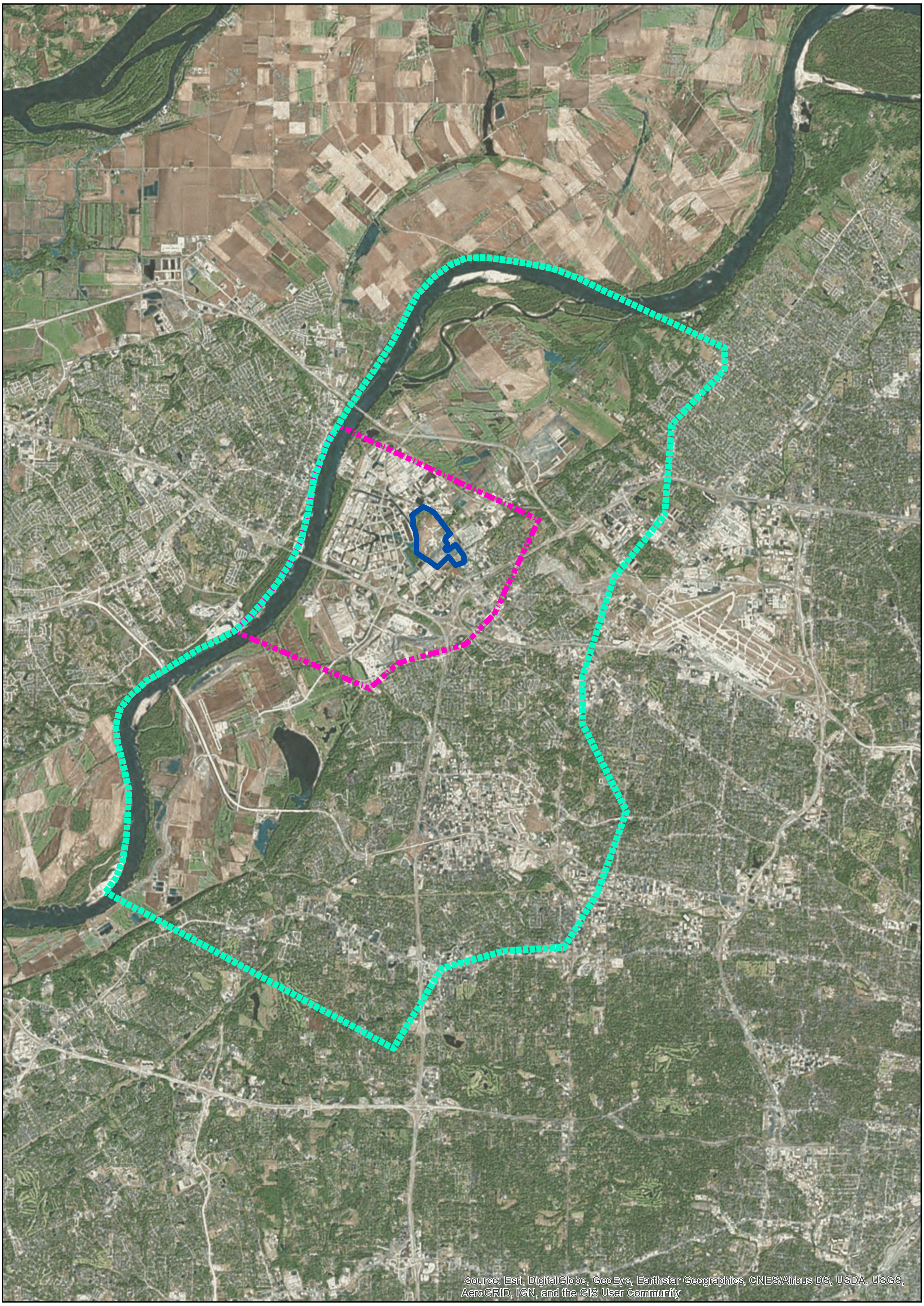
FIGURE 1-5

LANDFILL AND SURROUNDING AREA ZONING

WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Drawn By: KEJ	Checked By: MS	Scale: 1 " = 500 '	Date: 4/21/20	File: 1-5_Zoning_Fig1-5.mxd

M:\WTO\WESTLAKELANDFILL_ACP\GIS\MAPPING\202003_RIFS_FSP\1-5_ZONING_FIG1-5.MXD



EXPLANATION

- STUDY AREA
- USEPA PROPOSED GROUNDWATER MODELING DOMAIN
- SUPERFUND SITE BOUNDARY

N

0 8,000 '

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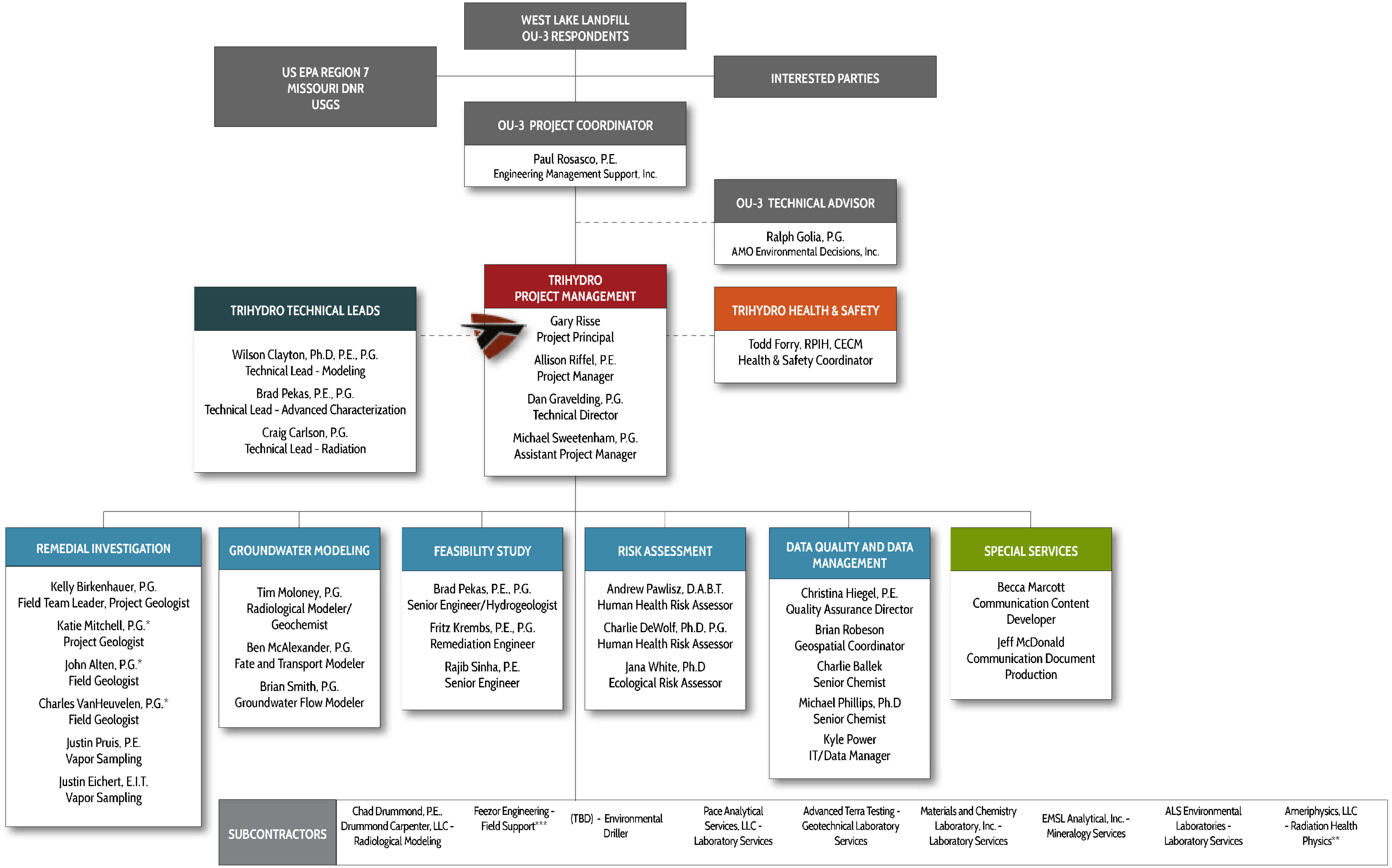
FIGURE 1-6

OU-3 STUDY AREA AND PRELIMINARY GROUNDWATER MODELING DOMAIN

WEST LAKE LANDFILL OU-3 REMEDIAL INVESTIGATION / FEASIBILITY STUDY FIELD SAMPLING PLAN

Drawn By: MGS	Checked By: WC	Scale: 1 " = 8,000 '	Date: 4/21/20	File: 1-6_OU-3_Fig1-6.mxd

M:\WTOZ\WESTLAKELANDFILL ACP\GIS\MAPPING\202003_RIFS_FSP\1-6_OU-3_FIG1-6.MXD



NOTES:

US EPA - UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
DNR - DEPARTMENT OF NATURAL RESOURCES
USGS - UNITED STATES GEOLOGICAL SURVEY
OU-3 - OPERABLE UNIT 3
P.E. - PROFESSIONAL ENGINEER
P.G. - PROFESSIONAL GEOLOGIST
USACE - UNITED STATES ARMY CORPS OF ENGINEERS
RPIH - REGISTERED PROFESSIONAL INDUSTRIAL HYGIENIST
CECM - CERTIFIED ENVIRONMENTAL COMPLIANCE MANAGER
E.I.T - ENGINEER IN TRAINING
D.A.B.T - DIPLOMAT OF THE AMERICAN BOARD OF TOXICOLOGY
PH.D - DOCTOR OF PHILOSOPHY
TBD - TO BE DETERMINED
IT - INFORMATION TECHNOLOGY
LLC - LIMITED LIABILITY COMPANY
* MAY SERVE AS SITE QUALITY CONTROL OFFICER AND/OR SITE HEALTH AND SAFETY OFFICER AT ANYTIME.
** RADIATION SAFETY OFFICER AND RADIOLOGICAL CONTROL SUPERVISOR
*** RADIOLOGICAL CONTROL SUPERVISOR

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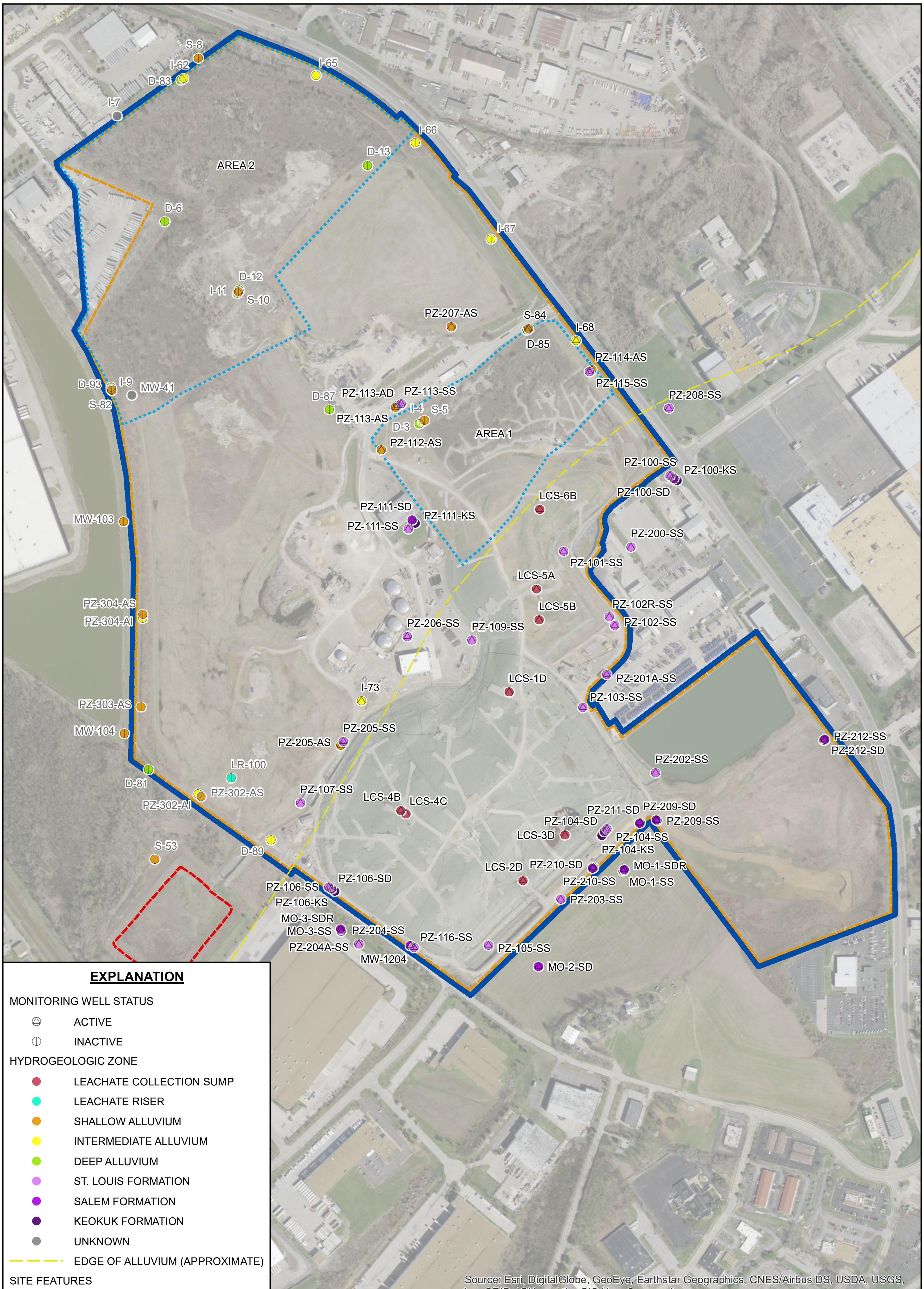
FIGURE 1-7

PROJECT ORGANIZATIONAL CHART

WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Drawn By: KEJ	Checked By: MS		Date: 4/22/20	File: 1-7_OrgChart_Fig1-7.mxd



EXPLANATION

MONITORING WELL STATUS

- ACTIVE
- INACTIVE

HYDROGEOLOGIC ZONE

- LEACHATE COLLECTION SUMP
- LEACHATE RISER
- SHALLOW ALLUVIUM
- INTERMEDIATE ALLUVIUM
- DEEP ALLUVIUM
- ST. LOUIS FORMATION
- SALEM FORMATION
- KEOKUK FORMATION
- UNKNOWN
- EDGE OF ALLUVIUM (APPROXIMATE)

SITE FEATURES

- OU-1
- FORMER LEACHATE LAGOON
- LANDFILL PROPERTY BOUNDARY
- SUPERFUND SITE BOUNDARY

NOTE:

THE LOCATION OF MW-1201 UNKNOWN AND IS NOT DISPLAYED

N

0 500 '

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FIGURE 3-1

CURRENT MONITORING WELL NETWORK

WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Drawn By: MGS	Checked By: SLL	Scale: 1 " = 500 '	Date: 4/21/20	File: 3-1_MWNetwork_Fig3-1.mxd

M:\WTOZ\WESTLAKELANDFILL_ACP\GIS\MAPPING\202003_RIFS_FSP\3-1_MWNETWORK_FIG3-1.MXD

NOTE:

PROPOSED WELL LOCATIONS SUBJECT TO CHANGE DUE TO THE POTENTIAL FOR BURIED UTILITIES OR LACK OF ACCESS BY LANDOWNERS

N

0 100 '

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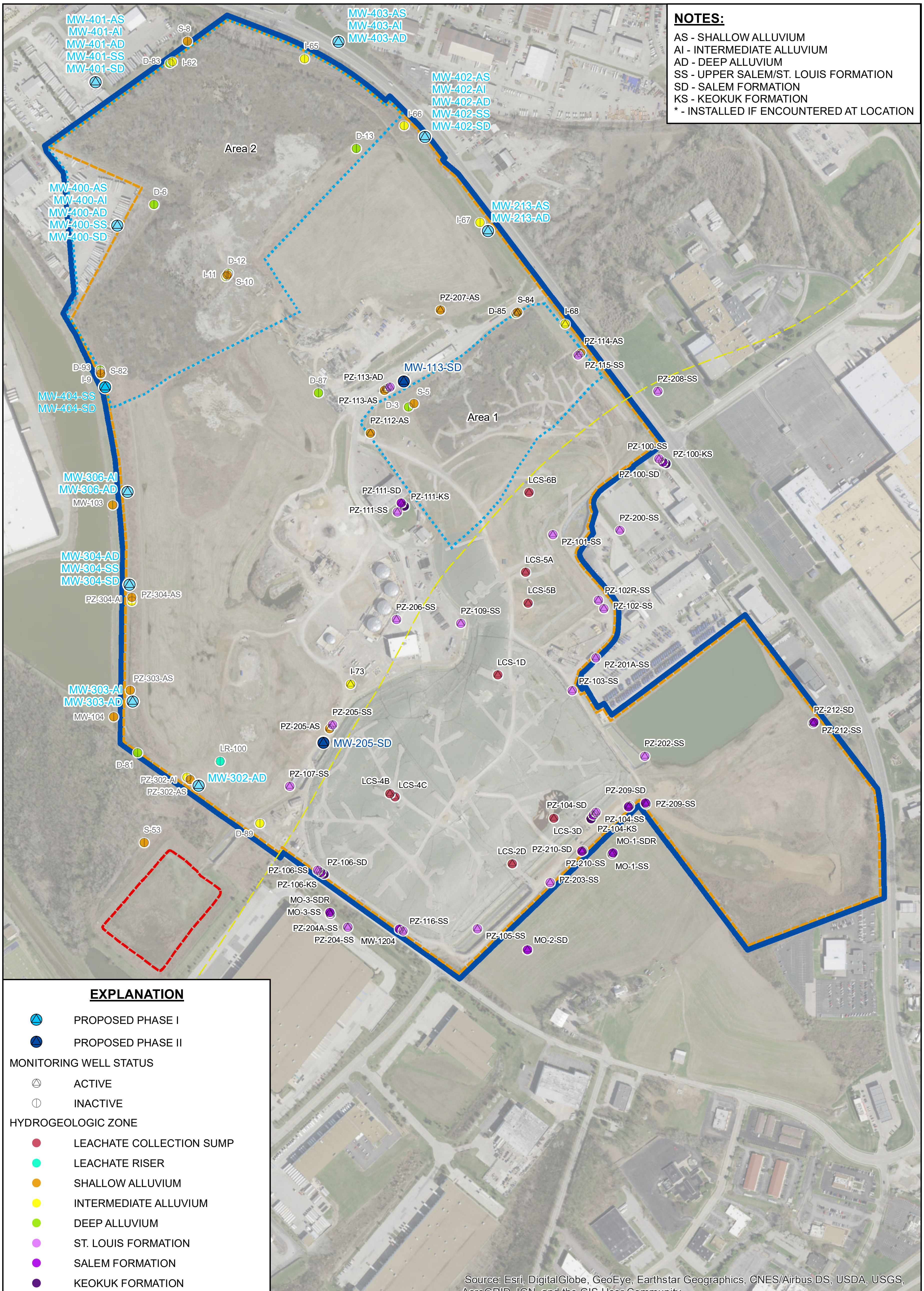
FIGURE 3-2

PROPOSED HYDRAULIC PROFILING TOOL TRANSECT

WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Drawn By: MGS	Checked By: AMR	Scale: 1 " = 100 '	Date: 4/21/20	File: 3-2_ProposedHPT_Fig3-2.mxd



NOTES:

AS - SHALLOW ALLUVIUM
AI - INTERMEDIATE ALLUVIUM
AD - DEEP ALLUVIUM
SS - UPPER SALEM/ST. LOUIS FORMATION
SD - SALEM FORMATION
KS - KEOKUK FORMATION
* - INSTALLED IF ENCOUNTERED AT LOCATION

EXPLANATION

PROPOSED PHASE I
PROPOSED PHASE II

MONITORING WELL STATUS
ACTIVE
INACTIVE

HYDROGEOLOGIC ZONE
LEACHATE COLLECTION SUMP
LEACHATE RISER
SHALLOW ALLUVIUM
INTERMEDIATE ALLUVIUM
DEEP ALLUVIUM
ST. LOUIS FORMATION
SALEM FORMATION
KEOKUK FORMATION
UNKNOWN
EDGE OF ALLUVIUM (APPROXIMATE)

SITE FEATURES
OU-1
FORMER LEACHATE LAGOON
LANDFILL PROPERTY BOUNDARY
SUPERFUND SITE BOUNDARY

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FIGURE 3-3

PROPOSED ON-SITE AND NEAR-SITE MONITORING WELLS

**WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN**

Drawn By: MGS	Checked By: SLL	Scale: 1 " = 500 '	Date: 4/22/20	File: 3-3_On-SiteMW_Fig3-3.mxd

M:\WTO\WESTLAKE\LANDFILL_ACP\GIS\MAPPING\202003_RIFS_FSP\3-3_ON-SITEMW_FIG3-3.MXD

EXPLANATION

PROPOSED OFF-SITE MONITORING WELL

MONITORING WELL STATUS
- ACTIVE
- INACTIVE

EDGE OF ALLUVIUM (APPROXIMATE)

SITE FEATURES
- OU-1
- FORMER LEACHATE LAGOON
- LANDFILL PROPERTY BOUNDARY
- SUPERFUND SITE BOUNDARY

HYDROGEOLOGIC ZONE
- LEACHATE COLLECTION SUMP
- LEACHATE RISER
- SHALLOW ALLUVIUM
- INTERMEDIATE ALLUVIUM
- DEEP ALLUVIUM
- ST. LOUIS FORMATION
- SALEM FORMATION
- KEOKUK FORMATION
- UNKNOWN

NOTES:

1. PROPOSED WELL LOCATIONS SUBJECT TO CHANGE DUE TO THE POTENTIAL FOR BURIED UTILITIES OR LACK OF ACCESS BY LANDOWNERS
2. 500-SERIES BEDROCK WELLS INSTALLED DURING PHASE II
3. DEFINITIONS:
   - AS - SHALLOW ALLUVIUM
   - AI - INTERMEDIATE ALLUVIUM
   - AD - DEEP ALLUVIUM
   - SS - UPPER SALEM/ST. LOUIS FORMATION
   - SD - SALEM FORMATION
   - KS - KEOKUK FORMATION

* - INSTALLED IF ENCOUNTERED AT LOCATION

N

0 800 '

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FIGURE 3-4

PROPOSED OFF-SITE MONITORING WELLS

WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Drawn By: MGS	Checked By: AMR	Scale: 1 " = 800 '	Date: 4/22/20	File: 3-4_Off-SiteMW_Fig3-4.mxd

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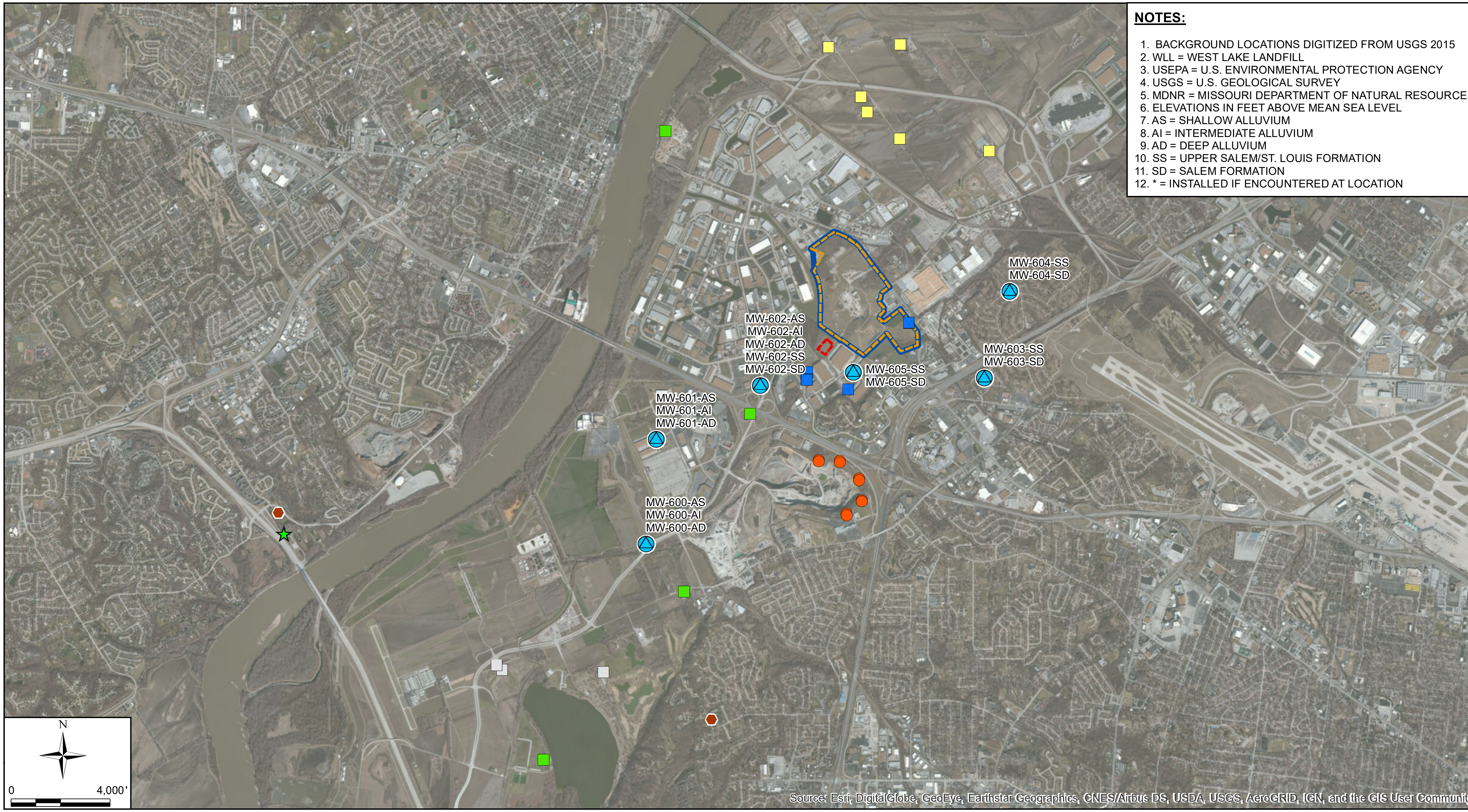

NOTES:

1. BACKGROUND LOCATIONS DIGITIZED FROM USGS 2015
2. WLL = WEST LAKE LANDFILL
3. USEPA = U.S. ENVIRONMENTAL PROTECTION AGENCY
4. USGS = U.S. GEOLOGICAL SURVEY
5. MDNR = MISSOURI DEPARTMENT OF NATURAL RESOURCES
6. ELEVATIONS IN FEET ABOVE MEAN SEA LEVEL
7. AS = SHALLOW ALLUVIUM
8. AI = INTERMEDIATE ALLUVIUM
9. AD = DEEP ALLUVIUM
10. SS = UPPER SALEM/ST. LOUIS FORMATION
11. SD = SALEM FORMATION
12. * = INSTALLED IF ENCOUNTERED AT LOCATION

EXPLANATION

PROPOSED BACKGROUND MONITORING WELL

USGS BACKGROUND DATA SOURCE

- WLL RESPONDENTS 2013 SAMPLE
- USEPA 2013 ALLUVIAL WELL SAMPLE
- USGS-RP 2013 ALLUVIAL WELL SAMPLE
- USGS-RP 2013 BEDROCK SAMPLE
- MDNR CHAMP LANDFILL EXPANSION SAMPLE
- HISTORICAL USGS DATA
- MDNR PUBLIC-DRINKING WATER BRANCH
- FORMER LEACHATE LAGOON
- LANDFILL PROPERTY BOUNDARY
- SUPERFUND SITE BOUNDARY

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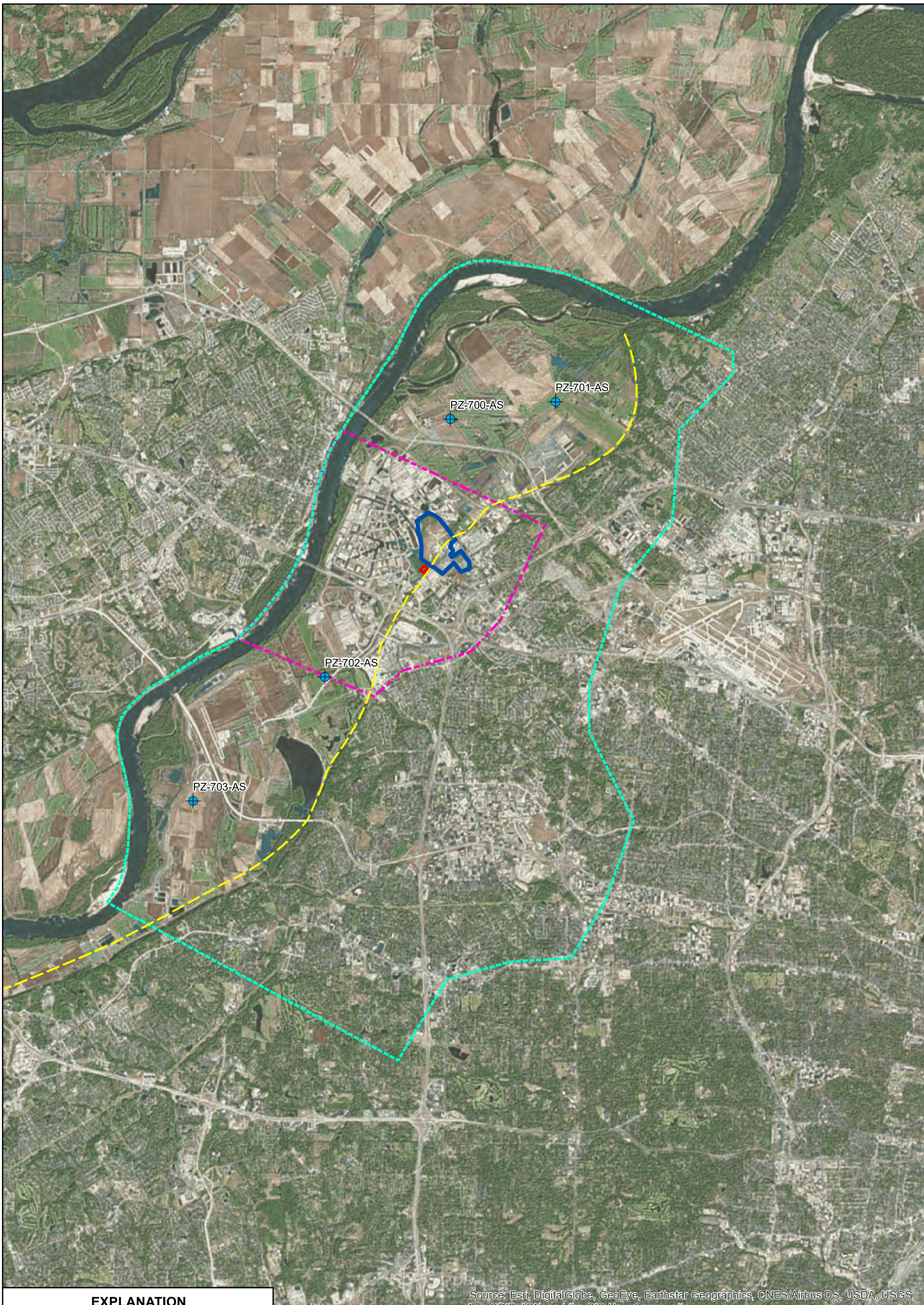
FIGURE 3-5

PROPOSED BACKGROUND MONITORING WELLS

WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Drawn By: MGS	Checked By: SLL	Scale: 1 " = 4,000 '	Date: 4/21/20	File: 3-5_BGMW_Fig3-5.mxd

M:\WTO\WESTLAKELANDFILL_ACP\GIS\MAPPING\202003_RIFS_FSP\3-5_BGMW_FIG3-5.MXD



EXPLANATION

- PROPOSED PIEZOMETER LOCATION
- EDGE OF ALLUVIUM (APPROXIMATE)
- STUDY AREA
- PRELIMINARY GROUNDWATER MODELING DOMAIN
- FORMER LEACHATE LAGOON
- SUPERFUND SITE BOUNDARY

N

0 8,000 '

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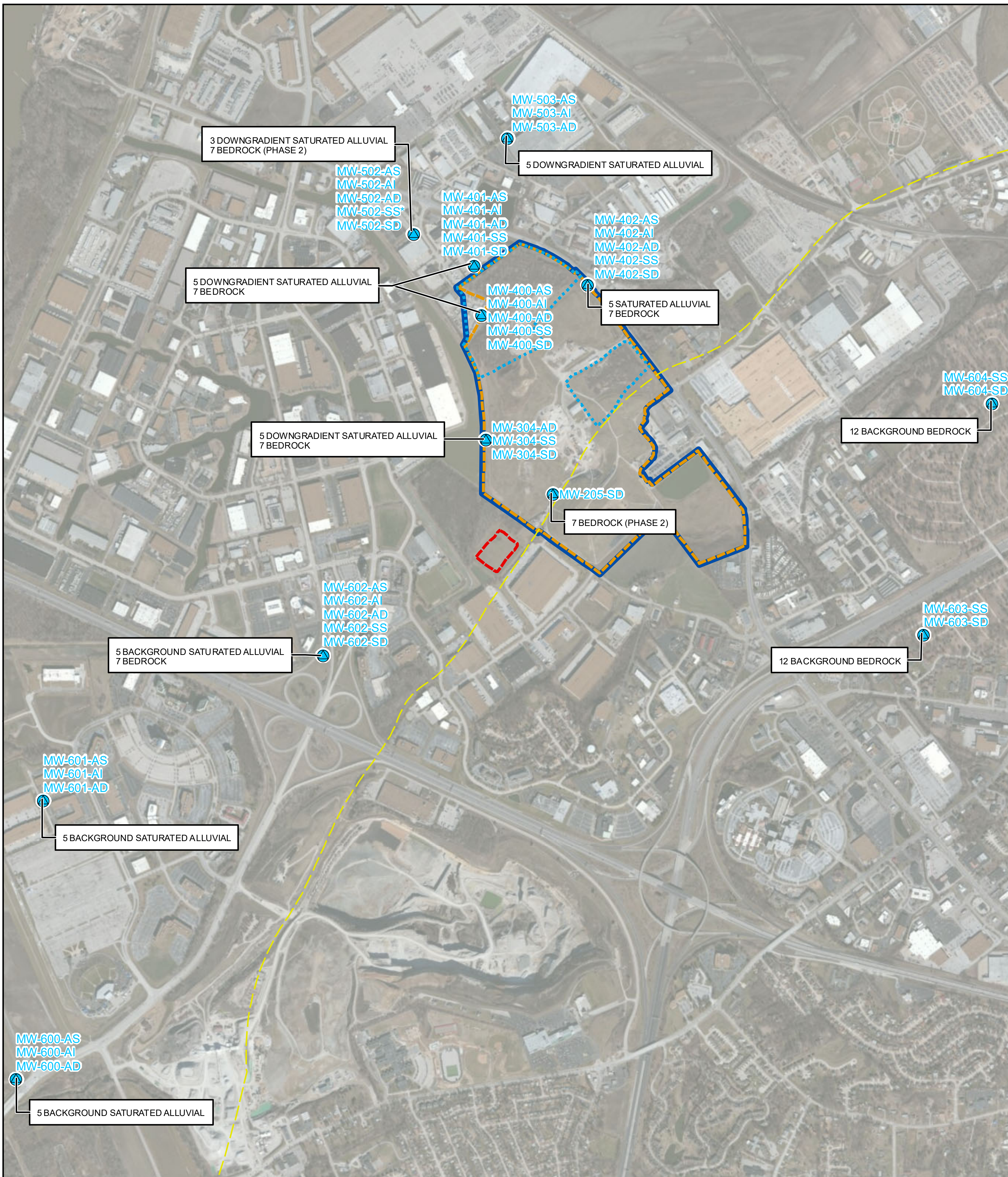
FIGURE 3-6

PROPOSED PIEZOMETER LOCATIONS

WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Drawn By: MGS	Checked By: WC	Scale: 1 " = 8,000 '	Date: 4/21/20	File: 3-6_PropPZ_Fig3-6.mxd



NOTES:

1. PROPOSED WELL LOCATIONS SUBJECT TO CHANGE DUE TO THE POTENTIAL FOR BURIED UTILITIES OR LACK OF ACCESS BY LANDOWNERS
2. NUMBER OF SAMPLES BASED ON ~100 FEET OF ALLUVIUM AND 140 FEET OF BEDROCK (240 FEET OF BEDROCK EAST OF EDGE OF ALLUVIUM)

AS - SHALLOW ALLUVIUM
AI - INTERMEDIATE ALLUVIUM
AD - DEEP ALLUVIUM
SS - UPPER SALEM/ST. LOUIS FORMATION
SD - SALEM FORMATION
KS - KEOKUK FORMATION
SE - ALLUVIAL
* - INSTALLED IF ENCOUNTERED AT LOCATION

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

EXPLANATION

PROPOSED MONITORING WELL
EDGE OF ALLUVIUM (APPROXIMATE)

SITE FEATURES
OU-1
FORMER LEACHATE LAGOON
LANDFILL PROPERTY BOUNDARY
SUPERFUND SITE BOUNDARY

N

0 1,600 '

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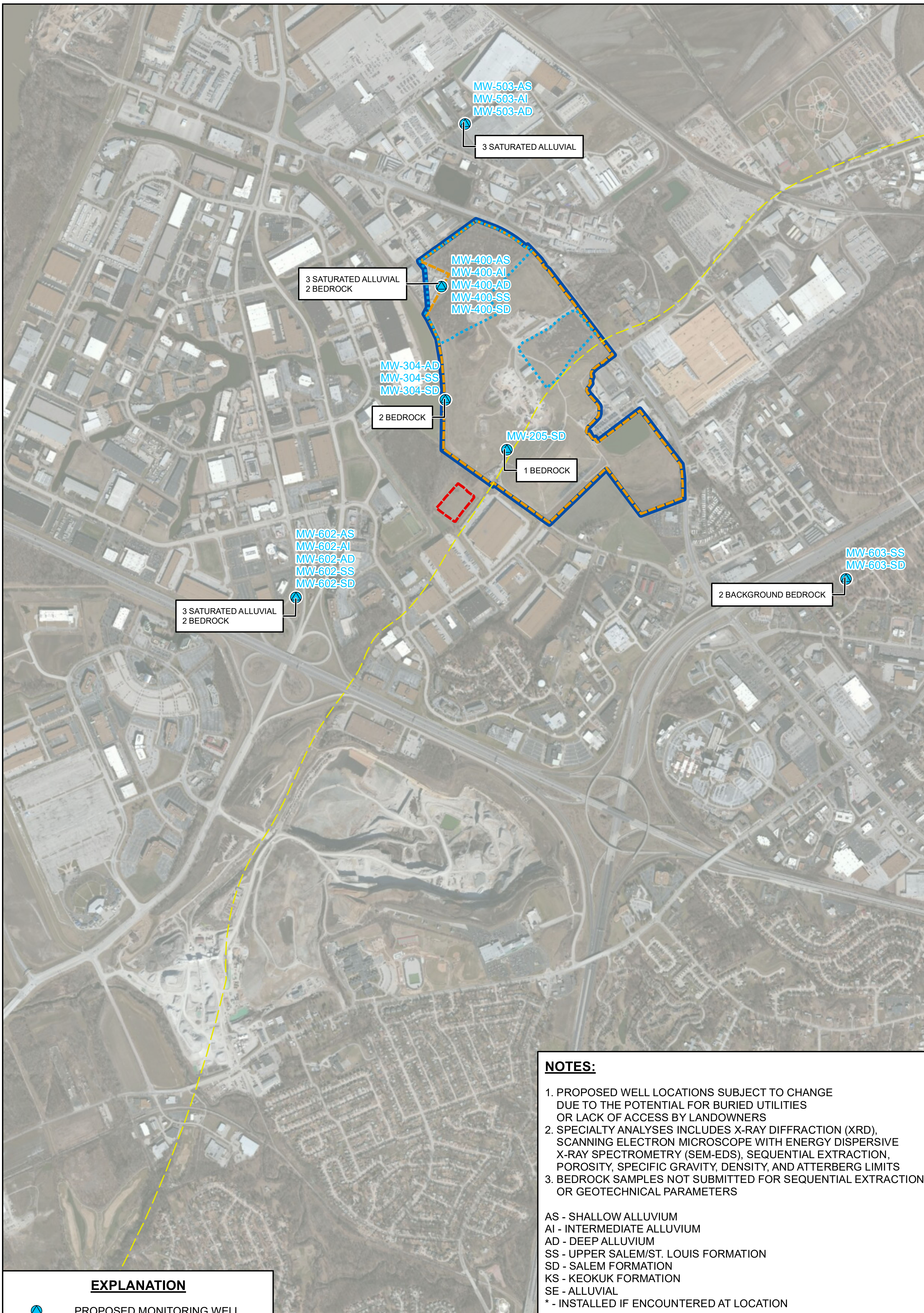
FIGURE 3-7a

ALLUVIAL/BEDROCK ANALYSES SAMPLE LOCATIONS

WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Drawn By: MGS	Checked By: AMR	Scale: 1 " = 1,600 '	Date: 4/22/20	File: 3-7a_SoilBedrockSamples_Fig3-7a.mxd



NOTES:

1. PROPOSED WELL LOCATIONS SUBJECT TO CHANGE DUE TO THE POTENTIAL FOR BURIED UTILITIES OR LACK OF ACCESS BY LANDOWNERS
2. SPECIALTY ANALYSES INCLUDES X-RAY DIFFRACTION (XRD), SCANNING ELECTRON MICROSCOPE WITH ENERGY DISPERSIVE X-RAY SPECTROMETRY (SEM-EDS), SEQUENTIAL EXTRACTION, POROSITY, SPECIFIC GRAVITY, DENSITY, AND ATTERBERG LIMITS
3. BEDROCK SAMPLES NOT SUBMITTED FOR SEQUENTIAL EXTRACTION OR GEOTECHNICAL PARAMETERS

AS - SHALLOW ALLUVIUM
AI - INTERMEDIATE ALLUVIUM
AD - DEEP ALLUVIUM
SS - UPPER SALEM/ST. LOUIS FORMATION
SD - SALEM FORMATION
KS - KEOKUK FORMATION
SE - ALLUVIAL
* - INSTALLED IF ENCOUNTERED AT LOCATION

EXPLANATION

PROPOSED MONITORING WELL
EDGE OF ALLUVIUM (APPROXIMATE)
SITE FEATURES
OU-1
FORMER LEACHATE LAGOON
LANDFILL PROPERTY BOUNDARY
SUPERFUND SITE BOUNDARY

N

0 1,600 '

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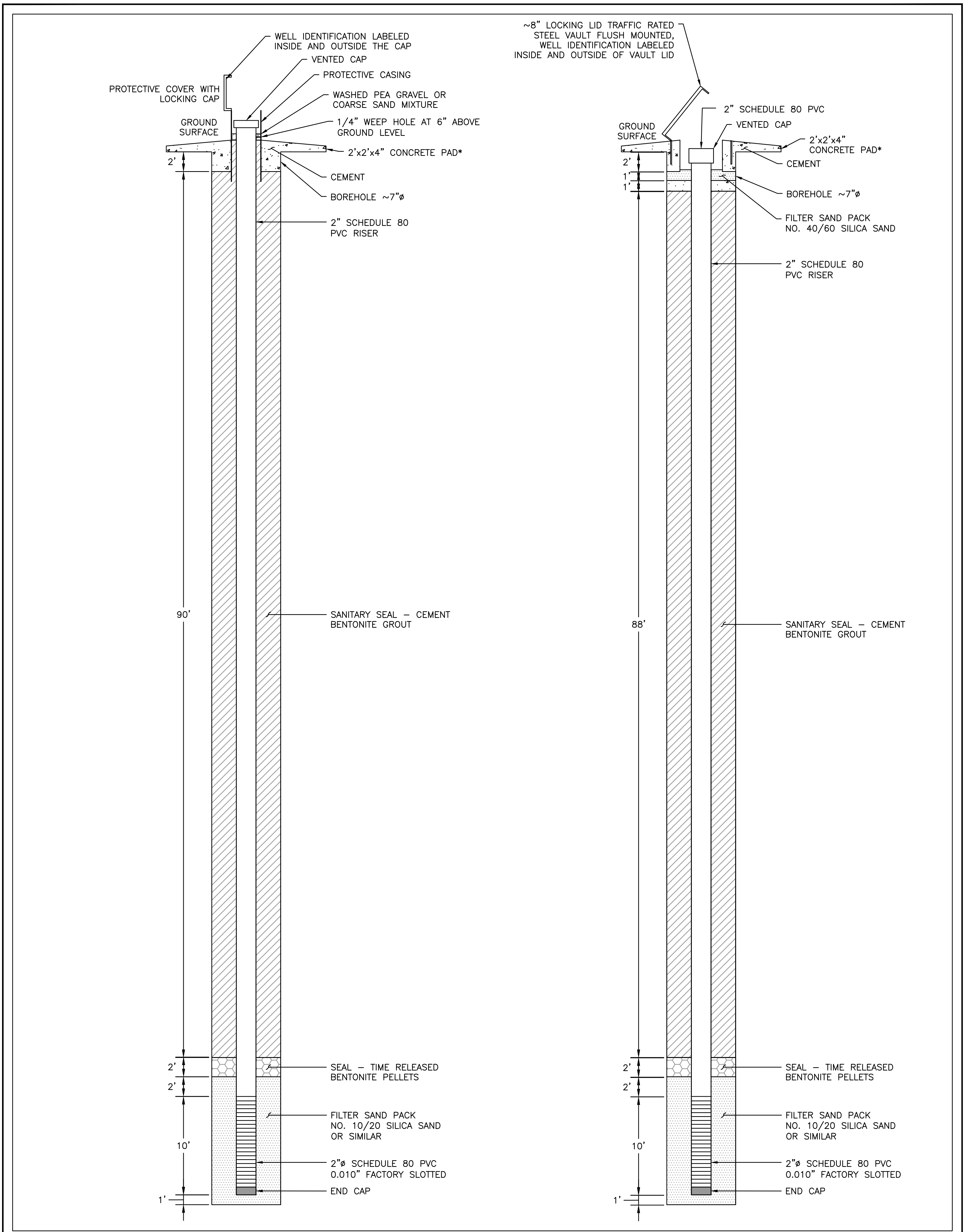
FIGURE 3-7b

SPECIALTY ANALYSES SAMPLE LOCATIONS

WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Drawn By: MGS	Checked By: AMR	Scale: 1 " = 1,600 '	Date: 4/22/20	File: 3-7b_MineralExtract_Fig3-7b.mxd

M:\WTOZ\WESTLAKELANDFILL_ACP\GIS\MAPPING\202003_RIFS_FSP\3-7B_MINERALEXTRACT_FIG3-7B.MXD



NOTES:

1. DRAWING IS SCALED VERTICALLY TO SHOW DEPTH. HORIZONTAL SCALE IS ADJUSTED TO SHOW FEATURES AND IS INDEPENDENT OF VERTICAL SCALE.
2. BGS = BELOW GROUND SURFACE
3. ACTUAL INTERVALS MAY VARY BASED ON FIELD CONDITIONS.
4. ALL MONITORING WELLS WILL BE CONSTRUCTED ACCORDING TO MISSOURI DEPARTMENT OF NATURAL RESOURCES MONITORING WELL CONSTRUCTION CODE (10 CSR 23-4) AND WILL BE PERMITTED PRIOR TO CONSTRUCTION WHERE APPLICABLE.
5. ALL MONITORING WELLS WILL BE INSTALLED BY A LICENSED WELL CONTRACTOR AND OVERSEEN BY AN ENVIRONMENTAL OR ENGINEERING ENTITY WITH A RESTRICTED MONITORING WELL CONTRACTOR'S PERMIT.
6. * = SURFACE COMPLETIONS ARE NOT TO SCALE

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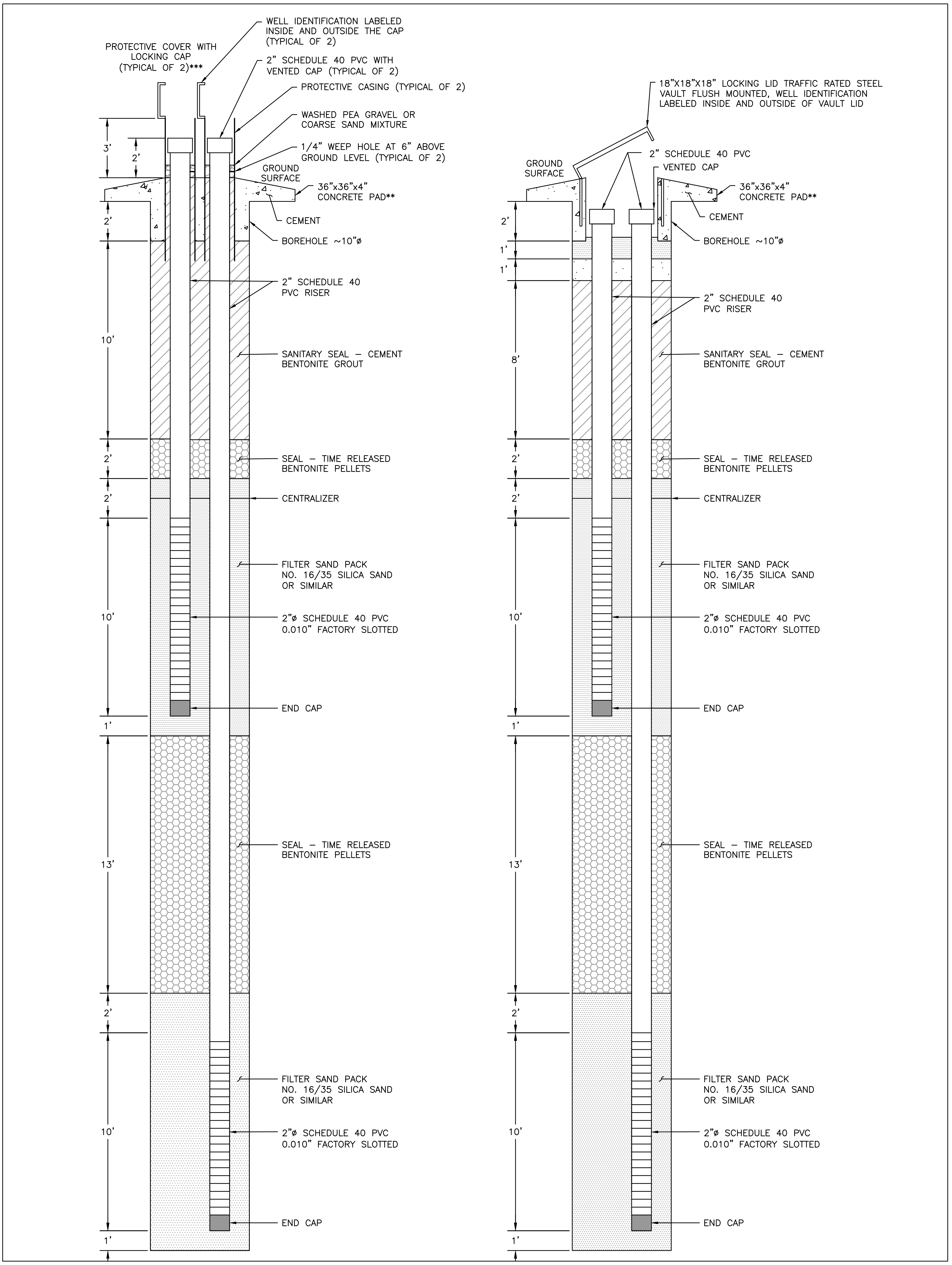
FIGURE 3-8a

EXAMPLE MONITORING WELL CONSTRUCTION DETAILS SINGLE ALLUVIAL MONITORING WELLS

WEST LAKE LANDFILL OU-3 REMEDIAL INVESTIGATION / FEASIBILITY STUDY FIELD SAMPLING PLAN

Drawn By: DMB	Checked By: MGS	Scale: NONE	Date: 4/8/2020	File: 63N_MONWELLDETAIL202003



NOTES:

1. DRAWING IS SCALED VERTICALLY TO SHOW DEPTH. HORIZONTAL SCALE IS ADJUSTED TO SHOW FEATURES AND IS INDEPENDENT OF VERTICAL SCALE.
2. BGS = BELOW GROUND SURFACE
3. ACTUAL INTERVALS MAY VARY BASED ON FIELD CONDITIONS.
4. ALL MONITORING WELLS WILL BE CONSTRUCTED ACCORDING TO MISSOURI DEPARTMENT OF NATURAL RESOURCES MONITORING WELL CONSTRUCTION CODE (10 CSR 23-4) AND WILL BE PERMITTED PRIOR TO CONSTRUCTION WHERE APPLICABLE.
5. ALL MONITORING WELLS WILL BE INSTALLED BY A LICENSED WELL CONTRACTOR AND OVERSEEN BY AN ENVIRONMENTAL OR ENGINEERING ENTITY WITH A RESTRICTED MONITORING WELL CONTRACTOR'S PERMIT.
6. ** = SURFACE COMPLETIONS ARE NOT TO SCALE
7. *** = NESTED WELLS MAY BE CONSTRUCTED WITH AN ABOVE-GROUND VAULT SURFACE COMPLETION.

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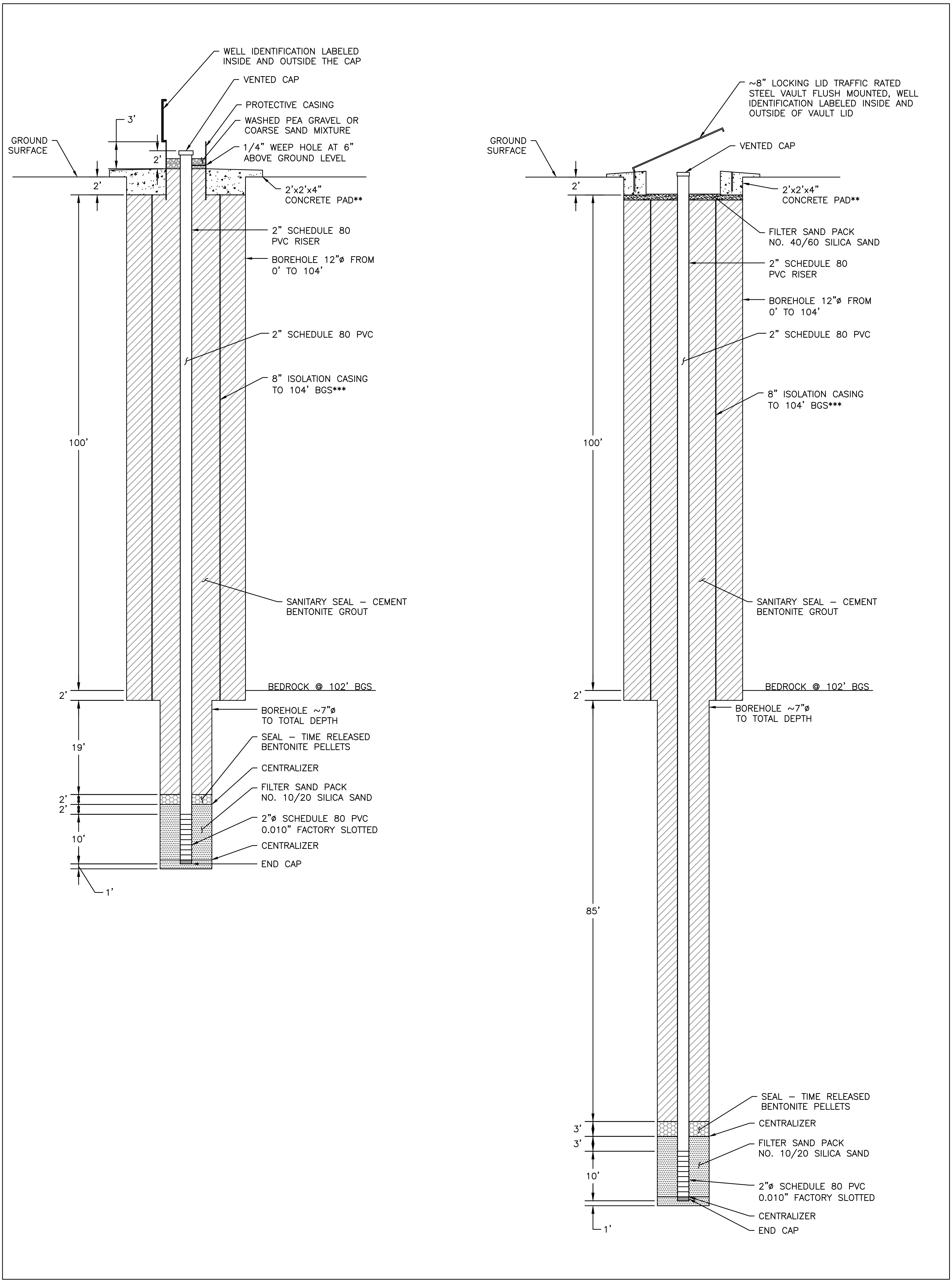
FIGURE 3-8b

EXAMPLE MONITORING WELL CONSTRUCTION DETAILS NESTED ALLUVIAL AQUIFER MONITORING WELLS

WEST LAKE LANDFILL OU-3 REMEDIAL INVESTIGATION / FEASIBILITY STUDY FIELD SAMPLING PLAN

Drawn By: DMB	Checked By: MGS	Scale: NONE	Date: 4/8/2020	File: 63N_MONWELLDETAIL202003

\\TRIHYDRO.COM\CLIENTS\WTOZ\WESTLAKELANDFILL_ACP\CADD\SINGLEFIGURES\63N_MONWELLDETAIL202003



NOTES:

1. DRAWING IS SCALED VERTICALLY TO SHOW DEPTH. HORIZONTAL SCALE IS ADJUSTED TO SHOW FEATURES AND IS INDEPENDENT OF VERTICAL SCALE.
2. BGS = BELOW GROUND SURFACE
3. ACTUAL INTERVALS MAY VARY BASED ON FIELD CONDITIONS.
4. ALL MONITORING WELLS WILL BE CONSTRUCTED ACCORDING TO MISSOURI DEPARTMENT OF NATURAL RESOURCES MONITORING WELL CONSTRUCTION CODE (10 CSR 23-4) AND WILL BE PERMITTED PRIOR TO CONSTRUCTION WHERE APPLICABLE.
5. ALL MONITORING WELLS WILL BE INSTALLED BY A LICENSED WELL CONTRACTOR AND OVERSEEN BY AN ENVIRONMENTAL OR ENGINEERING ENTITY WITH A RESTRICTED MONITORING WELL CONTRACTOR'S PERMIT.
6. ** = SURFACE COMPLETION IS NOT TO SCALE
7. *** = 8" ISOLATION CASING TO 2' BELOW BEDROCK SURFACE

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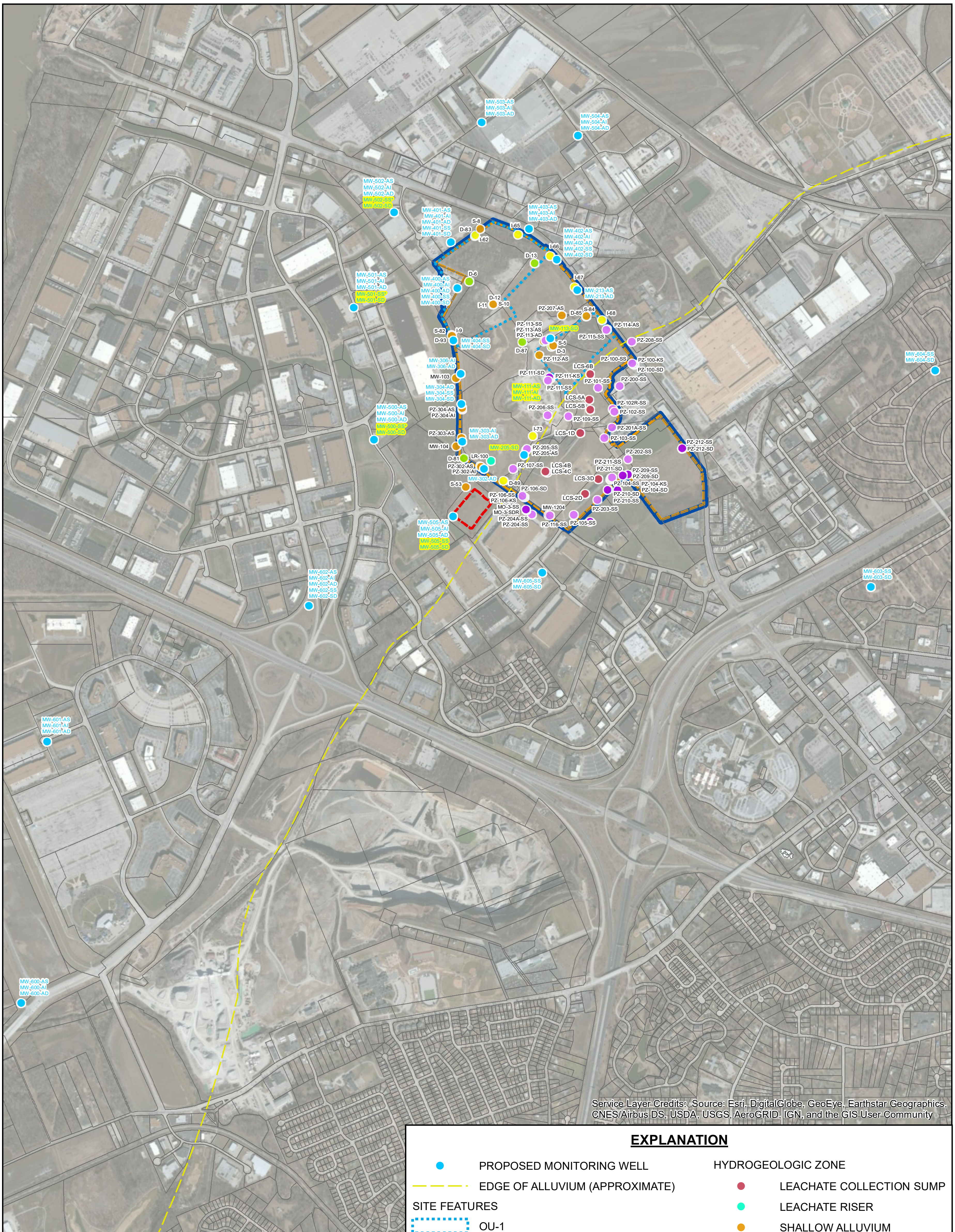
FIGURE 3-8c

EXAMPLE MONITORING WELL CONSTRUCTION DETAILS BEDROCK AQUIFER MONITORING WELLS

WEST LAKE LANDFILL OU-3 REMEDIAL INVESTIGATION / FEASIBILITY STUDY FIELD SAMPLING PLAN

Drawn By: DMB	Checked By: MGS	Scale: NONE	Date: 4/8/2020	File: 63N_MONWELLDETAIL202003

\\TRIHYDRO.COM\CLIENTS\WTOZ\WESTLAKELANDFILL_ACP\CADD\SINGLEFIGURES\63N_MONWELLDETAIL202003



EXPLANATION

- PROPOSED MONITORING WELL
- EDGE OF ALLUVIUM (APPROXIMATE)

SITE FEATURES

- OU-1
- FORMER LEACHATE LAGOON
- LANDFILL PROPERTY BOUNDARY
- SUPERFUND SITE BOUNDARY

HYDROGEOLOGIC ZONE

- LEACHATE COLLECTION SUMP
- LEACHATE RISER
- SHALLOW ALLUVIUM
- INTERMEDIATE ALLUVIUM
- DEEP ALLUVIUM
- ST. LOUIS FORMATION
- SALEM FORMATION
- KEOKUK FORMATION

NOTES:

1. PROPOSED WELL LOCATIONS SUBJECT TO CHANGE DUE TO THE POTENTIAL FOR BURIED UTILITIES OR LACK OF ACCESS BY LANDOWNERS
2. SEE FIGURE 5-5g FOR LOCATIONS OF PROPOSED PIEZOMETERS
3. HIGHLIGHTED WELLS PROPOSED TO BE INSTALLED DURING PHASE II AS OUTLINED IN WORK PLAN SECTION 4.3
4. DEFINITIONS:
   AS - SHALLOW ALLUVIUM
   AI - INTERMEDIATE ALLUVIUM
   AD - DEEP ALLUVIUM
   SS - UPPER SALEM/ST. LOUIS FORMATION
   SD - SALEM FORMATION
   KS - KEOKUK FORMATION

* - INSTALLED IF ENCOUNTERED AT LOCATION

N

0 1,600 '

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FIGURE 3-9

PROPOSED MONITORING WELL NETWORK

WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Drawn By: MGS	Checked By: AMR	Scale: 1 " = 1,600 '	Date: 4/22/20	File: 3-9_RevMW_Fig3-9.mxd

M:\WTO\WESTLAKELANDFILL_ACP\GIS\MAPPING\202003_RIFS_FSP\3-9_REVMW_FIG3-9.MXD

EXPLANATION

- MISSOURI RIVER STAFF GAUGE - USGS06935965
- PROPOSED STAFF GAUGE
- FORMER LEACHATE LAGOON
- LANDFILL PROPERTY BOUNDARY
- SUPERFUND SITE BOUNDARY

N

0 3,000 '

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FIGURE 3-10

PROPOSED STAFF GAUGE LOCATIONS

WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Drawn By: KEJ	Checked By: AMR	Scale: 1 " = 3,000 '	Date: 4/21/20	File: 3-10_ProposedStaffGauge_Fig3-10.mxd

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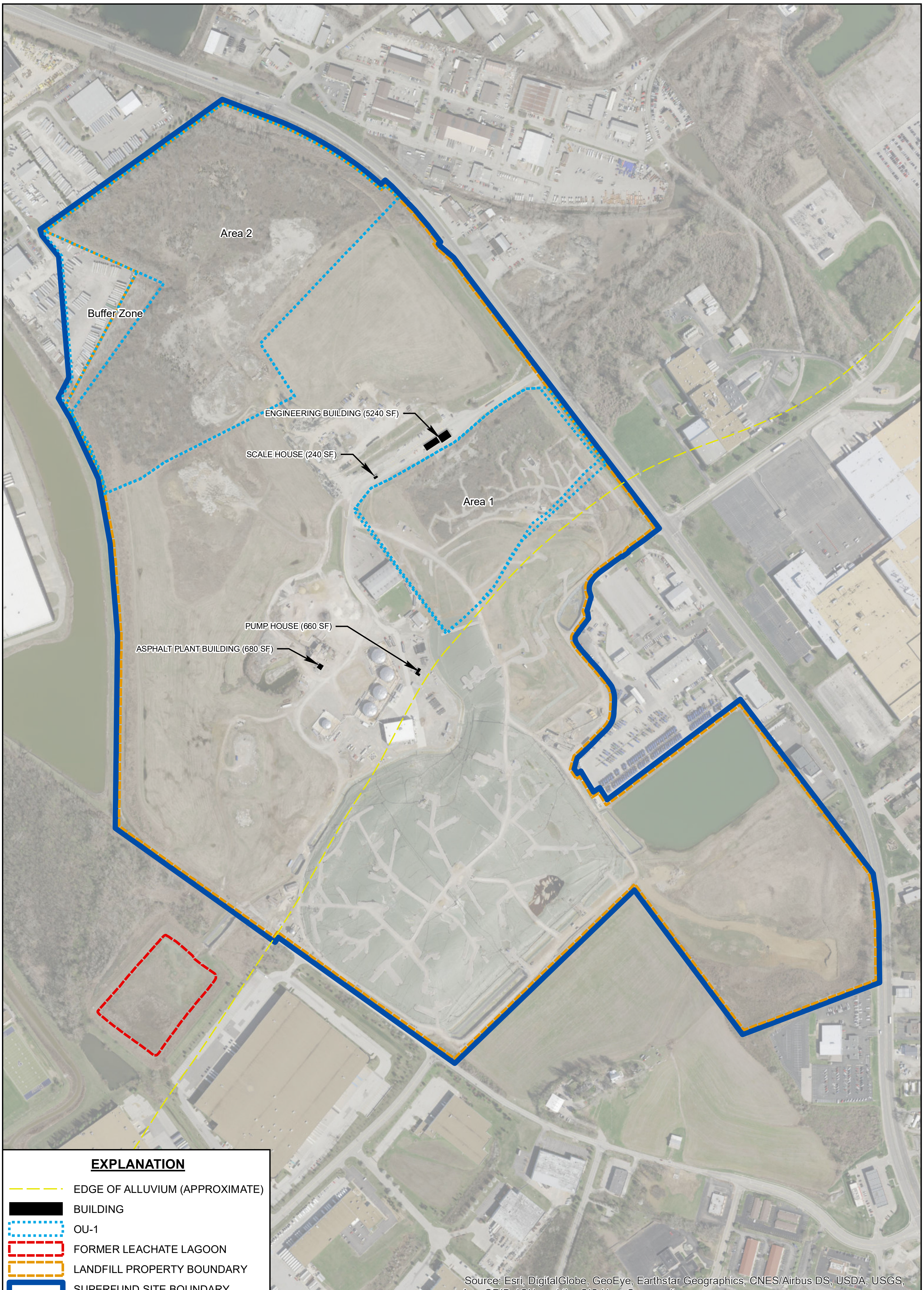

NOTES:

1. SF = SQUARE FEET
2. SCALE HOUSE EQUIPPED WITH SUB-SLAB DEPRESSURIZATION SYSTEM
3. ENGINEERING OFFICE EQUIPPED WITH HVAC FAN FOR ODOR REMOVAL

N

0 500 '

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FIGURE 3-11

VAPOR SAMPLING LOCATIONS

WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Drawn By: DH	Checked By: AR	Scale: 1 " = 500 '	Date: 4/21/20	File: 3-11_IndoorAirLoc_Fig3-11.mxd

M:\WTOZ\WESTLAKELANDFILL_ACP\GIS\MAPPING\202003_RIFS_FSP\3-11_INDOORAIRLOC_FIG3-11.MXD

EXPLANATION

- MISSOURI RIVER STAFF GAUGE - USGS06935965
- ABANDONED STAFF GAUGE
- ON-SITE PRECIPITATION GAUGE
- ST. LOUIS LAMBERT PRECIPITATION GAUGE
- FORMER LEACHATE LAGOON
- LANDFILL PROPERTY BOUNDARY
- SUPERFUND SITE BOUNDARY

N

0 2,000 '

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FIGURE 3-12

SURFACE WATER AND PRECIPITATION GAUGES

WEST LAKE LANDFILL OU-3
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Drawn By: MGS	Checked By: SLL	Scale: 1 " = 2,000 '	Date: 4/21/20	File: 3-12_SW_Precip_Fig3-12.mxd

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