

Final In-Situ Air Sparge Pilot Test Implementation Report

**Shepley's Hill Landfill
Former Fort Devens Army Installation
Devens, Massachusetts**

Contract No. W912WJ-19-D-0014
Contract Delivery Order No. W912WJ-20-F-0022

September 2022

Final –

In-Situ Air Sparge Pilot Test Implementation Report

**Shepley's Hill Landfill
Former Fort Devens Army Installation
Devens, Massachusetts**

September 2022

Prepared By:

SERES-Arcadis 8(a) JV 2, LLC
669 Marina Drive, Suite B-7
Charleston, South Carolina 29492
Tel 843 216 8531

Prepared For:

United States Army Corps of Engineers
New England District

CERTIFICATION

I hereby certify that the enclosed Report, shown and marked in this submittal, is that proposed to be incorporated with Contract Number W912WJ-19-D-0014. This document was prepared in accordance with the U.S. Army Corps of Engineers (USACE) Scope of Work and is hereby submitted for Government approval.

Reviewed By:



Andy Vitolins, PG
Project Manager



Heather Levesque, PMP
Deputy Project Manager

Received By:

Penelope Reddy
USACE Project Manager

This document is intended only for the use of the individual or entity for which it was prepared and may contain information that is privileged, confidential and exempt from disclosure under applicable law. Any dissemination, distribution or copying of this document is strictly prohibited.

Contents

Acronyms and Abbreviations.....	v
1 Introduction.....	1
1.1 Site Background.....	1
1.2 Geochemical Basis of Air Sparging for Arsenic Remediation	2
1.3 Pilot Test Objectives	2
2 Pilot Test Site Activities.....	4
2.1 Air Sparge and Monitoring Well Installation	4
2.2 Site Work – Trenching for Air Conveyance Lines and System Installation	5
2.3 Step Testing	6
2.4 System Startup and Operation and Maintenance.....	6
2.5 Groundwater Monitoring and Sampling.....	7
2.6 Pre- and Post-Pilot Hydraulic Testing	9
2.7 Deviations from Work Plan.....	9
3 Pilot Test Results and Discussion.....	10
3.1 Site Characterization and Baseline Conditions	10
3.2 Arsenic and Geochemical Evaluation.....	11
3.2.1 Dissolved Oxygen, Iron, and Arsenic Dynamics	11
3.2.2 Alkalinity, pH, and Manganese Dynamics	12
3.2.3 Geochemical Modeling.....	13
3.3 Post-System Operation Monitoring and Testing	15
3.3.1 Performance Monitoring	15
3.3.2 Hydraulic Testing Results.....	15
3.4 Site Suitability Evaluation.....	16
3.4.1 Geochemical.....	16
3.4.2 Geological.....	17
3.4.3 Hydrological	17
3.5 Full-Scale System Conceptual Design Parameters.....	18
3.6 Conclusions	19
4 References	21

Tables

- Table 1 Sparge Point and Monitoring Well Construction**
- Table 2 Summary Soil Sampling Results**
- Table 3 Well Development Summary**
- Table 4 Distances Between Performance Monitoring Wells and Sparge Points**
- Table 5 System Operational Data**
- Table 6 System Operational Modes (in Text)**
- Table 7 System Downtime (in Text)**
- Table 8 Performance Monitoring Results – Field Parameters**
- Table 9 Performance Monitoring Results - Analytical Data**
- Table 10 Pre- and Post-Pilot Specific Capacity Comparison**
- Table 11 Vertical Hydraulic Gradient Calculations**

Figures

- Figure 1 Site Location**
- Figure 2 Air Sparge Pilot Layout And Cross Section Locations**
- Figure 3 Wellhead Completion Details**
- Figure 4 Piping And Instrumentation Diagram**
- Figure 5 Pilot Area Cross Section A-A'**
- Figure 6 Pilot Area Cross Section B-B'**
- Figure 7 Performance Monitoring Results - MW-21-1S**
- Figure 8 Performance Monitoring Results - MW-21-2S**
- Figure 9 Performance Monitoring Results - MW-21-3S**
- Figure 10 Performance Monitoring Results - MW-21-4S**
- Figure 11 Performance Monitoring Results - MW-21-1D**
- Figure 12 Performance Monitoring Results - MW-21-2D**
- Figure 13 Performance Monitoring Results - MW-21-3D**
- Figure 14 Performance Monitoring Results - MW-21-4D**
- Figure 15 Performance Monitoring Results - SHM-10-06**
- Figure 16 Performance Monitoring Results – Dissolved Manganese**

Figure 17 Calculated Carbonate Mineral Saturation: Shallow Wells

Figure 18 Calculated Carbonate Mineral Saturation: Deep Wells

Figure 19 Calculated Groundwater Carbon Dioxide Saturation

Figure 20 Localized Groundwater Contour Map

Appendices

Appendix A - Soil Boring Logs

Appendix B - Well Survey Report

Appendix C - Step Test Results

Appendix D - Groundwater Sampling Logs

Appendix E - Laboratory and Validation Reports

Appendix F - Arsenic Treatment Plant Data

Appendix G - Response to Comments

Acronyms and Abbreviations

µg/L	microgram per liter
AGP	acid generation potential
ANP	acid neutralization potential
Army	United States Army
ATP	arsenic treatment plant
bgs	below ground surface
BOD ₅	5-day biochemical oxygen demand
CaCO ₃	calcium carbonate
cfm	cubic foot per minute
CO ₂	carbon dioxide
COD	chemical oxygen demand
D	deep
DTW	depth to water
Fe	iron
ft	feet
HDPE	high-density polyethylene
IAS	in-situ air sparging
ID	identification
KGS	KOMAN Government Solutions, LLC
log pCO ₂	logarithm of the partial pressure of carbon dioxide gas in equilibrium with the solution
MassDEP	Massachusetts Department of Environmental Protection
mg/kg	milligram per kilogram
mg/L	milligram per liter
Mn	manganese
NA	not applicable
O&M	operation and maintenance
ORP	oxidation-reduction potential
psig	pounds per square inch gauge
PVC	polyvinyl chloride
QAPP	Quality Assurance Project Plan

Final - In-Situ Air Sparge Pilot Test Implementation Report

S	shallow
S-A JV	SERES-Arcadis 8(a) Joint Venture 2, LLC
SHL	Shepley's Hill Landfill
Site	Shepley's Hill Landfill located within the former Fort Devens Army Installation in Devens, Massachusetts
SM	Standard Method
TCaCO ₃ /kT	tons per kiloton as calcium carbonate
TOC	total organic carbon
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
ZOI	zone of influence

1 Introduction

On behalf of the United States Army Corps of Engineers (USACE), SERES-Arcadis 8(a) Joint Venture 2, LLC (S-A JV) has prepared this In-Situ Air Sparge Pilot Test Implementation Report for the Shepley's Hill Landfill (SHL) site (also known as Area of Contamination 5), located within the former Fort Devens Army Installation in Devens, Massachusetts (Site; Figure 1). The S-A JV prepared this report under contract number W912WJ-19-D-0014.

This report documents the activities performed and the results observed in the execution of the in-situ air sparging (IAS) pilot test (pilot test) at SHL as detailed in the In-Situ Air Sparge Pilot Test Work Plan (work plan; S-A JV 2021b). The means and methods employed in the pilot test have been informed by the USACE In-Situ Air Sparging Engineer Manual (USACE 2013). Activities performed as part of the pilot test include well installation and surveying, baseline bucket testing and groundwater monitoring, installation of subsurface infrastructure, installation of a temporary pilot test system, step-testing, operation and maintenance (O&M) of the IAS system for a period of 3 months, performance monitoring, and post-operation monitoring and testing.

1.1 Site Background

The U.S. Army operated SHL for more than 70 years (at least as early as 1917 until 1992; KOMAN Government Solutions, LLC [KGS] 2020b). Known waste within SHL includes demolition debris, asbestos, sanitary wastes, glass, and incinerator ash. Contaminants of concern include arsenic and volatile organic compounds. Since closure of SHL in the 1990s, several remedial efforts have been implemented to address arsenic impacts, migration, and exposure at SHL (KGS 2020a), as listed below:

- Landfill capping
- Groundwater monitoring
- Installation and operation of a groundwater extraction and treatment system
- Barrier wall installation between SHL and the Red Cove area of Plow Shop Pond
- Excavation of contaminated Red Cove sediments following the barrier wall installation
- Land use controls at SHL and the North Impact Area.

SHL is located within a bedrock valley, and the overburden deposits beneath SHL consist of glacially deposited, well-graded to poorly graded sands with silts and gravel. The saturated soil is predominantly medium and fine to medium sands with little variability. A discontinuous layer of till is present at the base of the sands directly overlying bedrock.

In general, groundwater in the southern portion of SHL flows to the northeast toward Plow Shop Pond, groundwater in the northern portion of SHL flows to the north, and groundwater to the northeast of SHL flows to the northwest toward Nonacoicus Brook. Groundwater in the deep overburden at the northern extent of SHL (in the Nearfield Area) is extracted as part of the arsenic treatment plant (ATP) operations.

Sources of dissolved arsenic in groundwater at SHL include anthropogenic (landfill waste) and geogenic materials. Groundwater within the SHL footprint and immediately downgradient contains high concentrations of dissolved metals consistent with a release of geogenic metals due to reducing conditions below a landfill with an impermeable cap (U.S. Geological Survey 2004). Specifically, water quality is indicative of active reductive

dissolution of iron and manganese, resulting in the dissolution of co-occurring arsenic. At landfill sites, reductive dissolution of iron minerals is common, as is the concomitant dissolution of arsenic that is coprecipitated with the iron minerals (U.S. Geological Survey 2004).

Groundwater at SHL generally has circumneutral pH levels and relatively low concentrations of anions, such as phosphate, that can compete with arsenic for sorption to precipitated iron minerals (such as iron oxyhydroxides). Therefore, mobilization, fate, and transport of arsenic in site groundwater are primarily dependent on oxidation-reduction conditions (S-A JV 2021a). Precipitation of iron oxyhydroxides and the coprecipitation of arsenic are expected to occur where the water transitions from reduced to oxic conditions.

1.2 Geochemical Basis of Air Sparging for Arsenic Remediation

Air sparging for the in-situ remediation of arsenic in groundwater is performed by supplying oxygen into the saturated subsurface through the injection of air using an aboveground compressor. Some oxygen in the injected air will dissolve into the groundwater. Dissolved iron (Fe) and manganese (Mn) present in the +II oxidation state in reducing groundwater are oxidized by dissolved oxygen and precipitate, with Fe(III) precipitating as iron oxyhydroxides and Mn(III/IV) precipitating as manganese oxyhydroxides. The oxidation of both iron and manganese is pH dependent, with more rapid oxidation at higher pH (Morgan 2005; Morgan and Lahav 2007).

Iron and manganese oxidation by dissolved oxygen can proceed either abiotically or mediated by microbes.

Abiotic oxidation of iron occurs much more rapidly than abiotic oxidation of manganese (Singer and Stumm 1970; Morgan 2005; Morgan and Lahav 2007). Generally, the oxidation of iron occurs very rapidly in the presence of dissolved oxygen (with a half-life on the order of a few minutes above pH 7; Singer and Stumm 1970). In contrast, the abiotic oxidation of manganese is much slower, but may still proceed on longer timescales and/or may be enhanced by microbial or surface catalytic processes (Davies and Morgan 1989; Morgan 2005), or otherwise may adsorb/coprecipitate as Mn(II) with oxidized iron (Cornell and Giovanoli 1987). With oxidative precipitation of iron and manganese via air sparge, arsenic is immobilized through adsorption and coprecipitation with the amorphous iron and manganese oxyhydroxide phases (Brunsting and McBean 2014; Kameda et al. 2014; Luong et al. 2018).

Successful IAS requires development of air-filled porosity in the aquifer to cause sufficient dissolution of oxygen into groundwater to reverse the chemical-reducing conditions and promote iron and manganese precipitation. The most suitable material for air sparging is permeable sands with a low degree of heterogeneity, to minimize channeling and/or short-circuiting of injected air (for reference, see Section 2 of the In-Situ Air Sparging Engineer Manual [USACE 2013]). The effectiveness of air sparging for arsenic immobilization also depends on dissolved iron and/or manganese concentrations in groundwater being high enough, relative to concentrations of arsenic, to provide sufficient arsenic uptake capacity. From there, the long-term effectiveness of the remedy relies on sufficient consumption of the reducing capacity in the aquifer during IAS to minimize the potential of a return to actively reducing conditions to an extent that iron and manganese reductively redissolve, resulting in rebound of arsenic concentrations in groundwater.

1.3 Pilot Test Objectives

The pilot test objectives as detailed in the work plan (S-A JV 2021b) are to determine the efficacy of IAS to immobilize arsenic in groundwater to the cleanup level of 10 µg/L (the current Maximum Contaminant Level for

arsenic) and to collect necessary data for comparison and evaluation of IAS to other remedial technologies in a subsequent focused feasibility study. Specific, related short-term field objectives are identified as:

- Determination of the operational and design parameters for a full-scale IAS treatment system including:
 - optimum injection pressure and injection flow rate
 - optimum operational mode
 - effective IAS zone of influence (ZOI).
- Assessment of the potential for iron fouling of the air sparging wells and the surrounding formation, resulting in a limited ability to inject air and reduced efficacy of treatment
- Evaluation of rebound of concentrations of arsenic in groundwater 1 month after shutdown of the system
- Assessment of the level of effort required to operate and maintain (O&M) an air sparging remediation system.

2 Pilot Test Site Activities

Air sparge and monitoring well installation is described in Section 2.1 and occurred from July 20 through August 4, 2021. Site work including air supply pipe trench installation and system installation is described in Section 2.2. Step testing performed on the newly installed wells from September 28 through October 1, 2021, is detailed in Section 2.3. The system operational period from October 13, 2021 through January 19, 2022 is discussed in Section 2.4. Groundwater and performance monitoring conducted throughout the pilot test is detailed in Section 2.5. Pre and post system operation hydraulic testing is described in Section 2.6. The final Section 2.7 details deviations from the work plan (S-A JV 2021b).

2.1 Air Sparge and Monitoring Well Installation

A ground-penetrating radar survey was performed by GPRS on July 8, 2021, to identify and mark out subsurface utilities. Utility clearance was conducted in conformance with Worksheet #17 of the Quality Assurance Project Plan (QAPP) Annual Long-Term Monitoring and Maintenance Program Addendum 1, including contacting Dig Safe to mark out utilities before commencement of drilling (S-A JV 2021c).

Drilex Environmental of Auburn, Massachusetts, installed four air sparge points and eight monitoring wells (MW-21 series wells; e.g., MW-21-1S) from July 20 through August 4, 2021, using a drive and wash drilling method under the oversight of an S-A JV field geologist. The locations of the wells are shown on Figure 2.

The four air sparge points were constructed in accordance with the USACE In-Situ Air Sparging Engineer Manual (USACE 2013) using 2-inch-diameter polyvinyl chloride (PVC) riser pipe and 2-inch-diameter, 2-foot-long 0.010-inch slotted stainless-steel well screens. The screens were positioned at two different depth intervals indicated as either shallow (S) or deep (D). The D sparge point screens were set to the top of till in the sandy geology conducive to the delivery of air to the formation (67 to 69 and 71.5 to 73.5 feet below ground surface [ft bgs] at AS-21-1D and AS-21-2D, respectively). The S sparge well screens were set to 15 feet above the top of the D sparge screen (screens at 50 to 52 and 54.5 to 56.5 ft bgs at AS-21-1S and AS-21-2S, respectively). Sand pack was placed in the annulus around the screen to 2 feet above the screen. To provide an adequate seal of the borehole, 2 feet of choker sand was placed above the sand pack, followed by neat cement to 3 feet below grade. The air sparge points were set in flush-mount protective well vaults during subsequent site work detailed in Section 2.2. Table 1 provides the construction details of the installed well network.

The eight monitoring wells were constructed using 2-inch-diameter Schedule 40 PVC riser pipe and 2-inch-diameter, 10-foot-long, 0.010-inch slotted screens. The D monitoring wells were installed and screened in the overburden to the top of till or bedrock if till was not encountered. The S monitoring wells were installed in the overburden to approximately 5 feet above the top of the D monitoring well screens. Sand pack was placed around the monitoring well screens to approximately 2 feet above the top of the well screen, followed by a 2-foot bentonite seal, and grouted to approximately 5 ft bgs. The monitoring wells were finished as stickups in protective steel casings.

An S-A JV field geologist collected split-spoon samples for geologic characterization in accordance with the Unified Soil Classification System as follows:

- Soils were logged continuously at the two D sparge points (AS-21-1D and AS-21-2D).
- Soils were logged continuously at the deepest, farthest downgradient well (MW-21-4D).

- Soils were logged every 5 feet from 50 feet to top of bedrock at the next three deepest monitoring well locations (MW-21-1D, MW-21-2D, and MW-21-3D).

Logging from these locations across the pilot test area allows for interpretation of geology of the overall area. Soil boring logs are provided in Appendix A.

Soil samples from five intervals in the saturated zone of well AS-21-1D were sent to the Eurofins Savannah and analyzed for total metals (iron, manganese, arsenic), percent moisture, total organic carbon (TOC), 5-day biochemical oxygen demand (BOD_5), and acid base accounting, including quantification of acid generation potential, acid neutralization potential, and sulfur forms. Results of the soil sampling are provided in Table 2, and the rationale and results of the soil sampling and analysis program are described in more detail in Section 3.1.

The wells were developed using a surge block and submersible pump until at least three well volumes were purged and turbidity requirements in the well development procedures included in the QAPP Addendum 1 (S-A JV 2021c) were met. The number of well volumes purged ranged from 5.1 to 18.5, and final turbidity measurements ranged from 3.46 to 38.3 NTU post well development. A well development summary is provided as Table 3. Development water was discharged to the surface and soil cuttings from the installation were spread near the point of origin in a manner consistent with USACE and United States Environmental Protection Agency (USEPA) guidance (USEPA 1992) and in compliance with the QAPP Addendum 1 (S-A JV 2021c).

In December 2021, WSP of Merrimack, New Hampshire, conducted a well survey to determine the coordinates and elevation for the newly installed well network. The reported coordinates are on the Massachusetts State Plane Coordinate System of North American Datum of 1983 and vertically on North American Vertical Datum of 1988. Table 3 provides the construction details of the installed well network. The well survey report can be found in Appendix B. Table 4 summarizes the distances between each air sparge point and performance monitoring well installed.

2.2 Site Work – Trenching for Air Conveyance Lines and System Installation

Site work including trenching, pipe installation, asphalt removal and disposal, backfilling, well vault installation, and site restoration, was performed by Tantara from September 13, 2021 through September 17, 2021 under oversight of the S-A JV. As mentioned in Section 2.1, the area was cleared for utilities by GPRS on July 8, 2021 (S-A JV 2021c).

The air conveyance line trench locations are shown on Figure 2. The trenches were excavated to a depth of 30 inches to mitigate freezing of any incidental water that made its way into the lines. The section of trench that was to be installed under existing pavement was saw-cut prior to removal of the asphalt, and the removed asphalt was separated and disposed of offsite in compliance with all applicable regulations.

One-inch-diameter DR17 high-density polyethylene (HDPE) piping was installed in the bottom of the trench, and individual conveyance lines were run from the system location to each sparge point. Open trenches and work areas were blocked off with cones, caution tape, and fences at the end of each day. Pressure testing on the HDPE air supply lines was performed on September 16, 2021. The lines were pressure tested to 50 pounds per square inch gauge (psig) and determined to be leak-free.

The trenches were backfilled using native material. Metallic utility warning tape was installed approximately 9 to 12 inches above the piping during backfill. The backfill material was compacted in 12-inch maximum lifts, bank to

bank, to prevent settling. The trenches were restored to match existing surfaces, including asphalt replacement and swale restoration. The asphalt was replaced from approximately 4 inches bgs to the surface to match the original grade and depth.

At each of the four sparge points, a 24-inch by 24-inch by 24-inch HD-20 traffic-rated well vault was installed. Around each well vault, a concrete apron was poured. Well head completions consisted of a subsurface connection of the air sparge line to each air sparge point and associated fittings as detailed on Figure 3.

The system trailer was delivered to the Site on September 14, 2021 by Fliteway. Tantara assisted in final placement of the trailer approximately 3 feet from the eastern exterior wall of the ATP. Final connections between the air sparge conveyance lines and the system manifold were completed by the S-A JV. A piping and instrumentation diagram of the rental air sparge system trailer is included as Figure 4.

R.L. Proulx, a licensed Massachusetts electrician, was subcontracted to connect the electrical power to the treatment trailer from the existing ATP power supply. A disconnect switch was installed by R.L. Proulx on the outside wall of the ATP and used to connect power to the system.

2.3 Step Testing

The S-A JV performed air sparge step testing from September 28 through October 1, 2021. The testing allowed for observation of the relationship between subsurface pressure and air flow and how these factors affect the lateral ZOI and vertical distribution of injected air from the sparge points. During the step test, air flow rates of 2, 4, and 8 cubic feet per minute (cfm) at both the S and D sparge points were tested. Each step was run until water levels were observed to peak and approach a stabilized condition in the monitoring well network consistent with methods described in the USACE In-Situ Air Sparging Engineer Manual (USACE 2013). All monitoring wells were sealed during the testing and changes in dissolved oxygen and water table deflection were measured at all performance monitoring wells via vented Aqua TROLL sondes placed within the screened zone and set to record readings every minute. All monitoring wells remained sealed during the testing. The S-A JV manually measured methane via a landfill gas meter at the ground surface, within the breathing zone, and at all monitoring wells throughout the pilot test. Methane was not detected at the ground surface and within the breathing zone throughout the step test. Methane was generally non-detect at the monitoring wells, with a high reading of 4% of the lower explosive limit for one measurement made at well MW-21-1S at the start of testing.

Two additional step tests were conducted on December 6 and December 7, 2021, to examine water-level responses in the monitoring well network at sparging rates of 10 and 12 cfm in the D sparge points only. Results of the step testing including field measurements, tables, and figures detailing the response in both S and D monitoring well network are included in Appendix C.

2.4 System Startup and Operation and Maintenance

The system was started on October 13, 2021, and initially operated at a flow rate of 4 cfm in the S and D intervals in pulsed mode (1 hour on, 1 hour off, alternating between S and D). During operation, the system and surrounding monitoring points were observed for changes in water levels and dissolved oxygen concentrations. Throughout the pilot study, flow rates and pulsing time intervals were adjusted based on field observations and review of laboratory analytical results. O&M visits included checking and balancing air flow and pressure between wells to ensure that the target volumes of air continued to be delivered. The visits also included troubleshooting any issues, including automated alarm responses.

The system was adjusted on November 11, 2021, to increase the flow rate in the D interval from 4 to 8 cfm, while keeping the air flow rate in the S interval at 4 cfm. On December 6, 2021, the S sparge interval was turned off and the D sparge interval was tested at higher flow rates and under various pulsing timing configurations. Continuous flow in the D interval was tested at a rate of 8 cfm from January 13 through January 19, 2022, at which time the system was shut down and demobilized from the Site as planned. Table 5 summarizes the system operational data collected while operating under the conditions and within the time frames summarized in Table 6.

Table 6. System Operational Modes

Date	S Interval Air Flow Rate Cfm	D Interval Air Flow Rate Cfm	Operational Mode	Time On Hour	Time Off Hour
Startup 13-Oct-21	4	4	Pulsed	1	1
11-Nov-21	4	8		1	1
6-Dec-21	Off	12		1	1
7-Dec-21		10		3	2
14-Dec-21		12		3	2
23-Dec-21		16		3	2
5-Jan-22		12		1	1
6-Jan-22		16		1	1
13-Jan-22		8	Continuous	NA	NA
19-Jan-22	Shutdown				

Note:

NA = not applicable

System operational issues encountered during the pilot test are summarized in Table 7. The S-A JV was alerted to alarm conditions via telemetry and promptly responded and corrected encountered system operational issues. The total system downtime over the course of the pilot study was approximately 12 days.

Table 7. System Downtime

Description	Dates
Offline: Blower V-Belt broken and replaced	10/16/2021 through 10/21/21
Offline: Low pressure alarm	12/23/21 through 12/27/21
Offline: Ice in air supply lines	1/3/22 through 1/5/22
Offline: Low flow alarm	1/11/22 through 1/12/22

2.5 Groundwater Monitoring and Sampling

Performance monitoring visits occurred weekly for the first month of the pilot test and biweekly (every other week) the second and third months, as planned (S-A JV 2021b). Based on field observations and initial results, additional performance monitoring events occurred between these dates to gather more data and adjust flow

rates and intervals of sparging. A total of 12 O&M and performance monitoring events were conducted during the 3 months of operation. Table 8 summarizes the field measurement and field parameter groundwater performance monitoring data collected over the duration of the pilot test. Table 9 includes the laboratory analytical sampling results.

During each performance monitoring event, the S-A JV recorded the following field measurements from the eight newly installed performance monitoring wells and one pre-existing monitoring well in the general vicinity (SHM-10-06):

- Groundwater elevations (using a water-level meter)
- Dissolved oxygen by optical sensor, oxidation-reduction potential (ORP), conductivity, temperature, and pH (with YSI meter)
- Turbidity (using a turbidimeter)
- Total and ferrous iron (using a HACH iron test kit)
- Volatile organic compound concentrations in well headspace (using a photoionization detector).

Groundwater samples for pilot test performance were collected periodically via low-flow methods from the eight new performance monitoring wells (MW-21-1S/D, MW-21-2S/D, MW-21-3S/D, and MW-21-4S/D) and one existing monitoring well (SHM-10-06). A baseline groundwater sampling event was conducted from August 18 through August 26, 2021. During the 3-month operation of the pilot test, groundwater sampling was conducted at the nine monitoring well locations approximately every 2 weeks during the first 2 months and once during the third month. An additional sampling event was conducted approximately 1 month following shutdown of the pilot test to evaluate rebound. A total of six sampling events occurred post startup, three of which included sampling of groundwater for an extended list of analytes (matching those analyses performed during the baseline groundwater sampling event).

These sampling events included measurement and recording of the field parameters described above. The standard analysis list for all six groundwater monitoring events included:

- Dissolved metals (iron, manganese, and arsenic) by USEPA Method 6010C
- Total metals (iron, manganese, and arsenic) by USEPA Method 6010C
- Alkalinity by Standard Method (SM) 2320B
- BOD₅ by SM 5210B (baseline for all, MW-21-1S, MW-21-2S, MW-21-1D, and MW-21-2D)
- Total dissolved solids by USEPA Method 160.1.

The extended analysis list for three groundwater monitoring events included the above, in addition to the following:

- Dissolved TOC by USEPA Method 9060A
- Chemical oxygen demand (COD) by USEPA Method 410.40 (baseline only)
- Metals (calcium, sodium, and potassium) by USEPA Method 6010C
- Anions (sulfate, chloride) by USEPA Method 9056A and nitrate by USEPA Method 353.2.

Total and dissolved metals (iron, manganese, and arsenic) were measured for the purposes of system performance monitoring. BOD₅, COD, and TOC were measured to evaluate oxygen demand; alkalinity was monitored to evaluate acid/base reactions in solution as a result of air introduction and iron oxidation; and major ions were monitored to evaluate mineral solubilities in response to air sparge.

Groundwater sampling logs from all events are included as Appendix D. Laboratory analysis was performed by Eurofins Savannah for the baseline groundwater sampling event and the soil sampling conducted during well installation activities. Laboratory analysis of all other groundwater sampling events were performed by Katahdin Analytical Services of Scarborough, Maine. Stage 2B data validation on the reported laboratory results was performed by Cadena, Inc . No major data quality issues were identified. Laboratory and validation reports have been included as Appendix E.

2.6 Pre- and Post-Pilot Hydraulic Testing

To evaluate the potential for and the degree of iron fouling within the screened intervals of both the sparge points and the performance monitoring well network, the S-A JV performed specific capacity testing before and after system operation. The tests were conducted using a submersible pump and a water-level indicator probe. An initial depth to water (DTW) measurement was made at each well prior to deployment of the submersible pump. The pump was then installed in the well being tested at a depth corresponding to the midpoint of the screened interval. Power was supplied to the pump, and the purge rate, time, and DTW were recorded until the water level stabilized. The pumping rate was adjusted as required until stabilization of the water level was observed. Stabilization was defined as a repeated DTW measurement within 0.01 over a 10-minute time period. Specific capacity was calculated by dividing the pumping rate by the stabilized drawdown observed. Hydraulic testing results are included in Table 10 and discussed in Section 3.3.2.

2.7 Deviations from Work Plan

The work plan (S-A JV 2021b) was followed for the air sparge pilot test, with minor deviations as listed below:

- Monitoring wells were installed in a slightly different configuration, where S and D wells were set approximately 5 feet apart for ease of well installation and to increase coverage.
- Trenches were installed to a depth of 30 inches instead of 12 inches to better protect subsurface piping from potential freezing.
- Monitoring wells were finished as standpipes instead of roadboxes for ease of location.
- Monitoring well SHM-10-06 was not monitored during the initial step testing because its diameter was too small to fit the downhole probe.
- The final installed system configuration was different than described in the work plan:
 - One compressor was used instead of two, as the supplied compressor was able to deliver the required air flow and pressure requirements for all four sparge points.
 - A transformer was not needed and therefore was not installed.
 - A forklift was not needed to offload the system, as it was trailer mounted.
- The pilot test was started up in pulsed mode based on step test results.
- Continuous mode was briefly tested at the end of the pilot test operational period in the D interval.
- Twelve instead of eight performance monitoring events were conducted to better assess and monitor performance.

3 Pilot Test Results and Discussion

Pilot test results and an analysis of the collected data are presented in this section. Section 3.1 details the site characterization of the pilot test area through analysis of the data collected during well installation and baseline groundwater sampling. Section 3.2 presents an analysis of the pilot test system operational period focused on the groundwater arsenic and geochemical changes observed. Section 3.3 details the results and analysis of data collected post system operation. Section 3.4 includes an analysis and discussion of the suitability of IAS for dissolved arsenic treatment from a geochemical, geologic, and hydrologic perspective. Section 3.5 identifies the conceptual design parameters for a full-scale IAS system. Section 3.6 discusses data gaps remaining after the pilot test.

3.1 Site Characterization and Baseline Conditions

Logging of soils during well installation indicated the geology was consistent with previous site characterizations. As detailed in the soil boring logs in Appendix A and the cross sections on Figures 5 and 6, the overburden geology is dominated by fine- to medium-grained and fine- to coarse-grained, poorly graded sands. The overburden ranges from approximately 68 to 72 feet in thickness. To the north and south of the pilot test area, alternating layers of poorly and well-graded sands are observed (Figure 5). Little silty sand to sandy silt and trace clayey sand were observed to the south just above the glacial till unit but pinched out to the northeast (Figure 6). At the base of the sand unit lies a discontinuous, very dense (N-values recorded between 40 to 50 and greater than 50) glacial till unit overlying the basal bedrock. Drilling refusal at bedrock was encountered at approximately 69 to 77 ft bgs (149 to 157 feet of elevation) across the pilot test area.

The laboratory analytical results of soil samples collected from various depths during installation of well AS-21-1D (described in Section 2.1) are summarized in Table 2. These data indicate that arsenic was present in soils at all depths sampled, with the highest concentration of arsenic detected in soils from the deepest interval near the bedrock surface (up to 33 milligrams per kilogram [mg/kg]). Iron concentrations in soil sampled ranged from 3,500 to 7,000 mg/kg, while manganese concentrations ranged from 41 to 150 mg/kg.

To evaluate the pH and reduction-oxidation buffering capacity of the soils, TOC, BOD_5 , and acid base accounting/sulfur forms were measured. TOC and sulfide sulfur may both consume oxygen introduced into the system, either in the short term due to direct reaction or over longer time frames coupled with microbial oxidation processes, while BOD_5 functionally represents the actual oxygen demand of a sample measured in the laboratory over a 5-day period. If present, these compounds would potentially cause a transition back to reducing conditions as they consume oxygen. The presence of sulfide sulfur would also indicate acid generation potential (AGP) as acidity is generated with oxidation of iron sulfide and formation of ferric iron and sulfate, particularly if the AGP is not completely balanced by acid neutralization potential (ANP; typically represented by carbonate minerals). The results indicate that TOC and BOD_5 were not measured in soil at any depths above the detection limit of 900 mg/kg. AGP was also below the detection limit of 1.2 tons per kiloton as calcium carbonate ($TCaCO_3/kT$), suggesting limited sulfide content in the soil, which is further confirmed by the sulfur form results, which indicate no measurable pyritic, sulfate, or other forms of sulfur in the soil above the detection limit of 0.04 percent (400 mg/kg). In contrast, ANP was low but detectable at 1.1 to 2.2 $TCaCO_3/kT$ (Table 2). Overall, these results suggest that the soils in this area exhibit limited potential for driving rebound to reducing conditions, which supports the long-term potential of IAS. The soil exhibits positive net neutralization potential (higher ANP relative to AGP), which suggests minimal risk of driving the system acidic upon oxidation; however, since the ANP of the soil

appears to be low, it is uncertain if there is enough pH buffering capacity to counteract the generation of acidity that occurs during the oxidation of dissolved Fe(II) and precipitation of ferric oxyhydroxides.

As previously described, the performance monitoring network contains monitoring wells screened at two depth intervals, indicated by either S or D in the well ID (Table 3). The D monitoring wells were installed and screened in the sandy overburden to either the top of till or to bedrock if till was not encountered. The S monitoring wells were installed in the overburden, with the bottom of their screens placed approximately 5 feet above the top of the collocated D monitoring well screen. All S monitoring wells were screened below the water table to prevent direct connection between the screen interval and the unsaturated zone.

Groundwater monitoring results from seven sampling events for the eight new performance monitoring wells (MW-21-1S/D, MW-21-2S/D, MW-21-3S/D, and MW-21-4S/D) and one existing monitoring well (SHM-10-06) are presented in Table 9. The seven groundwater sampling events include one baseline groundwater sampling event conducted from August 18 through August 26, 2021, five events during the 3-month operation of the pilot test, and one additional event conducted approximately 1 month following shutdown of the pilot test. Baseline groundwater sampling results indicate that the aquifer is in a reduced state with little to no dissolved oxygen or nitrate, negative ORP, and high iron and manganese in both the S and D intervals. The concentration of dissolved arsenic was observed to be highest in the D monitoring wells, with concentrations ranging from 1,070 to 2,260 micrograms per liter ($\mu\text{g/L}$). Dissolved arsenic was detected at concentrations ranging from 18.2 to 390 $\mu\text{g/L}$ in the S monitoring wells. The ratio of iron to arsenic was 39 in the D monitoring wells and 1,180 in the S monitoring wells; pH ranged from 6.21 to 6.77, with an alkalinity ranging from 120 to 230 milligrams per liter (mg/L). Iron to arsenic ratios in the bucket tests conducted previously and described in the work plan (S-A JV 2021b) where successful coprecipitation of arsenic was observed were 16 and 53.3. Therefore, the iron to arsenic ratio in the monitoring well network at baseline appears to be conducive to coprecipitation of arsenic.

3.2 Arsenic and Geochemical Evaluation

3.2.1 Dissolved Oxygen, Iron, and Arsenic Dynamics

Total and dissolved arsenic, total and dissolved iron, and dissolved oxygen measured in the S monitoring well network over the course of the pilot study are plotted on Figures 7 through 10. Upon startup of the system, dissolved oxygen was readily distributed to three of the S-interval wells (MW-21-1S, MW-21-2S, and MW-21-3S) located at corresponding distances of 2.5 feet, 10.5 feet, and 14.5 feet to the closest S sparge well. An injection rate of 4 cfm in pulsed mode (1 hour on, 3 hours off) was highly effective in distributing and maintaining dissolved oxygen in the S interval throughout the operational period. During step testing, dissolved oxygen was observed at all three of these wells (MW-21-1S, -2S, and -3S), as shown in Appendix C, indicating that they all fall within the S-interval ZOI.

With the arrival of dissolved oxygen in wells MW-21-1S, MW-21-2S, and MW-21-3S, iron was oxidized and resulted in the coprecipitation of dissolved arsenic to less than 10 $\mu\text{g/L}$ within 21 days. Dissolved arsenic remained below 10 $\mu\text{g/L}$ in these three S wells for the duration of the pilot test. At monitoring well MW-21-4S, located approximately 40 feet downgradient of sparge points AS-21-1S and AS-21-2S, dissolved oxygen increased from a baseline concentration of 0.08 mg/L to 1.25 mg/L approximately 40 days after startup of the system. Based upon a 3PE analysis in this area of the site, the estimated average groundwater velocity is 1.5 feet per day (S-A JV, 2021a). The concentration of dissolved arsenic at Well MW-21-4S was measured at less than 10 $\mu\text{g/L}$ 56 days after system startup.

Total and dissolved arsenic, total and dissolved iron, and dissolved oxygen in the D monitoring well network over the course of the pilot study are shown on Figures 11 through 16. Dissolved oxygen was to arrive at monitoring well MW-21-1D, located 3 feet from the AS-21-1D sparge point 12 days after startup. This occurred at an injection rate of 4 cfm in the D interval in pulsed mode. With dissolved oxygen present, iron and arsenic concentrations decreased. Dissolved arsenic decreased from a concentration of 2,140 to 24.8 µg/L 41 days after startup. For the remainder of the pilot test, dissolved oxygen concentrations continued to increase, and dissolved arsenic decreased to a concentration of 12 µg/L at the conclusion of the pilot test (Figure 11).

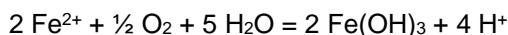
At well MW-21-2D, located 12 feet from the AS-21-2D sparge point, dissolved oxygen was measured at 6.66 mg/L 57 days after startup. Similar to well MW-21-1D, iron and arsenic concentrations in groundwater were observed to decrease upon the arrival of dissolved oxygen. Dissolved arsenic at MW-21-2D decreased from an initial concentration of 1,600 µg/L to 2.5 µg/L at the conclusion of the pilot test (Figure 12).

Achieving distribution of dissolved oxygen at the D-interval performance monitoring wells was more challenging than in the S interval over the pilot test operational time frame (3 months) and took longer to occur. During step testing, an increase in dissolved oxygen was not measured at any of the D monitoring wells, suggesting a limited D-interval ZOI over a short time frame:

- Dissolved oxygen was observed after 12 days of sparging at a rate of 4 cfm 3 feet away from the AS-21-1D sparge point at MW-21-1D and after 61 days of sparging at an injection rate of 12 cfm 12 feet away from the AS-21-2D sparge point at MW-21-2D. The time it took for dissolved oxygen to be distributed to the D monitoring wells suggests that distribution of dissolved oxygen at that depth may be more dependent on groundwater transport and/or diffusion, as sparging may have formed limited horizontal air channeling. Injected air in the D sparge points may have preferentially sparged upward vertically, either due to the deeper sands having a lower permeability or potentially through short-circuiting to the adjacent S sparge points or performance monitoring wells (Figures 5 and 6).
- At monitoring well MW-21-3D located 18 feet from the AS-21-2D sparge point, dissolved oxygen was not observed at high enough concentrations to directly result in the oxidation of iron or coprecipitation of arsenic. Both arsenic and iron concentrations were observed to remain relatively stable and unchanged throughout the pilot study (Figure 13).
- An increase in dissolved oxygen was not observed at MW-21-4D, located 40 feet downgradient of sparge points AS-21-1D and AS-21-2D, and iron and arsenic concentrations remained stable from startup through shutdown of the system (Figure 14).
- Monitoring well SHM-10-06, located crossgradient and approximately 30 feet from sparge point AS-21-2D, was also monitored during the pilot test. Dissolved oxygen and arsenic concentrations remained stable at this location and did not indicate influence of the pilot test on this area (Figure 15).

3.2.2 Alkalinity, pH, and Manganese Dynamics

Introduction of dissolved oxygen via air sparge and iron oxidation has additional effects on water quality. The oxidative precipitation of iron by oxygen will generate acidity via the following reaction:



Accordingly, each mole of iron oxidized releases two moles of acidity. In solution, this acidity is balanced by the dissolved alkalinity, with conversion of carbonate to bicarbonate and bicarbonate to carbonic acid. On a mass basis, for each mg/L of iron oxidized, approximately 1.8 mg/L of alkalinity as calcium carbonate (CaCO_3) is

anticipated to be consumed (this does not account for any buffering of ferrous iron or pH/alkalinity by the soil). Dissolved oxygen introduction and ferrous iron oxidation may therefore be expected to reduce the solution pH and alkalinity. However, the pH change may also be affected by changes in the dissolved carbon dioxide (CO_2) content of the solution, which may also be influenced by air sparging. For example, it is very common for groundwaters to exhibit dissolved CO_2 in excess of the concentration in water in equilibrium with the atmosphere. Air sparging would tend to remove dissolved CO_2 (carbonic acid) from the groundwater, causing the pH to increase, but with no change in alkalinity. CO_2 removal and iron oxidation may cause competing influences on solution pH.

Figures 7 through 15 detail the observed change in pH and alkalinity in the monitoring well network over the course of the pilot test. Monitoring wells that exhibited increases in dissolved oxygen concentrations with corresponding reductions in iron and arsenic concentrations also exhibited decreases in pH and alkalinity. Initial pre-operation alkalinity values in S monitoring wells were between 180 and 320 mg/L. Following IAS, alkalinity decreased to between 44 and 110 mg/L in wells MW-21-1S, MW-21-2S, and MW-21-3S, with slightly less of a decrease observed in well MW-21-4S (to 190 mg/L; Figure 10). Along with alkalinity, solution pH also decreased in the S wells approximately 0.5 pH units (from pH values near 6.5 to 7 to values near 6.0 or occasionally lower). Similar decreases in pH and alkalinity were also observed in the deeper monitoring wells influenced by air sparge, particularly MW-21-1D and MW-21-2D, with little to no significant response in MW-21-3D and MW-21-4D, noting that large fluctuations between 120 mg/L and more than 200 mg/L appear to be typical in these wells. Following system shutdown, some rebound in alkalinity was observed, but in most cases alkalinity did not rebound to the initial pre-sparge levels.

The alkalinity decreases observed in the monitoring wells over the course of the pilot test were reasonably consistent with the anticipated decrease due to iron oxidation acidity. The greatest iron reduction was observed in MW-21-3S, which exhibited a decrease from approximately 60,000 $\mu\text{g}/\text{L}$ to less than 200 $\mu\text{g}/\text{L}$ on a dissolved basis. Based on the factor of 1.8 mentioned previously, this reduction would result in consumption of alkalinity of more than 100 mg/L. Although the actual apparent alkalinity reduction in MW-21-3S was approximately 160 mg/L, this difference is within the level of temporal variability observed across the well network.

Concentrations of dissolved manganese also changed with time throughout the pilot test but exhibited more complex dynamics relative to iron (Figure 16). In the S monitoring wells, manganese concentrations decreased or remained the same, with the greatest concentration reductions observed in MW-21-1S and MW-21-3S. In contrast, manganese concentrations in D monitoring wells influenced by air sparge (MW-21-1D and MW-21-2D) exhibited an increase during and following air sparging. This is further discussed below in Section 3.2.3.

3.2.3 Geochemical Modeling

Geochemical modeling calculations were conducted to evaluate mineral saturation and dissolved CO_2 content in groundwater during the pilot test. These calculations were conducted to evaluate the potential effects of air sparge on the stability of minerals in the aquifer; specifically, the potential for minerals other than iron oxyhydroxide to dissolve or precipitate in response to changes in water quality with aeration. The geochemical simulations were conducted using the modeling code PHREEQC with the WATEQ4F database (Parkhurst and Appelo 2013). The calculations included aqueous speciation and mineral saturation calculations using the measured water quality data (including pH, temperature, alkalinity, major ion content, and dissolved metals concentrations) for each data point collected during the monitoring period. Geochemical modeling results are provided on Figures 17 through 19.

The saturation indices of carbonate minerals, including calcite (CaCO_3), siderite (iron carbonate), and rhodochrosite (manganese carbonate), are shown on Figure 17 for the shallow monitoring wells and Figure 18 for the deep monitoring wells. The saturation index is an indicator of a mineral's propensity to dissolve (if it is present) or precipitate. A saturation index of zero indicates a solution in equilibrium with that mineral phase; if the value is above zero, the mineral would tend to precipitate, while negative values indicate either a tendency to dissolve, or that the mineral is likely not present in the formation. Key observations from the carbonate mineral saturation calculations include the following:

- In both the S and D monitoring wells, calcite is significantly undersaturated (saturation indices near -1 or lower), suggesting that calcite is likely not present in the formation and is not contributing to the measured ANP discussed in Section 3.1.
- Siderite is at or above saturation in monitoring wells pre-sparge, and in wells exhibiting little to no influence from air sparge (MW-21-3D and MW-21-4D). This suggests that siderite may be present in the formation in or near equilibrium with dissolved ferrous iron, but any siderite present is likely consumed during air sparging.
- Rhodochrosite is very close to saturation in all wells pre-air sparge, indicating the potential for its presence in the formation, but particularly in the deeper portion of the formation. In monitoring well MW-21-1D, manganese concentrations increase in solution while the alkalinity decreases, and the rhodochrosite saturation index stays constant. This suggests that rhodochrosite is likely present at this location and is actively dissolving in response to oxygen addition (acidity generation and decrease in alkalinity); this dissolution increases the concentration of manganese in solution. Although this effect may be happening in MW-21-2D, it is possible that rhodochrosite is exhausted with continued oxidation. In contrast, rhodochrosite saturation quickly dips to below the saturation index without significant increases in dissolved manganese, suggesting little to no rhodochrosite in shallower zones.

The geochemical model was also used to estimate the concentration of dissolved CO_2 in water. These results are provided on Figure 19, with CO_2 content expressed as $\log \text{pCO}_2$ (i.e., logarithm of the partial pressure of CO_2 gas in equilibrium with the solution). At atmospheric pressure near sea level, the pCO_2 is approximately -3.4, while gas under pressure within the deepest air sparge wells (water column depth approximately 58 feet) would have a pCO_2 of approximately -3.0. A calculated pCO_2 value for groundwater higher than this range indicates a water that is supersaturated with respect to atmosphere.

Calculated pCO_2 values range between approximately -2 to -1 or higher (Figure 19), suggesting that the dissolved CO_2 content of the groundwater is highly elevated relative to atmospheric equilibrium and did not change substantially throughout the aeration period. As noted above, there are competing factors that would be acting to affect the dissolved CO_2 content; whereas solution acidification would convert bicarbonate to carbonic acid (increasing the dissolved CO_2 content), air sparge of a water supersaturated with CO_2 would be expected to remove CO_2 , bringing the concentration down. It is likely that these two effects compete to result in no net change in the dissolved CO_2 content of the groundwater.

These results provide key insights into the reactions which buffer the groundwater pH on air sparge. Oxidation and precipitation of iron results in acid generation. The water quality modeling results along with geochemical calculations suggest that this acid generation is primarily buffered by dissolved alkalinity. Although significant quantities of calcite are not likely present in the formation, it is possible that other carbonate phases (such as siderite and rhodochrosite) account for some of the measured acid neutralization potential in the formation but may not be present in substantial concentrations and may be rapidly consumed with iron oxidation. It is also apparent that off gassing of CO_2 with aeration is likely not playing a major role in affecting aquifer pH post-air sparge. Although a significant quantity of dissolved alkalinity was consumed during the air sparge, the majority of

iron was also consumed; therefore, the results do not necessarily suggest that groundwater acidification would be a major issue with continued and/or larger-scale air sparge implementation.

3.3 Post-System Operation Monitoring and Testing

3.3.1 Performance Monitoring

Groundwater monitoring and sampling were performed approximately 1 month after shutdown of the pilot system. The results of the post-operation groundwater monitoring and sampling are included in Tables 8 and 9. The post-system operational data indicate that at the S monitoring wells:

- Arsenic concentrations remained below 10 µg/L in all S monitoring wells 1 month after system shutdown (Figures 7 through 10).
- Dissolved oxygen concentrations remained elevated at wells MW-21-2S and MW-21-3S and decreased to less than 1 mg/L at wells MW-21-1S and MW-21-4S.
- Iron concentrations remained low in the S monitoring wells except for MW-21-4S, where it increased to 14,500 µg/L from 702 µg/L at end of system operation. The baseline iron concentration at MW-21-4S was 67,000 µg/L (Figure 10).

In the D monitoring wells:

- Arsenic remained at a similar low concentration at well MW-21-1D and declined further to less than 10 µg/L at well MW-21-2D. At wells MW-21-3D and MW-21-4D, both iron and arsenic concentrations decreased from concentrations measured at the conclusion of system operation (Figures 11 through 14).
- Arsenic concentrations at wells MW-21-3D (1,520 µg/L) and MW-21-4D (1,390 µg/L) were still elevated following 1 month post-operation, but were lower than at baseline (2,210 and 1,570 µg/L, respectively). The observed reduction may be reflective of groundwater transport from areas of treatment upgradient rather than coprecipitation and absorption of arsenic to iron oxyhydroxides in these areas.

Additional sampling would be required to determine if the observed decrease would continue, be sustained, or rebound over a longer time frame following cessation of air sparging.

3.3.2 Hydraulic Testing Results

The results of the baseline and post-operation hydraulic testing conducted at the sparge points and monitoring wells are summarized in Table 10. Results indicate that at the sparge points:

- There was no adverse impact on the measured specific capacity of the S sparge points after the system was operated for 3 months.
- Over the same period, the specific capacity was observed to decrease in D sparge points AS-21-1D and AS-21-2D at a percentage of 25% and 52%, respectively. The measured decrease in specific capacity did not impact the functionality of the D sparge points, which continued to distribute air to the formation during the pilot test at similar air flow rates and injection pressures.

Within the monitoring well network downgradient of the sparge points:

- Specific capacity decreased by more than 10% in wells MW-21-3S (29%), MW-21-4S (37%), and MW-21-1D (13%). These results may indicate precipitation in the S interval was most prevalent in the farther downgradient monitoring wells and closer to the sparge points in the D interval.

The potential changes in specific capacity observed as a result of this testing are due to minor changes in drawdown. Additional testing over an extended treatment period would be required to determine if such a trend exists and its significance to the long-term operational maintenance requirements (and associated costs) of an IAS system. A notable increase in sparge pressure would be observed if fouling of the sparge points and the surrounding formation occurred, and no increase was observed over the 3-month pilot test.

3.4 Site Suitability Evaluation

The suitability of the site for full scale treatment of arsenic via IAS is discussed in this section. Results from the pilot test are used to evaluate and discuss the geochemical, geological, and hydrological suitability of the site for IAS treatment.

3.4.1 Geochemical

From a geochemical standpoint, the site appears to be well suited for immobilization of arsenic through an IAS treatment system. Keys to geochemical suitability of the IAS system include the following.

- Groundwater pH less than 7 that slows the kinetics of iron precipitation. The baseline pH of the S and D interval wells were all below 7 and ranged from 6.21 to 6.77. Over the course of the pilot study, the pH trends in the monitoring well network are shown on Figures 7 through 14. pH decreased in all wells where arsenic coprecipitation occurred and maintained a pH below 7. Overall, it is desirable to have the iron oxidation kinetics sufficiently rapid that oxidation and precipitation occurs within realistic timeframes for treatment of arsenic; however, the kinetics must also be slow enough to minimize oxygen consumption before distribution within the target ZOI is achieved. If iron oxidation is too rapid, this may result in an overabundance of oxidation products (iron mineral precipitates) in the immediate vicinity of the air sparge points, which could result in formation fouling.
- The results indicate in the S interval, oxidized iron does precipitate, but not within the well pack. The D interval indicated a small potential for fouling of the D well screens, although additional testing and longer-term operation of the pilot would be required to determine if this trend would continue and the degree of fouling that would be expected through long term operation. Characterization of the fouling trend in the D sparge wells would allow for a better estimate of the long-term operation and maintenance costs associated with a full-scale IAS remedy for the site.
- There is a sufficient iron to arsenic concentration ratio in groundwater to support dissolved arsenic uptake that reduces arsenic concentrations to below 10 µg/L, when dissolved oxygen distribution is achieved. Bucket tests conducted on site in January 2021 as described in the IAS Pilot Test Work Plan (SA-JV, 2021b) highlight the importance of having sufficient dissolved iron present in solution to support arsenic attenuation. Generally, this can be gauged based on the dissolved iron concentration, as well as the ratio of iron to arsenic in solution. Monitoring wells SHM-10-06 and SHM-10-14 both exhibited initial dissolved iron concentrations near 50 mg/L or greater, with iron-to-arsenic ratios of 50 and 16 on a mass basis, respectively, whereas initial iron concentrations in well SHP-2016-06A were less than 1 mg/L and in lesser abundance on a mass basis relative to arsenic with an iron-to-arsenic ratio of 0.5 (S-A JV 2021b). These results indicate that IAS should

be successful at locations with higher concentrations of dissolved iron (i.e., near well SHM-10-06), but air sparging without additional modifications may not be as effective in areas of the Site with low dissolved iron.

3.4.2 Geological

Cross sections illustrating the geology of the pilot test area, as interpreted using the soil boring logs included in Appendix A, are included as Figures 5 and 6. Based on previous site characterization and confirmed through additional soil borings collected as part of this pilot test, the Site contains suitable material for air sparging: permeable sands with a low degree of heterogeneity to minimize channeling and/or short-circuiting of injected air (for reference, see Section 2 of the In-Situ Air Sparging Engineer Manual [USACE 2013]).

The soils contain low TOC concentrations, and the reductive poise of the system appears to be quickly overcome where dissolved oxygen is distributed. The aquifer has not shown an immediate propensity to revert back to reducing conditions post-system operation, which would potentially allow a full-scale system longer extended periods of shutdown between operation.

Arsenic is present at higher concentrations in deeper soil and groundwater near the bedrock interface. A key to successful application of a full-scale IAS system would be to achieve distribution of dissolved oxygen and oxidation of iron within the deep interval that will result in the coprecipitation of arsenic at depth. Permeability of the deeper sands above the till (and bedrock, where till is not present) is more variable, and potential short-circuiting and subtle permeability differences in stratigraphy at those depths should be evaluated in more detail if the system were to be implemented at full-scale. Silty sand or clayey were noted to be present above bedrock and/or till at AS-21-1D, AS-21-2D, MW-21-2D, and MW-21-4D (Appendix A). Sands with silt content would be anticipated to be less conducive to successful distribution of air throughout the aquifer. These deeper depths in the overburden correlate with higher concentrations of arsenic in both groundwater and soils, making treatment at this interval more difficult. A successful full-scale application of air sparging would require closer-spaced D sparge points (perhaps 15 or 20 feet on center, as compared to 30 feet on center during the pilot test) and a focus on installation of sparge points as deep as possible within the sand unit to target the greatest concentrations of arsenic in groundwater at SHL.

3.4.3 Hydrological

In general, groundwater in the southern portion of SHL flows to the northeast toward Plow Shop Pond, groundwater in the northern portion of SHL flows to the north, and groundwater to the northeast of SHL flows to the northwest toward Nonacoicus Brook. Groundwater in the deep overburden at the northern extent of SHL (in the Nearfield Area) is extracted and treated by the ATP. Groundwater contours are presented on Figure 2.

During the pilot test, the ATP was in operation and experienced no significant downtime. The combined extraction rate from wells EW-01 and EW-04 averaged from 44.7 to 54.8 gallons per minute during the months of October 2021 through January 2022. Appendix F contains information on the ATP, including the total volume of water treated by month, depth to water and water table elevations of the extraction wells over the operating period of the pilot test, and laboratory sampling results for arsenic, iron, and manganese in the extraction wells in September and December 2021. The concentrations of arsenic, iron, and manganese in the extraction wells were all within typical ranges. Groundwater flows from the pilot test area northwest toward the extraction wells. The average depth to water under pumping conditions in the extraction wells in December 2021 was 34.5 feet in EW-1 and 45.5 feet in EW-4, corresponding to an average drawdown of 19.5 and 30.7 feet, respectively. While the operation

of the ATP influenced groundwater flow direction from the pilot test area toward the extraction wells, there were no other observed impacts of the ATP operation on the pilot test (Figure 20).

Post-data analysis determined minimal vertical hydraulic gradient with no significant magnitude between well clusters containing shallow and deep well screen intervals (Table 11). The average groundwater seepage velocity in this area of the Site was estimated at 1.5 feet per day (S-A JV, 2021a). After 40 days of operation, dissolved oxygen increased from 0.08 mg/L at baseline to 1.25 mg/L in well MW-21-4S located 40 feet from the closest sparge point. Assuming an S-interval ZOI of 15 feet, this correlates to an observed groundwater velocity of (40 feet – 15 feet) / (40 days) or 0.6 feet per day. Dissolved oxygen will oxidize reduced metals present at various reaction rates and be consumed by any other oxygen demand as it travels downgradient. Therefore, 0.6 foot per day likely represents a conservative estimate of the actual site groundwater velocity, but clearly indicates a connection with the upgradient sparge points and the ability of an IAS system to reduce dissolved arsenic concentrations downgradient in the S interval.

3.5 Full-Scale System Conceptual Design Parameters

A conceptual full-scale IAS system would likely be installed to treat the area directly downgradient of SHL and entail a line of sparge points spaced a certain distance apart and spanning the width of the landfill. The sparge points would be installed to target the depth of the sand aquifer containing the highest concentrations of arsenic. Based on data collected during the pilot test, the vertical sparge treatment interval would target the overburden soils located at depth from the top of bedrock to 30 feet above the bedrock surface.

Pilot test results indicate that distribution of dissolved oxygen within the aquifer was achieved at flow rates of 4 cfm in the S interval and 4 to 8 cfm in the D interval. The corresponding injection pressure at this flow range was observed to be 20 to 30 psig, consistent with pre-pilot design calculations.

Pulsed mode of operation provided good distribution of dissolved oxygen. There was no apparent improvement in performance when operating in continuous mode. One month after shutdown of the system, dissolved oxygen concentrations remained elevated above baseline conditions in 5 of the 8 installed pilot test monitoring wells, dissolved arsenic concentrations remained low in 6 of these 8 monitoring wells, and dissolved iron remained depressed in 5 of these 8 monitoring wells. This suggests a full-scale air sparge system may be suited to pulsed operation with a longer off period than was tested in the active operational period of the pilot.

The S sparge points were turned off 49 days into the pilot test and remained offline for the duration. With only the D sparge points operating, dissolved oxygen concentrations continued to increase in the S interval. A full-scale system potentially could be effective with only deeper sparge points in place. Additional testing would be needed to determine if this is the case.

The following details the conceptual operational design parameters for the S-interval sparging:

- 1) Effective ZOI greater than 15 feet
- 2) Injection flow rates of up to 4 cfm
- 3) Operational mode: pulsed
- 4) Injection pressure of 20 to 25 psig
- 5) 2-foot screened interval.

The following details the conceptual operational design parameters for the D-interval sparging:

- 1) Effective ZOI of 10 feet

- 2) Injection flow rates of 4 to 8 cfm
- 3) Operational mode: pulsed
- 4) Injection pressure of 25 to 30 psig
- 5) 2-foot screened interval positioned at the bottom of the sand aquifer.

The level of effort required to operate and maintain the air sparge infrastructure was minimal. The system required minimal maintenance and was able to be effectively monitored remotely to alert of any issues encountered. Colder weather provided more maintenance issues with air sparge lines freezing during pulsed mode operation. A full-scale system design should consider operation during colder weather and provide adequate safeguards to prevent icing issues during off periods of the sparge system.

The pilot study results cannot conclusively determine if fouling of sparge points would become an issue over longer-term operation. During operation of the pilot test system, no adverse effects such as increased injection pressure or an impact on the ability to distribute dissolved oxygen to the aquifer over time were observed. Indeed, it is unknown if changes to specific capacity measured in some wells was due to iron precipitation or the result of redistribution of fine sands and silts due the on/off action of air injection during the test. The kinetics of abiotic iron oxidation are driven largely by pH, and at a pH less than 7, the reaction kinetics are slower such that iron precipitation would be expected to occur away from the well screen. The results indicate no adverse effect on the specific capacity of the S sparge points and a potential decrease in specific capacity of the D sparge points from baseline. Additional testing over longer-term operation is required to confirm these results and to fully evaluate the impact of fouling on sparge performance and the need/frequency for redevelopment of sparge points.

3.6 Conclusions

The results from the pilot test indicate that IAS is a technology that can effectively reduce dissolved arsenic flux flowing within alluvium downgradient of the landfill and is a valid remedial option to evaluate and include as part of a feasibility study. The main challenge to the full-scale implementation of this technology appears to be achieving dissolved oxygen distribution and arsenic coprecipitation at the deepest portions of the overburden where the highest dissolved arsenic concentrations have typically been observed. It is uncertain if implementation of a full-scale system would be capable of meeting the current remedial goal (MCL) at all locations downgradient of its application particularly at depth.

The pilot study results indicate that the rate of oxygen delivery that was tested appears to be high relative to the reductive poise of the system and the corresponding iron and arsenic transport. A full-scale system would certainly employ pulsed operation. However, effective treatment of arsenic could most likely be achieved utilizing much longer off periods than were tested during the study, perhaps spanning days. Post system testing indicates dissolved arsenic remained below the MCL in monitoring wells downgradient of the pilot study 29 days post system shutdown.

While the pilot test met the primary objectives, additional testing and evaluation of results is recommended prior to or in conjunction with design and implementation of this technology at full-scale to eliminate uncertainties. These include:

- It is uncertain whether sufficient oxygen can be delivered to the deepest parts of the overburden aquifer (low permeability glacial till) to oxidize the iron at that depth. Additional testing will be required to determine if this is possible and the well spacing that would be effective.

- Determining the need for both an S and D air sparge point to span the vertical extent of the targeted treatment interval. The data collected during the pilot test suggest that full-scale treatment of the targeted treatment interval may be able to be attained through one vertical sparge point located in the D interval at depth. Suggested additional testing would include a small-scale pilot to test dissolved oxygen distribution with only the D sparge points active. The abbreviated test would include monitoring for changes in dissolved oxygen within the surrounding monitoring wells to determine if adequate distribution of dissolved oxygen and corresponding arsenic treatment is observed within the S monitoring well network.
- Determining the degree of iron fouling that might occur during longer-term operation of IAS. While there was no observed change in functionality of the system and no drop in specific capacity of the S sparge points, the D sparge points showed a decrease in specific capacity over baseline conditions. Additional testing of the D sparge points is recommended to confirm these results at a minimum. Longer-term observation of changes in specific capacity of the D sparge points is recommended to establish the trend of any decline in performance of the sparge points over a period longer than 3 months, to better understand the expected time frame for potential redevelopment.
- Determining the time for the aquifer to return to reducing conditions post-application of IAS treatment. The post-system monitoring indicated that dissolved oxygen remained elevated in two of the four S monitoring wells and two of the two D monitoring wells where dissolved oxygen was observed during the pilot test operational period. Additional monitoring of the pilot test network is suggested to determine when the aquifer returns to reducing conditions and how that impacts the dissolved metals concentrations in groundwater over time.

4 References

- Brunsting, J.H. and E.A. McBean. 2014. In situ treatment of arsenic-contaminated groundwater by air sparging. *Journal of Contaminant Hydrology*, 159, 20-35.
- Cornell, R.M. and R. Giovanoli. 1987. Effect of manganese on the transformation of ferrihydrite into goethite and jacobsite in alkaline media. *Clays and Clay Minerals*, 35, 1, 11-20.
- Davies, S.H.R. and J.J. Morgan. 1989. Manganese (II) oxidation kinetics on metal oxide surfaces. *Journal of Colloid and Interface Science*, 129, 63-77.
- Kameda, T., Y. Suzuki, and T. Yoshioka. 2014. Removal of arsenic from an aqueous solution by coprecipitation with manganese oxide. *Journal of Environmental Chemical Engineering*, 2, 4, 2045-2049.
- KGS. 2020a. Draft 2019 Annual Operations, Maintenance, and Monitoring Report, Shepley's Hill Landfill, Former Fort Devens Army Installation. May. 1-3 p.
- KGS. 2020b. Final Fifth 2020 Five-Year Review Report, Former Fort Devens Army Installation, BRAC Legacy Sites, Devens, Massachusetts. Prepared for the U.S. Army Corps of Engineers New England District. September.
- Luong, V.T., E.E. Cañas Hurz, U. Hellriegel, T.L. Luu, J. Hoinkis, and J. Bundschuh. 2018. Iron-based subsurface arsenic removal technologies by aeration: A review of the current state and future prospects. *Water Research*, 133, 110-122.
- Morgan, J.J. 2005. Kinetics of reaction between O₂ and Mn(II) species in aqueous solutions. *Geochimica et Cosmochimica Acta*, 69, 1, 35-48.
- Morgan, B. and O. Lahav. 2007. The effect of pH on the kinetics of spontaneous Fe(II) oxidation by O₂ in aqueous solution- basic principles and a simple heuristic description. *Chemosphere*, 68, 2080-2084.
- Parkhurst, D.L. and C.A.J. Appelo. 2013. Description of input and examples for PHREEQC version 3 – A computer program for speciation, batch-reaction, one-dimensional transport, and inverse geochemical calculations. U.S. Geological Survey Techniques and Methods, book6, chapter A43, 497 p., <https://pubs.usgs.gov/tm/06/a43/>.
- S-A JV. 2021a. Draft Phase I EPA SOW – Demonstrate Plume Capture, Technical Memorandum Phase I Subtask 1.g Delineate Capture Zone based on Hydraulic and Geochemical Data, SHL Former Fort Devens Army Installation. March.
- S-A JV. 2021b. Final In-Situ Air Sparge Pilot Test Work Plan, Shepley's Hill Landfill, Former Fort Devens Army Installation, Devens, Massachusetts. July.
- S-A JV. 2021c. Quality Assurance Project Plan for Annual Long-Term Monitoring and Maintenance Program Addendum 1. July.
- Singer, P.C. and W. Stumm. 1970. Acid mine drainage – The rate determining step. *Science*, 167, 1121-1123.
- U.S. Geological Survey. 2004. Natural Remediation of Arsenic Contaminated Ground Water Associated With Landfill Leachate. Fact Sheet 2004-3057. May.
- USACE. 2013. In-Situ Air Sparging Engineer Manual, EM 200-1-19. December.
- USEPA. 1992. Guide to Management of Investigation-Derived Wastes, 9345.3-03FS. April.

Tables

Table 1
Sparge Point and Monitoring Well Construction
Shepley's Hill Landfill
Former Fort Devens Army Installation
Devens, Massachusetts

Well	Installation Date(s)		Development Date(s)		Well Diameter inches	Ground ft amsl	Top of Screen ft bgs	Bottom of Screen ft bgs	Northing ft	Easting ft	Top of Silt ft bgs	Top of Bedrock ft bgs	Top of Silt ft amsl	Top of Bedrock ft amsl	Silt Layer Thickness feet
AS-21-1D	7/20/2021	7/21/2021	7/27/2021	7/28/2021	2.0	226.89	67.0	69.0	3027876.0	630158.3	69.2	73.5	157.7	153.4	4.3
AS-21-2D	7/16/2021	7/19/2021	7/28/2021	7/29/2021	2.0	226.34	71.5	73.5	3027881.6	630182.2	73.7	76.7	152.6	149.6	3.0
MW 21-1D	7/23/2021		7/27/2021	7/29/2021	2.0	226.87	59.0	69.0	3027878.2	630156.0	--	69.1	--	157.8	0.0
MW 21-2D	7/26/2021	7/27/2021	7/28/2021	7/29/2021	2.0	226.07	64.0	74.0	3027892.4	630181.5	74.0	77.0	152.1	149.1	3.0
MW 21-3D	7/29/2021	7/29/2021	7/30/2021	8/2/2021	2.0	225.96	63.5	73.5	3027890.3	630168.2	--	73.5	--	152.5	0.0
MW 21-4D	8/2/2021	8/2/2021	8/3/2021		2.0	224.86	62.0	72.0	3027915.2	630160.2	72.6	72.9	152.3	152.0	0.3
AS-21-1S	7/20/2021	7/21/2021	7/27/2021	7/30/2021	2.0	226.86	50.0	52.0	3027876.7	630160.6					
AS-21-2S	7/20/2021		7/28/2021		2.0	226.11	54.5	56.5	3027882.0	630175.8					
MW 21-1S	7/23/2021	7/26/2021	7/27/2021	7/28/2021	2.0	226.54	44.0	54.0	3027878.6	630162.2					
MW 21-2S	7/27/2021	7/28/2021	7/29/2021	7/30/2021	2.0	225.88	49.0	59.0	3027891.6	630175.1					
MW 21-3S	7/29/2021	7/30/2021	8/2/2021	8/3/2021	2.0	225.97	48.5	58.5	3027890.6	630162.2					
MW 21-4S	8/2/2021	8/2/2021	8/4/2021		2.0	225.26	47.0	57.0	3027914.3	630155.2					

	Highest ft amsl	Lowest ft amsl	Difference feet
S Wells Screen Range	182.5	166.9	15.7
S Sparge Wells Screen Range	176.9	169.6	7.3
D Wells Screen Range	167.9	152.1	15.8
D Sparge Wells Screen Range	159.9	152.8	7.0
Top of Bedrock Range	157.8	149.1	8.7

Acronyms and Abbreviations:

-- = no data

amsl = above mean sea level

bgs = below ground surface

ft = foot

Table 2
Soil Sampling Results
Shepley's Hill Landfill
Former Fort Devens Army Installation
Devens, Massachusetts

Well:	AS-21-1D	AS-21-1D	AS-21-1D	AS-21-1D	AS-21-1D
Date:	7/21/2021	7/21/2021	7/21/2021	7/21/2021	7/21/2021
Depth (ft bgs):	24-28	34-38	48-54	60-64	70-72
Description:	SAND, f.-c. grained, subangular; trace f. gravel; m. loose, saturated, brown	SAND, f.-m. grained; trace silt; m. loose, saturated, brown	SAND, f.-m. grained; trace silt; m. loose, saturated, brown	SAND, f.-m. grained, subangular, m. loose, saturated, gray-brown	SAND, f.-c. grained; some silt; some clay; trace f. gravel at base; very dense, hard (Till)
USCS:	SW	SP	SP	SP	SC
Analyte	Unit				
Arsenic	mg/kg	17	3.3	1.8 J	8.5
Biochemical Oxygen Demand	mg/kg	900 UJ	980 UJ	980 UJ	970 UJ
Iron	mg/kg	7000	3500	3700 J	4900
Manganese	mg/kg	47	43	41	47
Percent Moisture	%	16.6	23.5	23.4	22.6
Percent Solids	%	83.4	76.5	76.6	77.4
Total Organic Carbon	g/kg	0.90 U	0.90 U	0.90 U	0.90 U
Acid-Base Accounting	TCaCO ₃ /kT			1.2 U	1.4
Acid Generation Potential	TCaCO ₃ /kT			1.2 U	1.2 U
Acid Neutralization Potential	TCaCO ₃ /kT			1.1	1.4
Non-extractable Sulfur	%			0.040 U	0.040 U
Non-Sulfate Sulfur	%			0.040 U	0.040 U
Pyritic Sulfur	%			0.040 U	0.040 U
Sulfate Sulfur	%			0.040 U	0.040 U
Total Sulfur	%			0.040 U	0.040 U

Acronyms and Abbreviations:

bgs = below ground surface

ft = feet

amsl = above mean sea level

mg/kg = milligrams per kilogram

g/kg = grams per kilogram

TCaCO₃/kT = tons of calcium carbonate per kiloton

USCS = United Soil Classification and Symbol

SW = Well-graded sands, gravelly sands, little or no fines

SP = Poorly graded sands, gravelly sands, little or no fines

SC = Clayey sands, sand-clay mixtures

Data Qualifiers:

U = Indicates that the analyte/compound was analyzed for, but not detected

UJ = The analyte/compound was not detected above the reported sample Quantitation limit. The Quantitation limit is considered to be approximate due to associated QA results.

Table 3
Well Development Summary
Shepley's Hill Landfill
Former Fort Devens Army Installation
Devens, Massachusetts

Well	Well Volume gal	Date	Pumping Rate gpm	Total Volume Purged gal	Turbidity NTU	Number of Well Volumes Purged
AS-21-1S	6.45	7/27/2021	1	15	64.4	
				20	91.9	
				23	--	
		7/28/2021	1	43 (DRY)	19.4	
		7/29/2021	1	53 (DRY)	--	
		7/30/2021	1	68	35.7	
				70.5 (DRY)	--	
		8/2/2021	0.3	74.5	24.9	11.6
AS-21-2S	7.3	7/28/2021	1.5	30	15.8	
				50	5.75	6.8
MW-21-1S	6.81	7/27/2021	1.5	12	43.7	
				17	21.5	
		7/28/2021	1.5	37	7.95	5.4
MW-21-2S	7.84	7/29/2021	2	10		
				20	turbid	
				30	268	
				40	180	
				55	146	
				70	70.1	
				90	93.4	
				105	56.8	
		7/30/2021	2	125	124	
				140	11.5	
				145	14.3	18.5
				25	--	
MW-21-3S	7.5	8/2/2021	1	30	52.2	
				40	13.9	5.3
		8/3/2021	1	15	--	
MW-21-4S	7.4	8/4/2021	1.5	35	115	
				45	71.5	
				55	56	
				65	49.2	
				75	49.9	
				85	38.3	11.5

Table 3
Well Development Summary
Shepley's Hill Landfill
Former Fort Devens Army Installation
Devens, Massachusetts

Well	Well Volume gal	Date	Pumping Rate gpm	Total Volume Purged gal	Turbidity NTU	Number of Well Volumes Purged
AS-21-1D	9.14	7/27/2021	1.5	7	86.9	
				17	17.7	
				20	20.1	
				25	14.8	
				30	16.4	
		7/28/2021	1.5	50	3.46	5.5
AS-21-2D	10.1	7/28/2021	1.5	20		
				40	40	
		7/29/2021	1.5	65	6.63	6.4
MW-21-1D	9.14	7/27/2021	1.5	15	---	
		7/28/2021	1.5	25	215	
		7/29/2021	1.5	35	60.9	
				45	37.2	
				55	15.5	6.0
MW-21-2D	10.2	7/28/2021	1.5	20	90	
				25	--	
		7/29/2021	1.5	45	16	
				50	25.5	
				60	7.4	5.9
MW-21-3D	10.2	7/30/2021	2	20	--	
				35	32.7	
		8/2/2021	2	50	22.1	
				60	35	5.9
MW-21-4D	9.9	8/3/2021	1	15	--	
				30	44.3	
				35	51.2	
				50	29.7	5.1

Acronyms and Abbreviations:

gal = gallon

gpm = gallon per minute

NTU = nephelometric turbidity unit

Final Values

Table 4**Distance Between Performance Monitoring Wells and Sparge Points****Shepley's Hill Landfill****Former Fort Devens Army Installation****Devens, Massachusetts**

Well	Ground Elevation ft amsl	AS-21-1S feet	AS-21-2S feet	AS-21-1D feet	AS-21-2D feet
		226.86	226.11	226.89	226.34
MW-21-1S	226.54	2.5	14.1	4.6	20.2
MW-21-2S	225.88	20.8	9.6	22.9	12.2
MW-21-3S	225.97	13.9	16.1	15.1	21.9
MW-21-4S	225.26	37.9	38.3	38.4	42.3
<hr/>					
MW-21-1D	226.87	4.8	20.2	3.2	26.3
MW-21-2D	226.07	26.1	11.7	28.3	10.8
MW-21-3D	225.96	15.6	11.2	17.3	16.4
MW-21-4D	224.86	38.5	36.7	39.2	40.2
SHM-10-06	232.91	54.0	39.0	59.0	32.0

Acronyms and Abbreviations:

amsl = above mean sea level

ft = foot

Table 5
System Operational Data
Shepley's Hill Landfill
Former Fort Devens Army Installation
Devens, Massachusetts



Date	Time	Operational Time Days	System Status		HMI Readings								
			Arrival	Departure	Pres psi	SV-01 2D hours	SV-02 2S hours	SV-03 1S hours	SV-04 1D hours	Shallow		Deep	
										On Time min	Off Time min	On Time min	Off Time min
10/13/2021	14:20	0	Off	On	79.9	0	0	0	0	60	60	60	60
10/16/2021		3	On	Off									
10/21/2021	12:00	3	Off	On	79.8	26.1	26.8	26.8	26.1	60	60	60	60
10/25/2021	18:15	7	On	On	78.5	47.8	49.6	49.6	44.2	60	60	60	60
11/5/2021	16:00	18	On	On	79	107.2	109.8	109.9	103.6	60	60	60	60
11/11/2021	14:50	24	On	On	78.5	139	143.3	143.4	135.4	60	60	60	60
11/17/2021	14:21	30	On	On	82.9	169.7	174.8	174.9	166.1	60	60	60	60
11/23/2021	13:47	36	On	On	77.4	199.4	205	205.1	195.8	60	60	60	60
12/6/2021	16:31	49	On	On	77.2	269.8	275.6	275.7	269	0	0	240	60
12/14/2021	15:15	57	On	On	76.7	376.2	275.6	275.5	374.3	0	0	180	120
12/23/2021	14:25	66	On	On	73.7	499.8	275.6	275.7	497.7	0	0	180	120
12/27/2021	7:40	70	Off	On	77.2	505.2	275.6	275.7	503.3	0	0	180	120
12/29/2021	18:00	72	Off	On	77.2	510.4	275.6	275.7	508.5	0	0	180	120
1/5/2022	16:00	79	Off	On	78.7	559.3	275.6	275.7	557.4	0	0	60	60
1/6/2022	20:30	80	On	On	76.8	572.4	275.6	275.7	570.5	0	0	60	60
1/12/2022	10:30	86	Off	On	76.8	616	275.6	275.7	614.1	0	0	60	60
1/13/2022	12:56	87	Off	On	77	623.5	275.6	275.7	621.6	0	0	60	60

Table 5
System Operational Data
Shepley's Hill Landfill
Former Fort Devens Army Installation
Devens, Massachusetts

Date	Manifold Readings								Well Vault Readings			
	AS-21-1S		AS-21-2S		AS-21-1D		AS-21-2D		AS-21-2D	AS-21-2S	AS-21-1S	AS-21-1D
	Pres psi	Flow Rate cfm	Pres psi	Flow Rate cfm	Pres psi	Flow Rate cfm	Pres psi	Flow Rate cfm	Pres psi	Pres psi	Pres psi	Pres psi
10/13/2021	22	4	22	4	28	4	25	4	28	23	22	26
10/16/2021												
10/21/2021	19	4	20	4	29	4	21	4	29	21	19	26
10/25/2021	15	4	25	4	25	4	24	4.5	25	20	20	20
11/5/2021	20	4	20	4	27	4	22	4	22	21	20	10
11/11/2021	18	4	20	4	NM	8	NM	8	18	22	22	10
11/17/2021	NM	4	NM	4	NM	8	NM	8	0	8	16	0
11/23/2021	19	4	20	4	28	8	20	8	30	22	20	26
12/6/2021	Off	Off	Off	Off	27	12	26	12	26	Off	Off	25
12/14/2021	Off	Off	Off	Off	28	12	26	12	28	Off	Off	26
12/23/2021	Off	Off	Off	Off	34	16	30	16	30	Off	Off	27
12/27/2021	Off	Off	Off	Off	34	16	30	16	31	Off	Off	27
12/29/2021	Off	Off	Off	Off	34	16	30	16	31	Off	Off	26
1/5/2022	Off	Off	Off	Off	30	12	28	12	29	Off	Off	26
1/6/2022	Off	Off	Off	Off	35	16	30	16	NM	Off	Off	NM
1/12/2022	Off	Off	Off	Off	34	16	30	16	NM	off	Off	NM
1/13/2022	Off	Off	Off	Off	35	16	30	16	NM	Off	Off	NM

Acronyms and Abbreviations:

cfm = cubic feet per minute
 HMI = Human Machine Interface
 min = minute
 NM = not measured
 psi = pound per square inch
 Pres = pressure

Table 8
Performance Monitoring Results - Field Parameters
Shepley's Hill Landfill
Former Fort Devens Army Installation
Devens, Massachusetts

Well	Date	Time Since Startup days	System Airflow and Operational Summary						Temp °C	DTW ft bmp	DO mg/L	Cond. ms/cm	pH S.U.	ORP mV	Turbidity NTU	Total Iron mg/L	Ferrous Iron mg/L	VOC Headspace ppm
			Shallow cfm	Time On hr	Time Off hr	Deep cfm	Time On hr	Time Off hr										
MW-21-1S	8/18/2021		Off			Off			13.2	15.53	0.00	0.710	11.59	-208.1	7.1	NR	60.6	NR
	10/12/2021	-1	Off			Off			16.0	13.55	2.79	NR	11.35	-262.2	NR	NR	NR	NR
	10/25/2021	12	4	1	1	4	1	1	10.9	11.79	13.16	0.346	7.07	157.9	43.42	0.89	NR	0.4
	11/4/2021	22	4	1	1	4	1	1	8.9	12.97	17.25	0.385	6.86	230.0	13.73	0.14	0.02	0.0
	11/11/2021	29	4	1	1	4	1	1	11.4	14.75	13.82	0.445	7.25	-125.0	34.6	0.17	ND	0.0
	11/17/2021	35	4	1	1	8	1	1	10.5	15.15	14.45	0.290	6.42	46.2	NR	0.14	0.22	0.0
	11/23/2021	41	4	1	1	8	1	1	9.6	15.77	8.25	0.291	6.84	-53.6	153.24	0.07	0.04	0.0
	12/7/2021	55	Off			10	3	2	NR	NR	13.42	NR	NR	NR	NR	NR	NR	NR
	12/13/2021	61	Off			10	3	2	NR	15.05	NR	NR	NR	NR	NR	NR	NR	0.0
	12/14/2021	62	Off			10	3	2	NR	15.94	13.88	0.331	7.09	107.3	0.61	0.19	0.04	0.0
	12/29/2021	77	Off			16	3	2	9.1	15.77	13.59	0.375	6.48	176.5	0.84	ND	ND	0.0
	1/5/2022	84	Off			16	3	2	9.5	14.88	12.31	0.389	6.25	188.1	NR	NR	NR	NR
	1/19/2022	98	Off			8	Continuous		16.36	10.13	0.205	6.32	197.5	54.1	0.12	0.09	NR	
	2/16/2022		Off			Off			8.7	15.35	0.84	0.329	6.58	-394.3	50.27	ND	0.07	RN
MW-21-2S	8/20/2021		Off			Off			14.4	14.44	0.14	0.477	6.25	-40.7	11.14	NR	30.2	NR
	10/12/2021	-1	Off			Off			15.9	14.27	5.13	NR	6.79	-44.9	NR	NR	NR	NR
	10/25/2021	12	4	1	1	4	1	1	11.6	14.02	11.54	0.531	6.67	123.8	42.86	2.6	NR	5.4
	11/5/2021	23	4	1	1	4	1	1	9.8	13.34	4.19	0.443	6.46	-59.6	8.11	0.84	0.76	0.7
	11/11/2021	29	4	1	1	4	1	1	12.4	13.49	8.96	0.530	6.72	-87.4	135	8.6	0.8	0.0
	11/17/2021	35	4	1	1	8	1	1	10.8	14.11	10.81	0.394	6.76	-15.2	NR	3.6	0.5	0.0
	11/23/2021	41	4	1	1	8	1	1	9.7	14.35	3.06	0.295	6.30	-75.6	193.61	3.9	2.6	0.0
	12/7/2021	55	Off			10	3	2	NR	NR	7.38	NR	NR	NR	NR	NR	NR	NR
	12/13/2021	61	Off			10	3	2	NR	15.18	NR	NR	NR	NR	NR	NR	NR	NR
	12/14/2021	62	Off			10	3	2	11.6	14.82	4.04	0.398	6.66	34.8	17.9	4.12	2.64	0.0
	12/23/2021	71	Off			12	3	2	6.1	15.16	6.79	0.609	6.35	116.4	107	NR	NR	NR
	12/29/2021	77	Off			16	3	2	9.0	14.19	5.14	0.438	6.23	149.7	46.6	5.4	0.73	0.0
	1/5/2022	84	Off			16	3	2	9.5	13.97	8.16	0.662	6.12	173.8	NR	NR	NR	NR
	1/13/2022	92	Off			16	1	1	5.6	15.17	7.45	0.224	6.41	106.8	NR	2.22	0.13	0.1
	1/20/2022	99	Off			8	Continuous		9.2	14.68	6.55	0.305	6.34	44.4	117.9	3.1	1.65	NR
	2/16/2022		Off			Off			8.5	14.46	7.53	0.465	6.45	155.9	17.18	0	0	NR

Table 8
Performance Monitoring Results - Field Parameters
Shepley's Hill Landfill
Former Fort Devens Army Installation
Devens, Massachusetts

Well	Date	Time Since Startup days	System Airflow and Operational Summary						Temp °C	DTW ft bmp	DO mg/L	Cond. ms/cm	pH S.U.	ORP mV	Turbidity NTU	Total Iron mg/L	Ferrous Iron mg/L	VOC Headspace ppm
			Shallow cfm	Time On hr	Time Off hr	Deep cfm	Time On hr	Time Off hr										
MW-21-3S	8/25/2021		Off			Off			14.6	14.50	0.34	0.444	6.48	-58.9	7.18	NR	65.8	NR
	10/12/2021	-1	Off			Off			15.9	13.97	2.14	NR	6.22	-44.1	NR	NR	NR	NR
	10/25/2021	12	4	1	1	4	1	1	11.9	14.81	13.11	0.288	6.36	63.8	34.15	0.8	NR	0.0
	11/4/2021	22	4	1	1	4	1	1	9.4	13.47	13.91	0.387	6.34	237.1	8.69	0.35	0.06	0.4
	11/11/2021	29	4	1	1	4	1	1	11.8	13.74	12.68	0.386	6.71	-75.2	150	6.35	0.1	0.1
	11/17/2021	35	4	1	1	8	1	1	10.7	14.60	13.50	0.272	6.39	12.4	NR	9.4	0.7	0.0
	11/22/2021	40	4	1	1	8	1	1	10.6	14.54	8.11	0.243	6.26	-100.4	291.5	6.6	5	0.0
	12/7/2021	55	Off			10	3	2	NR	NR	11.38	NR	NR	NR	NR	NR	NR	NR
	12/13/2021	61	Off			10	3	2	10.7	15.24	5.71	0.191	6.61	51.9	13.7	2.2	0.8	0.0
	12/23/2021	71	Off			12	3	2	6.1	15.61	13.78	0.344	6.50	100.7	424	NR	NR	NR
	12/28/2021	76	Off			16	3	2	9.8	14.63	5.67	0.229	5.75	166.7	22.3	2.45	1.58	0.0
	1/5/2022	84	Off			16	3	2	9.3	14.39	8.63	0.320	5.75	126.2	NR	NR	NR	NR
	1/13/2022	92	Off			16	1	1	5.0	15.79	13.03	0.124	6.29	62.4	NR	0.31	0.06	0.2
	1/20/2022	99	Off			8	Continuous		9.4	15.17	11.22	0.236	6.02	125.8	74.2	0.29	0.26	NR
	2/16/2022		Off			Off			8.6	14.86	11.00	0.230	6.37	-88.9	148.23	0.13	0.06	NR
MW-21-4S	8/25/2021		Off			Off			14.5	13.66	0.08	0.452	6.21	-66.0	4.51	NR	60.8	NR
	10/12/2021	-1	Off			Off			15.9	13.08	1.88	NR	6.26	-67.9	NR	NR	NR	NR
	10/25/2021	12	4	1	1	4	1	1	11.6	13.89	0.64	0.438	6.33	-34.7	2.72	>3.3	NR	0.0
	11/4/2021	22	4	1	1	4	1	1	11.1	12.58	0.49	0.648	6.28	-43.9	2.39	>16.5	6.25	NR
	11/11/2021	29	4	1	1	4	1	1	11.9	13.30	1.61	0.581	6.27	-156.8	43.9	36.2	11.05	0.2
	11/17/2021	35	4	1	1	8	1	1	11.1	13.60	1.74	0.424	6.25	-23.5	NR	37.2	23.7	0.0
	11/22/2021	40	4	1	1	8	1	1	11.6	13.63	1.25	0.485	6.31	-47.9	156.76	27.6	15.1	0.0
	12/6/2021	54	4	1	1	8	1	1	8.0	13.97	0.33	0.353	6.18	-4.9	16.9	28.8	19.4	0.1
	12/7/2021	55	Off			12	4	1	NR	NR	1.17	NR	NR	NR	NR	NR	NR	NR
	12/7/2021	55	Off			10	3	2	NR	NR	0.70	NR	NR	-13.0	NR	NR	NR	NR
	12/13/2021	61	Off			10	3	2	11.2	14.00	5.37	0.388	6.38	56.2	15	4.4	3	0.0
	12/23/2021	71	Off			12	3	2	6.1	14.35	8.31	0.534	NR	43.7	315	NR	NR	NR
	12/29/2021	77	Off			16	3	2	9.0	13.77	4.35	1.236	6.13	49.9	54.6	6.45	4	0.8
	1/5/2022	84	Off			16	3	2	9.6	13.47	3.23	0.586	5.72	101.6	NR	NR	NR	NR
	1/13/2022	92	Off			16	1	1	5.4	14.42	11.13	0.200	6.23	110.8	NR	19.6	0.09	2.8
	1/19/2022	98	Off			8	Continuous		8.8	14.68	7.53	0.434	5.19	202.3	19.6	0.13	0.02	NR
	2/17/2022		Off			Off			11.1	14.09	0.94	0.434	5.99	29.2	15.88	8.4	4	0.0

Table 8
Performance Monitoring Results - Field Parameters
Shepley's Hill Landfill
Former Fort Devens Army Installation
Devens, Massachusetts

Well	Date	Time Since Startup days	System Airflow and Operational Summary						Temp °C	DTW ft bmp	DO mg/L	Cond. ms/cm	pH S.U.	ORP mV	Turbidity NTU	Total Iron mg/L	Ferrous Iron mg/L	VOC Headspace ppm
			Shallow cfm	Time On hr	Time Off hr	Deep cfm	Time On hr	Time Off hr										
MW-21-1D	8/18/2021		Off			Off			16.0	15.91	0.08	0.404	6.38	-74.0	8.4	NR	56.2	NR
	10/12/2021	-1	Off			Off			15.7	14.76	2.01	NR	6.64	-92.6	NR	NR	NR	NR
	10/25/2021	12	4	1	1	4	1	1	10.4	15.58	13.26	0.220	6.81	-18.8	93.87	27.2	NR	0.4
	11/4/2021	22	4	1	1	4	1	1	10.9	13.98	1.59	0.386	6.27	-4.9	9.02	28.4	25.5	NR
	11/11/2021	29	4	1	1	4	1	1	11.6	15.18	2.11	0.469	6.40	-188.3	211	37.2	15	0.0
	11/17/2021	35	4	1	1	8	1	1	10.5	15.39	2.61	0.287	6.22	8.5	NR	15.8	10.5	0.0
	11/23/2021	41	4	1	1	8	1	1	9.6	15.52	2.30	0.265	6.23	-55.0	215.52	2.6	0.9	0.0
	12/6/2021	54	4	1	1	8	1	1	7.6	15.86	10.82	0.234	7.02	257.9	39.7	6.4	0.2	0.0
	12/7/2021	55	Off			12	4	1	NR	NR	6.01	NR	NR	NR	NR	NR	NR	NR
	12/7/2021	55	Off			10	3	2	NR	NR	10.34	NR	NR	216.3	NR	NR	NR	NR
	12/13/2021	61	Off			10	3	2	NR	16.30	NR	NR	NR	NR	NR	NR	NR	NR
	12/14/2021	62	Off			12	3	2	10.4	16.37	5.59	0.323	6.53	63.5	8.88	3.1	0.6	0.0
	12/29/2021	77	Off			16	3	2	9.1	15.44	9.25	0.286	6.22	151.9	14.2	0.84	0.43	0.0
	1/5/2022	84	Off			16	3	2	9.5	15.18	11.27	0.451	6.04	159.3	NR	NR	NR	NR
	1/13/2022	92	Off			16	1	1	5.6	16.45	10.80	0.189	6.40	46.5	NR	NR	1.05	0.0
	1/19/2022	98	Off			8	Continuous		8.8	16.89	8.84	0.339	6.26	58.0	60.1	4.9	1.49	NR
	2/16/2022		Off			Off			9.1	15.68	4.64	0.424	6.09	-188.2	137.11	ND	0.6	NR
MW-21-2D	8/19/2021		Off			Off			15.1	14.94	0.02	0.307	6.77	-105.3	14.5	NR	51.6	NR
	10/12/2021	-1	Off			Off			15.8	13.79	1.53	NR	7.18	-153.0	NR	NR	NR	NR
	10/25/2021	12	4	1	1	4	1	1	12.3	14.90	0.74	0.321	6.84	-82.9	13.61	>3.3	NR	0.0
	11/5/2021	23	4	1	1	4	1	1	12.4	13.71	0.20	0.411	6.65	-170.0	1.61	14.7	8.1	0.0
	11/11/2021	29	4	1	1	4	1	1	12.6	13.50	1.27	0.407	6.72	-182.9	37.6	23.3	16.3	0.0
	11/17/2021	35	4	1	1	8	1	1	10.9	14.33	0.65	0.287	6.59	-55.3	NR	37.8	23.4	0.0
	11/22/2021	40	4	1	1	8	1	1	11.3	14.32	0.42	0.290	6.61	-84.8	16.39	>33.0	22.1	0.0
	12/6/2021	54	4	1	1	8	1	1	7.9	14.76	0.31	0.212	6.62	-11.0	20.1	23.5	13.9	0.0
	12/7/2021	55	Off			12	4	1	NR	NR	0.43	NR	NR	NR	NR	NR	NR	NR
	12/7/2021	55	Off			10	3	2	NR	NR	0.44	NR	NR	-7.7	NR	NR	NR	NR
	12/13/2021	61	Off			10	3	2	NR	15.60	NR	NR	NR	NR	NR	NR	NR	NR
	12/14/2021	62	Off			10	3	2	11.5	15.20	6.66	0.236	6.26	54.5	91.3	4.85	1.48	0.0
	12/23/2021	71	Off			12	3	2	6.1	15.33	10.38	0.245	6.03	108.7	270	NR	NR	NR
	12/29/2021	77	Off			16	3	2	9.0	14.45	4.05	0.181	5.55	152.7	48.8	1.79	0.06	0.0
	1/5/2022	84	Off			16	3	2	9.5	14.20	6.69	0.268	5.55	90.6	NR	NR	NR	NR
	1/13/2022	92	Off			16	1	1	5.6	15.31	9.81	0.105	6.20	114.1	NR	1.18	0.23	0.0
	1/20/2022	99	Off			8	Continuous		7.5	14.89	7.74	0.154	5.95	192.5	NR	1.04	0.09	NR
	2/16/2022		Off			Off			8.9	14.68	5.55	0.207	6.03	170.2	8.12	0.36	0.23	NR

Table 8
Performance Monitoring Results - Field Parameters
Shepley's Hill Landfill
Former Fort Devens Army Installation
Devens, Massachusetts

Well	Date	Time Since Startup days	System Airflow and Operational Summary						Temp °C	DTW ft bmp	DO mg/L	Cond. ms/cm	pH S.U.	ORP mV	Turbidity NTU	Total Iron mg/L	Ferrous Iron mg/L	VOC Headspace ppm
			Shallow cfm	Time On hr	Time Off hr	Deep cfm	Time On hr	Time Off hr										
MW-21-3D	8/20/2021		Off			Off			14.8	14.24	0.03	0.397	6.64	-109.6	12.1	NR	57.2	NR
	10/12/2021	-1	Off			Off			15.8	13.32	1.78	NR	6.38	-73.6	NR	NR	NR	NR
	10/25/2021	12	4	1	1	4	1	1	11.7	14.11	0.66	0.359	6.57	-61.5	5.66	>3.3	NR	0.3
	11/4/2021	22	4	1	1	4	1	1	8.2	13.15	0.25	0.484	6.52	-80.1	13.23	10.8	4.05	0.0
	11/11/2021	29	4	1	1	4	1	1	12.0	13.61	1.36	0.514	6.46	-200.6	114	41.8	9.85	0.0
	11/17/2021	35	4	1	1	8	1	1	11.0	14.00	0.68	0.408	6.40	-59.8	NR	59	27	0.0
	11/22/2021	40	4	1	1	8	1	1	11.0	13.89	0.73	0.319	6.43	-310.5	30.9	46.4	24.4	0.0
	12/6/2021	54	4	1	1	8	1	1	7.6	14.33	0.34	0.363	6.44	-23.5	18.9	44.4	23.2	0.1
	12/7/2021	55	Off			12	4	1	NR	NR	0.58	NR	NR	NR	NR	NR	NR	NR
	12/7/2021	55	Off			10	3	2	NR	NR	0.70	NR	NR	4.6	NR	NR	NR	NR
	12/13/2021	61	Off			10	3	2	NR	15.22	NR	NR	NR	NR	NR	NR	NR	NR
	12/14/2021	62	Off			10	3	2	11.0	14.63	0.14	0.448	6.83	-101.5	3.59	43.2	20.7	0.0
	12/23/2021	71	Off			12	3	2	6.0	14.96	1.45	0.588	6.51	-85.8	17.2	42.5	35.8	NR
	12/28/2021	76	Off			16	3	2	9.1	14.02	1.40	1.049	6.50	-43.9	14.2	40.2	34	0.0
	1/5/2022	84	Off			16	3	2	9.7	13.81	0.56	0.655	6.18	-46.1	NR	79.3	37.5	NR
	1/13/2022	92	Off			16	1	1	5.3	15.05	1.61	0.226	6.50	-66.5	NR	53.8	31.1	0.0
	1/20/2022	99	Off			8	Continuous		7.3	14.50	1.18	0.416	6.24	-83.1	44.7	53.4	19.2	NR
	2/16/2022		Off			Off			9.3	14.22	1.03	0.391	6.50	-14.2	30.22	33	27.6	NR
MW-21-4D	8/25/2021		Off			Off			15.2	13.30	0.06	0.344	6.55	-108.6	23.4	NR	42.2	NR
	10/12/2021	-1	Off			Off			16.6	12.81	1.49	NR	6.65	-85.1	NR	NR	NR	NR
	10/25/2021	12	4	1	1	4	1	1	11.8	13.56	0.59	0.346	6.59	-77.1	1.56	>3.3	NR	0.0
	11/4/2021	22	4	1	1	4	1	1	10.7	12.37	0.17	0.521	6.61	-98.1	0.99	8.5	4.6	NR
	11/11/2021	29	4	1	1	4	1	1	11.7	13.07	1.17	0.538	6.54	-145.7	11.6	>33	18.2	0.0
	11/17/2021	35	4	1	1	8	1	1	11.4	13.34	0.61	0.425	6.52	-72.8	NR	53.6	27	0.0
	11/22/2021	40	4	1	1	8	1	1	11.6	13.32	0.49	0.471	6.60	-103.5	7.76	>66.0	28.3	0.0
	12/6/2021	54	4	1	1	8	1	1	7.9	13.66	0.29	0.346	6.48	-37.4	1.92	39	15.6	0.1
	12/7/2021	55	Off			12	4	1	NR	NR	0.24	NR	NR	NR	NR	NR	NR	NR
	12/7/2021	55	Off			10	3	2	NR	NR	0.31	NR	NR	-24.0	NR	NR	NR	NR
	12/13/2021	61	Off			10	3	2	11.2	14.11	0.19	0.431	6.87	-95.8	3.65	71.2	17.4	0.0
	12/23/2021	71	Off			12	3	2	6.2	14.04	1.21	0.572	6.58	-81.2	19.9	53.4	35.3	NR
	12/28/2021	76	Off			16	3	2	9.5	13.44	0.33	0.386	6.38	-45.8	12.89	54	13.2	0.0
	1/5/2022	84	Off			16	3	2	9.8	13.17	0.44	0.607	6.32	-82.1	NR	50	21	NR
	1/13/2022	92	Off			16	1	1	5.6	14.38	1.38	0.214	6.62	-88.9	NR	52.2	22.2	0.0
	1/19/2022	98	Off			8	Continuous		8.6	14.32	0.52	0.379	6.63	-88.4	NR	63.6	35	NR
	2/17/2022		Off			Off			11.1	13.72	0.19	0.268	6.65	-111.9	21.99	17.4	11.2	0.0

Table 8
Performance Monitoring Results - Field Parameters
Shepley's Hill Landfill
Former Fort Devens Army Installation
Devens, Massachusetts

Well	Date	Time Since Startup days	System Airflow and Operational Summary						Temp °C	DTW ft bmp	DO mg/L	Cond. ms/cm	pH S.U.	ORP mV	Turbidity NTU	Total Iron mg/L	Ferrous Iron mg/L	VOC Headspace ppm
			Shallow cfm	Time On hr	Time Off hr	Deep cfm	Time On hr	Time Off hr										
SHM-10-06	8/26/2021		Off			Off			14.4	18.55	0.03	0.422	6.56	-107.6	4.65	NR	48	NR
	10/12/2021	-1	Off			Off			16.7	17.87	2.04	NR	7.29	-123.8	NR	NR	NR	NR
	10/25/2021	12	4	1	1	4	1	1	14.1	18.51	1.30	0.448	6.53	-77.7	7.49	>3.3	NR	0.0
	11/5/2021	23	4	1	1	4	1	1	10.2	17.64	0.05	0.584	6.50	-183.3	1.27	15.5	2.25	0.2
	11/11/2021	29	4	1	1	8	1	1	13.9	18.09	1.61	0.620	6.57	-132.3	8.17	>3.3	2.26	0.0
	11/17/2021	35	4	1	1	8	1	1	13.1	18.45	0.87	0.456	6.54	-79.5	NR	55.6	19.1	0.0
	11/22/2021	40	4	1	1	8	1	1	12.4	18.39	0.70	0.375	6.55	-358.6	1.48	63.6	28	0.0
	12/8/2021	56	Off			10	3	2	NR	NR	0.45	NR	NR	NR	NR	NR	NR	NR
	12/13/2021	61	Off			10	3	2	11.3	18.98	0.25	0.387	6.91	-95.4	0.72	54.8	16.6	0.0
	12/28/2021	76	Off			16	3	2	9.8	18.49	0.32	0.508	6.07	-107.7	3.21	57.2	33.8	0.0
	1/5/2022	84	Off			16	3	2	9.9	18.30	0.55	0.756	6.28	-80.0	NR	NR	NR	NR
	1/13/2022	92	Off			16	1	1	7.2	19.24	1.35	0.245	6.62	-101.4	NR	53.2	23.1	0.0
	1/19/2022	98	Off			8	Continuous		10.1	19.38	0.83	0.480	6.49	-107.2	57.8	>66.6	23.4	NR
	2/17/2022		Off			Off			10.9	18.79	0.84	0.530	6.47	-351.4	36.65	58.2	31.4	0.0

Acronyms and Abbreviations:

°C = degree Celsius
bmp = below measuring point
cfm = cubic feet per minute
DO = dissolved oxygen
DTW = depth to water
ft = foot
hr = hour
mg/L = milligram per liter
ms/cm = millisiemens per centimeter
mV = millivolt
NR = no reading
nd = not detected
NTU = nephelometric turbidity unit
ORP = oxidation-reduction potential
ppm = part per million
S.U. = scientific units
Temp = temperature
VOC = volatile organic compound

Note

The field monitoring procedure was refined after November 10, 2021 to turn the system off for at least an hour before the collection of readings.

Table 9
Performance Monitoring Results - Analytical Data
Shepley's Hill Landfill
Former Fort Devens Army Installation
Devens, Massachusetts

Parameter	Unit	MW-21-1S						
		8/18/2021 System Off Baseline	11/4/2021 System On 22 days post startup	11/23/2021 System On 41 days post startup	12/14/2021 System On 57 days post startup	12/28/2021 System On 71 days post startup	1/19/2022 System Off 98 days post startup	2/16/2022 System Off 28 days post shutdown
Arsenic	µg/L	18.6	1.7 J	8 U	8 U	8 U	8 U	8 U
Dissolved Arsenic	µg/L	18.2	8 U	8 U	1.4 J	8 U	8 U	8 U
Iron	µg/L	48,700	904	26 J	20 J	17 J	16 J	100 U
Dissolved iron	µg/L	48,700	26	9.6 J	8.8 J	100 U	26 J	100 U
Nitrate	mg/L	0.25 U		0.15		1.8		6.8
Sulfate	mg/L	31		10		15		17
Manganese	µg/L	2,530	968	945	552	666	448	643
Dissolved manganese	µg/L	2,500	939	923	552	667	441	698
Calcium	µg/L	52,400		37,100			21,200	43,400
Magnesium	µg/L	6,990		6,110			3,230	6,850
Potassium	µg/L	28,800		10,700			6,750	12,300
Sodium	µg/L	41,800		24,000			18,800	19,200
Chloride	mg/L	36		28		26		25
Alkalinity	mg/L	320	150	150	130	180	44	140
Total Dissolved Solids	mg/L	400	200	200	160	170	130	220
Total Organic Carbon	mg/L	7.1						
Dissolved Organic Carbon	mg/L			3.8		3.7		2.8
BOD	mg/L	21	2 U	2	2 U	2 U	2 U	3
COD	mg/L	15 U						
Field Parameters								
Depth to Water	ft bmp	15.53	12.97	15.77	15.94	15.77	16.36	15.35
Dissolved Oxygen	mg/L	0.00	17.25	8.25	13.88	13.59	10.13	0.84
ORP	mV	-208.1	230	-53.6	107.3	176.5	197.5	-394.3
pH	S.U.	11.59	6.86	6.84	7.09	6.48	6.32	6.58
Conductivity	ms/cm	0.710	0.385	0.291	0.331	0.375	0.205	0.329
Ferrous Iron	mg/L	60.6	0.02	0.04	0.04	ND	0.09	0.07
Total Iron	mg/L		0.14	0.07	0.19	ND	0.12	ND

Table 9
Performance Monitoring Results - Analytical Data
Shepley's Hill Landfill
Former Fort Devens Army Installation
Devens, Massachusetts

Parameter	Unit	MW-21-2S						
		8/20/2021 System Off Baseline	11/5/2021 System On 23 days post startup	11/23/2021 System On 41 days post startup	12/14/2021 System On 57 days post startup	12/29/2021 System On 72 days post startup	1/20/2022 System Off 99 days post startup	2/16/2022 System Off 28 days post shutdown
Arsenic	µg/L	415	9	9.4	12	5.2 J	3.7 J	2.8 J
Dissolved Arsenic	µg/L	390	6.9 J	8 U	3.8 J	2.5 J	8 U	8 U
Iron	µg/L	47,700	4,880	4,320	5,200	6,520	2,550	501
Dissolved iron	µg/L	45,400	4,590	3,240	3,420	5,960	1,940	28 J
Nitrate	mg/L	0.025 U		0.06		0.19		1.2
Sulfate	mg/L	27		24		26		18
Manganese	µg/L	1,190	975	741	933	1,010	718	888
Dissolved manganese	µg/L	1,160	1,010	730	926	1,100	721	963
Calcium	µg/L	43,600		32,200			29,800	43,600
Magnesium	µg/L	5,480		3,310			3,940	7,650
Potassium	µg/L	13,500		7,800			9,160	9,080
Sodium	µg/L	44,100		31,100			24,600	31,300
Chloride	mg/L	46		33		34		34
Alkalinity	mg/L	180	160	110	120	120	110	180
Total Dissolved Solids	mg/L	270	230	180	180	110	170	220
Total Organic Carbon	mg/L	3.6						
Dissolved Organic Carbon	mg/L			2.5		3		3.2
BOD	mg/L	4.5 J	0.81 J	1.5	1.1 J	2 U	1.8 J	2.4 J
COD	mg/L	10 U						
Field Parameters								
Depth to Water	ft bmp	14.44	13.34	14.35	14.82	14.19	14.68	14.46
Dissolved Oxygen	mg/L	0.14	4.19	3.06	4.04	5.14	6.55	7.53
ORP	mV	-40.7	-59.6	-75.6	34.8	149.7	44.4	155.9
pH	S.U.	6.25	6.46	6.30	6.66	6.23	6.34	6.45
Conductivity	ms/cm	0.477	0.443	0.295	0.398	0.438	0.305	0.465
Ferrous Iron	mg/L	30.2	0.76	2.6	2.64	0.73	1.65	0
Total Iron	mg/L		0.84	3.9	4.12	5.4	3.1	0

Table 9
Performance Monitoring Results - Analytical Data
Shepley's Hill Landfill
Former Fort Devens Army Installation
Devens, Massachusetts

Parameter	Unit	MW-21-3S						
		8/25/2021 System Off Baseline	11/4/2021 System On 22 days post startup	11/22/2021 System On 40 days post startup	12/13/2021 System On 56 days post startup	12/28/2021 System On 71 days post startup	1/20/2022 System Off 99 days post shutdown	2/16/2022 System Off 28 days post shutdown
Arsenic	µg/L	162	3 J	7.1 J	6.3 J	2.8 J	2.5 J	4.4 J
Dissolved Arsenic	µg/L	176	8 U	8 U	4.2 J	8 U	8 U	2.1 J
Iron	µg/L	60,400	797	6,590	2,600	3,520	417	495
Dissolved iron	µg/L	62,600	198	5,730	1,400	2,270	139	195
Nitrate	mg/L	0.05 U		0.05		0.05 U		0.61
Sulfate	mg/L	5		6.4		12		13
Manganese	µg/L	2,350	634	670	421	353	222	330
Dissolved manganese	µg/L	2,400	658	646	427	357	222	323
Calcium	µg/L	45,900		39,200			23,500	21,300
Magnesium	µg/L	7,770		4,560			3,670	3,440
Potassium	µg/L	11,000		11,900			8,700	8,030
Sodium	µg/L	23,000		19,600			19,300	19,300
Chloride	mg/L	29 J		26		31		30
Alkalinity	mg/L	240	140	140	80	71	76	88
Total Dissolved Solids	mg/L	290	180	170	110	120 J	100	10 U
Total Organic Carbon	mg/L	3.7						
Dissolved Organic Carbon	mg/L			2.9		2.2		2.7
BOD	mg/L	4.3 J						
COD	mg/L	15 U						
Field Parameters								
Depth to Water	ft bmp	14.50	13.47	14.54	15.24	14.63	15.17	14.86
Dissolved Oxygen	mg/L	0.34	13.91	8.11	5.71	5.67	11.22	11.00
ORP	mV	-58.9	237.1	-100.4	51.9	166.7	125.8	-88.9
pH	S.U.	6.48	6.34	6.26	6.61	5.75	6.02	6.37
Conductivity	ms/cm	0.444	0.387	0.243	0.191	0.229	0.236	0.230
Ferrous Iron	mg/L	65.8	0.06	5	0.8	1.58	0.26	0.06
Total Iron	mg/L		0.35	6.6	2.2	2.45	0.29	0.13

Table 9
Performance Monitoring Results - Analytical Data
Shepley's Hill Landfill
Former Fort Devens Army Installation
Devens, Massachusetts

Parameter	Unit	MW-21-4S						
		8/25/2021 System Off Baseline	11/4/2021 System On 22 days post startup	11/22/2021 System On 40 days post startup	12/13/2021 System On 56 days post startup	12/29/2021 System On 72 days post startup	1/19/2022 System Off 98 days post startup	2/17/2022 System Off 29 days post shutdown
Arsenic	µg/L	41.5	31.5	19.3	4.6 J	8 U	8 U	1.6 J
Dissolved Arsenic	µg/L	40.1	30.2	16.3	4.3 J	8 U	8 U	8 U
Iron	µg/L	67,000	56,300	39,400	7,200	10,200	702	14,500
Dissolved iron	µg/L	64,400	55,200	46,400	4,190	11,200	35 J	13,600
Nitrate	mg/L	0.05 U		0.23		0.1 U		0.05 U
Sulfate	mg/L	12		13		13		14
Manganese	µg/L	1,940	1,570	1,280	1,440	1,540	1,310	1,560
Dissolved manganese	µg/L	1,920	1,530	1,540	1,470	1,570	1,330	1,500
Calcium	µg/L	53,100		42,700			50,400	46,400
Magnesium	µg/L	7,920		6,260			6,940	6,340
Potassium	µg/L	11,600		9,840			11,600	10,700
Sodium	µg/L	21,400		14,700			18,600	19,200
Chloride	mg/L	20		21		24		23
Alkalinity	mg/L	240	230	250	200	200	190	210
Total Dissolved Solids	mg/L	290	270	230	200	110	180	140
Total Organic Carbon	mg/L	4.3						
Dissolved Organic Carbon	mg/L			4.3		4		3.3
BOD	mg/L	4.3 J						
COD	mg/L	11 J						
Field Parameters								
Depth to Water	ft bmp	13.66	12.58	13.63	14.00	13.77	14.68	14.09
Dissolved Oxygen	mg/L	0.08	0.49	1.25	5.37	4.35	7.53	0.94
ORP	mV	-66	-43.9	-47.9	56.2	49.9	202.3	29.2
pH	S.U.	6.21	6.28	6.31	6.38	6.13	5.19	5.99
Conductivity	ms/cm	0.452	0.648	0.485	0.388	1.236	0.434	0.434
Ferrous Iron	mg/L	60.8	6.25	15.1	3	4	0.02	4
Total Iron	mg/L		>16.5		27.6	4.4	6.45	0.13

Table 9
Performance Monitoring Results - Analytical Data
Shepley's Hill Landfill
Former Fort Devens Army Installation
Devens, Massachusetts

Parameter	Unit	MW-21-1D						
		8/18/2021 System Off Baseline	11/4/2021 System On 22 days post startup	11/23/2021 System On 41 days post startup	12/14/2021 System On 57 days post startup	12/29/2021 System On 72 days post startup	1/19/2022 System Off 98 days post startup	2/16/2022 System Off 28 days post shutdown
Arsenic	µg/L	2,190	766	57.6	37.3	31.7	22.5	26.9
Dissolved Arsenic	µg/L	2,140	627	24.8	11	6.2 J	12	11
Iron	µg/L	57,500	41,700	4,280	1,900	2,060	4,040	2,540
Dissolved iron	µg/L	48,700	34,500	3,420	942	1,130	3,590	1,320
Nitrate	mg/L	0.05 UJ		0.056		0.05 U		0.91
Sulfate	mg/L	22 J		17		20		18
Manganese	µg/L	2,820	3,530	5,310	5,370	4,780	8,410	10,600
Dissolved manganese	µg/L	2,820	3,190	5,610	5,270	4,700	8,730	10,700
Calcium	µg/L	48,800		39,900			51,800	69,000
Magnesium	µg/L	7,480		6,220			7,220	10,100
Potassium	µg/L	8,740 J		6,540			6,730	8,010
Sodium	µg/L	17,900 J		15,500			15,200	15,000
Chloride	mg/L	28		23		26		25
Alkalinity	mg/L	230 J	120	130	140	120	170	240
Total Dissolved Solids	mg/L	320	200	190	190	66	180	290
Total Organic Carbon	mg/L	2.4			2			
Dissolved Organic Carbon	mg/L			2.2		2.8		1.8
BOD	mg/L	13	3.2	0.83	2 U	2 U	2 U	1.1 J
COD	mg/L	15 U						
Field Parameters								
Depth to Water	ft bmp	15.91	13.98	15.52	16.37	15.44	16.89	15.68
Dissolved Oxygen	mg/L	0.08	1.59	2.30	5.59	9.25	8.84	4.64
ORP	mV	-74	-4.9	-55	63.5	151.9	58	-188.2
pH	S.U.	6.38	6.27	6.23	6.53	6.22	6.26	6.09
Conductivity	ms/cm	0.404	0.386	0.265	0.323	0.286	0.339	0.424
Ferrous Iron	mg/L	56.2	25.5	0.9	0.6	0.43	1.49	0.6
Total Iron	mg/L		28.4	2.6	3.1	0.84	4.9	ND

Table 9
Performance Monitoring Results - Analytical Data
Shepley's Hill Landfill
Former Fort Devens Army Installation
Devens, Massachusetts

Parameter	Unit	MW-21-2D						
		8/19/2021 System Off Baseline	11/5/2021 System On 23 days post startup	11/22/2021 System On 40 days post startup	12/14/2021 System On 57 days post startup	12/29/2021 System On 72 days post startup	1/20/2022 System Off 99 days post shutdown	2/16/2022 System Off 28 days post shutdown
Arsenic	µg/L	1,650	1600	1130	234	68.8	15.5	2.9 J
Dissolved Arsenic	µg/L	1,600	1530	1120	85.6	6.4 J	2.5 J	8 U
Iron	µg/L	39,700	39,500	32,100	9,160	3,420	1,300	1,300
Dissolved iron	µg/L	38,500	38,100	32,200	2420	658	205	1,030
Nitrate	mg/L	0.025 U		0.053		0.05 U		0.059
Sulfate	mg/L	30		22		23		34
Manganese	µg/L	986	768	682	965	1,020	1,600	2,370
Dissolved manganese	µg/L	977	747	691	965	1,020	1,640	2,630
Calcium	µg/L	33,600		21,400			10,100	12,200
Magnesium	µg/L	5,240		3,140			1,550	2,240
Potassium	µg/L	6,690		5,520			4,460	4,830
Sodium	µg/L	21,100		19,500			18,000	20,500
Chloride	mg/L	34		34		37		33
Alkalinity	mg/L	130	95	87	41	25	21	31
Total Dissolved Solids	mg/L	240	210	160	110	15	93	120
Total Organic Carbon	mg/L	1.5						
Dissolved Organic Carbon	mg/L			1.4		1.5		1
BOD	mg/L	3.6 J	4.2	2.7	0.35 J	0.36 J	2 U	1.2 J
COD	mg/L	15 U						
Field Parameters								
Depth to Water	ft bmp	14.94	13.71	14.32	15.20	14.45	14.89	14.68
Dissolved Oxygen	mg/L	0.02	0.20	0.42	6.66	4.05	7.74	5.55
ORP	mV	-105.3	-170	-84.8	54.5	152.7	192.5	170.2
pH	S.U.	6.77	6.65	6.61	6.26	5.55	5.95	6.03
Conductivity	ms/cm	0.307	0.411	0.290	0.236	0.181	0.154	0.207
Ferrous Iron	mg/L	51.6	8.1	22.1	1.48	0.06	0.09	0.23
Total Iron	mg/L		14.7	>33	4.85	1.79	1.04	0.36

Table 9
Performance Monitoring Results - Analytical Data
Shepley's Hill Landfill
Former Fort Devens Army Installation
Devens, Massachusetts

Parameter	Unit	MW-21-3D						
		8/20/2021 System Off Baseline	11/4/2021 System On 22 days post startup	11/22/2021 System On 40 days post startup	12/14/2021 System On 57 days post startup	12/28/2021 System On 71 days post startup	1/20/2022 System Off 99 days post shutdown	2/16/2022 System Off 28 days post shutdown
Arsenic	µg/L	2,210	2,090	2,280	2,060	1,820	2,390	1,520
Dissolved Arsenic	µg/L	2,260	2,030	2,250	2,070	2,410	2,170	1,460
Iron	µg/L	65,500	58,300	60,400	54,200	51,200	63,400	43,800
Dissolved iron	µg/L	68,700	56,800	58,500	55,700	63,600	61,400	43,800
Nitrate	mg/L	0.025 U		0.06		0.1 U		0.05 U
Sulfate	mg/L	18		21		19		25
Manganese	µg/L	3,450	2,620	3,280	3,320	3,090	3,900	4,000
Dissolved manganese	µg/L	3,590	2,580	3,210	3,440	3,560	3,950	4,060
Calcium	µg/L	51,600		43,700			45,800	31,100
Magnesium	µg/L	7,270		6,600			6,680	5,040
Potassium	µg/L	7,520		6,780			6,690	5,860
Sodium	µg/L	16,500		15,400			16,000	16,800
Chloride	mg/L	28		25		27		27
Alkalinity	mg/L	200	130	190	150	110	140	100
Total Dissolved Solids	mg/L	280	170	210	220	100	180	96
Total Organic Carbon	mg/L	2.3						
Dissolved Organic Carbon	mg/L			2.3		2.2		1.7
BOD	mg/L	5.3 J			4.3 J			
COD	mg/L	10 U						
Field Parameters								
Depth to Water	ft bmp	14.24	13.15	13.89	14.63	14.02	14.50	14.22
Dissolved Oxygen	mg/L	0.03	0.25	0.73	0.14	1.40	1.18	1.03
ORP	mV	-109.6	-80.1	-310.5	-101.5	-43.9	-83.1	-14.2
pH	S.U.	6.64	6.52	6.43	6.83	6.50	6.24	6.5
Conductivity	ms/cm	0.397	0.484	0.319	0.448	1.049	0.416	0.391
Ferrous Iron	mg/L	57.2	4.05	24.4	20.7	34	19.2	27.6
Total Iron	mg/L		10.8	46.4	43.2	40.2	44.4	33

Table 9
Performance Monitoring Results - Analytical Data
Shepley's Hill Landfill
Former Fort Devens Army Installation
Devens, Massachusetts

Parameter	Unit	MW-21-4D						
		8/25/2021 System Off Baseline	11/4/2021 System On 22 days post startup	11/22/2021 System On 40 days post startup	12/13/2021 System On 56 days post startup	12/28/2021 System On 71 days post startup	1/19/2022 System Off 98 days post startup	2/17/2022 System Off 29 days post shutdown
Arsenic	µg/L	1,570	1,290	2,040	1,900	1,900	1,740	1,390
Dissolved Arsenic	µg/L	1,490	1,270	2,000	1,990	246	1,820	1,350
Iron	µg/L	58,200	60,500	67,700	63,300	58,600	42,800	29,400
Dissolved iron	µg/L	56,100	59,400	67,200	66,200	25,800	42,500	27,600
Nitrate	mg/L	0.05 U		0.046		0.1 U		
Sulfate	mg/L	34		23		22		22
Manganese	µg/L	1,140	800	1,770	1,680	1,460	1,370	918
Dissolved manganese	µg/L	1,140	785	1,750 J	1,850	1,360	1,400	898
Calcium	µg/L	31,700		43,500			29,700	18,200
Magnesium	µg/L	4,880		6,670			4,200	2,780
Potassium	µg/L	7,750		7,480			5,540	4,640
Sodium	µg/L	20,800		19,300			15,000	13,800
Chloride	mg/L	28		25		28		29
Alkalinity	mg/L	120	110	210	160	140	100	58
Total Dissolved Solids	mg/L	230	170	200	250	190	140 J	69
Total Organic Carbon	mg/L	1.9						
Dissolved Organic Carbon	mg/L			2.6		3.9		1.2
BOD	mg/L	5						
COD	mg/L	14 J						
Field Parameters								
Depth to Water	ft bmp	13.30	12.37	13.32	14.11	13.44	14.32	13.72
Dissolved Oxygen	mg/L	0.06	0.17	0.49	0.19	0.33	0.52	0.19
ORP	mV	-108.6	-98.1	-103.5	-95.8	-45.8	-88.4	-111.9
pH	S.U.	6.55	6.61	6.60	6.87	6.38	6.63	6.65
Conductivity	ms/cm	0.344	0.521	0.471	0.431	0.386	0.379	0.268
Ferrous Iron	mg/L	42.2	4.6	28.3	17.4	13.2	35	11.2
Total Iron	mg/L		8.5	>66	71.2	54	63.6	17.4

Table 9
Performance Monitoring Results - Analytical Data
Shepley's Hill Landfill
Former Fort Devens Army Installation
Devens, Massachusetts

Parameter	Unit	SHM-10-06						
		8/26/2021 System Off Baseline	11/5/2021 System On 23 days post startup	11/22/2021 System On 40 days post startup	12/13/2021 System On 56 days post startup	12/28/2021 System On 71 days post startup	1/19/2022 System Off 98 days post startup	2/17/2022 System Off 29 days post shutdown
Arsenic	µg/L	1,110	1,000	1,120	1,040	1,140	1,110	1,050
Dissolved Arsenic	µg/L	1,070	1040	864	988	1120	1130	968
Iron	µg/L	84,300	81,000	79,900	80,100	86,000	82,800	65,400
Dissolved iron	µg/L	81,000	81,800	62,800	77,400	81,600	83,700	62,100
Nitrate	mg/L	0.25 U		0.058		0.1 U		0.05 UJ
Sulfate	mg/L	10		7.3		7.4		11
Manganese	µg/L	3,240	2,740	2,800	2,660	2,830	2,720	2,470
Dissolved manganese	µg/L	3,150	2,690	2,190	2,550	2,710	2,840	2,330
Calcium	µg/L	38,700		37,600			38,300	30,800
Magnesium	µg/L	6,520		5,710			5,580	4,800
Potassium	µg/L	11,700		10,600			10,600	9,140
Sodium	µg/L	19,200		17,500			17,700	15,700
Chloride	mg/L	30		31		32		30
Alkalinity	mg/L	180	170	210	150	180	140	140
Total Dissolved Solids	mg/L	280	240	160	180	190	160	130
Total Organic Carbon	mg/L	2.5						
Dissolved Organic Carbon	mg/L			2.6		3.5		2.1
BOD	mg/L	6.4						
COD	mg/L	11 J						
Field Parameters								
Depth to Water	ft bmp	18.55	17.64	18.39	18.98	18.49	19.38	18.79
Dissolved Oxygen	mg/L	0.03	0.05	0.70	0.25	0.32	0.83	0.84
ORP	mV	-107.6	-183.3	-358.6	-95.4	-107.7	-107.2	-351.4
pH	S.U.	6.56	6.50	6.55	6.91	6.07	6.49	6.47
Conductivity	ms/cm	0.422	0.584	0.375	0.387	0.508	0.480	0.53
Ferrous Iron	mg/L	48	2.25	28	16.6	33.8	23.4	31.4
Total Iron	mg/L		15.5	63.6	54.8	57.2	>66.6	58.2

Acronyms and Abbreviations:

µg/L = microgram per liter
 amsl = above mean sea level
 bmp = below measuring point
 ft = foot
 mg/L = milligram per liter
 ms/cm = millisiemens per centimeter
 mV = millivolt
 ND = non-detect
 S.U. = scientific units
 BOD = Biological oxygen demand
 COD = Chemical oxygen demand
 ORP = oxidation-reduction potential

Data Qualifiers:

J = Indicates an estimated value.
 U = Indicates that the analyte/compound was analyzed for, but not detected
 UJ = The analyte/compound was not detected above the reported sample Quantitation limit.
 The Quantitation limit is considered to be approximate due to associated QA results.

Table 10
Pre- and Post-Pilot Specific Capacity Comparison
Shepley's Hill Landfill
Former Fort Devens Army Installation
Devens, Massachusetts



Well	Date	Pumping Rate gpm	Drawdown ft	Specific Capacity gpm/ft	Well	Date	Pumping Rate gpm	Drawdown ft	Specific Capacity gpm/ft
Shallow Interval									
AS-21-1S	9/8/2021	0.09	13.79	0.006	AS-21-1D	9/7/2021	2.35	1.45	1.621
	2/23/2022	0.60	18.95	0.032		2/23/2022	2.25	2.92	0.771
	Change - Percent					Change - Percent			
AS-21-2S	9/8/2021	2.00	5.20	0.385	AS-21-2D	9/8/2021	2.30	2.86	0.804
	2/23/2022	2.05	5.29	0.388		2/23/2022	2.00	3.35	0.597
	Change - Percent					Change - Percent			
MW-21-1S	9/7/2021	1.45	17.42	0.083	MW-21-1D	9/7/2021	2.45	1.29	1.899
	2/21/2022	1.35	13.85	0.097		2/21/2022	1.85	1.12	1.652
	Change - Percent					Change - Percent			
MW-21-2S	9/7/2021	1.65	1.19	1.387	MW-21-2D	9/7/2021	1.65	0.87	1.897
	2/21/2022	2.00	1.36	1.471		2/21/2022	1.90	1.00	1.900
	Change - Percent					Change - Percent			
MW-21-3S	9/7/2021	1.75	1.29	1.357	MW-21-3D	9/7/2021	1.70	0.91	1.868
	2/21/2022	2.10	2.19	0.959		2/21/2022	2.10	1.08	1.944
	Change - Percent					Change - Percent			
MW-21-4S	9/3/2021	2.00	1.85	1.081	MW-21-4D	9/7/2021	1.60	0.61	2.623
	2/23/2022	1.93	2.84	0.678		2/17/2022	2.00	0.82	2.439
	Change - Percent					Change - Percent			

Acronyms and Abbreviations:

ft = foot

gpm = gallon per minute

gpm/ft = gallon per minute per foot

Percent Increase in Specific Capacity

Percent Decrease in Specific Capacity

Table 11
Vertical Hydraulic Gradient Calculations
Shepley's Hill Landfill
Former Fort Devens Army Installation
Devens, Massachusetts

Well Cluster	Interval	Date	Water Elevation ft amsl	Δ in Water Elevation ft	Vertical Hydraulic Gradient
MW-21-1	Shallow	Aug-21	213.81	0.00	0.000
	Deep	Aug-21	213.81		
	Direction				
	Shallow	Feb-22	213.99	0.05	0.003
	Deep	Feb-22	214.04		
	Direction				
MW-21-2	Shallow	Aug-21	214.04	-0.28	-0.019
	Deep	Aug-21	213.76		
	Direction				
	Shallow	Feb-22	214.02	0.00	0.000
	Deep	Feb-22	214.02		
	Direction				
MW-21-3	Shallow	Aug-21	214.37	-0.36	-0.024
	Deep	Aug-21	214.01		
	Direction				
	Shallow	Feb-22	214.01	0.02	0.001
	Deep	Feb-22	214.03		
	Direction				
MW-21-4	Shallow	Aug-21	214.16	0.06	0.004
	Deep	Aug-21	214.22		
	Direction				
	Shallow	Feb-22	213.73	0.07	0.005
	Deep	Feb-22	213.80		
	Direction				

Acronyms and Abbreviations:

ft = foot

ft amsl = feet above mean sea level

gpm/ft = gallon per minute per foot

Upward Vertical Hydraulic Gradient

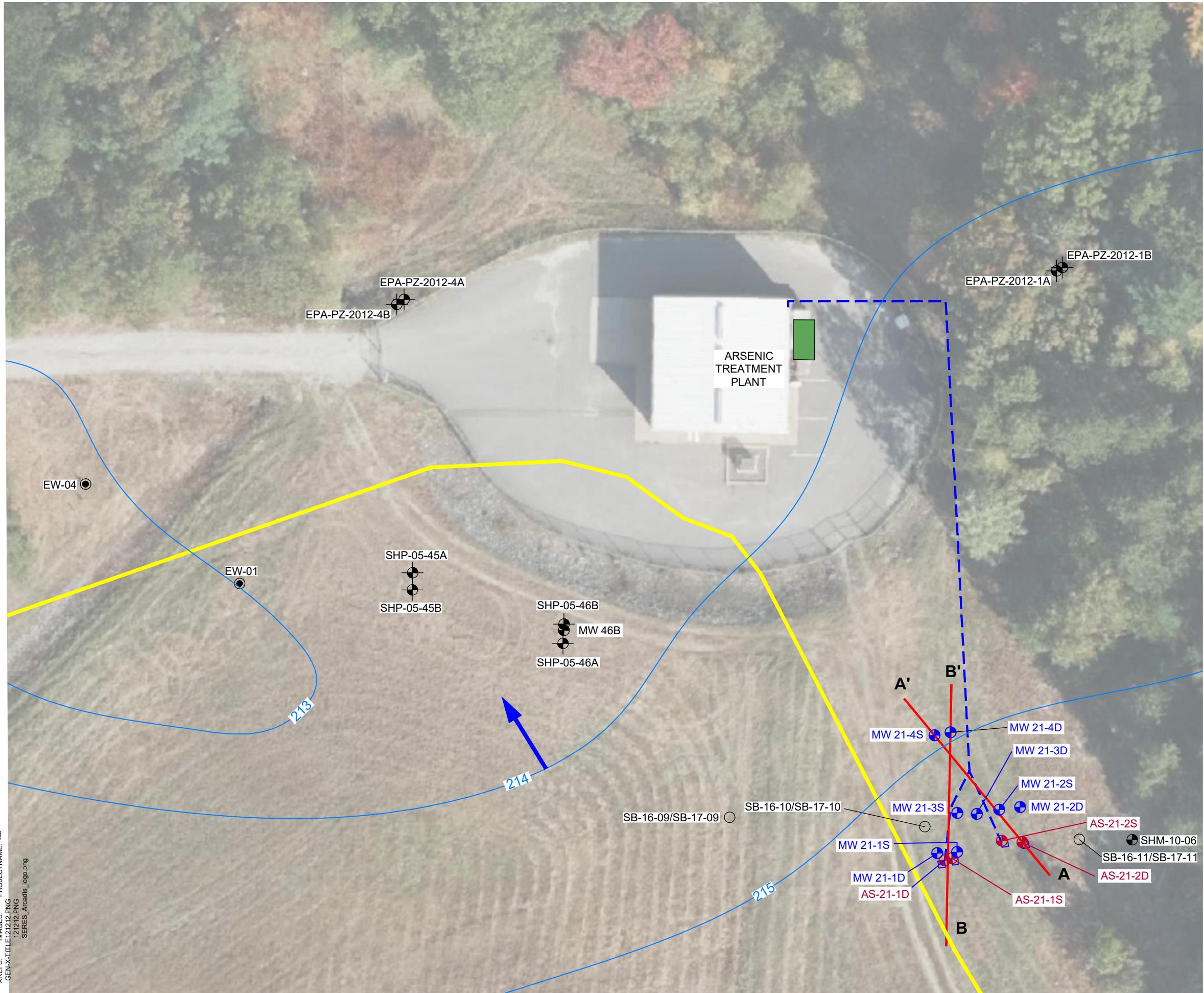
Downward Vertical Hydraulic Gradient

No Vertical Hydraulic Gradient

Measurements made under non-sparging conditions

Figures





LEGEND

- MONITORING WELL
- AIR SPARGE LOCATION
- GROUNDWATER PROFILING LOCATION/MONITORING WELL
- OVERBURDEN MONITORING WELL/PIEZOMETER
- SOIL BORING
- EXTRACTION WELL
- AIR SPARGE PILOT TEST SYSTEM CONTAINER
- SHEPLEY'S HILL LANDFILL BOUNDARY
- 10.86 GROUNDWATER CONTOUR (2021) (FT NAVD88)
- GROUNDWATER FLOW DIRECTION
- A-A' CROSS SECTION TRANSECT LINE
- PIPE TRENCH LOCATION

0 30' 60'
Approximate Scale: 1 in. = 30 ft.

IN-SITU AIR SPARGE PILOT TEST
SHEPLEY'S HILL LANDFILL
FORMER FORT DEVENS ARMY INSTALLATION
DEVENS, MASSACHUSETTS

AIR SPARGE PILOT LAYOUT AND CROSS SECTION LOCATIONS

24" x 24" x 24" WELL VAULT

GROUND SURFACE

CONCRETE APRON 12" x 12" MINIMUM

~20 FEET BGS

4 $\frac{1}{4}$ " BOREHOLE

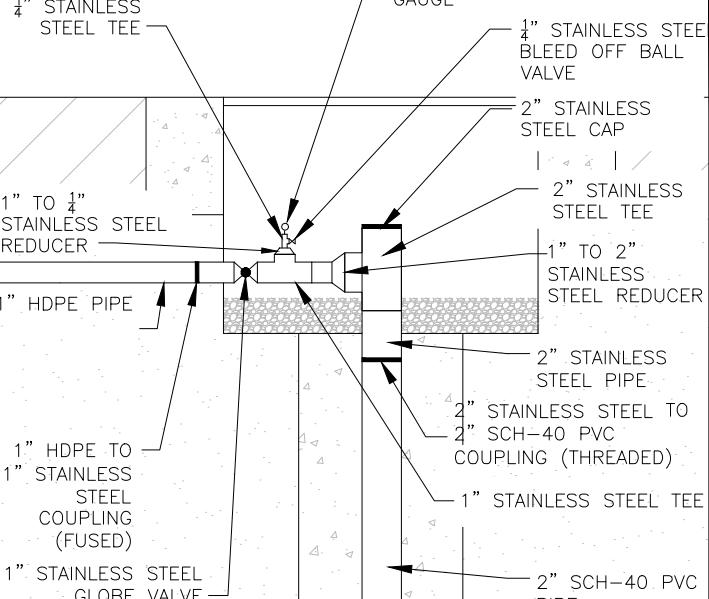
NEAT CEMENT

CHOKER SAND

SAND PACK

2" \varnothing SCH-40 PVC RISER PIPE

2" \varnothing SCH-40 PVC CAP



WELL VAULT DETAILS

SHEPLEY'S HILL LANDFILL
FORMER FORT DEVENS ARMY INSTALLATION
DEVENS, MASSACHUSETTS
IN-SITU AIR SPARGE PILOT TEST

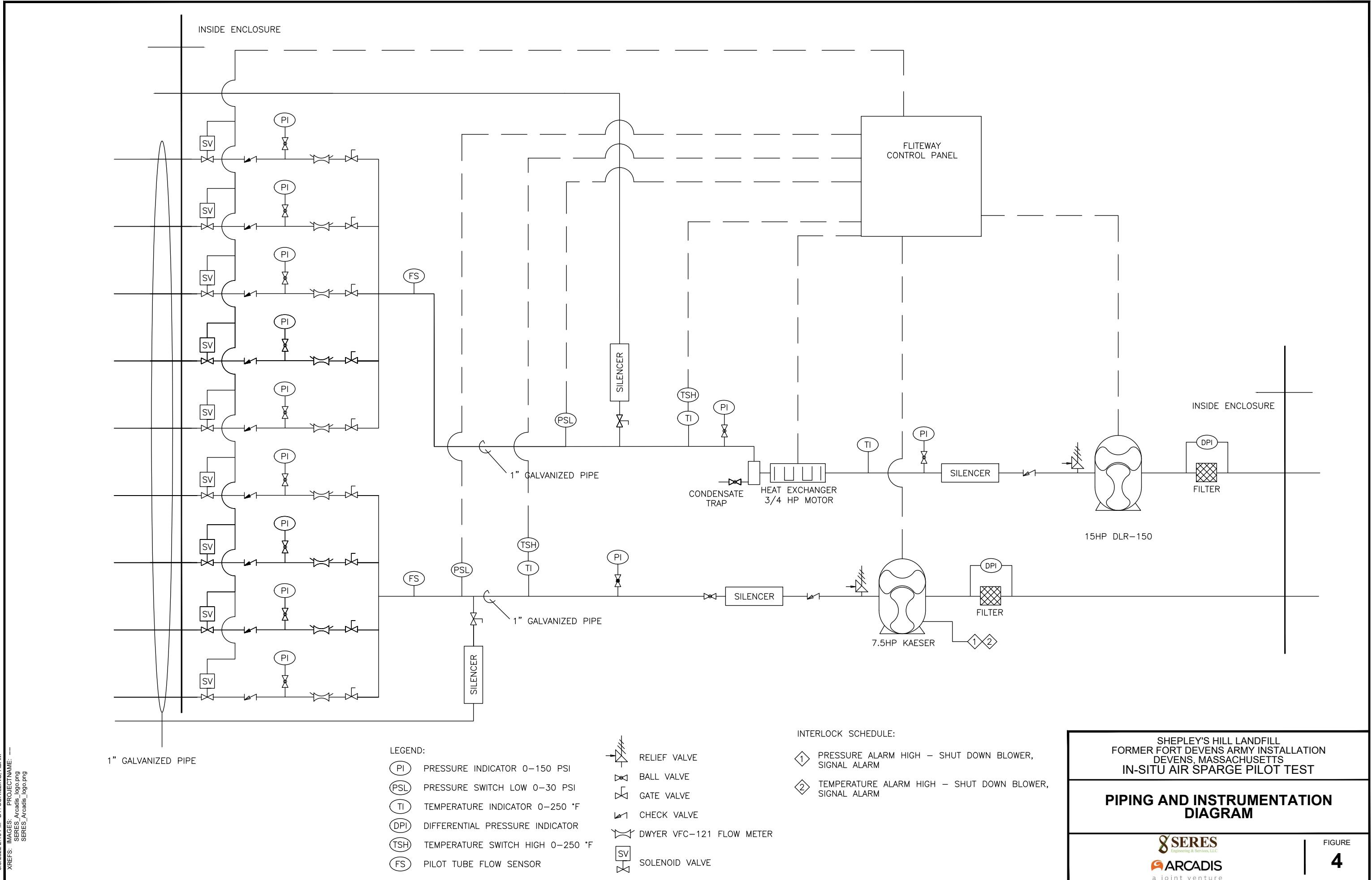
WELLHEAD COMPLETION DETAILS

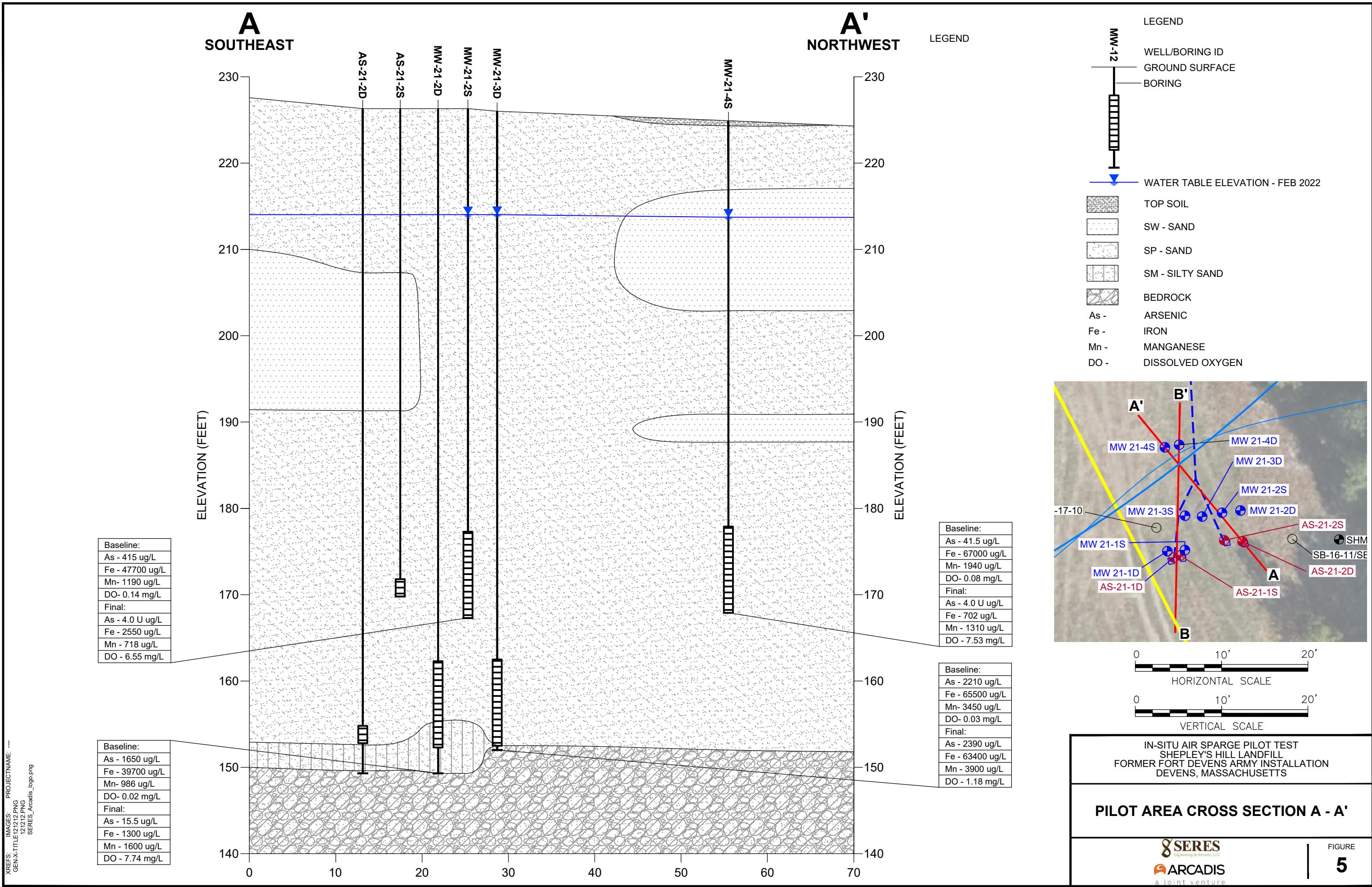
NOTES:

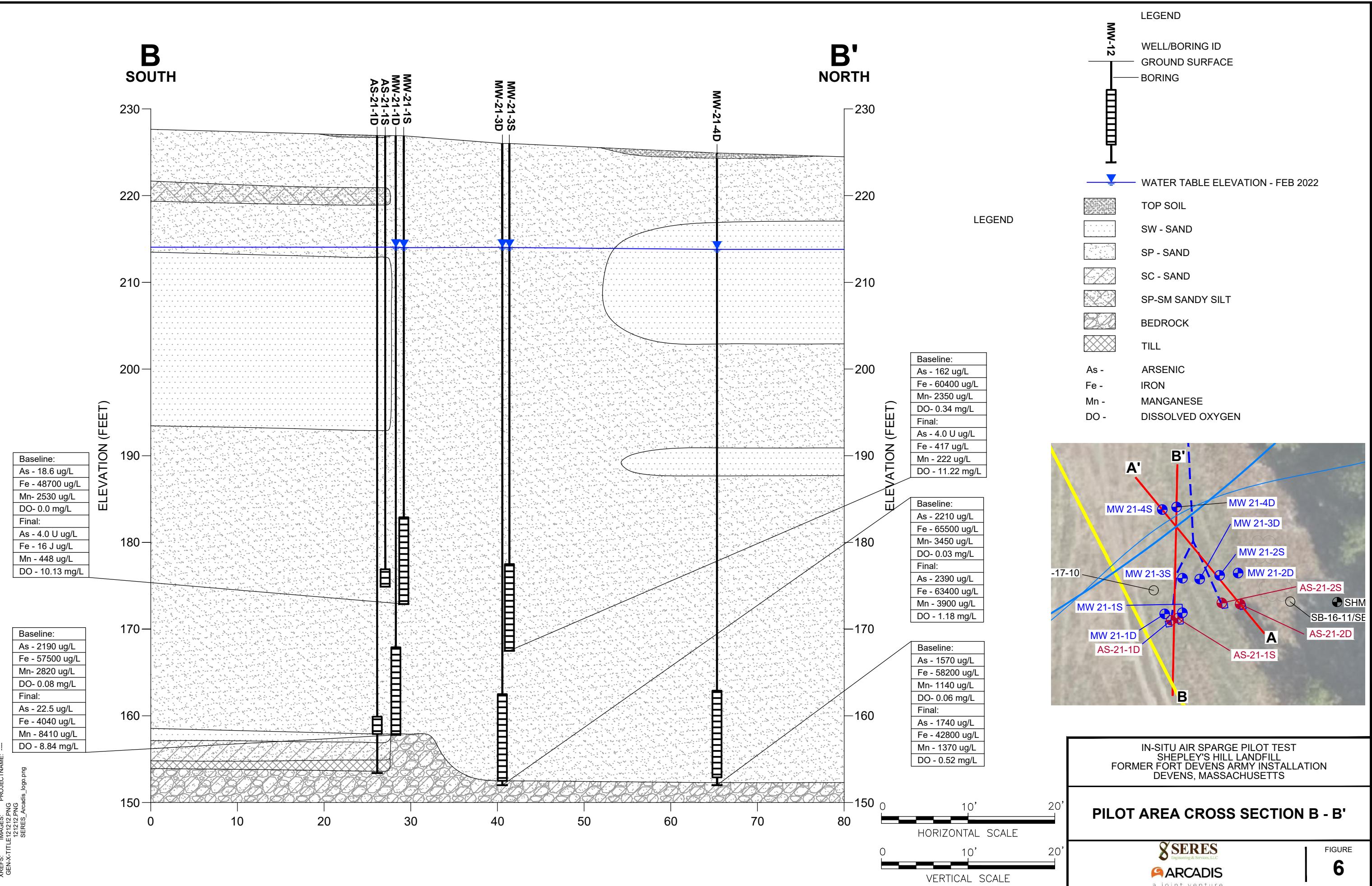
bgs = BELOW GROUND SURFACE

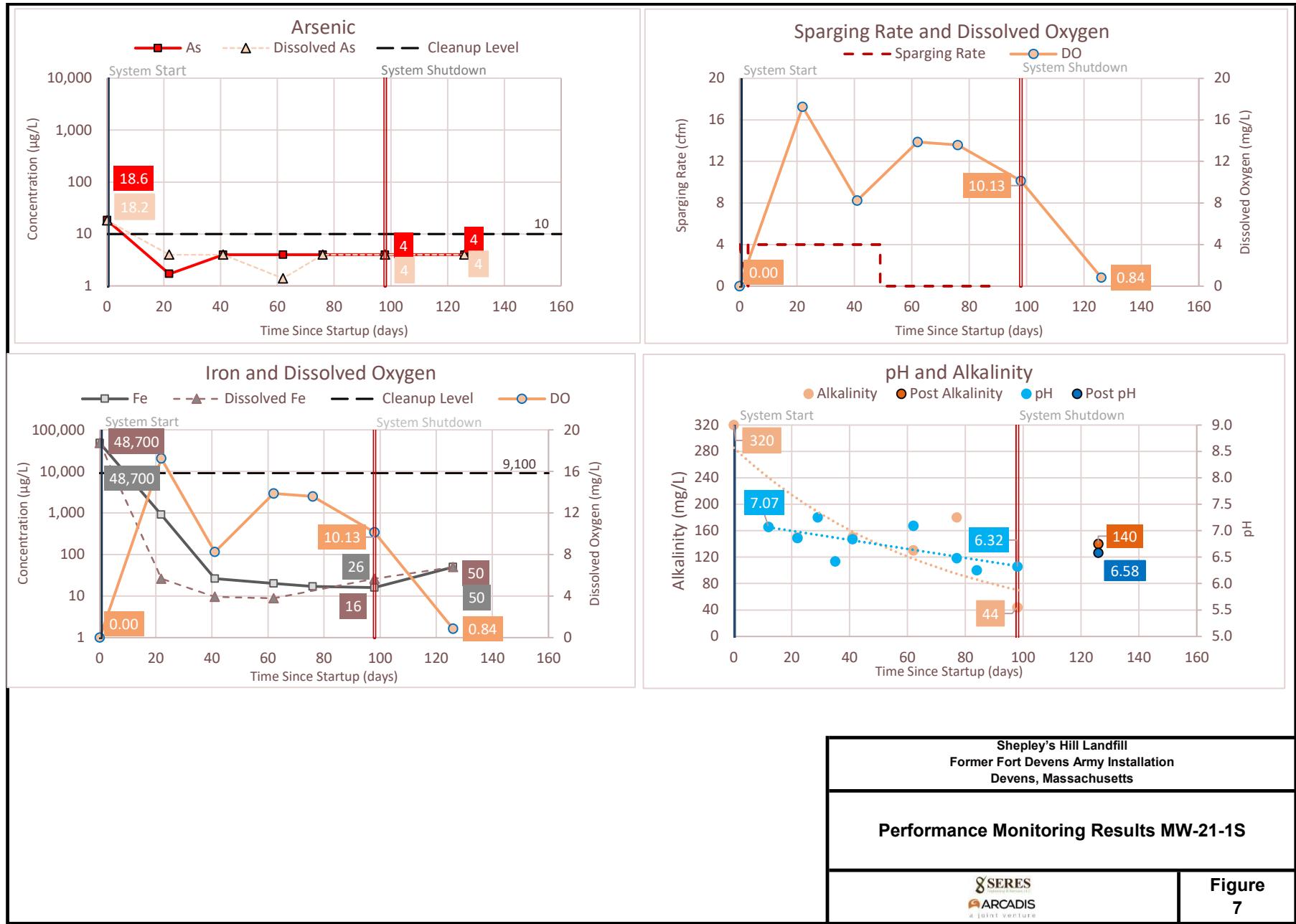
HDPE = HIGH DENSITY POLYETHYLENE

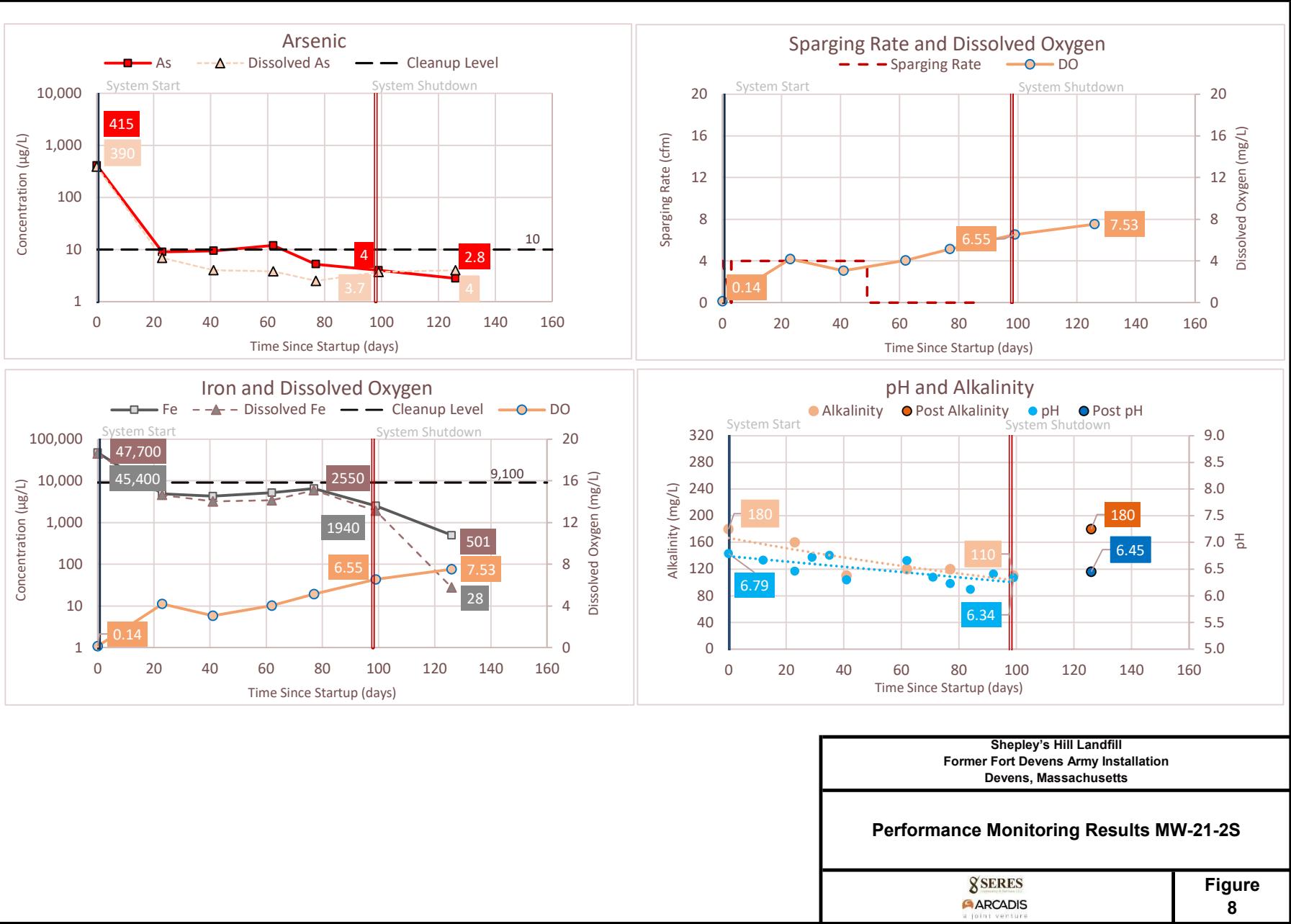
NOT TO SCALE

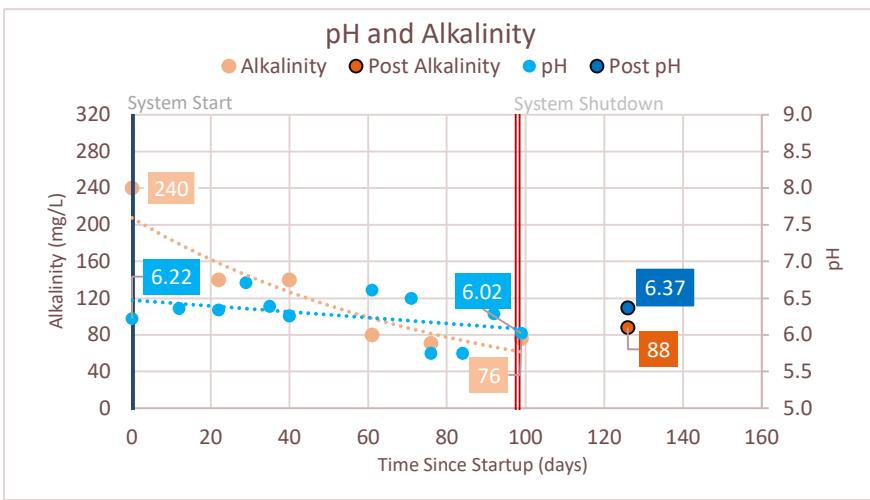
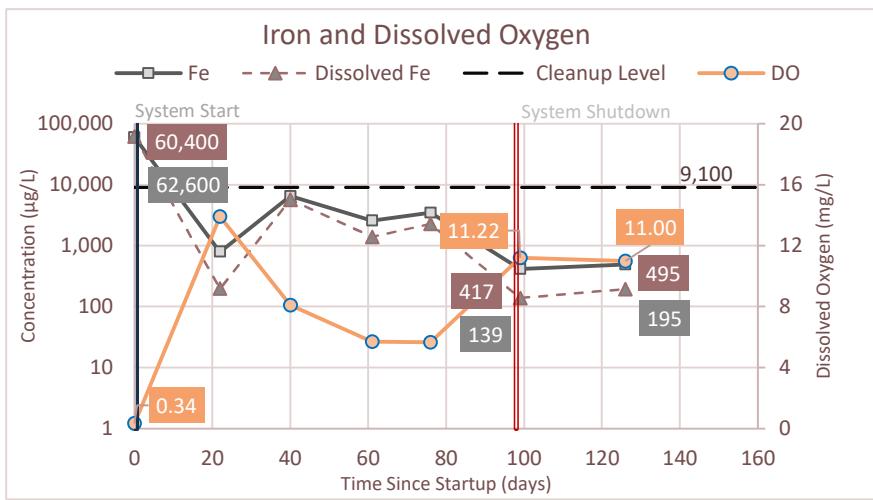
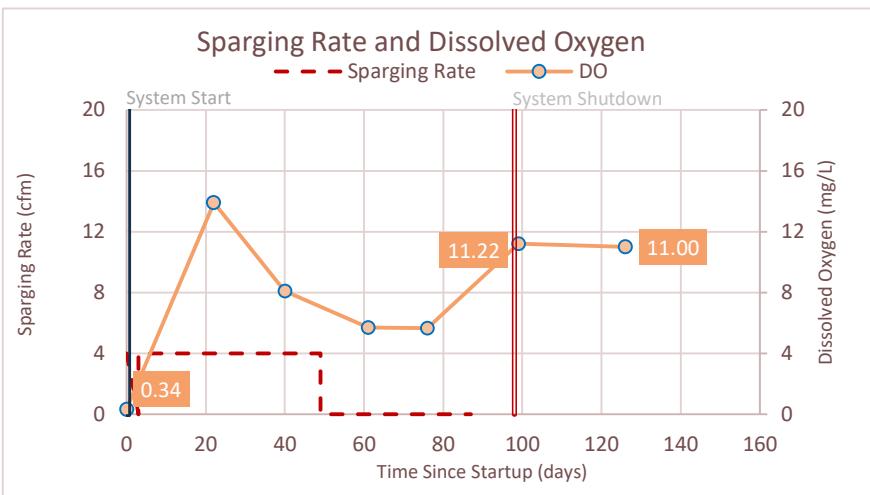






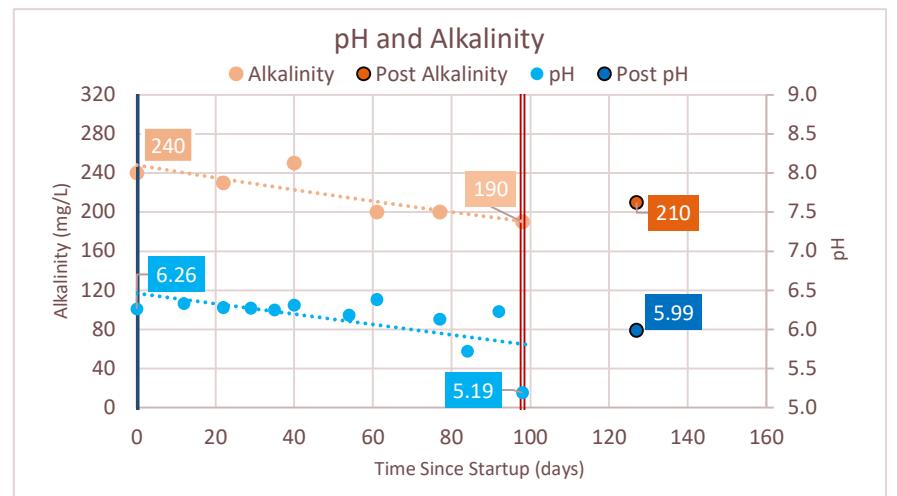
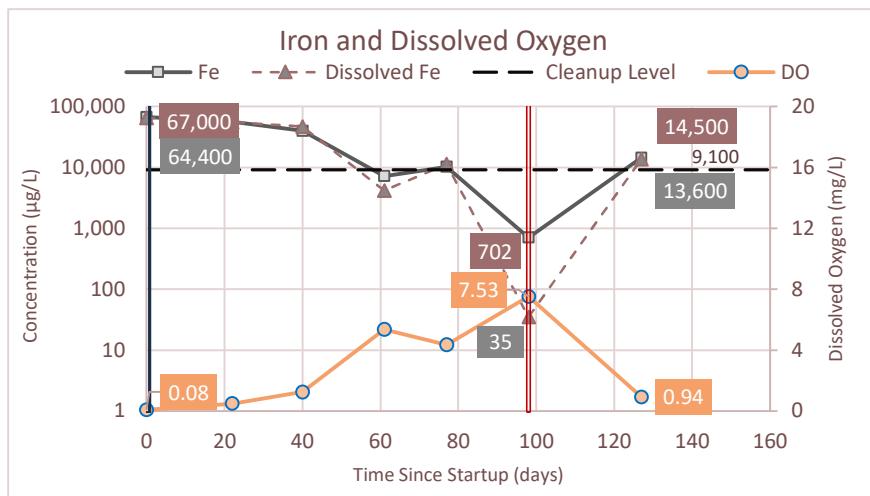
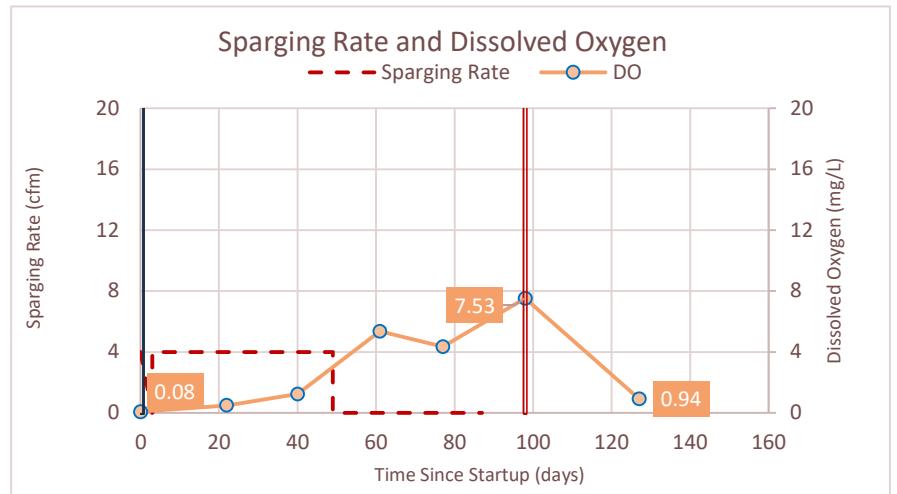
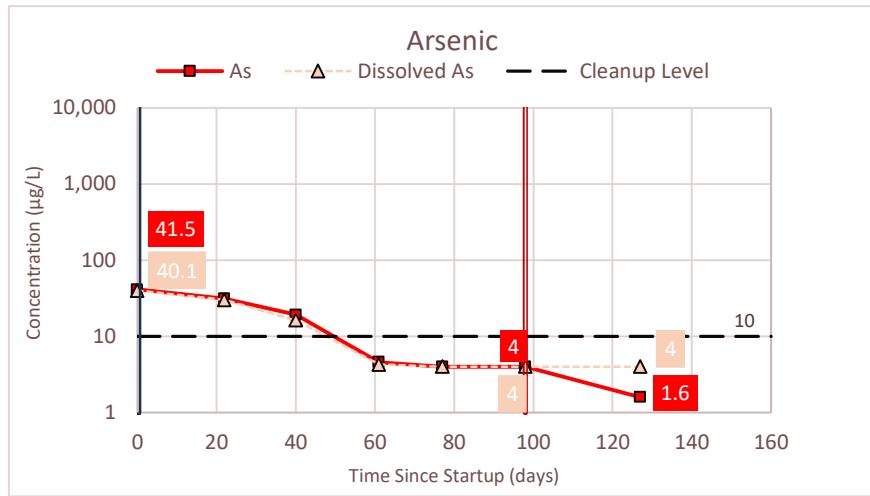






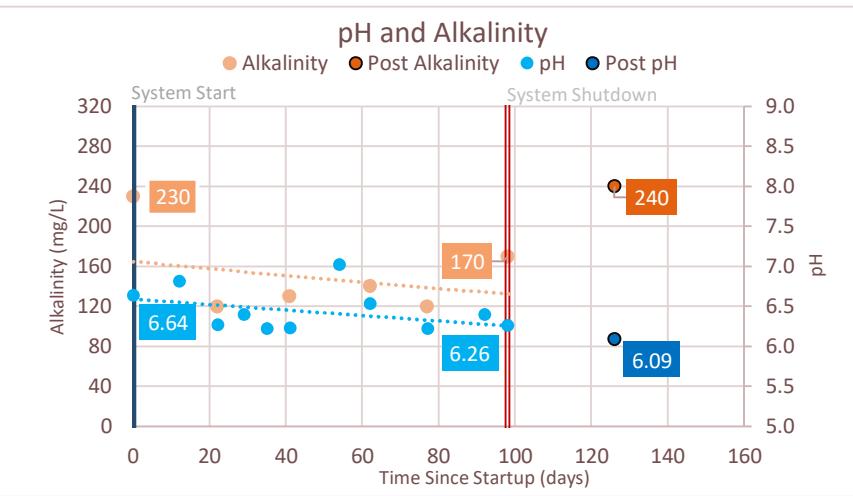
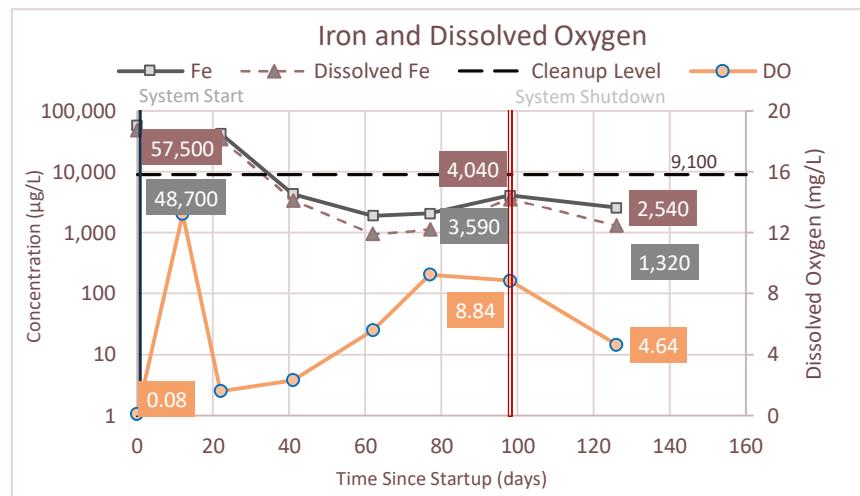
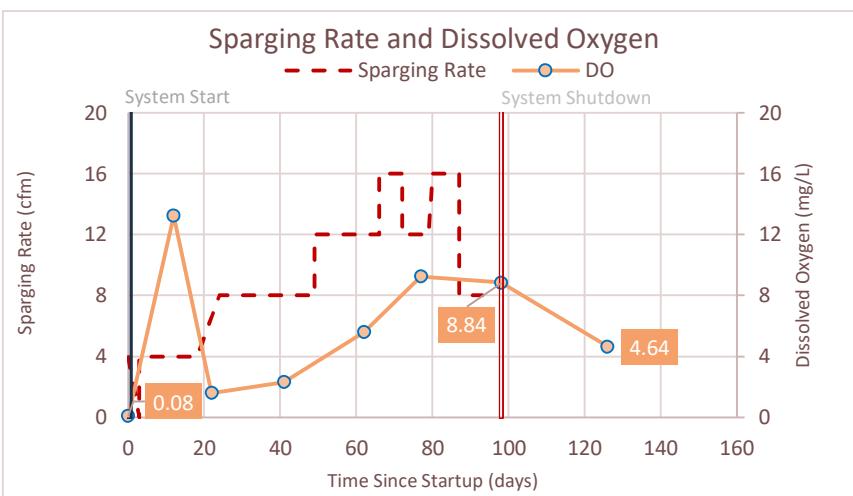
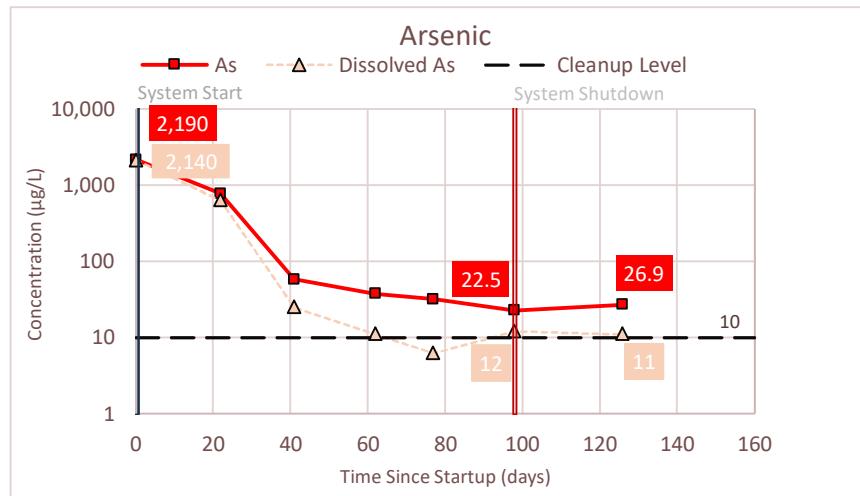
Shepley's Hill Landfill
Former Fort Devens Army Installation
Devens, Massachusetts

Performance Monitoring Results MW-21-3S



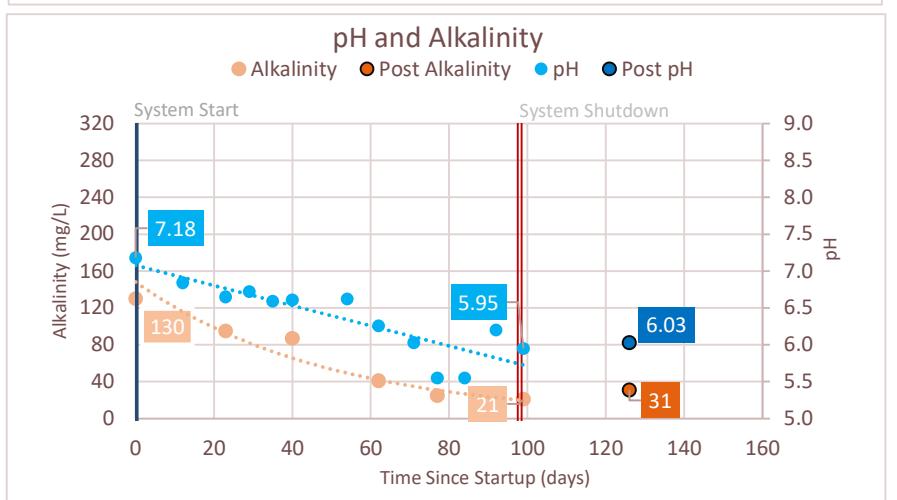
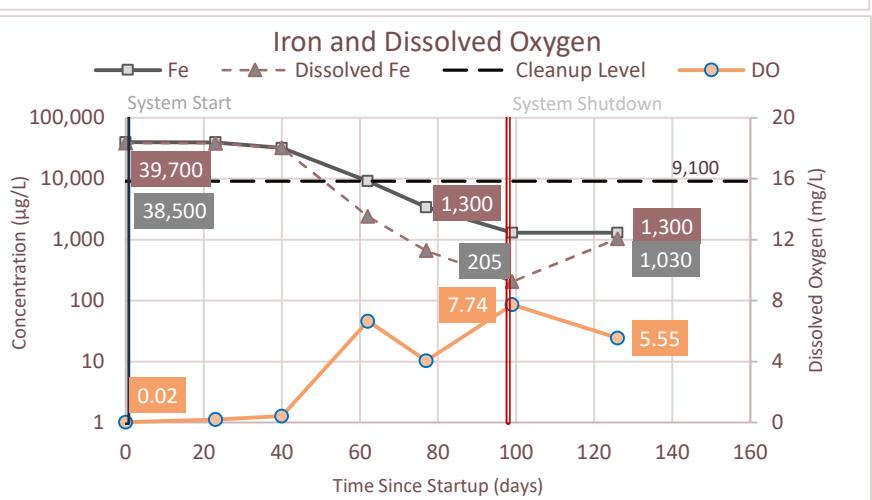
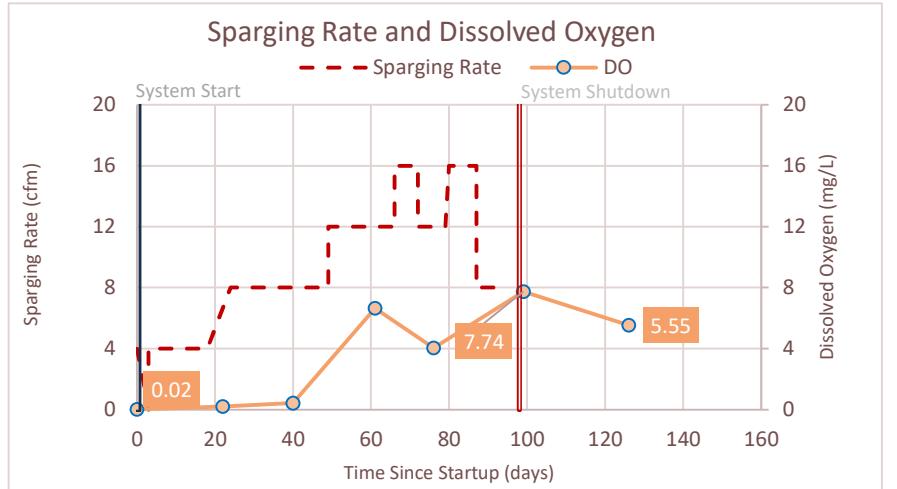
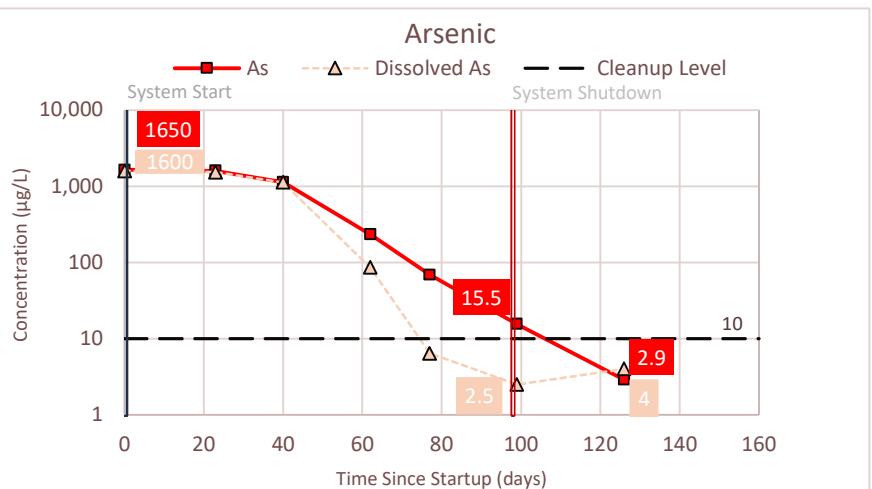
Shepley's Hill Landfill
Former Fort Devens Army Installation
Devens, Massachusetts

Performance Monitoring Results MW-21-4S



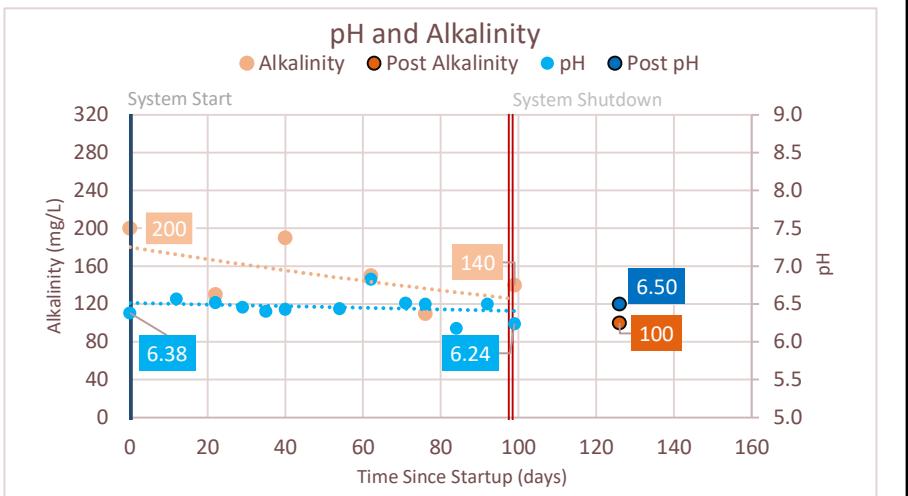
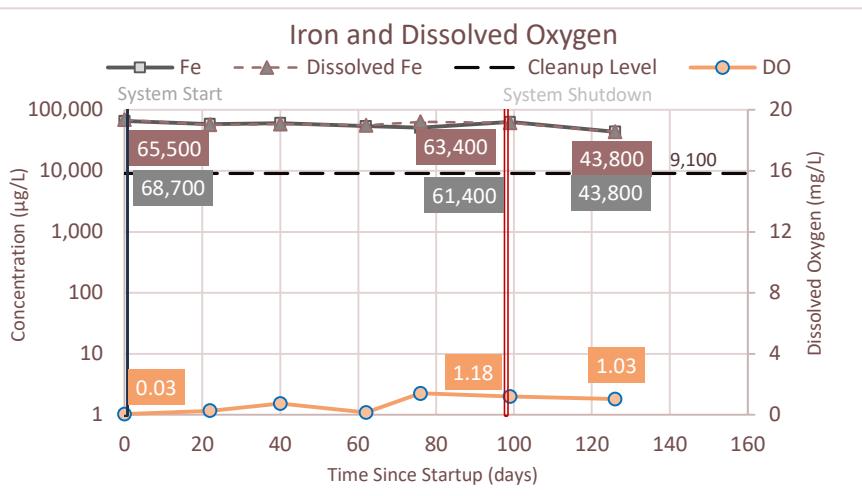
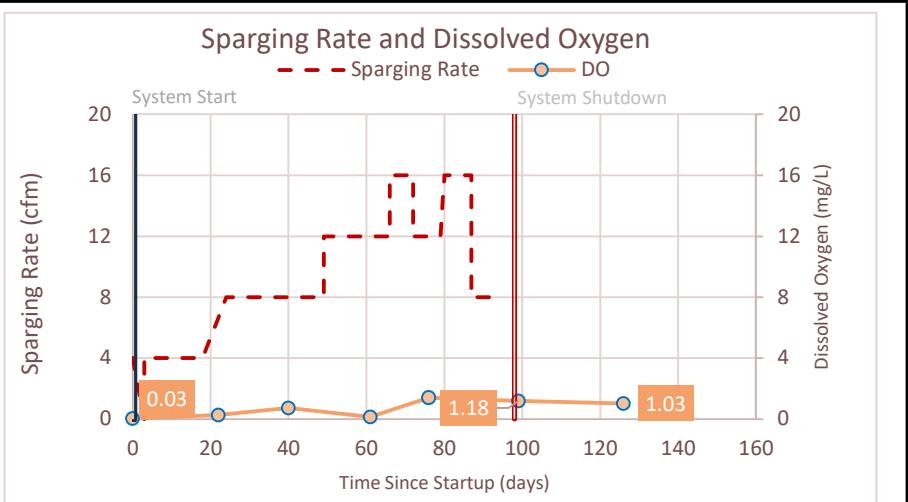
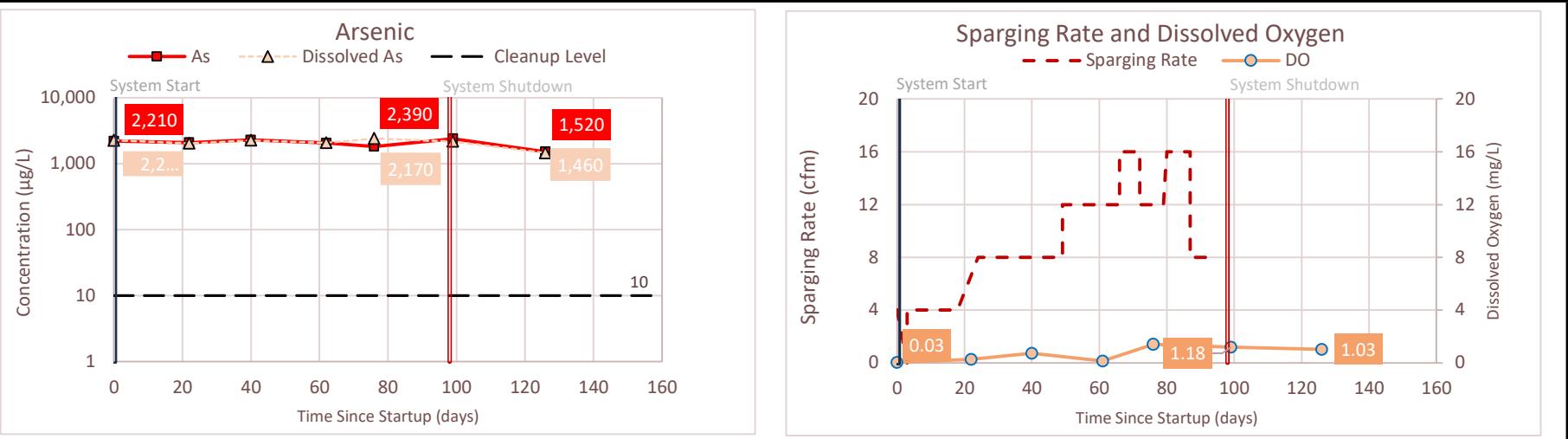
Shepley's Hill Landfill
Former Fort Devens Army Installation
Devens, Massachusetts

Performance Monitoring Results MW-21-1D



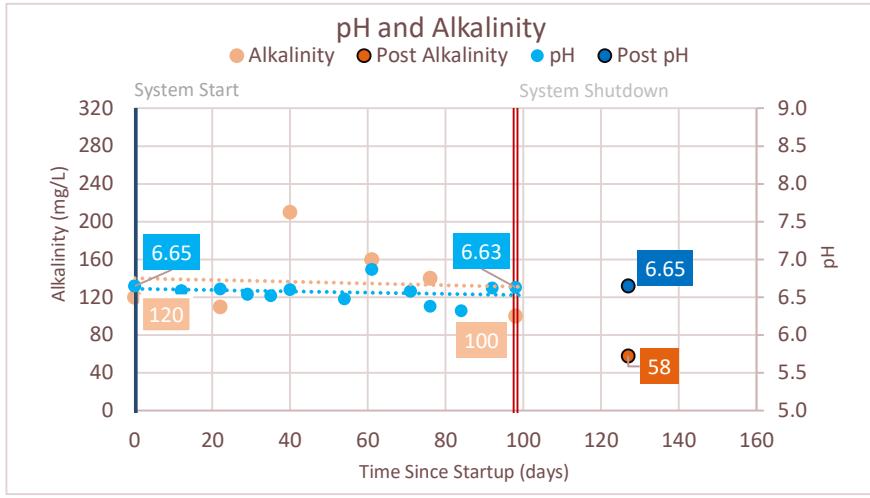
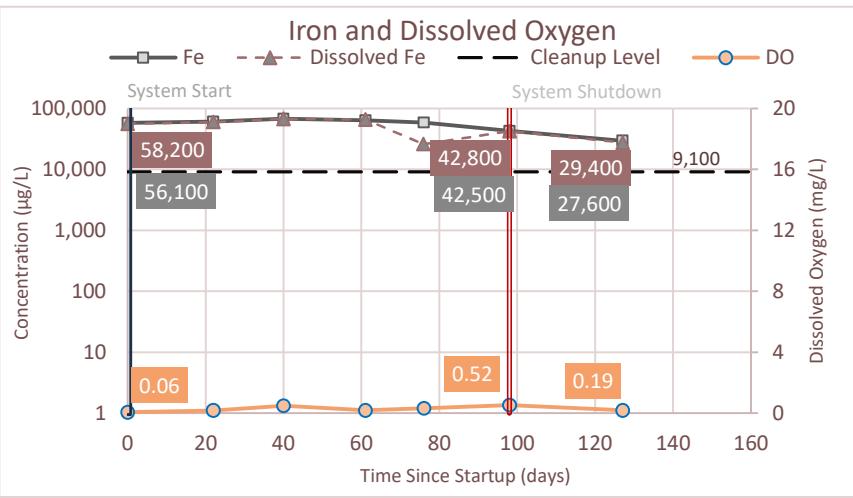
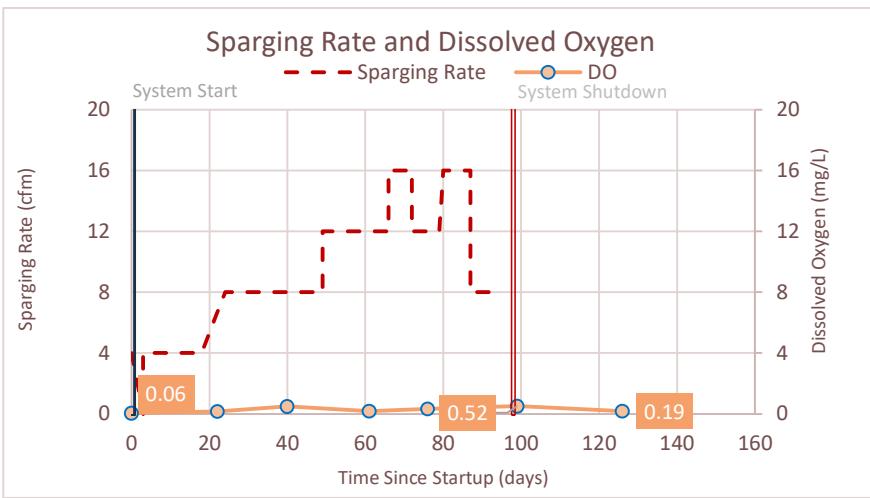
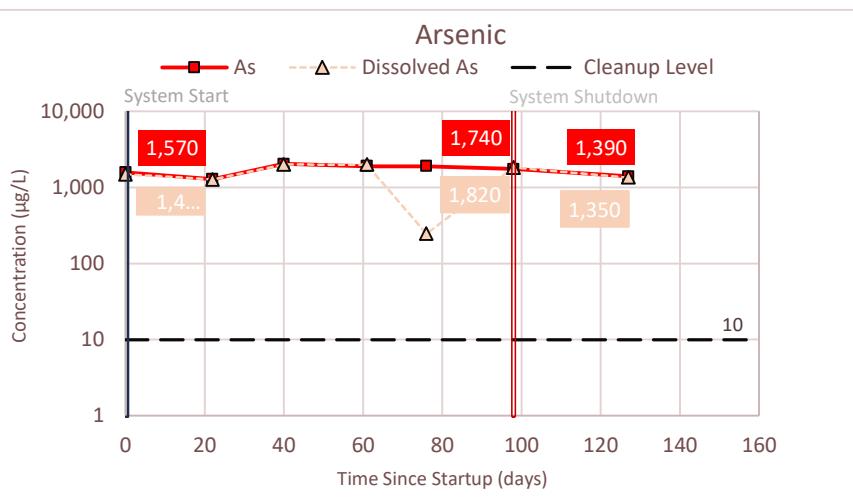
Shepley's Hill Landfill
Former Fort Devens Army Installation
Devens, Massachusetts

Performance Monitoring Results MW-21-2D



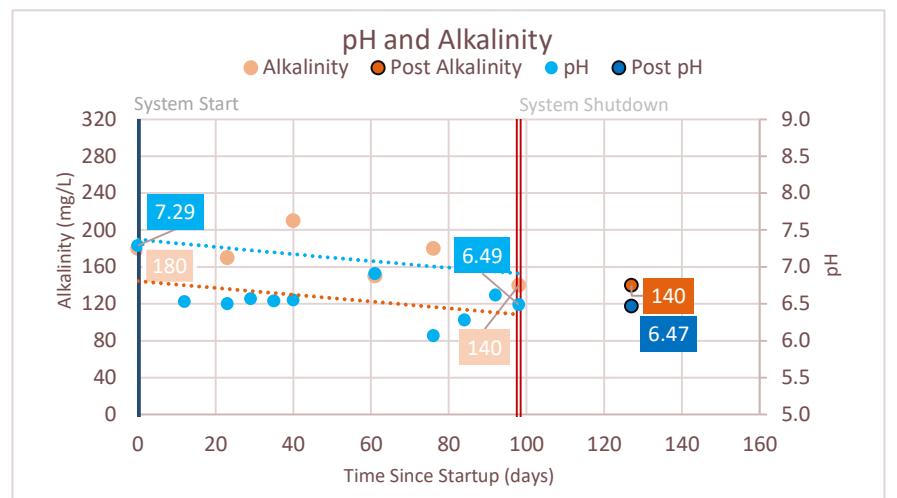
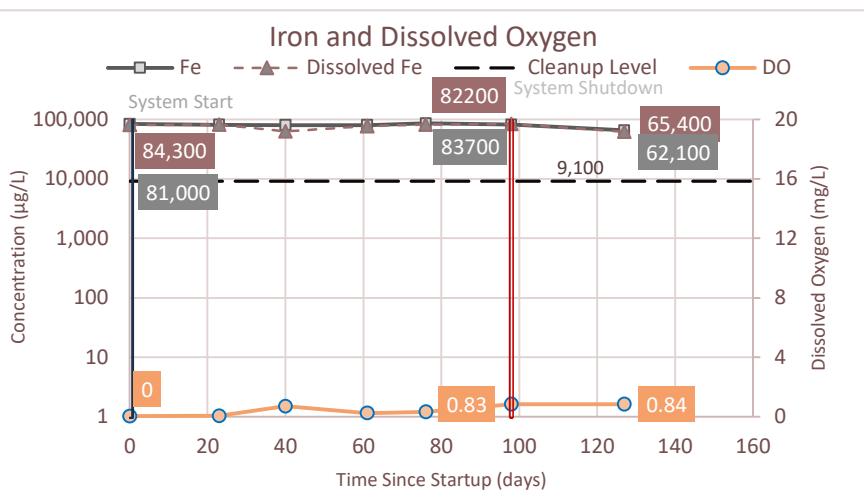
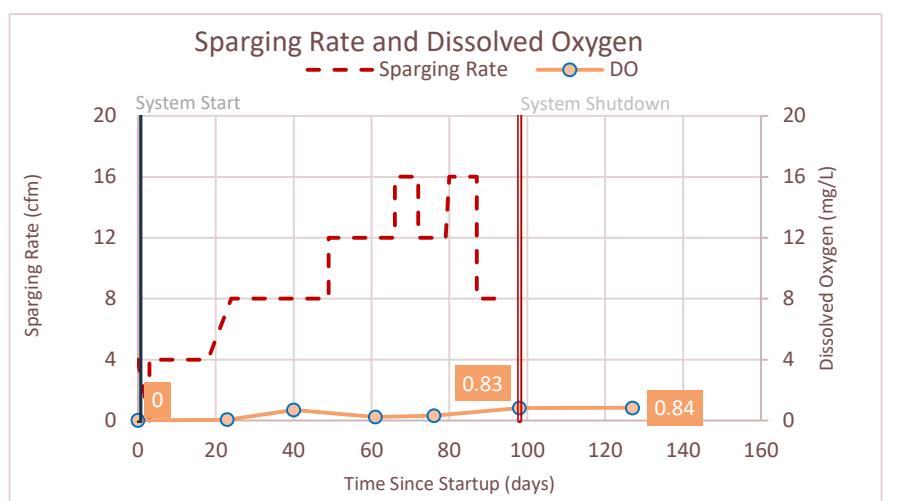
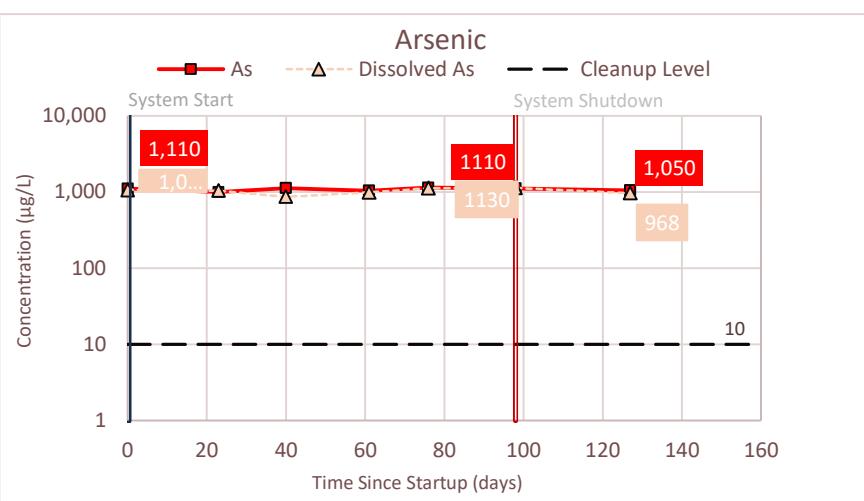
Shepley's Hill Landfill
Former Fort Devens Army Installation
Devens, Massachusetts

Performance Monitoring Results MW-21-3D



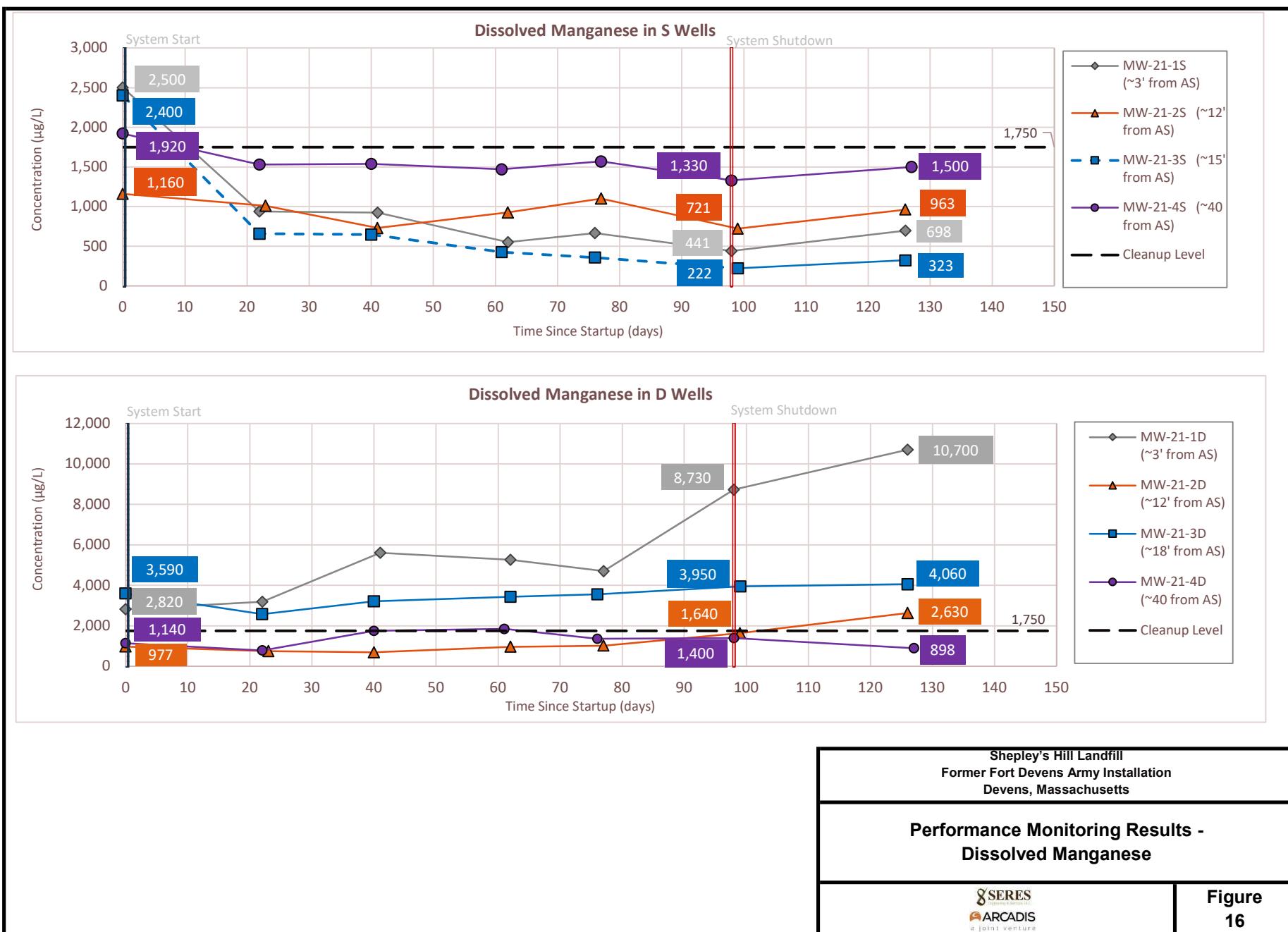
Shepley's Hill Landfill
Former Fort Devens Army Installation
Devens, Massachusetts

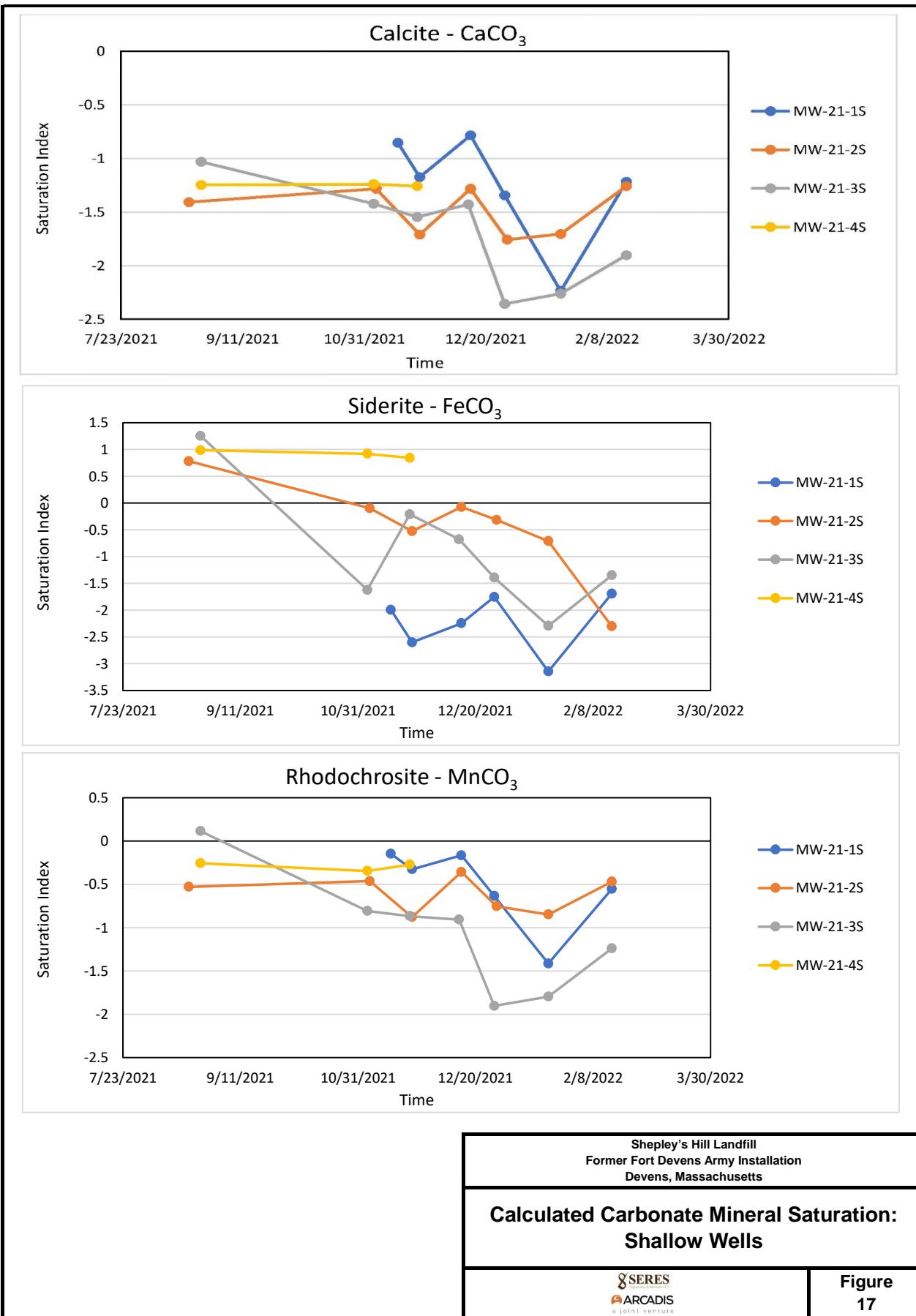
Performance Monitoring Results MW-21-4D

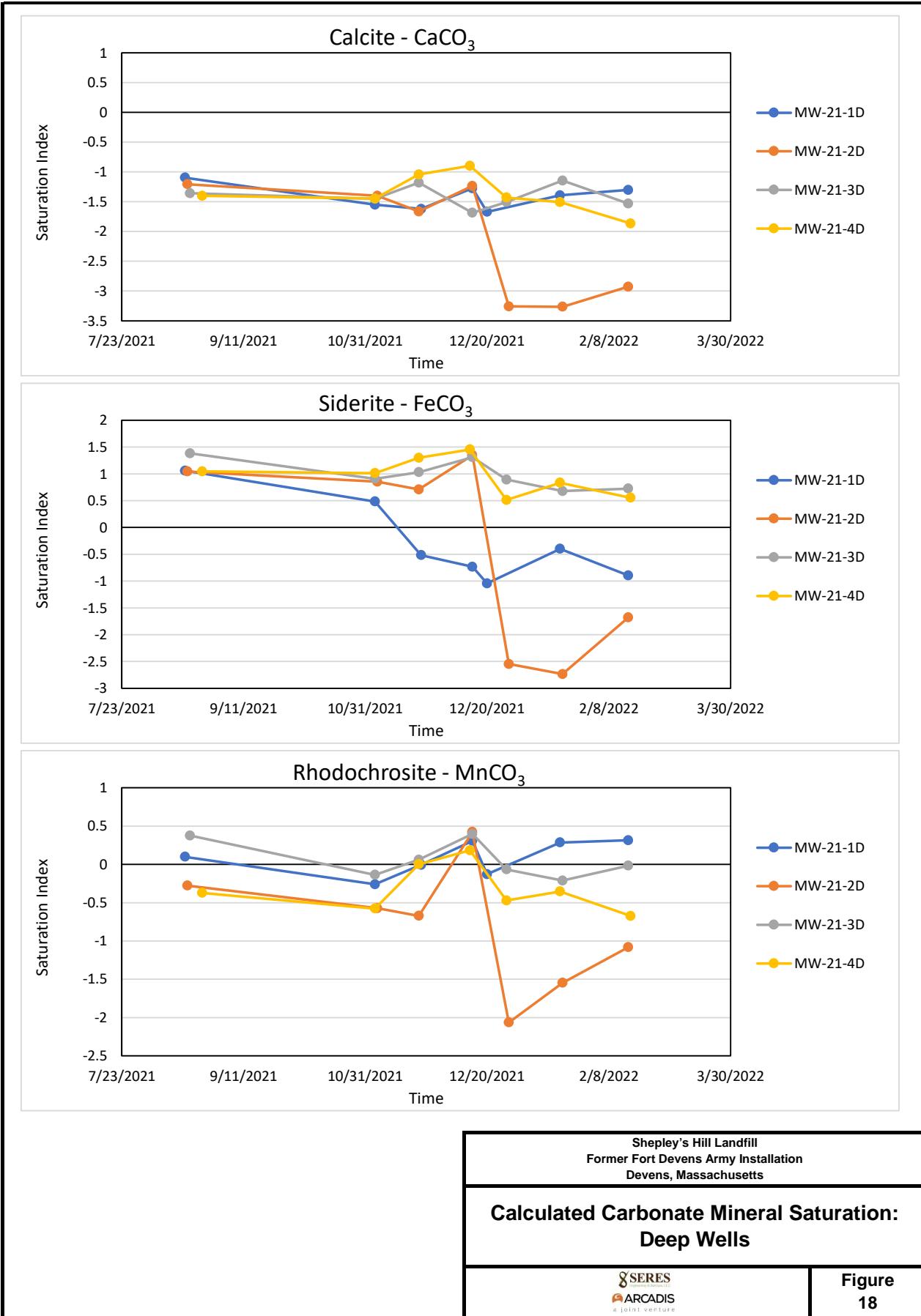


Shepley's Hill Landfill
Former Fort Devens Army Installation
Devens, Massachusetts

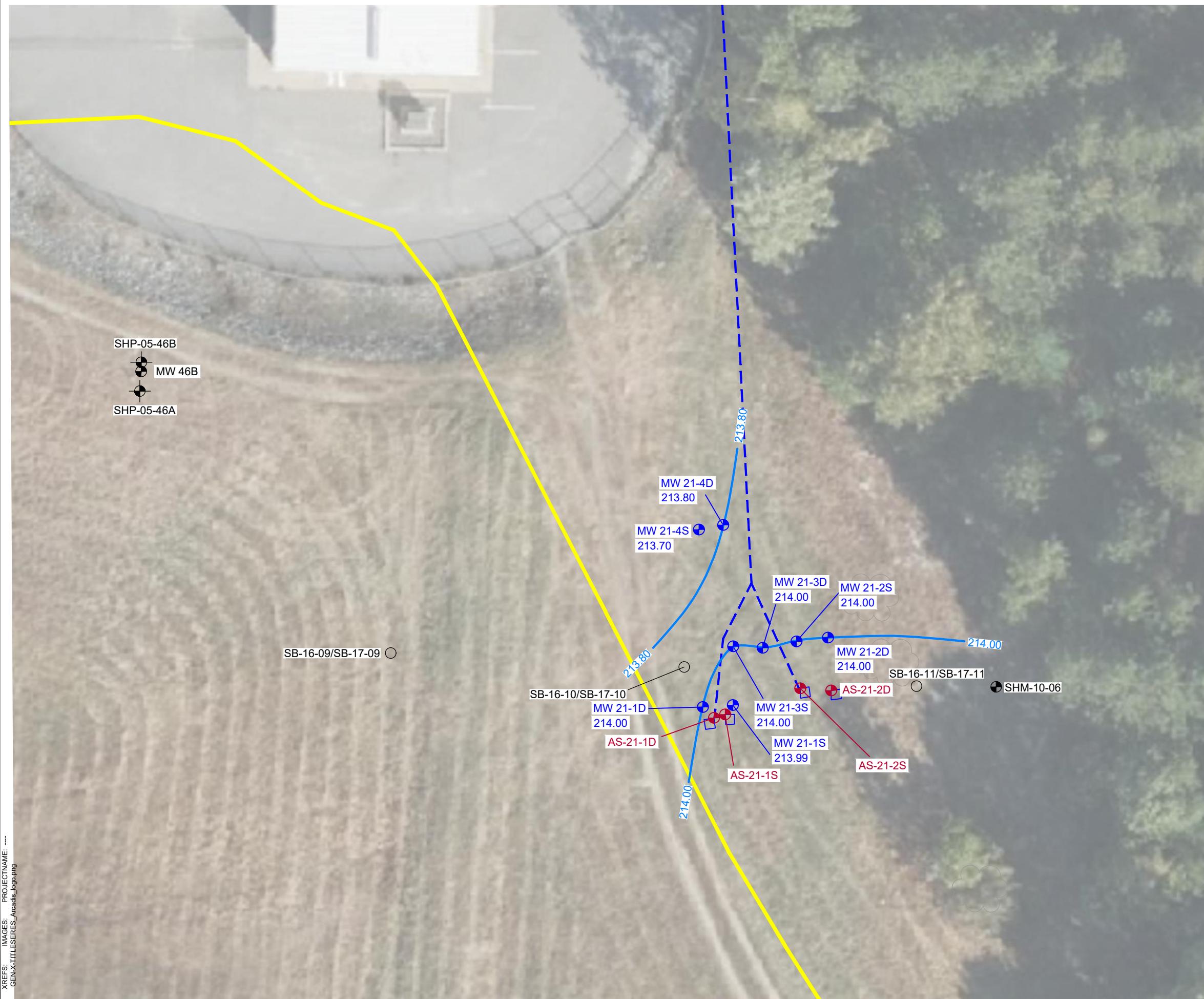
Performance Monitoring Results SHM-10-06









**LEGEND**

- MONITORING WELL
- GROUNDWATER PROFILING LOCATION/MONITORING WELL
- OVERTBURDEN MONITORING WELL/PIEZOMETER
- SOIL BORING
- AIR SPARGE PILOT TEST SYSTEM CONTAINER
- SHEPLEY'S HILL LANDFILL BOUNDARY
- PIPE TRENCH LOCATION
- GROUNDWATER ELEVATION CONTOUR (FT NAVD88; FEBRUARY 2022)

0 30' 60'
Approximate Scale: 1 in. = 30 ft.

IN-SITU AIR SPARGE PILOT TEST
SHEPLEY'S HILL LANDFILL
FORMER FORT DEVENS ARMY INSTALLATION
DEVENS, MASSACHUSETTS

LOCALIZED GROUNDWATER CONTOUR MAP

Appendix A

Soil Boring Logs

Soil Boring Log

Boring No.: AS-21-1D

Sheet: 1 of 3

Project Name: Fort Devens SHL

Date Started: 07/20/2021

Logger: J. Sandorf

Project Number: 30048392

Date Completed: 07/21/2021

Editor: J. Towell

Project Location: Devens, MA

AOC:

Depth (feet)	Sample Interval	Blow Counts (N value)	Recovery (in.)	PID (ppm)	USCS	USCS Graphic	Description	Construction Details	Well
1	X	2-2-2-3 (4)	16.8	0.0	SP		Topsoil SAND, f.-m. grained, subangular; trace c. sand; loose, dry, brown		
2	X	5-7-10-15 (17)	21.6	0.0	SP		SAND, f.-m. grained, subangular, loose, dry		
3	X	10-12-12-11 (24)	13.2	0.0	SP		SAND, f.-m. grained, subangular, loose, moist		
4	X	11-10-11-9 (21)	20.4	0.0	SP-SM		SAND, f.-m. grained, subangular; with SILT; m. loose, moist, brown		
5	X	2-3-4-3 (7)	10.8	0.0	SP		SAND, f.-m. grained, m. loose, subangular, saturated, brown		
6	X	2-4-6-6 (10)	13.2	0.0					
7	X	5-4-5-5 (9)	15.6	0.0	SP		SAND, f.-m. grained, subangular; trace c. sand; m. loose, saturated		
8	X	6-8-14-14 (22)	12	0.0					
9	X	17-15-14-15 (29)	15.6	0.0					
10	X	11-7-4-5 (11)	10.8	0.0					
11	X	2-3-4-4 (7)	7.2	0.0					
12	X	5-3-3-3 (6)	18	0.0					
13	X	9-8-8-3 (16)	9.6	0.0					
14	X	2-2-1-1 (3)	19.2	0.0					
15	X	1-1-2-1 (3)	9.6	0.0					

Portland
Cement

Drilling Co.: Drilex
 Driller: Chris Hogan
 Drilling Method: Drive & Wash
 Drilling Fluid: Water
 Remarks: WH: Weight of Hammer
 NA: Not Available

Sampling Method: Split Spoon
 Sampling Interval: 2 feet
 Water Level Start (ft. bgs.):
 Water Level Finish (ft. btoc.):
 Converted to Well: Yes No
 Surface Elev.: 226.9
 North Coor: 3027876.0
 East Coor: 630158.3



Engineering & Services, LLC



Soil Boring Log

Boring No.: AS-21-1D

Sheet: 2 of 3

Project Name: Fort Devens SHL

Date Started: 07/20/2021

Logger: J. Sandorf

Project Number: 30048392

Date Completed: 07/21/2021

Editor: J. Towell

Project Location: Devens, MA

AOC:

Remarks:

Soil Boring Log

Boring No.: AS-21-1D

Sheet: 3 of 3

Project Name: Fort Devens SHL

Date Started: 07/20/2021

Logger: J. Sandorf

Project Number: 30048392

Date Completed: 07/21/2021

Editor: J. Towell

Project Location: Devens, MA

AOC:

Depth (feet)	Sample Interval	Blow Counts (N value)	Recovery (in.)	PID (ppm)	USCS	USCS Graphic	Description	Construction Details	Well
63	X	1-1-4-4 (5)	9.6	0.0	SP		SAND, f.-m. grained, subangular, m. loose, saturated, gray-brown	#8 Choker Sand	
64	X	2-2-2-2 (4)	10.8	0.0			SAND, f.-m. grained, subangular, m. loose, saturated, gray-brown		
65	X	2-3-5-8 (8)	24	0.0			SAND, f.-m. grained, subangular, m. loose, saturated, gray-brown		
66	X	5-2-3-6 (5)	15.6	0.0			SAND, f.-m. grained, subangular; trace f. gravel; m. loose, gray-brown, saturated		
67	X	10-26-25-43 (51)	24	0.0	SC		SILTY SAND, f.-c. grained; little f. gravel; m. loose, gray	#1 Sand Pack	
68	X	34-39-50 (89)	3.6	0.0			SAND, f.-c. grained; some silt; some clay; trace f. gravel at base; very dense, hard (Till)		
69							TILL, v. dense, hard		
70							Encountered refusal at 73.5 ft below ground surface.		
71									
72									
73									
74									
75									
76									
77									
78									
79									
80									
81									
82									
83									
84									
85									
86									
87									
88									
89									
90									
91									
92									
93									
94									

Remarks:

Soil Boring Log

Boring No.: AS-21-1S

Sheet: 1 of 2

Project Name: Fort Devens SHL

Date Started: 07/20/2021

Logger: J. Sandorf

Project Number: 30048392

Date Completed: 07/21/2021

Editor: J. Towell

Project Location: Devens, MA

AOC:

Depth (feet)	Sample Interval	Blow Counts (N value)	Recovery (in.)	PID (ppm)	USCS	USCS Graphic	Description	Construction Details	Well
1	X	2-2-2-3 (4)	16.8	0.0	SP		Topsoil SAND, f.-m. grained, subangular; trace c. sand; loose, dry, brown		
2	X	5-7-10-15 (17)	21.6	0.0	SP		SAND, f.-m. grained, subangular, loose, dry		
3	X	10-12-12-11 (24)	13.2	0.0	SP		SAND, f.-m. grained, subangular, loose, moist		
4	X	11-10-11-9 (21)	20.4	0.0	SP-SM		SAND, f.-m. grained, subangular; with SILT; m. loose, moist, brown		
5	X	2-3-4-3 (7)	10.8	0.0	SP		SAND, f.-m. grained, m. loose, subangular, saturated, brown		
6	X	2-4-6-6 (10)	13.2	0.0					
7	X	5-4-5-5 (9)	15.6	0.0	SP		SAND, f.-m. grained, subangular; trace c. sand; m. loose, saturated		
8	X	6-8-14-14 (22)	12	0.0					
9	X	17-15-14-15 (29)	15.6	0.0					
10	X	11-7-4-5 (11)	10.8	0.0					
11	X	2-3-4-4 (7)	7.2	0.0					
12	X	5-3-3-3 (6)	18	0.0					
13	X	9-8-8-3 (16)	9.6	0.0					
14	X	2-2-1-1 (3)	19.2	0.0					
15	X	1-1-2-1 (3)	9.6	0.0					

Portland
Cement

Drilling Co.: Drilex
 Driller: Chris Hogan
 Drilling Method: Drive & Wash
 Drilling Fluid: Water
 Remarks: WH: Weight of Hammer
 NA: Not Available

Sampling Method: Split Spoon
 Sampling Interval: 2 feet
 Water Level Start (ft. bgs.):
 Water Level Finish (ft. btoc.):
 Converted to Well: Yes No
 Surface Elev.: 226.9
 North Coor: 3027876.7
 East Coor: 630160.6

Soil Boring Log

Boring No.: AS-21-1S

Sheet: 2 of 2

Project Name: Fort Devens SHL

Date Started: 07/20/2021

Logger: J. Sandorf

Project Number: 30048392

Date Completed: 07/21/2021

Editor: J. Towell

Project Location: Devens, MA

AOC:

Depth (feet)	Sample Interval	Blow Counts (N value)	Recovery (in.)	PID (ppm)	USCS	USCS Graphic	Description	Construction Details	Well
31	X	1-1-1-1 (2)	9.6	0.0	SW		SAND, f.-c. grained, subangular; trace f. gravel; m. loose, saturated, brown	Portland Cement	
32	X	1-1-2-1 (3)	15.6	0.0			SAND, f.-m. grained; trace silt; m. loose, saturated, brown End of boring at 52 ft below ground surface, no refusal encountered.		
33	X	5-4-4-5 (8)	13.2	0.0					
34	X	4-3-3-4 (6)	20.4	0.0					
35	X	1-2-3-3 (5)	13.2	0.0					
36	X	1-1-4-5 (5)	16.8	0.0					
37	X	1-1-1-1 (2)	14.4	0.0					
38	X	1-1-1-1 (2)	15.6	0.0					
39	X	1-2-1-2 (3)	24	0.0					
40	X	3-1-1-2 (2)	22.8	0.0					
41	WH-WH-1-1	24	0.0						
42									
43									
44									
45									
46									
47									
48									
49									
50									
51									
52									
53									
54									
55									
56									
57									
58									
59									
60									
61									
62									

Remarks:

Soil Boring Log

Boring No.: AS-21-2D

Sheet: 1 of 3

Project Name: Fort Devens SHL

Date Started: 07/16/2021

Logger: J. Sandorf

Project Number: 30048392

Date Completed: 07/19/2021

Editor: J. Towell

Project Location: Devens, MA

AOC:

Depth (feet)	Sample Interval	Blow Counts (N value)	Recovery (in.)	PID (ppm)	USCS	USCS Graphic	Description	Construction Details	Well
1	X	2-2-2-2 (4)	15.6	0.0	SP		SAND, f.-m. grained, subangular; trace c. sand; dry, m. loose, brown to light brown		
2							No sample collected.		
3									
4									
5									
6	X	4-5-5-5 (10)	15.6	0.0	SP		SAND, f.-m. grained, subangular; trace c. sand; dry, m. loose, brown to light brown		
7									
8	X	5-4-4-4 (8)	20.4	0.0					
9									
10	X	2-2-3-1 (5)	8.4	0.0	SP		SAND, f.-m. grained, subangular; trace c. gravel; m. loose, saturated, brown		
11									
12	X	7-7-8-6 (15)	12	0.0					
13									
14	X	3-4-4-5 (8)	13.2	0.0	SP				
15									
16	X	3-4-4-5 (8)	10.8	0.0					
17									
18	X	4-5-6-6 (11)	18	0.0	SW				
19									
20	X	5-6-6-7 (12)	13.2	0.0	SW		SAND, f.-c. grained, subangular; trace f. gravel; m. loose, well graded, brown		
21									
22	X	8-9-7-7 (16)	16.8	0.0					
23									
24	X	6-5-5-6 (10)	12	0.0	SW				
25									
26	X	4-4-4-5 (8)	15.6	0.0					
27									
28	X	5-4-4-5 (8)	15.6	0.0	SW				
29									
30	X	4-2-5-6							

Drilling Co.: Drilex

Sampling Method: Split Spoon

Driller: Chris Hogan

Sampling Interval: 2 feet

Drilling Method: Drive & Wash

Water Level Start (ft. bgs.):

Drilling Fluid: Water

Water Level Finish (ft. btoc.):

Remarks: WH: Weight of Hammer

Converted to Well: Yes No

NA: Not Available

Surface Elev.: 226.3

North Coor: 3027881.6

East Coor: 630182.2

Portland
Cement

Soil Boring Log

Boring No.: AS-21-2D

Sheet: 2 of 3

Project Name: Fort Devens SHL

Date Started: 07/16/2021

Logger: J. Sandorf

Project Number: 30048392

Date Completed: 07/19/2021

Editor: J. Towell

Project Location: Devens, MA

AOC:

Depth (feet)	Sample Interval	Blow Counts (N value)	Recovery (in.)	PID (ppm)	USCS	USCS Graphic	Description	Construction Details	Well
31		(7)	12	0.0			SAND, f.-c. grained, subangular; trace f. gravel; m. loose, well graded, brown		
32		5-6-6-7 (12)	3.6	0.0					
33									
34		3-3-6-7 (9)	15.6	0.0					
35									
36		4-4-5-6 (9)	13.2	0.0					
37									
38		8-7-10-12 (17)	22.8	0.0					
39									
40		5-6-8-7 (14)	16.8	0.0					
41									
42		4-1-1-2 (2)	24	0.0					
43									
44		3-2-1-2 (3)	22.8	0.0					
45									
46		4-1-1-2 (2)	24	0.0					
47									
48		2-3-3-2 (6)	24	0.0					
49									
50		1-1-1-1 (2)	8.4	0.0					
51									
52		1-2-3-2 (5)	24	0.0					
53									
54		3-5-6-7 (11)	12	0.0					
55									
56		2-3-5-7 (8)	7.2	0.0					
57									
58		6-11-12-15 (23)	24	0.0					
59									
60		2-3-3-5 (6)	0	0.0					
61									
62		3-3-3-4							

Remarks:



Boring No.: AS-21-2D



Soil Boring Log

Sheet: 3 of 3

Project Name: Fort Devens SHL

Date Started: 07/16/2021

Logger: J. Sandorf

Project Number: 30048392

Date Completed: 07/19/2021

Editor: J. Towell

Project Location: Devens, MA

AOC:

Remarks:

Soil Boring Log

Boring No.: AS-21-2S

Sheet: 1 of 2

Project Name: Fort Devens SHL

Date Started: 07/16/2021

Logger: J. Sandorf

Project Number: 30048392

Date Completed: 07/19/2021

Editor: J. Towell

Project Location: Devens, MA

AOC:

Depth (feet)	Sample Interval	Blow Counts (N value)	Recovery (in.)	PID (ppm)	USCS	USCS Graphic	Description	Construction Details	Well
1	X	2-2-2-2 (4)	15.6	0.0	SP		SAND, f.-m. grained, subangular; trace c. sand; dry, m. loose, brown to light brown	Portland Cement	
2									
3									
4									
5	X	4-5-5-5 (10)	15.6	0.0					
6					SP		SAND, f.-m. grained, subangular; trace c. gravel; m. loose, saturated, brown	Portland Cement	
7	X	5-4-4-4 (8)	20.4	0.0					
8									
9									
10	X	2-2-3-1 (5)	8.4	0.0					
11					SP			Portland Cement	
12	X	7-7-8-6 (15)	12	0.0					
13									
14	X	3-4-4-5 (8)	13.2	0.0					
15									
16	X	3-4-4-5 (8)	10.8	0.0	SW			Portland Cement	
17									
18	X	4-5-6-6 (11)	18	0.0					
19									
20	X	5-6-6-7 (12)	13.2	0.0			SAND, f.-c. grained, subangular; trace f. gravel; m. loose, well graded, brown		
21					SW			Portland Cement	
22	X	8-9-7-7 (16)	16.8	0.0					
23									
24	X	6-5-5-6 (10)	12	0.0					
25									
26	X	4-4-4-5 (8)	15.6	0.0	SW			Portland Cement	
27									
28	X	5-4-4-5 (8)	15.6	0.0					
29									
30	X	4-2-5-6							

Drilling Co.: Drilex

Sampling Method: Split Spoon

Driller: Chris Hogan

Sampling Interval: 2 feet

Drilling Method: Drive & Wash

Water Level Start (ft. bgs.):

Drilling Fluid: Water

Water Level Finish (ft. btoc.):

Remarks: Well installed: 7/20/2021

Converted to Well: Yes No

WH: Weight of Hammer

Surface Elev.: 226.1

NA: Not Available

North Coor: 3027882.0

East Coor: 630175.8

Soil Boring Log

Sheet: 2 of 2

Project Name: Fort Devens SHL

Date Started: 07/16/2021

Logger: J. Sandorf

Project Number: 30048392

Date Completed: 07/19/2021

Editor: J. Towell

Project Location: Devens, MA

AOC: _____

Remarks:

Soil Boring Log

Boring No.: MW-21-1D

Sheet: 1 of 3

Project Name: Fort Devens SHL

Date Started: 07/22/2021

Logger: J. Sandorf

Project Number: 30048392

Date Completed: 07/23/2021

Editor: J. Towell

Project Location: Devens, MA

AOC:

Depth (feet)	Sample Interval	Blow Counts (N value)	Recovery (in.)	PID (ppm)	USCS	USCS Graphic	Description	Construction Details	Well
1							Drive & wash to 50 ft below ground surface, no samples collected.		
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									Portland Cement
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									

Drilling Co.: Drilex

Sampling Method: Split Spoon

Driller: Chris Hogan

Sampling Interval: 2 feet

Drilling Method: Drive & Wash

Water Level Start (ft. bgs.):

Drilling Fluid: Water

Water Level Finish (ft. btoc.):

Remarks: Well installed: 7/23/2021

Converted to Well: Yes No

WH: Weight of Hammer

Surface Elev.: 226.9

NA: Not Available

North Coor: 3027878.2

East Coor: 630156.0

Soil Boring Log

Boring No.: MW-21-1D

Sheet: 2 of 3

Project Name: Fort Devens SHL

Date Started: 07/22/2021

Logger: J. Sandorf

Project Number: 30048392

Date Completed: 07/23/2021

Editor: J. Towell

Project Location: Devens, MA

AOC:

Depth (feet)	Sample Interval	Blow Counts (N value)	Recovery (in.)	PID (ppm)	USCS	USCS Graphic	Description	Construction Details	Well
31							Drive & wash to 50 ft below ground surface, no samples collected.		
32									
33									
34									
35									
36									
37									
38									
39									
40									
41									
42									
43									
44									
45									
46									
47									
48									
49									
50	X 1-1-1-1 (2)	24	0.0	SP		SAND, f.-m. grained, loose, subangular, saturated, brown			
51									
52									
53									
54	X 2-3-4-4 (7)	20	0.0	SP		SAND, f.-m. grained, loose, subrounded, saturated, brown			
55									
56									
57									
58									
59	X NA	2.4	0.0	SP		SAND, f.-m. grained, loose, subangular, saturated, gray-brown			
60									
61									
62									

Remarks:

Soil Boring Log

Boring No.: MW-21-1D

Sheet: 3 of 3

Project Name: Fort Devens SHL

Date Started: 07/22/2021

Logger: J. Sandorf

Project Number: 30048392

Date Completed: 07/23/2021

Editor: J. Towell

Project Location: Devens, MA

AOC:

Depth (feet)	Sample Interval	Blow Counts (N value)	Recovery (in.)	PID (ppm)	USCS	USCS Graphic	Description	Construction Details	Well
63									
64									
65	X 2-1-1-2 (2)	12	0.0	SP	SAND		f.-m. grained, loose, subangular, saturated, gray-brown		
66									
67									
68									
69									
70	X NA	0	0.0				No recovery. Encountered refusal at 69.1 ft below ground surface.		
71									
72									
73									
74									
75									
76									
77									
78									
79									
80									
81									
82									
83									
84									
85									
86									
87									
88									
89									
90									
91									
92									
93									
94									

Remarks:

Soil Boring Log

Boring No.: MW-21-1S

Sheet: 1 of 2

Project Name: Fort Devens SHL

Date Started: 07/22/2021

Logger: J. Sandorf

Project Number: 30048392

Date Completed: 07/23/2021

Editor: J. Towell

Project Location: Devens, MA

AOC:

Depth (feet)	Sample Interval	Blow Counts (N value)	Recovery (in.)	PID (ppm)	USCS	USCS Graphic	Description	Construction Details	Well
1							Drive & wash to 49 ft below ground surface, no samples collected.		
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									Portland Cement
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									

Drilling Co.: Drilex
 Driller: Chris Hogan
 Drilling Method: Drive & Wash
 Drilling Fluid: Water
 Remarks: Well installed: 7/26/2021

WH: Weight of Hammer
 NA: Not Available

Sampling Method: Split Spoon
 Sampling Interval: 2 feet
 Water Level Start (ft. bgs.):
 Water Level Finish (ft. btoc.):
 Converted to Well: Yes No
 Surface Elev.: 226.5
 North Coor: 3027878.6
 East Coor: 630162.2

Soil Boring Log

Sheet: 2 of 2

Project Name: Fort Devens SHL

Date Started: 07/22/2021

Logger: J. Sandorf

Project Number: 30048392

Date Completed: 07/23/2021

Editor: J. Towell

Project Location: Devens, MA

AOC:

Remarks:

Soil Boring Log

Boring No.: MW-21-2D

Sheet: 1 of 3

Project Name: Fort Devens SHL

Date Started: 07/26/2021

Logger: J. Sandorf

Project Number: 30048392

Date Completed: 07/27/2021

Editor: J. Towell

Project Location: Devens, MA

AOC:

Depth (feet)	Sample Interval	Blow Counts (N value)	Recovery (in.)	PID (ppm)	USCS	USCS Graphic	Description	Construction Details	Well
1							Drive & wash to 49 ft below ground surface, no samples collected.		
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									Portland Cement
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									

Drilling Co.: Drilex Sampling Method: Split Spoon
 Driller: Chris Hogan Sampling Interval: 2 feet
 Drilling Method: Drive & Wash Water Level Start (ft. bgs.):
 Drilling Fluid: Water Water Level Finish (ft. btoc.):
 Remarks: WH: Weight of Hammer Converted to Well: Yes No
 NA: Not Available Surface Elev.: 226.1
 North Coor: 3027881.6
 East Coor: 630182.2

Soil Boring Log

Boring No.: MW-21-2D

Sheet: 2 of 3

Project Name: Fort Devens SHL

Date Started: 07/26/2021

Logger: J. Sandorf

Project Number: 30048392

Date Completed: 07/27/2021

Editor: J. Towell

Project Location: Devens, MA

AOC:

Depth (feet)	Sample Interval	Blow Counts (N value)	Recovery (in.)	PID (ppm)	USCS	USCS Graphic	Description	Construction Details	Well
31							Drive & wash to 49 ft below ground surface, no samples collected.		
32									
33									
34									
35									
36									
37									
38									
39									
40									
41									
42									
43									
44									
45									
46									
47									
48									
49									
50	X 1-2-3-1 (5)	22.8	0.0	SP		SAND, f.-m. grained, subrounded; trace f. gravel; m. loose, saturated, brown			
51									
52									
53									
54									
55									
56									
57									
58	X 1-1-4-7 (5)	19.2	0.0	SP		SAND, f.-m. grained, subrounded; trace f. gravel; m. loose, saturated, brown			
59									
60	X 3-4-6-6 (10)	12	0.0	SP		SAND, f.-m. grained, m. loose, subrounded, saturated, brown			
61									
62									

Remarks:

Portland Cement

Bentonite Pellets

Soil Boring Log

Boring No.: MW-21-2D

Sheet: 3 of 3

Project Name: Fort Devens SHL

Date Started: 07/26/2021

Logger: J. Sandorf

Project Number: 30048392

Date Completed: 07/27/2021

Editor: J. Towell

Project Location: Devens, MA

AOC:

Depth (feet)	Sample Interval	Blow Counts (N value)	Recovery (in.)	PID (ppm)	USCS	USCS Graphic	Description	Construction Details	Well
63									
64									
65	X 3-5-7-9 (12)	13.2	0.0	SP			SAND, f.-m. grained, subrounded; trace c. gravel; m. loose, saturated, gray-brown		#1 Sand Pack
66									
67									
68									
69									
70	X 7-8-11-14 (19)	14.4	0.0	SP			SAND, f.-m. grained, subrounded; trace c. gravel; m. loose, saturated, gray-brown		Screen Interval
71									
72									
73									
74									
75	X 7-8-6-8 (14)	10.8	0.0	SM			SILTY SAND and SAND, f.-m. grained; with gravel; little Silt; little f.-m. gravel; m. loose, saturated, gray-brown Encountered refusal at 77 ft below ground surface.		
76									
77									
78									
79									
80									
81									
82									
83									
84									
85									
86									
87									
88									
89									
90									
91									
92									
93									
94									

Remarks:

Soil Boring Log

Boring No.: MW-21-2S

Sheet: 1 of 2

Project Name: Fort Devens SHL

Date Started: 07/26/2021

Logger: J. Sandorf

Project Number: 30048392

Date Completed: 07/27/2021

Editor: J. Towell

Project Location: Devens, MA

AOC:

Depth (feet)	Sample Interval	Blow Counts (N value)	Recovery (in.)	PID (ppm)	USCS	USCS Graphic	Description	Construction Details	Well
1							Drive & wash to 49 ft below ground surface, no samples collected.		
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									Portland Cement
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									

Drilling Co.: Drilex

Sampling Method: Split Spoon

Driller: Chris Hogan

Sampling Interval: 2 feet

Drilling Method: Drive & Wash

Water Level Start (ft. bgs.):

Drilling Fluid: Water

Water Level Finish (ft. btoc.):

Remarks: WH: Weight of Hammer

Converted to Well: Yes No

NA: Not Available

Surface Elev.: 225.9

North Coor: 3027891.6

East Coor: 630175.1

Soil Boring Log

Boring No.: MW-21-2S

Sheet: 2 of 2

Project Name: Fort Devens SHL

Date Started: 07/26/2021

Logger: J. Sandorf

Project Number: 30048392

Date Completed: 07/27/2021

Editor: J. Towell

Project Location: Devens, MA

AOC:

Depth (feet)	Sample Interval	Blow Counts (N value)	Recovery (in.)	PID (ppm)	USCS	USCS Graphic	Description	Construction Details	Well
31							Drive & wash to 49 ft below ground surface, no samples collected.		
32									
33									
34									
35									
36									
37									
38									
39									
40									
41									
42									
43									
44									
45									
46									
47									
48									
49									
50	X 1-2-3-1 (5)	22.8	0.0	SP		SAND, f.-m. grained, subrounded; trace f. gravel; m. loose, saturated, brown			
51									
52									
53									
54									
55									
56									
57									
58	X 1-1-4-7 (5)	19.2	0.0	SP		SAND, f.-m. grained, subrounded; trace f. gravel; m. loose, saturated, brown			
59							End of boring at 59 ft below ground surface, no refusal encountered.		
60									
61									
62									

Remarks:

Soil Boring Log

Boring No.: MW-21-3D

Sheet: 1 of 3

Project Name: Fort Devens SHL

Date Started: 07/28/2021

Logger: J. Sandorf

Project Number: 30048392

Date Completed: 07/29/2021

Editor: J. Towell

Project Location: Devens, MA

AOC:

Depth (feet)	Sample Interval	Blow Counts (N value)	Recovery (in.)	PID (ppm)	USCS	USCS Graphic	Description	Construction Details	Well
1							Drive & wash up tp 49 ft below ground surface, no samples collected.		
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									

Portland Cement

Drilling Co.: Drilex

Sampling Method: Split Spoon

Driller: Chris Hogan

Sampling Interval: 2 feet

Drilling Method: Drive & Wash

Water Level Start (ft. bgs.):

Drilling Fluid: Water

Water Level Finish (ft. btoc.):

Remarks: Well installed: 7/29/2021

Converted to Well: Yes No

WH: Weight of Hammer

Surface Elev.: 226.0

NA: Not Available

North Coor: 3027890.3

East Coor: 630168.2

Soil Boring Log

Boring No.: MW-21-3D

Sheet: 2 of 3

Project Name: Fort Devens SHL

Date Started: 07/28/2021

Logger: J. Sandorf

Project Number: 30048392

Date Completed: 07/29/2021

Editor: J. Towell

Project Location: Devens, MA

AOC:

Depth (feet)	Sample Interval	Blow Counts (N value)	Recovery (in.)	PID (ppm)	USCS	USCS Graphic	Description	Construction Details	Well
31							Drive & wash up tp 49 ft below ground surface, no samples collected.		
32									
33									
34									
35									
36									
37									
38									
39									
40									
41									
42									
43									
44									
45									
46									
47									
48									
49									
50	X	1-1-1-1 (2)	22.8	0.0	SP		SAND, f.-m. grained, loose, subrounded, saturated, brown		
51									
52									
53									
54	X	1-3-5-8 (8)	18	0.0	SP		SAND, f.-m. grained, loose, subrounded, saturated, brown		
55									
56									
57									
58									
59									
60	X	3-7-8-8 (15)	14.4	0.0	SP		SAND, f.-m. grained, loose, subrounded, saturated, brown		
61									
62									

Remarks:

Portland Cement

Bentonite Pellets

Soil Boring Log

Boring No.: MW-21-3D

Sheet: 3 of 3

Project Name: Fort Devens SHL

Date Started: 07/28/2021

Logger: J. Sandorf

Project Number: 30048392

Date Completed: 07/29/2021

Editor: J. Towell

Project Location: Devens, MA

AOC:

Depth (feet)	Sample Interval	Blow Counts (N value)	Recovery (in.)	PID (ppm)	USCS	USCS Graphic	Description	Construction Details	Well
63									
64									
65	X	3-5-6-8 (11)	12	0.0	SP		SAND, f.-m. grained, loose, subrounded, saturated, brown		#1 Sand Pack
66									
67									
68									
69									
70	X	3-5-7-7 (12)	14.4	0.0	SP		SAND, f.-m. grained, loose, subrounded, saturated, brown Encountered refusal at 73.5 ft below ground surface.		Screen Interval
71									
72									
73									
74									
75									
76									
77									
78									
79									
80									
81									
82									
83									
84									
85									
86									
87									
88									
89									
90									
91									
92									
93									
94									

Remarks:

Soil Boring Log

Boring No.: MW-21-3S

Sheet: 1 of 2

Project Name: Fort Devens SHL

Date Started: 07/28/2021

Logger: J. Sandorf

Project Number: 30048392

Date Completed: 07/29/2021

Editor: J. Towell

Project Location: Devens, MA

AOC:

Depth (feet)	Sample Interval	Blow Counts (N value)	Recovery (in.)	PID (ppm)	USCS	USCS Graphic	Description	Construction Details	Well
1							Drive & wash up tp 49 ft below ground surface, no samples collected.		
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									

Portland Cement

Drilling Co.: Drilex
 Driller: Chris Hogan
 Drilling Method: Drive & Wash
 Drilling Fluid: Water
 Remarks: Well installed: 7/30/2021

WH: Weight of Hammer
 NA: Not Available

Sampling Method: Split Spoon
 Sampling Interval: 2 feet
 Water Level Start (ft. bgs.):
 Water Level Finish (ft. btoc.):
 Converted to Well: Yes No
 Surface Elev.: 226.0
 North Coor: 3027890.6
 East Coor: 630162.2

Soil Boring Log

Boring No.: MW-21-3S

Sheet: 2 of 2

Project Name: Fort Devens SHL

Date Started: 07/28/2021

Logger: J. Sandorf

Project Number: 30048392

Date Completed: 07/29/2021

Editor: J. Towell

Project Location: Devens, MA

AOC:

Depth (feet)	Sample Interval	Blow Counts (N value)	Recovery (in.)	PID (ppm)	USCS	USCS Graphic	Description	Construction Details	Well
31							Drive & wash up tp 49 ft below ground surface, no samples collected.		
32									
33									
34									
35									
36									
37									
38									
39									
40									
41									
42									
43									
44									
45									
46									
47									
48									
49									
50	X	1-1-1-1 (2)	22.8	0.0	SP		SAND, f.-m. grained, loose, subrounded, saturated, brown		
51									
52									
53									
54	X	1-3-5-8 (8)	18	0.0	SP		SAND, f.-m. grained, loose, subrounded, saturated, brown End of boring at 58.5 ft below ground surface, no refusal encountered.		
55									
56									
57									
58									
59									
60									
61									
62									

Remarks:

Soil Boring Log

Boring No.: MW-21-4D

Sheet: 1 of 3

Project Name: Fort Devens SHL

Date Started: 07/30/2021

Logger: J. Sandorf

Project Number: 30048392

Date Completed: 08/02/2021

Editor: J. Towell

Project Location: Devens, MA

AOC:

Drilling Co.

Drilex

Driller:

Chris Hogan

Drilling Method: Drive & Wash

Drilling Fluid: Water

Remarks:

Well installed: 8/2/2021

Sampling Method: Split Spoon

Sampling Interval: 2 feet

Water Level Start (ft. bas.):

Water Level Finish (ft. btoc.):

Converted to Well: Yes

Surface Elev.:224.9

North Coor: 3027915.2

East Coor: 630160.2

Soil Boring Log

Boring No.: MW-21-4D

Sheet: 2 of 3

Project Name: Fort Devens SHL

Date Started: 07/30/2021

Logger: J. Sandorf

Project Number: 30048392

Date Completed: 08/02/2021

Editor: J. Towell

Project Location: Devens, MA

AOC:

Depth (feet)	Sample Interval	Blow Counts (N value)	Recovery (in.)	PID (ppm)	USCS	USCS Graphic	Description	Construction Details	Well
31		2-3-3-3 (6)	13.2	0.0	SP		SAND, f.-m. grained, subrounded; little c. sand; m. loose, saturated, brown	Portland Cement	
32		4-5-4-3 (9)	22.8	0.0			SAND, f.-c. grained, subrounded, m. loose, saturated, brown		
33		3-4-8-9 (12)	14.4	0.0	SW		SAND, f.-c. grained, subrounded, m. loose, saturated, brown		
34		12-13-10-11 (23)	22.8	0.0			SAND, f.-m. grained, subrounded, m. loose, saturated, brown		
35		3-2-2-2 (4)	22.8	0.0			SAND, f.-m. grained, subrounded; trace c. gravel; m. loose, saturated, gray-brown		
36		2-2-3-4 (5)	18	0.0	SP		SAND, f.-m. grained, subrounded; trace c. gravel; m. loose, saturated, gray-brown		
37		2-3-3-3 (6)	24	0.0			SAND, f.-m. grained, subrounded; trace c. gravel; m. loose, saturated, gray-brown		
38		2-3-2-4 (5)	18	0.0			SAND, f.-m. grained, subrounded; trace c. gravel; m. loose, saturated, gray-brown		
39		2-3-4-4 (7)	24	0.0			SAND, f.-m. grained, subrounded; trace c. gravel; m. loose, saturated, gray-brown		
40		1-2-1-1 (3)	24	0.0			SAND, f.-m. grained, subrounded; trace c. gravel; m. loose, saturated, gray-brown		
41		1-1-1-2 (2)	24	0.0			SAND, f.-m. grained, subrounded; trace c. gravel; m. loose, saturated, gray-brown		
42		1-1-1-1 (2)	24	0.0			SAND, f.-m. grained, subrounded; trace c. gravel; m. loose, saturated, gray-brown		
43		1-1-2-1 (3)	22.8	0.0			SAND, f.-m. grained, subrounded; trace c. gravel; m. loose, saturated, gray-brown		
44		1-2-1-1 (3)	24	0.0			SAND, f.-m. grained, subrounded; trace c. gravel; m. loose, saturated, gray-brown		
45		3-4-5-7 (9)	2.4	0.0			SAND, f.-m. grained, subrounded; trace c. gravel; m. loose, saturated, gray-brown		
46		2-5-6-8 (11)	14.4	0.0			SAND, f.-m. grained, subrounded; trace c. gravel; m. loose, saturated, gray-brown		
47									
48									
49									
50									
51									
52									
53									
54									
55									
56									
57									
58									
59									
60									
61									
62									

Remarks:

Soil Boring Log

Boring No.: MW-21-4D

Sheet: 3 of 3

Project Name: Fort Devens SHL

Date Started: 07/30/2021

Logger: J. Sandorf

Project Number: 30048392

Date Completed: 08/02/2021

Editor: J. Towell

Project Location: Devens, MA

AOC:

Depth (feet)	Sample Interval	Blow Counts (N value)	Recovery (in.)	PID (ppm)	USCS	USCS Graphic	Description	Construction Details	Well
63		5-8-11-10 (19)	0	0.0			SAND, f.-m. grained, subrounded; trace c. gravel; m. loose, saturated, gray-brown		
64									
65		5-9-10-12 (19)	16.8	0.0					
66									
67		7-10-12-13 (22)	13.2	0.0					
68									
69		4-5-6-8 (11)	6	0.0					
70									
71		1-2-5-8 (7)	24	NA					
72									
73		16	8.4	0.0			TILL and CLAYEY SAND; some f.-c. gravel; dense, brown Encountered refusal at 72.9 ft below ground surface.		#1 Sand Pack
74									
75									
76									
77									
78									
79									
80									
81									
82									
83									
84									
85									
86									
87									
88									
89									
90									
91									
92									
93									
94									

Remarks:

Soil Boring Log

Boring No.: MW-21-4S

Sheet: 1 of 2

Project Name: Fort Devens SHL

Date Started: 07/30/2021

Logger: J. Sandorf

Project Number: 30048392

Date Completed: 08/02/2021

Editor: J. Towell

Project Location: Devens, MA

AOC:

Depth (feet)	Sample Interval	Blow Counts (N value)	Recovery (in.)	PID (ppm)	USCS	USCS Graphic	Description	Construction Details	Well
1	X	1-2-3-1 (5)	20.4	0.0	SP		TOPSOIL; some Silty Sand; trace gravel; trace roots; loose, dry, dark brown SAND, f.-m. grained; trace c. gravel; m. loose, dry, brown		
2	X	3-5-7-8 (12)	24	0.0	SP		SAND, f.-m. grained; trace gravel; m. loose, dry		
3	X	4-7-7-8 (14)	12	0.0	SP		SAND, f.-m. grained, moist, brown		
4	X	8-6-6-5 (12)	1.2	0.0	SP		SAND, f.-m. grained, saturated, brown		
5	X	5-2-2-3 (4)	14.4	0.0	SW		SAND, f.-c. grained, loose, saturated, brown	Portland Cement	
6	X	2-3-5-6 (8)	14.4	0.0					
7	X	5-6-8-8 (14)	22.8	0.0					
8	X	3-4-5-5 (9)	14.4	0.0	SW		SAND, f.-c. grained, loose, saturated, dark brown	Portland Cement	
9	X	6-9-10-10 (19)	24	0.0					
10	X	4-3-3-4 (6)	13.2	0.0			SAND, f.-m. grained, subrounded, m. loose, brown		
11	X	1-1-1-1 (2)	13.2	0.0	SP			Portland Cement	
12	X	2-2-2-2 (4)	24	0.0					
13	X	3-5-6-8 (11)	0	0.0					
14	X	7-9-10-13 (19)	0	0.0	SP			Portland Cement	
15	X	2-4-5-5 (9)	12	0.0					

Drilling Co.: Drilex

Sampling Method: Split Spoon

Driller: Chris Hogan

Sampling Interval: 2 feet

Drilling Method: Drive & Wash

Water Level Start (ft. bgs.):

Drilling Fluid: Water

Water Level Finish (ft. btoc.):

Remarks: Well installed: 8/2/2021

Converted to Well: Yes No

WH: Weight of Hammer

Surface Elev.: 225.3

NA: Not Available

North Coor: 3027914.3

East Coor: 630155.2

Soil Boring Log

Boring No.: MW-21-4S

Sheet: 2 of 2

Project Name: Fort Devens SHL

Date Started: 07/30/2021

Logger: J. Sandorf

Project Number: 30048392

Date Completed: 08/02/2021

Editor: J. Towell

Project Location: Devens, MA

AOC:

Depth (feet)	Sample Interval	Blow Counts (N value)	Recovery (in.)	PID (ppm)	USCS	USCS Graphic	Description	Construction Details	Well
31	X	2-3-3-3 (6)	13.2	0.0	SP		SAND, f.-m. grained, subrounded; little c. sand; m. loose, saturated, brown	Portland Cement	
32	X	4-5-4-3 (9)	22.8	0.0			SAND, f.-c. grained, subrounded, m. loose, saturated, brown		
33	X	3-4-8-9 (12)	14.4	0.0			SAND, f.-m. grained, subrounded, m. loose, saturated, brown		
34	X	12-13-10-11 (23)	22.8	0.0			SAND, f.-m. grained, subrounded, m. loose, saturated, brown		
35	X	3-2-2-2 (4)	22.8	0.0	SP		SAND, f.-m. grained, subrounded; trace c. gravel; m. loose, saturated, gray-brown	Bentonite Pellets	
36	X	2-2-3-4 (5)	18	0.0			End of boring at 58.5 ft below ground surface, no refusal encountered.		
37	X	2-3-3-3 (6)	24	0.0					
38	X	2-3-2-4 (5)	18	0.0					
39	X	2-3-4-4 (7)	24	0.0	SP			#1 Sand Pack	
40	X	1-2-1-1 (3)	24	0.0					
41	X	1-1-1-2 (2)	24	0.0					
42	X	1-1-1-1 (2)	24	0.0					
43	X	1-1-2-1 (3)	22.8	0.0	SP			Screen Interval	
44	X	1-2-1-1 (3)	24	0.0					
45	X								
46	X								
47	X								
48	X								
49	X								
50	X								
51	X								
52	X								
53	X								
54	X								
55	X								
56	X								
57	X								
58	X								
59	X								
60	X								
61	X								
62	X								

Remarks:

Appendix B

Well Survey Report

**SHEPLEY'S HILL LANDFILL
DEVENS, MASSACHUSETTS
MONITORING WELL SURVEY**

Project No: 30901563.001

Date Printed: January 10, 2022

Client: Arcadis US, Inc.

Horizontal Datum: Massachusetts State Plane Coordinate System NAD83*

Vertical Datum: NAVD88

Instruments: GPS Unit - Leica GS16
Automatic Level - Nikon AP-8
Data Collector - Leica MS20

Field Crew: J. Lapointe
I. Maniscalchi

Project Manager: M. Soucy

Project Benchmark: MW-46B - RIM Existing Monitoring Well
N: 3,027,946.4
E: 630,041.8
EL: 227.76'

Revisions:



Darren J. Hardy, P.L.S.
Reg. No. 48385
WSP USA

January 10, 2022



9 Executive Park Drive
Suite 101
Merrimack, NH 03054
www.wsp.com

SURVEY PROJECT DESCRIPTION

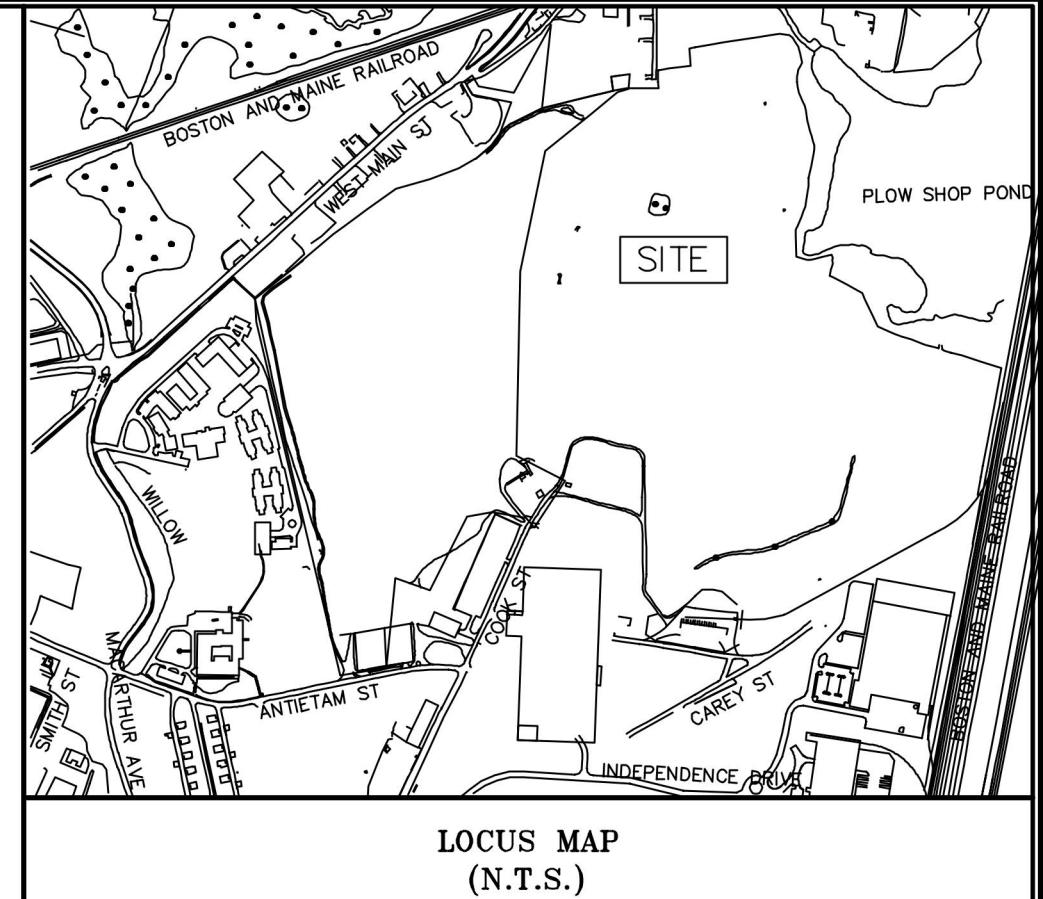
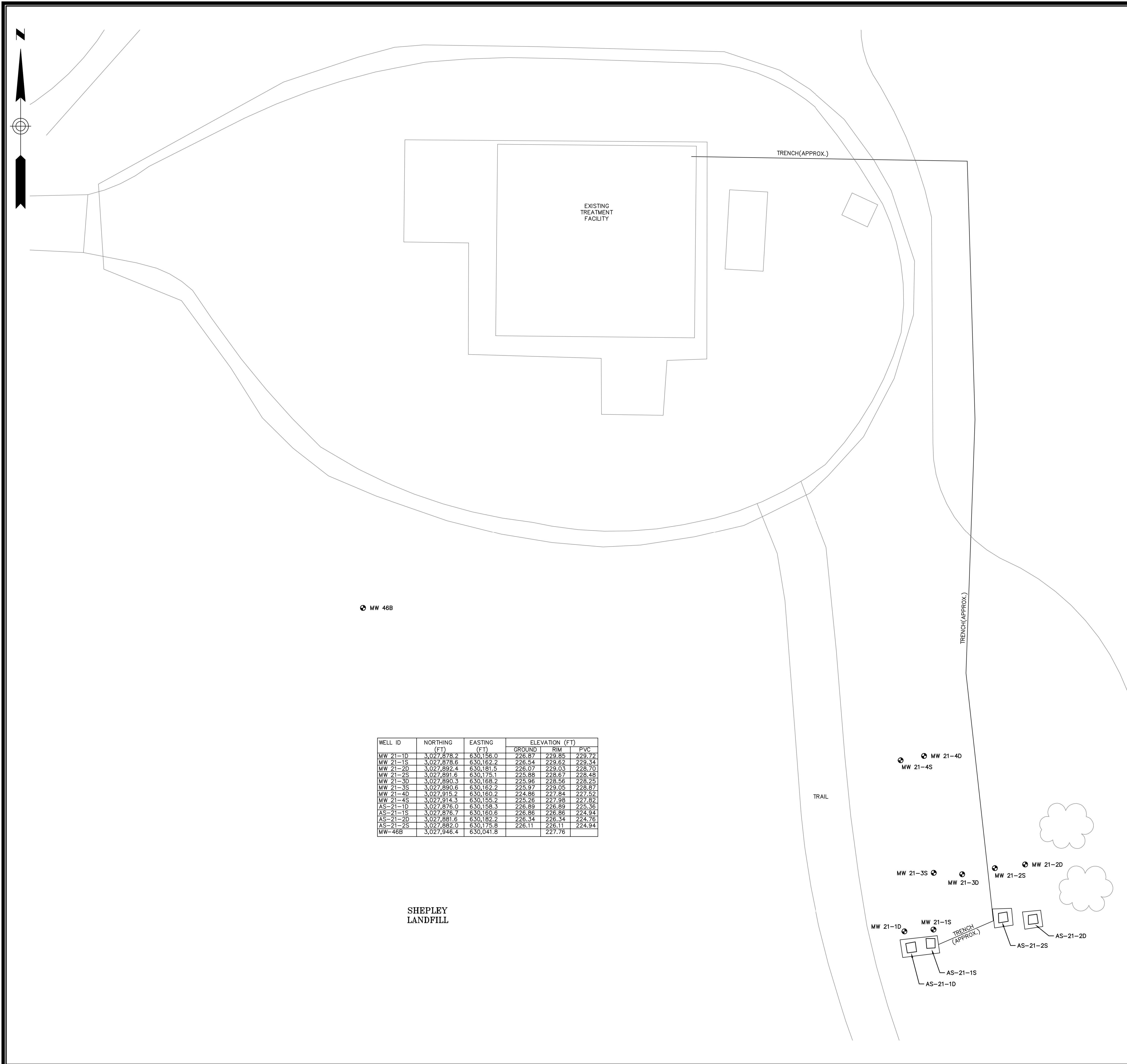
WSP conducted this monitoring well survey utilizing a combination of GPS and on the ground field survey using the latest in conventional survey equipment. All coordinate values are reported in relationship to the Devens, MA Control Network and Geographic System (GIS). Reference is made to the control survey and report entitled, "Survey Control Report Fort Devens, Massachusetts" prepared for Massachusetts Development Finance Agency, by Chas. H. Sells, Inc. dated April 8, 2002. All coordinates are on the Massachusetts State Plane Coordinate System of NAD 1983 and vertically on NAVD 1988. WSP used horizontal and vertical control points previously established by this office to perform the survey.

Differential leveling was implemented to ensure accurate elevations were established on all survey control to be used and the ground, rim and pvc elevation for each well. All vertical locations were collected using a Nikon AP-8 Automatic Level. All data obtained by differential leveling is reported to the 0.01' elevation. A peg test was performed prior to each visit on site to ensure the accuracy of the equipment being used.

The horizontal positions for the monitoring wells were collected using a Leica GS 16 GPS Unit and Leica MS20 Data Collector and/or with a Leica GS15 Real Time Kinematic GPS Unit. All data is reported to the nearest 0.1' horizontally.

All set up information, level notes and sketches were recorded in a field book at the time of the survey. At the end of each day the field crew downloaded the data collector and made copies of all field book pages.

WELL ID	NORTHING (FT)	EASTING (FT)	ELEVATION (FT)		
			GROUND	RIM	PVC
MW 21-1D	3,027,878.2	630,156.0	226.87	229.85	229.72
MW 21-1S	3,027,878.6	630,162.2	226.54	229.62	229.34
MW 21-2D	3,027,892.4	630,181.5	226.07	229.03	228.70
MW 21-2S	3,027,891.6	630,175.1	225.88	228.67	228.48
MW 21-3D	3,027,890.3	630,168.2	225.96	228.56	228.25
MW 21-3S	3,027,890.6	630,162.2	225.97	229.05	228.87
MW 21-4D	3,027,915.2	630,160.2	224.86	227.84	227.52
MW 21-4S	3,027,914.3	630,155.2	225.26	227.98	227.82
AS-21-1D	3,027,876.0	630,158.3	226.89	226.89	225.36
AS-21-1S	3,027,876.7	630,160.6	226.86	226.86	224.94
AS-21-2D	3,027,881.6	630,182.2	226.34	226.34	224.76
AS-21-2S	3,027,882.0	630,175.8	226.11	226.11	224.94
MW-46B	3,027,946.4	630,041.8		227.76	



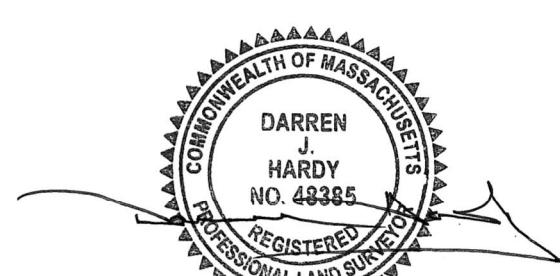
NOTES

1. THIS PLAN WAS PREPARED FROM AN ACTUAL ON THE GROUND FIELD SURVEY CONDUCTED BY WSP IN DECEMBER OF 2021.
 2. THE HORIZONTAL DATUM SHOWN HEREON REFERENCES NAD83.
 3. THE VERTICAL DATUM SHOWN HEREON REFERENCES NAVD88.
 4. THE BACKGROUND INFORMATION SHOWN HEREON REFERENCES THE MASSDEVLOPMENT GEOGRAPHICAL INFORMATION SYSTEM.

LEGEND

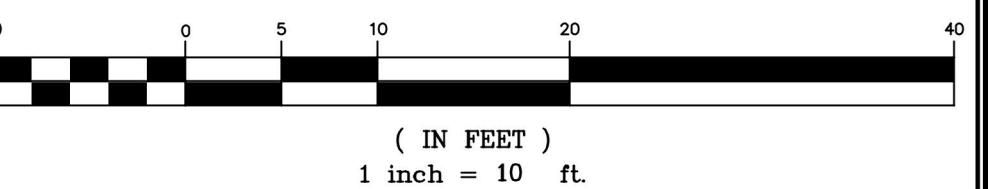
 MONITORING WELL
AS AIR SPARGE WELL

CERTIFICATION:



DARREN J. HARDY, P.L.S. DATE: JANUARY 10, 2022
REG. NO. 48385
WSP USA INC.

GRAPHIC SCALE



REVISION

DATE	DESCRIPTION
-- / -- / --	---

MONITORING WELL SURVEY

SHEPLEY'S HILL LANDFILL
FORMER FORT DEVENS ARMY BASE
ANTIETAM STREET

EVENS, MASSACHUSETTS
PREPARED FOR
ARCADIS US INC

WSP USA Inc.
9 Executive Park Dr, Suite 101
Merrimack, NH 03054
603-324-0894

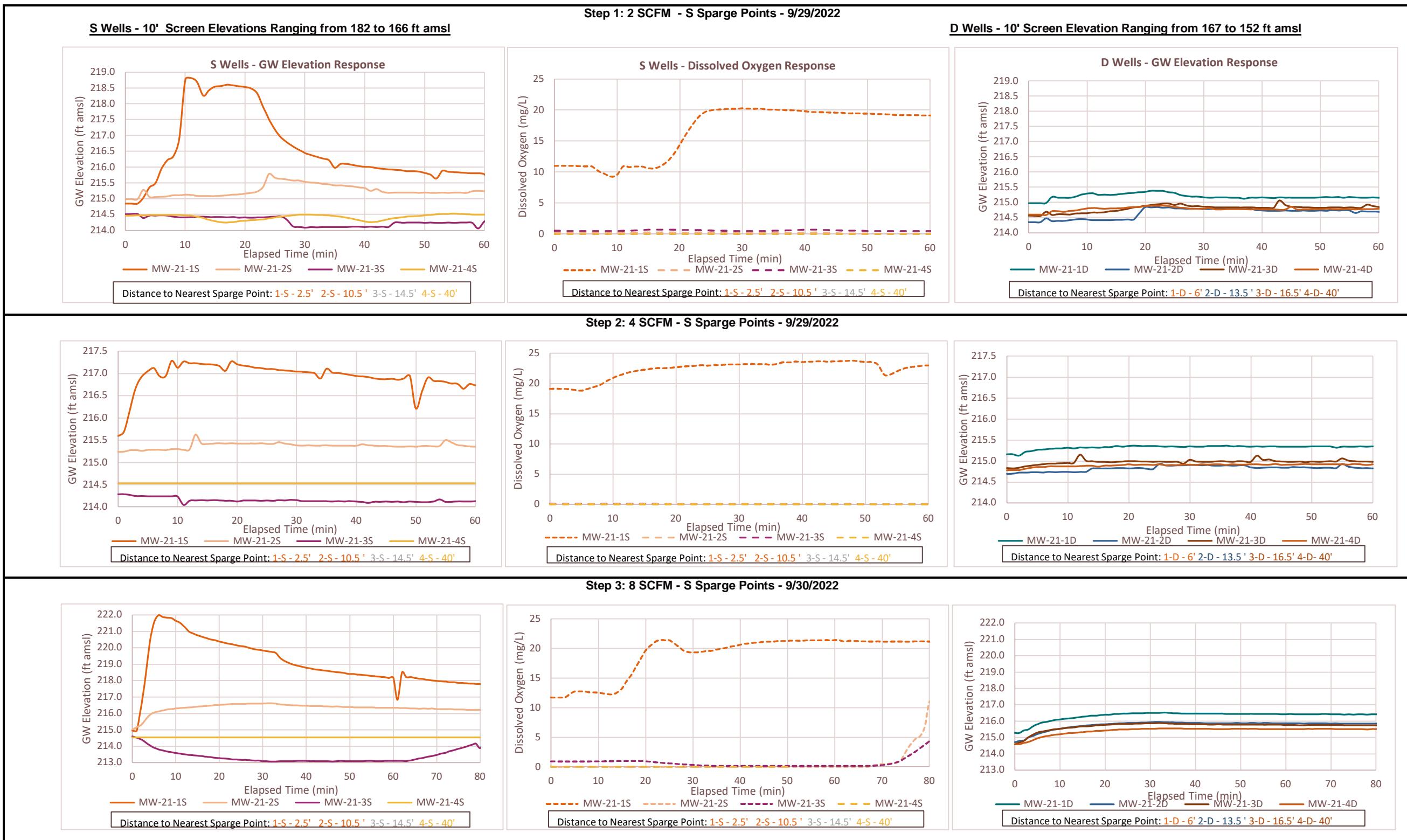
Drawn By	MS	Date	Job No.
Surveyed By	JL, IM	JANUARY 10, 2022	30901563.001
Checked By	DH	Scale	Sheet No.
Book No.	N-155N	1" = 10'	1 OF 1

Appendix C

Step Test Results

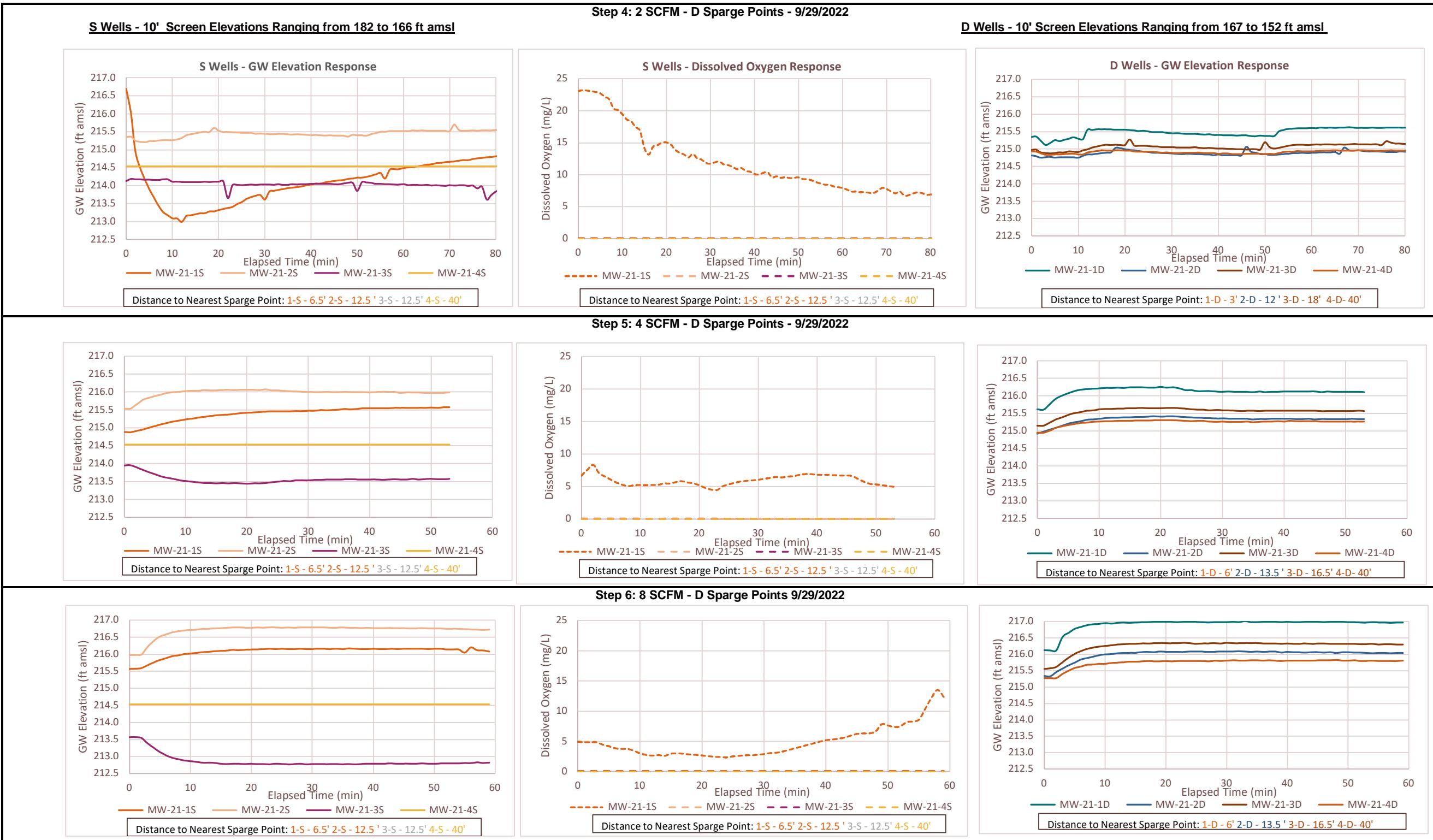
S Sparge Wells with 2' Screen Elevations Ranging from 177 to 170 ft amsl

Step Tests at Sparge Points AS-21-1S and AS-21-2S



Step Tests at Sparge Points AS-21-1D and AS-21-2D

D Sparge Wells with 2' Screen Elevations Ranging From 160 to 152 ft amsl



Devens Air Sparge Pilot - Step Test Gas Data From
 September 29, 2021

Arcadis Personnel on Site: Desmond Bedard & Brian Therriault
 USACE Personnel on Site: Dan Groher

Instruments Used: Manometer --> Dwyer Series 475 Mark III --> SN: 443357-00R7
 Landfill Gas Meter --> EAGLE 2 --> SN: E21567
 PID --> PhoCheckTIGER --> SN: L-115530

Air Sparge Operating Condition	Well ID	Time	Well Head Pressure (inWC)	Methane (%LEL)	Carbon Monoxide (ppm)	Carbon Dioxide (% Volume)	PID (ppm)
Air Sparge Start @ 11:00. Conditions: AS-21-1S @ 2-scfm and 22-psi (at well vault) AS-21-2S @ 2-scfm and 22-psi (at well vault) AS-21-1D - OFFLINE AS-21-2D - OFFLINE	MW-21-1S	11:10	6.45	4	17	22	3.9
		11:31	1.7	1	0	0.5	1.2
		11:47	1.67	0	0	2.9	1.3
		12:00	2.15	0	0	2.2	1.1
	MW-21-1D	11:08	0.23	2	0	0.1	1.9
		11:33	0	0	0	0.5	0.8
		11:50	0	0	0	0.5	0.6
		12:01	0	0	0	1	1.2
	SHM-10-06	11:14	0	1	0	0	0.2
		11:35	-0.3	0	0	0	0.1
		11:52	-0.28	0	0	0	0.1
	MW-21-2S	11:18	0.57	1	0	0.2	0.6
		11:39	-0.25	0	0	0	0.4
		11:56	0	0	0	0	0.4
	MW-21-2D	11:16	0.52	1	0	0.1	0.5
		11:37	-1.03	0	0	0	0.4
		11:54	-0.65	0	0	0	0.4
	MW-21-3S	11:22	0.71	2	0	0.3	1.9
		11:43	-1.44	0	0	0	1.2
		11:59	-0.54	0	0	0	1.1
	MW-21-3D	11:20	0	2	0	0.3	1.1
		11:42	0	0	0	0.2	1.2
		11:57	0	0	0	0.1	0.9
	MW-21-4D	11:27	0	0	0	0	2.7
		11:45	0	0	0	0	1.7
		12:00	0	0	0	0	2.3
Air Sparge Conditions Change							
Air Sparge Conditions Change @ 12:03. New Conditions: AS-21-1S @ 4-scfm and 20-psi (at well vault) AS-21-2S @ 4-scfm and 20-psi (at well vault) AS-21-1D - OFFLINE AS-21-2D - OFFLINE	MW-21-1S	12:05	5.9	0	0	2.1	1.4
		12:15	6.97	0	0	3.2	1.1
		12:32	8.8	0	0	2	0.8
		12:47	11.63	0	0	2.7	0.9
		12:58	13.9	0	0	2.4	0.8
	MW-21-1D	12:06	0	0	0	0.4	1.5
		12:18	0	0	0	0.1	1.4
		12:34	0	0	0	0.6	1.3
		12:49	0	0	0	0	1.3
	SHM-10-06	12:12	0	0	0	0	0.1
		12:22	0	0	0	0	0.1
		12:35	0	0	0	0	0.1
		12:54	0	0	0	0	0.1
	MW-21-2S	12:10	0.43	0	0	0	0.3
		12:25	-0.34	0	0	0	0.5
		12:37	0	0	0	0	0.3
		12:52	-0.2	0	0	0.1	0.4
	MW-21-2D	12:11	0.25	0	0	0	0.3
		12:24	-0.12	0	0	0	0.4
		12:36	-0.62	0	0	0	0.3
		12:53	-0.45	0	0	0	0.3
	MW-21-3S	12:08	0.42	0	0	0.1	0.6
		12:29	0	0	0	0	1.2
		12:40	-1.04	0	0	0	0.6
		12:50	-0.27	0	0	0	0.6
	MW-21-3D	12:09	0	0	0	0.1	1
		12:27	-0.25	0	0	0	1.2
		12:39	0	0	0	0	0.5
		12:51	-0.28	0	0	0	0.8
	MW-21-4D	12:13	0	0	0	0	2.2
		12:30	0	0	0	0	2.1
		12:41	0	0	0	0	2.5
		12:56	0	0	0	0	2.1

Devens Air Sparge Pilot - Step Test Gas Data From
 September 29, 2021

Arcadis Personnel on Site: Desmond Bedard & Brian Therriault
 USACE Personnel on Site: Dan Groher
 Instruments Used: Manometer --> Dwyer Series 475 Mark III --> SN: 443357-00R7
 Landfill Gas Meter --> EAGLE 2 --> SN: E21567
 PID --> PhoCheckTIGER --> SN: L-115530

Air Sparge Operating Condition	Well ID	Time	Well Head Pressure (inWC)	Methane (%LEL)	Carbon Monoxide (ppm)	Carbon Dioxide (% Volume)	PID (ppm)
Air Sparge Conditions Change							
Air Sparge Conditions Change @ 13:00. New Conditions: AS-21-1D @ 2-scfm and 25-psi (at well vault) AS-21-2D @ 2-scfm and 25-psi (at well vault) AS-21-1S - OFFLINE AS-21-2S - OFFLINE	MW-21-1S	13:10	0.09	0	0	1.2	0.6
		13:29	0.21	2	0	1.5	0.7
		13:55	0.25	1	0	1.4	0.8
		14:21	0.11	0	0	1	1.2
Air Sparge Conditions Not Checked During This Interval	MW-21-1D	13:09	0.12	2	0	0	1.4
		13:31	0	1	0	0	1.5
		13:57	0	0	0	0	1.7
		14:22	0	--	--	--	--
Air Sparge Conditions Change @ 13:00. New Conditions: AS-21-1D @ 2-scfm and 25-psi (at well vault) AS-21-2D @ 2-scfm and 25-psi (at well vault) AS-21-1S - OFFLINE AS-21-2S - OFFLINE	SHM-10-06	13:15	0	0	0	0	0.1
		13:42	0	0	0	0	0.3
		14:02	0	2	0	0	0.3
		13:18	-0.52	1	0	0	0.4
Air Sparge Conditions Not Checked During This Interval	MW-21-2S	13:45	0	0	0	0	0.6
		14:09	0	2	0	0	0.5
		13:16	0.17	1	0	0	0.4
		13:44	0	0	0	0	0.6
Air Sparge Conditions Not Checked During This Interval	MW-21-2D	14:05	-0.98	2	0	0	0.6
		13:21	-1.33	1	0	0	1.1
		13:47	-1.3	0	0	0	1.2
		14:15	-0.15	1	0	0	1.2
Air Sparge Conditions Not Checked During This Interval	MW-21-3S	13:20	0	0	0	0	0.5
		13:46	0	0	0	0	1
		14:13	0	2	0	0	0.6
		13:22	0	0	0	0	3
Air Sparge Conditions Not Checked During This Interval	MW-21-3D	13:48	0	0	0	0	3.2
		14:19	0	0	0	0	2.9
		Max Reading		4	17	22	3.9

Step 1 - 2 SCFM Shallow - 9/29/2022

Time min	Elevation									
	MW-21-1S ft amsl	MW-21-2S ft amsl	MW-21-3S ft amsl	MW-21-4S ft amsl	Time min	MW-21-1D ft amsl	MW-21-2D ft amsl	MW-21-3D ft amsl	MW-21-4D ft amsl	
0	214.85	215.00	214.51	214.46	0	214.97	214.35	214.56	214.60	
1	214.85	214.99	214.52	214.47	1	214.98	214.35	214.56	214.59	
2	214.85	214.99	214.52	214.48	2	214.97	214.35	214.55	214.60	
3	215.03	215.29	214.40	214.48	3	214.98	214.48	214.69	214.59	
4	215.36	215.06	214.47	214.48	4	215.18	214.38	214.59	214.71	
5	215.49	215.06	214.47	214.49	5	215.16	214.39	214.61	214.71	
6	215.94	215.07	214.48	214.49	6	215.15	214.39	214.61	214.69	
7	216.23	215.08	214.47	214.49	7	215.15	214.42	214.60	214.72	
8	216.34	215.11	214.43	214.49	8	215.18	214.44	214.63	214.73	
9	216.88	215.11	214.42	214.49	9	215.25	214.45	214.64	214.77	
10	218.78	215.13	214.41	214.48	10	215.29	214.44	214.65	214.80	
11	218.81	215.13	214.42	214.47	11	215.30	214.42	214.67	214.82	
12	218.69	215.09	214.43	214.44	12	215.25	214.41	214.66	214.81	
13	218.26	215.08	214.44	214.39	13	215.26	214.42	214.68	214.79	
14	218.44	215.09	214.42	214.33	14	215.25	214.42	214.71	214.80	
15	218.55	215.08	214.42	214.29	15	215.26	214.43	214.72	214.81	
16	218.56	215.10	214.42	214.26	16	215.28	214.43	214.76	214.81	
17	218.61	215.11	214.41	214.25	17	215.30	214.44	214.79	214.84	
18	218.58	215.13	214.42	214.26	18	215.32	214.44	214.84	214.85	
19	218.56	215.14	214.40	214.29	19	215.34	214.66	214.86	214.85	
20	218.53	215.16	214.41	214.31	20	215.35	214.85	214.89	214.88	
21	218.49	215.19	214.40	214.32	21	215.38	214.83	214.91	214.89	
22	218.34	215.23	214.41	214.34	22	215.39	214.85	214.94	214.89	
23	217.91	215.37	214.41	214.35	23	215.38	214.83	214.96	214.89	
24	217.52	215.78	214.43	214.37	24	215.34	214.84	214.96	214.88	
25	217.18	215.66	214.43	214.41	25	215.32	214.81	214.92	214.85	
26	216.95	215.63	214.44	214.43	26	215.24	214.80	214.96	214.83	
27	216.79	215.61	214.34	214.46	27	215.21	214.79	214.90	214.81	
28	216.66	215.58	214.13	214.48	28	215.19	214.79	214.87	214.79	
29	216.55	215.58	214.11	214.50	29	215.19	214.79	214.88	214.79	
30	216.45	215.53	214.09	214.50	30	215.17	214.78	214.86	214.79	
31	216.38	215.51	214.10	214.50	31	215.15	214.79	214.86	214.82	
32	216.33	215.50	214.10	214.49	32	215.16	214.79	214.84	214.77	
33	216.27	215.47	214.11	214.48	33	215.16	214.80	214.84	214.77	
34	216.22	215.45	214.11	214.47	34	215.16	214.79	214.84	214.78	
35	215.98	215.42	214.11	214.45	35	215.15	214.79	214.84	214.78	
36	216.11	215.42	214.11	214.43	36	215.15	214.80	214.83	214.78	
37	216.10	215.40	214.11	214.40	37	215.13	214.78	214.84	214.78	
38	216.07	215.39	214.12	214.36	38	215.16	214.79	214.84	214.77	
39	216.03	215.36	214.12	214.33	39	215.15	214.75	214.83	214.78	
40	216.01	215.34	214.11	214.28	40	215.16	214.74	214.83	214.77	
41	216.00	215.25	214.12	214.26	41	215.16	214.72	214.83	214.77	
42	215.97	215.31	214.10	214.28	42	215.14	214.72	214.83	214.77	
43	215.95	215.21	214.12	214.31	43	215.17	214.72	215.06	214.76	
44	215.93	215.19	214.11	214.35	44	215.16	214.74	214.92	214.77	
45	215.92	215.20	214.25	214.39	45	215.16	214.72	214.86	214.86	
46	215.90	215.20	214.25	214.41	46	215.15	214.72	214.85	214.77	
47	215.88	215.20	214.24	214.44	47	215.16	214.73	214.84	214.77	
48	215.87	215.20	214.25	214.45	48	215.16	214.72	214.84	214.77	
49	215.86	215.19	214.25	214.45	49	215.16	214.72	214.83	214.78	
50	215.82	215.20	214.24	214.48	50	215.16	214.73	214.83	214.78	
51	215.76	215.19	214.25	214.49	51	215.18	214.72	214.83	214.79	
52	215.65	215.19	214.24	214.51	52	215.16	214.74	214.84	214.78	
53	215.88	215.20	214.23	214.52	53	215.17	214.73	214.84	214.77	
54	215.86	215.19	214.25	214.53	54	215.16	214.74	214.83	214.78	
55	215.84	215.20	214.24	214.53	55	215.17	214.73	214.83	214.78	
56	215.83	215.20	214.25	214.52	56	215.17	214.65	214.83	214.77	
57	215.82	215.18	214.25	214.51	57	215.16	214.71	214.82	214.78	
58	215.81	215.24	214.24	214.50	58	215.16	214.70	214.93	214.77	
59	215.81	215.25	214.06	214.50	59	215.16	214.70	214.88	214.78	
60	215.78	215.24	214.28	214.50	60	215.16	214.69	214.85	214.79	
61	215.59	215.24	214.28	214.50	61	215.16	214.69	214.83	214.78	
62	215.69	215.24	214.28	214.51	62	215.16	214.70	214.82	214.78	

Appendix C
Step Test Results
Shepley's Hill Landfill
Former Fort Devens Army Installation
Devens, Massachusetts

Step 1 - 2 SCFM Shallow - 9/29/2022

Dissolved Oxygen									
Time min	MW-21-1S mg/L	MW-21-2S mg/L	MW-21-3S mg/L	MW-21-4S mg/L	Time min	MW-21-1D mg/L	MW-21-2D mg/L	MW-21-3D mg/L	MW-21-4D mg/L
0	11.01	0.21	0.53	0.00	0	0.06	0.00	0.00	0.00
1	11.02	0.21	0.52	0.00	1	0.06	0.00	0.00	0.00
2	11.02	0.22	0.51	0.00	2	0.06	0.00	0.00	0.00
3	11.01	0.22	0.51	0.00	3	0.06	0.00	0.00	0.00
4	10.96	0.32	0.51	0.00	4	0.06	0.00	0.00	0.00
5	10.92	0.31	0.50	0.00	5	0.06	0.00	0.00	0.00
6	10.90	0.30	0.50	0.00	6	0.06	0.00	0.00	0.00
7	10.17	0.29	0.50	0.00	7	0.06	0.01	0.00	0.00
8	9.73	0.28	0.50	0.00	8	0.06	0.02	0.00	0.00
9	9.27	0.29	0.50	0.00	9	0.06	0.01	0.00	0.00
10	9.56	0.29	0.51	0.00	10	0.06	0.00	0.00	0.00
11	10.93	0.29	0.52	0.00	11	0.06	0.00	0.00	0.00
12	10.80	0.28	0.55	0.00	12	0.06	0.00	0.00	0.00
13	10.90	0.27	0.60	0.00	13	0.06	0.00	0.00	0.00
14	10.89	0.27	0.66	0.00	14	0.06	0.00	0.00	0.00
15	10.61	0.27	0.70	0.00	15	0.06	0.00	0.00	0.00
16	10.61	0.26	0.73	0.00	16	0.06	0.00	0.00	0.00
17	10.98	0.26	0.74	0.00	17	0.06	0.00	0.00	0.00
18	11.70	0.25	0.73	0.00	18	0.05	0.00	0.00	0.00
19	12.82	0.24	0.70	0.00	19	0.05	0.00	0.00	0.00
20	14.37	0.23	0.68	0.00	20	0.05	0.00	0.00	0.00
21	16.08	0.23	0.67	0.00	21	0.05	0.00	0.00	0.00
22	17.58	0.23	0.65	0.00	22	0.05	0.00	0.00	0.00
23	18.87	0.25	0.64	0.00	23	0.05	0.00	0.00	0.00
24	19.66	0.29	0.62	0.00	24	0.05	0.00	0.00	0.00
25	19.96	0.26	0.58	0.00	25	0.05	0.00	0.00	0.00
26	20.09	0.23	0.56	0.00	26	0.05	0.00	0.00	0.00
27	20.13	0.22	0.53	0.00	27	0.05	0.00	0.00	0.00
28	20.20	0.20	0.51	0.00	28	0.05	0.00	0.00	0.00
29	20.21	0.20	0.49	0.00	29	0.05	0.00	0.00	0.00
30	20.28	0.20	0.49	0.00	30	0.05	0.00	0.00	0.00
31	20.23	0.19	0.49	0.00	31	0.05	0.00	0.00	0.00
32	20.22	0.19	0.50	0.00	32	0.05	0.00	0.00	0.00
33	20.23	0.19	0.51	0.00	33	0.05	0.00	0.00	0.00
34	20.10	0.20	0.52	0.00	34	0.05	0.00	0.00	0.00
35	20.08	0.20	0.54	0.00	35	0.05	0.00	0.00	0.00
36	20.03	0.20	0.56	0.00	36	0.05	0.00	0.00	0.00
37	19.99	0.20	0.59	0.00	37	0.05	0.00	0.00	0.00
38	19.98	0.21	0.63	0.00	38	0.05	0.00	0.00	0.00
39	19.89	0.21	0.66	0.00	39	0.05	0.00	0.00	0.00
40	19.82	0.21	0.71	0.00	40	0.05	0.00	0.00	0.00
41	19.70	0.24	0.73	0.00	41	0.05	0.00	0.00	0.00
42	19.67	0.27	0.71	0.00	42	0.06	0.00	0.00	0.00
43	19.65	0.23	0.68	0.00	43	0.06	0.00	0.00	0.00
44	19.61	0.19	0.64	0.00	44	0.06	0.00	0.00	0.00
45	19.59	0.15	0.60	0.00	45	0.06	0.00	0.00	0.00
46	19.55	0.12	0.58	0.00	46	0.06	0.00	0.00	0.00
47	19.48	0.10	0.56	0.00	47	0.06	0.00	0.00	0.00
48	19.49	0.09	0.54	0.00	48	0.06	0.00	0.00	0.00
49	19.44	0.08	0.54	0.00	49	0.06	0.00	0.00	0.00
50	19.43	0.07	0.51	0.00	50	0.06	0.00	0.00	0.00
51	19.39	0.07	0.50	0.00	51	0.06	0.00	0.00	0.00
52	19.36	0.06	0.48	0.00	52	0.06	0.00	0.00	0.00
53	19.31	0.05	0.47	0.00	53	0.06	0.00	0.00	0.00
54	19.26	0.04	0.46	0.00	54	0.06	0.00	0.00	0.00
55	19.19	0.03	0.46	0.00	55	0.06	0.00	0.00	0.00
56	19.22	0.03	0.47	0.00	56	0.06	0.00	0.00	0.00
57	19.17	0.03	0.48	0.00	57	0.06	0.00	0.00	0.00
58	19.18	0.13	0.49	0.00	58	0.06	0.00	0.00	0.00
59	19.12	0.12	0.49	0.00	59	0.06	0.00	0.00	0.00
60	19.11	0.11	0.49	0.00	60	0.06	0.00	0.00	0.00
61	19.10	0.11	0.49	0.00	61	0.06	0.00	0.00	0.00
62	19.12	0.10	0.48	0.00	62	0.06	0.00	0.00	0.00

Appendix C
Step Test Results
Shepley's Hill Landfill
Former Fort Devens Army Installation
Devens, Massachusetts

Step 2 - 4 SCFM Shallow - 9/29/2022

Time min	Elevation									
	MW-21-1S ft amsl	MW-21-2S ft amsl	MW-21-3S ft amsl	MW-21-4S ft amsl	Time min	MW-21-1D ft amsl	MW-21-2D ft amsl	MW-21-3D ft amsl	MW-21-4D ft amsl	
0	215.59	215.24	214.28	214.53	0	215.16	214.69	214.83	214.78	
1	215.69	215.24	214.28	214.53	1	215.16	214.70	214.82	214.78	
2	216.20	215.27	214.26	214.53	2	215.12	214.72	214.84	214.78	
3	216.70	215.27	214.24	214.53	3	215.21	214.72	214.87	214.81	
4	216.93	215.26	214.24	214.53	4	215.24	214.73	214.89	214.84	
5	217.05	215.28	214.24	214.53	5	215.26	214.73	214.91	214.86	
6	217.12	215.28	214.24	214.53	6	215.27	214.73	214.92	214.85	
7	216.93	215.29	214.23	214.53	7	215.29	214.74	214.94	214.87	
8	216.94	215.28	214.23	214.53	8	215.29	214.73	214.94	214.87	
9	217.28	215.30	214.24	214.53	9	215.30	214.74	214.94	214.87	
10	217.13	215.30	214.23	214.53	10	215.31	214.74	214.95	214.87	
11	217.27	215.28	214.04	214.53	11	215.30	214.73	214.95	214.87	
12	217.23	215.29	214.14	214.53	12	215.32	214.74	215.15	214.88	
13	217.23	215.62	214.14	214.53	13	215.32	214.74	215.00	214.88	
14	217.21	215.42	214.15	214.53	14	215.32	214.82	214.99	214.88	
15	217.21	215.42	214.14	214.53	15	215.32	214.82	214.98	214.86	
16	217.20	215.43	214.15	214.53	16	215.33	214.82	214.98	214.89	
17	217.16	215.43	214.15	214.53	17	215.33	214.82	214.97	214.89	
18	217.06	215.42	214.14	214.53	18	215.35	214.83	214.97	214.90	
19	217.27	215.43	214.14	214.53	19	215.34	214.83	214.99	214.90	
20	217.20	215.42	214.12	214.53	20	215.36	214.82	214.99	214.92	
21	217.18	215.42	214.14	214.53	21	215.36	214.83	214.99	214.91	
22	217.16	215.43	214.14	214.53	22	215.35	214.83	214.99	214.91	
23	217.13	215.42	214.14	214.53	23	215.35	214.81	214.98	214.91	
24	217.12	215.43	214.14	214.53	24	215.36	214.81	214.98	214.90	
25	217.10	215.42	214.15	214.53	25	215.35	214.93	214.98	214.92	
26	217.10	215.42	214.14	214.53	26	215.34	214.90	214.98	214.90	
27	217.07	215.46	214.15	214.53	27	215.34	214.89	214.98	214.90	
28	217.07	215.42	214.14	214.53	28	215.34	214.90	214.98	214.90	
29	217.06	215.41	214.16	214.53	29	215.33	214.90	214.94	214.91	
30	217.04	215.38	214.15	214.53	30	215.35	214.90	215.03	214.91	
31	217.04	215.38	214.13	214.53	31	215.34	214.90	214.98	214.90	
32	217.02	215.38	214.13	214.53	32	215.34	214.90	214.98	214.92	
33	217.00	215.37	214.13	214.53	33	215.35	214.90	214.98	214.91	
34	216.89	215.38	214.13	214.53	34	215.36	214.89	214.98	214.92	
35	217.11	215.38	214.12	214.53	35	215.36	214.89	215.00	214.92	
36	217.02	215.37	214.12	214.53	36	215.36	214.90	214.99	214.90	
37	217.01	215.38	214.13	214.53	37	215.34	214.89	214.98	214.92	
38	216.99	215.38	214.12	214.53	38	215.36	214.89	214.99	214.91	
39	216.96	215.37	214.13	214.53	39	215.35	214.90	214.99	214.91	
40	216.94	215.37	214.12	214.53	40	215.34	214.84	214.98	214.92	
41	216.93	215.41	214.11	214.53	41	215.35	214.83	215.12	214.92	
42	216.92	215.39	214.09	214.53	42	215.34	214.84	215.02	214.91	
43	216.89	215.38	214.11	214.53	43	215.35	214.84	215.03	214.91	
44	216.87	215.37	214.11	214.53	44	215.34	214.85	215.00	214.93	
45	216.87	215.37	214.12	214.53	45	215.34	214.84	214.99	214.90	
46	216.88	215.36	214.11	214.53	46	215.34	214.84	214.98	214.91	
47	216.86	215.35	214.12	214.53	47	215.34	214.85	214.98	214.91	
48	216.89	215.35	214.10	214.53	48	215.34	214.84	214.98	214.92	
49	216.94	215.36	214.12	214.53	49	215.34	214.85	214.97	214.93	
50	216.21	215.35	214.11	214.53	50	215.35	214.84	214.98	214.92	
51	216.57	215.37	214.10	214.53	51	215.34	214.83	214.97	214.92	
52	216.90	215.37	214.11	214.53	52	215.35	214.84	214.98	214.92	
53	216.83	215.36	214.12	214.53	53	215.35	214.84	214.99	214.92	
54	216.83	215.37	214.17	214.53	54	215.32	214.83	214.99	214.92	
55	216.81	215.50	214.11	214.53	55	215.34	214.93	215.06	214.92	
56	216.77	215.45	214.12	214.53	56	215.34	214.87	215.01	214.91	
57	216.76	215.39	214.12	214.53	57	215.34	214.84	214.99	214.93	
58	216.66	215.38	214.12	214.53	58	215.34	214.83	214.99	214.92	
59	216.76	215.36	214.12	214.53	59	215.34	214.83	214.98	214.91	
60	216.73	215.35	214.12	214.53	60	215.35	214.82	214.98	214.92	

Appendix C
Step Test Results
Shepley's Hill Landfill
Former Fort Devens Army Installation
Devens, Massachusetts

Step 2 - 4 SCFM Shallow - 9/29/2022

Dissolved Oxygen									
Time min	MW-21-1S mg/L	MW-21-2S mg/L	MW-21-3S mg/L	MW-21-4S mg/L	Time min	MW-21-1D mg/L	MW-21-2D mg/L	MW-21-3D mg/L	MW-21-4D mg/L
0	19.10	0.11	0.06	0.00	0	0.06	0.00	0.00	0.00
1	19.12	0.10	0.05	0.00	1	0.06	0.00	0.00	0.00
2	19.08	0.09	0.05	0.00	2	0.06	0.00	0.00	0.00
3	19.06	0.09	0.05	0.00	3	0.06	0.00	0.00	0.00
4	18.90	0.08	0.05	0.00	4	0.06	0.00	0.00	0.00
5	18.79	0.06	0.05	0.00	5	0.06	0.00	0.00	0.00
6	19.09	0.06	0.05	0.00	6	0.06	0.00	0.00	0.00
7	19.42	0.05	0.05	0.00	7	0.06	0.00	0.00	0.00
8	19.77	0.05	0.05	0.00	8	0.06	0.00	0.00	0.00
9	20.38	0.05	0.05	0.00	9	0.06	0.00	0.00	0.00
10	20.90	0.06	0.05	0.00	10	0.06	0.00	0.00	0.00
11	21.31	0.06	0.05	0.00	11	0.06	0.00	0.00	0.00
12	21.67	0.06	0.05	0.00	12	0.06	0.00	0.00	0.00
13	21.94	0.10	0.05	0.00	13	0.06	0.00	0.00	0.00
14	22.14	0.10	0.05	0.00	14	0.06	0.00	0.00	0.00
15	22.25	0.08	0.05	0.00	15	0.06	0.00	0.00	0.00
16	22.42	0.07	0.05	0.00	16	0.05	0.00	0.00	0.00
17	22.53	0.06	0.05	0.00	17	0.05	0.00	0.00	0.00
18	22.51	0.06	0.05	0.00	18	0.05	0.00	0.00	0.00
19	22.57	0.06	0.05	0.00	19	0.05	0.00	0.00	0.00
20	22.69	0.06	0.05	0.00	20	0.05	0.00	0.00	0.00
21	22.77	0.06	0.05	0.00	21	0.05	0.00	0.00	0.00
22	22.87	0.06	0.05	0.00	22	0.05	0.00	0.00	0.00
23	22.91	0.06	0.05	0.00	23	0.05	0.00	0.00	0.00
24	23.01	0.06	0.05	0.00	24	0.05	0.00	0.00	0.00
25	22.93	0.06	0.05	0.00	25	0.05	0.00	0.00	0.00
26	23.05	0.07	0.05	0.00	26	0.05	0.00	0.00	0.00
27	23.03	0.09	0.05	0.00	27	0.04	0.00	0.00	0.00
28	23.12	0.09	0.05	0.00	28	0.04	0.00	0.00	0.00
29	23.12	0.09	0.05	0.00	29	0.04	0.00	0.00	0.00
30	23.14	0.09	0.05	0.00	30	0.04	0.00	0.00	0.00
31	23.19	0.08	0.05	0.00	31	0.04	0.00	0.00	0.00
32	23.21	0.08	0.05	0.00	32	0.04	0.00	0.00	0.00
33	23.17	0.07	0.05	0.00	33	0.04	0.00	0.00	0.00
34	23.19	0.07	0.05	0.00	34	0.04	0.00	0.00	0.00
35	23.08	0.07	0.05	0.00	35	0.03	0.00	0.00	0.00
36	23.23	0.07	0.05	0.00	36	0.03	0.00	0.00	0.00
37	23.50	0.06	0.05	0.00	37	0.03	0.00	0.00	0.00
38	23.47	0.06	0.05	0.00	38	0.02	0.00	0.00	0.00
39	23.62	0.08	0.05	0.00	39	0.02	0.00	0.00	0.00
40	23.53	0.06	0.05	0.00	40	0.02	0.00	0.00	0.00
41	23.60	0.09	0.05	0.00	41	0.01	0.00	0.00	0.00
42	23.62	0.10	0.05	0.00	42	0.01	0.00	0.00	0.00
43	23.68	0.09	0.05	0.00	43	0.01	0.00	0.00	0.00
44	23.59	0.08	0.05	0.00	44	0.00	0.00	0.00	0.00
45	23.64	0.07	0.05	0.00	45	0.00	0.00	0.00	0.00
46	23.67	0.06	0.05	0.00	46	0.00	0.00	0.00	0.00
47	23.70	0.05	0.05	0.00	47	0.00	0.00	0.00	0.00
48	23.78	0.05	0.05	0.00	48	0.00	0.00	0.00	0.00
49	23.65	0.05	0.05	0.00	49	0.00	0.00	0.00	0.00
50	23.53	0.05	0.05	0.00	50	0.00	0.00	0.00	0.00
51	23.53	0.05	0.05	0.00	51	0.00	0.00	0.00	0.00
52	23.10	0.04	0.05	0.00	52	0.00	0.00	0.00	0.00
53	21.44	0.04	0.05	0.00	53	0.00	0.00	0.00	0.00
54	21.47	0.04	0.05	0.00	54	0.00	0.00	0.00	0.00
55	22.00	0.04	0.05	0.00	55	0.00	0.00	0.00	0.00
56	22.41	0.06	0.05	0.00	56	0.00	0.00	0.00	0.00
57	22.67	0.06	0.05	0.00	57	0.00	0.00	0.00	0.00
58	22.79	0.06	0.05	0.00	58	0.00	0.00	0.00	0.00
59	22.93	0.06	0.05	0.00	59	0.00	0.00	0.00	0.00
60	22.96	0.05	0.05	0.00	60	0.00	0.00	0.00	0.00

Step 3 -8 SCFM Shallow - 9/30/2022

Time min	Elevation									
	MW-21-1S ft amsl	MW-21-2S ft amsl	MW-21-3S ft amsl	MW-21-4S ft amsl	Time min	MW-21-1D ft amsl	MW-21-2D ft amsl	MW-21-3D ft amsl	MW-21-4D ft amsl	
0	214.95	215.02	214.58	214.53	0	215.27	214.70	214.58	214.57	
1	214.96	215.15	214.51	214.53	1	215.27	214.79	214.69	214.58	
2	216.42	215.29	214.40	214.53	2	215.43	214.82	214.78	214.65	
3	218.16	215.60	214.24	214.53	3	215.48	214.99	214.99	214.72	
4	220.35	215.91	214.04	214.53	4	215.68	215.09	215.17	214.83	
5	221.53	216.05	213.90	214.53	5	215.81	215.20	215.30	214.94	
6	221.97	216.12	213.80	214.53	6	215.90	215.28	215.35	215.02	
7	221.86	216.18	213.73	214.53	7	215.95	215.36	215.41	215.07	
8	221.83	216.23	213.67	214.53	8	216.02	215.45	215.46	215.12	
9	221.80	216.26	213.62	214.53	9	216.07	215.49	215.50	215.16	
10	221.64	216.29	213.58	214.53	10	216.10	215.53	215.52	215.20	
11	221.50	216.32	213.53	214.53	11	216.13	215.57	215.56	215.22	
12	221.27	216.33	213.49	214.53	12	216.16	215.62	215.59	215.26	
13	220.99	216.36	213.47	214.53	13	216.18	215.64	215.60	215.27	
14	220.86	216.38	213.44	214.53	14	216.23	215.67	215.64	215.30	
15	220.75	216.41	213.40	214.53	15	216.26	215.70	215.67	215.32	
16	220.67	216.43	213.39	214.53	16	216.29	215.73	215.68	215.35	
17	220.58	216.45	213.35	214.53	17	216.32	215.75	215.70	215.36	
18	220.51	216.47	213.32	214.53	18	216.33	215.77	215.73	215.39	
19	220.46	216.50	213.28	214.53	19	216.36	215.79	215.75	215.40	
20	220.38	216.51	213.26	214.53	20	216.38	215.80	215.77	215.42	
21	220.30	216.53	213.24	214.53	21	216.38	215.82	215.78	215.43	
22	220.25	216.55	213.22	214.53	22	216.42	215.83	215.80	215.46	
23	220.20	216.56	213.19	214.53	23	216.43	215.86	215.81	215.47	
24	220.15	216.56	213.18	214.53	24	216.45	215.86	215.82	215.48	
25	220.09	216.57	213.15	214.53	25	216.45	215.88	215.83	215.48	
26	220.05	216.58	213.15	214.53	26	216.48	215.88	215.83	215.50	
27	219.98	216.59	213.13	214.53	27	216.48	215.89	215.84	215.50	
28	219.92	216.59	213.11	214.53	28	216.48	215.90	215.85	215.52	
29	219.88	216.60	213.11	214.53	29	216.49	215.91	215.86	215.52	
30	219.84	216.60	213.08	214.53	30	216.50	215.93	215.87	215.53	
31	219.78	216.60	213.07	214.53	31	216.50	215.94	215.87	215.53	
32	219.74	216.61	213.07	214.53	32	216.50	215.95	215.88	215.54	
33	219.69	216.58	213.07	214.53	33	216.52	215.92	215.86	215.55	
34	219.38	216.54	213.07	214.53	34	216.50	215.92	215.85	215.54	
35	219.19	216.52	213.08	214.53	35	216.48	215.91	215.83	215.54	
36	219.07	216.50	213.08	214.53	36	216.47	215.90	215.82	215.54	
37	218.97	216.48	213.08	214.53	37	216.46	215.90	215.81	215.54	
38	218.90	216.48	213.10	214.53	38	216.46	215.89	215.82	215.52	
39	218.83	216.47	213.09	214.53	39	216.45	215.89	215.80	215.52	
40	218.78	216.46	213.09	214.53	40	216.44	215.89	215.79	215.53	
41	218.74	216.45	213.09	214.53	41	216.45	215.88	215.80	215.53	
42	218.68	216.44	213.09	214.53	42	216.44	215.87	215.79	215.52	
43	218.65	216.44	213.08	214.53	43	216.44	215.87	215.79	215.52	
44	218.61	216.43	213.07	214.53	44	216.45	215.87	215.78	215.51	
45	218.58	216.42	213.07	214.53	45	216.45	215.87	215.80	215.51	
46	218.54	216.41	213.07	214.53	46	216.44	215.87	215.79	215.51	
47	218.51	216.42	213.08	214.53	47	216.43	215.87	215.78	215.51	
48	218.48	216.39	213.09	214.53	48	216.43	215.86	215.78	215.51	
49	218.44	216.39	213.08	214.53	49	216.43	215.88	215.78	215.52	
50	218.40	216.38	213.08	214.53	50	216.43	215.87	215.79	215.52	
51	218.39	216.37	213.08	214.53	51	216.43	215.87	215.78	215.52	
52	218.36	216.36	213.08	214.53	52	216.44	215.87	215.78	215.51	
53	218.34	216.36	213.08	214.53	53	216.44	215.88	215.79	215.52	
54	218.30	216.36	213.09	214.53	54	216.42	215.87	215.78	215.51	
55	218.28	216.36	213.09	214.53	55	216.43	215.87	215.77	215.51	
56	218.25	216.35	213.08	214.53	56	216.43	215.87	215.77	215.51	
57	218.22	216.34	213.08	214.53	57	216.43	215.87	215.77	215.50	
58	218.21	216.34	213.09	214.53	58	216.42	215.87	215.77	215.51	
59	218.16	216.34	213.09	214.53	59	216.41	215.87	215.77	215.51	
60	218.16	216.34	213.10	214.53	60	216.41	215.87	215.76	215.50	
61	216.82	216.33	213.10	214.53	61	216.43	215.86	215.75	215.50	
62	218.48	216.31	213.11	214.53	62	216.41	215.86	215.75	215.51	
63	218.21	216.31	213.09	214.53	63	216.41	215.86	215.74	215.51	
64	218.21	216.30	213.13	214.53	64	216.41	215.84</td			

Step 3 -8 SCFM Shallow - 9/30/2022

Dissolved Oxygen									
Time min	MW-21-1S mg/L	MW-21-2S mg/L	MW-21-3S mg/L	MW-21-4S mg/L	Time min	MW-21-1D mg/L	MW-21-2D mg/L	MW-21-3D mg/L	MW-21-4D mg/L
0	11.70	0.00	0.91	0.00	0	0.00	0.00	0.00	0.00
1	11.70	0.00	0.91	0.00	1	0.00	0.00	0.00	0.00
2	11.70	0.00	0.90	0.00	2	0.00	0.00	0.00	0.00
3	11.73	0.00	0.90	0.00	3	0.00	0.00	0.00	0.00
4	12.29	0.00	0.90	0.00	4	0.00	0.00	0.00	0.00
5	12.73	0.00	0.89	0.00	5	0.00	0.00	0.00	0.00
6	12.74	0.00	0.89	0.00	6	0.00	0.00	0.00	0.00
7	12.74	0.00	0.89	0.00	7	0.00	0.00	0.00	0.00
8	12.60	0.00	0.90	0.00	8	0.00	0.00	0.00	0.00
9	12.58	0.00	0.91	0.00	9	0.00	0.00	0.00	0.00
10	12.52	0.00	0.93	0.00	10	0.00	0.00	0.00	0.00
11	12.40	0.00	0.94	0.00	11	0.00	0.00	0.00	0.00
12	12.25	0.00	0.95	0.00	12	0.00	0.00	0.00	0.00
13	12.26	0.00	0.96	0.00	13	0.00	0.00	0.00	0.00
14	12.56	0.00	0.97	0.00	14	0.00	0.00	0.00	0.00
15	13.21	0.00	0.98	0.00	15	0.00	0.00	0.00	0.00
16	14.49	0.00	0.99	0.00	16	0.00	0.00	0.00	0.00
17	15.52	0.00	1.00	0.00	17	0.00	0.00	0.00	0.00
18	16.94	0.00	1.01	0.00	18	0.00	0.00	0.00	0.00
19	18.27	0.00	1.00	0.00	19	0.00	0.00	0.00	0.00
20	19.64	0.00	0.95	0.00	20	0.00	0.00	0.00	0.00
21	20.45	0.00	0.87	0.00	21	0.00	0.00	0.00	0.00
22	21.06	0.00	0.78	0.00	22	0.00	0.00	0.00	0.00
23	21.41	0.00	0.71	0.00	23	0.00	0.00	0.00	0.00
24	21.36	0.00	0.65	0.00	24	0.00	0.00	0.00	0.00
25	21.37	0.00	0.59	0.00	25	0.00	0.00	0.00	0.00
26	20.86	0.00	0.53	0.00	26	0.00	0.00	0.00	0.00
27	20.26	0.00	0.48	0.00	27	0.00	0.00	0.00	0.00
28	19.64	0.00	0.42	0.00	28	0.00	0.00	0.00	0.00
29	19.36	0.00	0.37	0.00	29	0.00	0.00	0.00	0.00
30	19.33	0.00	0.32	0.00	30	0.00	0.00	0.00	0.00
31	19.33	0.00	0.27	0.00	31	0.00	0.00	0.00	0.00
32	19.44	0.00	0.24	0.00	32	0.00	0.00	0.00	0.00
33	19.56	0.00	0.21	0.00	33	0.00	0.00	0.00	0.00
34	19.60	0.00	0.19	0.00	34	0.00	0.00	0.00	0.00
35	19.81	0.00	0.17	0.00	35	0.00	0.00	0.00	0.00
36	19.98	0.00	0.16	0.00	36	0.00	0.00	0.00	0.00
37	20.09	0.00	0.15	0.00	37	0.00	0.00	0.00	0.00
38	20.29	0.00	0.14	0.00	38	0.00	0.00	0.00	0.00
39	20.41	0.00	0.14	0.00	39	0.00	0.00	0.00	0.00
40	20.62	0.00	0.15	0.00	40	0.00	0.00	0.00	0.00
41	20.77	0.00	0.15	0.00	41	0.00	0.00	0.00	0.00
42	20.83	0.00	0.15	0.00	42	0.00	0.00	0.00	0.00
43	20.93	0.00	0.14	0.00	43	0.00	0.00	0.00	0.00
44	20.99	0.00	0.14	0.00	44	0.00	0.00	0.00	0.00
45	21.11	0.00	0.14	0.00	45	0.00	0.00	0.00	0.00
46	21.13	0.00	0.13	0.00	46	0.00	0.00	0.00	0.00
47	21.14	0.00	0.14	0.00	47	0.00	0.00	0.00	0.00
48	21.22	0.00	0.14	0.00	48	0.00	0.00	0.00	0.00
49	21.24	0.00	0.14	0.00	49	0.00	0.00	0.00	0.00
50	21.25	0.00	0.14	0.00	50	0.00	0.00	0.00	0.00
51	21.30	0.00	0.15	0.00	51	0.00	0.00	0.00	0.00
52	21.28	0.00	0.14	0.00	52	0.00	0.00	0.00	0.00
53	21.27	0.00	0.14	0.00	53	0.00	0.00	0.00	0.00
54	21.35	0.00	0.15	0.00	54	0.00	0.00	0.00	0.00
55	21.36	0.00	0.15	0.00	55	0.00	0.00	0.00	0.00
56	21.35	0.00	0.15	0.00	56	0.00	0.00	0.00	0.00
57	21.35	0.00	0.16	0.00	57	0.00	0.00	0.00	0.00
58	21.38	0.00	0.17	0.00	58	0.00	0.00	0.00	0.00
59	21.37	0.00	0.17	0.00	59	0.00	0.00	0.00	0.00
60	21.38	0.00	0.17	0.00	60	0.00	0.00	0.00	0.00
61	21.37	0.00	0.17	0.00	61	0.00	0.00	0.00	0.00
62	21.13	0.00	0.17	0.00	62	0.00	0.00	0.00	0.00
63	21.27	0.00	0.16	0.00	63	0.00	0.00	0.00	0.00
64	21.26	0.00	0.17	0.00	64	0.00	0.00	0.00	0.00
65	21.21	0.00	0.18	0.00	65	0.00	0.00	0.00	0.00
66	21.19	0.00	0.18	0.00	66	0.00	0.00	0.00	0.00
67	21.15	0.02	0.19	0.00	67	0.00	0.00	0.00	0.00
68	21.15	0.15	0.19	0.00	68	0.00	0.00	0.00	0.00
69	21.16	0.39	0.22	0.00	69	0.00	0.00	0.00	0.00
70	21.14	0.46	0.28	0.00	70	0.00	0.00	0.00	0.00
71	21.12	0.49	0.38	0.00	71	0.00	0.00	0.00	0.00
72	21.15	0.57	0.54	0.00	72	0.00	0.00	0.00	0.00
73	21.16	0.70	0.73	0.00	73	0.00	0.00	0.00	0.00
74	21.15	1.14	1.07	0.00	74	0.00	0.00	0.00	0.00
75	21.12	2.52	1.56	0.00	75	0.00	0.00	0.00	0.00

Step 4 - 2 SCFM Deep - 9/29/2022

Time min	Elevation									
	MW-21-1S ft amsl	MW-21-2S ft amsl	MW-21-3S ft amsl	MW-21-4S ft amsl	Time min	MW-21-1D ft amsl	MW-21-2D ft amsl	MW-21-3D ft amsl	MW-21-4D ft amsl	
0	216.69	215.35	214.13	214.53	0	215.35	214.81	214.97	214.93	
1	216.01	215.36	214.18	214.53	1	215.35	214.79	214.98	214.92	
2	214.92	215.25	214.17	214.53	2	215.23	214.75	214.90	214.87	
3	214.50	215.22	214.17	214.53	3	215.11	214.76	214.88	214.83	
4	214.18	215.20	214.17	214.53	4	215.17	214.77	214.87	214.83	
5	213.90	215.23	214.17	214.53	5	215.25	214.75	214.88	214.84	
6	213.66	215.24	214.16	214.53	6	215.22	214.76	214.90	214.84	
7	213.43	215.25	214.16	214.53	7	215.26	214.76	214.90	214.85	
8	213.26	215.26	214.17	214.53	8	215.30	214.76	214.93	214.85	
9	213.17	215.26	214.17	214.53	9	215.34	214.76	214.92	214.86	
10	213.09	215.26	214.11	214.53	10	215.29	214.75	214.91	214.84	
11	213.08	215.29	214.11	214.53	11	215.29	214.80	214.96	214.84	
12	212.99	215.32	214.10	214.53	12	215.55	214.84	214.99	214.90	
13	213.15	215.40	214.09	214.53	13	215.55	214.84	215.04	214.92	
14	213.17	215.42	214.10	214.53	14	215.57	214.86	215.07	214.94	
15	213.20	215.46	214.10	214.53	15	215.57	214.88	215.10	214.96	
16	213.23	215.48	214.10	214.53	16	215.57	214.89	215.12	214.95	
17	213.23	215.49	214.10	214.53	17	215.56	214.90	215.11	214.95	
18	213.28	215.48	214.10	214.53	18	215.56	215.04	215.12	214.96	
19	213.28	215.61	214.11	214.53	19	215.55	215.02	215.11	214.96	
20	213.32	215.52	214.10	214.53	20	215.55	214.99	215.12	214.95	
21	213.35	215.49	214.12	214.53	21	215.54	214.97	215.27	214.95	
22	213.38	215.49	213.65	214.53	22	215.53	214.96	215.10	214.93	
23	213.41	215.48	214.01	214.53	23	215.51	214.94	215.09	214.92	
24	213.49	215.48	214.02	214.53	24	215.52	214.93	215.09	214.92	
25	213.54	215.47	214.01	214.53	25	215.50	214.91	215.08	214.92	
26	213.63	215.47	214.02	214.53	26	215.48	214.89	215.07	214.92	
27	213.68	215.46	214.03	214.53	27	215.49	214.89	215.07	214.91	
28	213.72	215.44	214.02	214.53	28	215.48	214.88	215.05	214.89	
29	213.74	215.45	214.03	214.53	29	215.46	214.88	215.05	214.90	
30	213.61	215.44	214.03	214.53	30	215.45	214.87	215.05	214.89	
31	213.84	215.43	214.03	214.53	31	215.45	214.86	215.04	214.88	
32	213.86	215.43	214.02	214.53	32	215.45	214.85	215.04	214.88	
33	213.88	215.44	214.04	214.53	33	215.43	214.86	215.04	214.89	
34	213.91	215.43	214.02	214.53	34	215.43	214.86	215.04	214.89	
35	213.93	215.43	214.02	214.53	35	215.43	214.85	215.05	214.89	
36	213.94	215.41	214.04	214.53	36	215.42	214.85	215.03	214.89	
37	213.96	215.43	214.03	214.53	37	215.42	214.84	215.02	214.88	
38	213.98	215.42	214.04	214.53	38	215.42	214.84	215.03	214.88	
39	214.01	215.41	214.04	214.53	39	215.40	214.82	215.02	214.88	
40	214.03	215.40	214.05	214.53	40	215.41	214.84	215.01	214.86	
41	214.05	215.41	214.05	214.53	41	215.40	214.82	215.01	214.87	
42	214.06	215.40	214.05	214.53	42	215.39	214.82	215.00	214.87	
43	214.08	215.39	214.05	214.53	43	215.39	214.82	215.00	214.85	
44	214.11	215.40	214.05	214.53	44	215.38	214.82	214.99	214.85	
45	214.13	215.39	214.04	214.53	45	215.40	214.82	214.99	214.85	
46	214.14	215.39	214.04	214.53	46	215.39	215.06	214.98	214.86	
47	214.16	215.39	214.06	214.53	47	215.37	214.92	214.99	214.86	
48	214.19	215.36	214.07	214.53	48	215.37	214.89	214.99	214.86	
49	214.20	215.41	214.07	214.53	49	215.38	214.85	214.98	214.86	
50	214.22	215.40	213.85	214.53	50	215.37	214.85	215.19	214.85	
51	214.22	215.40	214.09	214.53	51	215.37	214.83	215.05	214.86	
52	214.25	215.39	214.09	214.53	52	215.37	214.83	215.01	214.85	
53	214.28	215.43	214.08	214.53	53	215.50	214.84	215.03	214.88	
54	214.31	215.46	214.05	214.53	54	215.55	214.85	215.06	214.91	
55	214.35	215.50	214.05	214.53	55	215.58	214.86	215.09	214.92	
56	214.20	215.50	214.04	214.53	56	215.58	214.88	215.11	214.92	
57	214.44	215.51	214.04	214.53	57	215.59	214.88	215.12	214.94	
58	214.46	215.51	214.03	214.53	58	215.59	214.89	215.12	214.93	
59	214.46	215.52	214.02	214.53	59	215.59	214.88	215.11	214.93	
60	214.49	215.52	214.04	214.53	60	215.60	214.89	215.12	214.93	
61	214.51	215.52	214.01	214.53	61	215.60	214.89	215.13	214.94	
62	214.51	215.53	214.02	214.53	62	215.61	214.90	215.13	214.94	
63	214.54	215.52	214.02	214.53	63	215.60	214.90	215.13	214.95	
64	214.56	215.53	214.01	214.53	64	215.61	214.90</td			

Step 4 - 2 SCFM Deep -9/29/2022

Dissolved Oxygen									
Time min	MW-21-1S mg/L	MW-21-2S mg/L	MW-21-3S mg/L	MW-21-4S mg/L	Time min	MW-21-1D mg/L	MW-21-2D mg/L	MW-21-3D mg/L	MW-21-4D mg/L
0	23.07	0.05	0.05	0.00	0	0.00	0.00	0.00	0.00
1	23.21	0.05	0.05	0.00	1	0.00	0.00	0.00	0.00
2	23.12	0.04	0.05	0.00	2	0.00	0.00	0.00	0.00
3	23.05	0.05	0.05	0.00	3	0.00	0.00	0.00	0.00
4	22.91	0.05	0.05	0.00	4	0.03	0.00	0.00	0.00
5	22.71	0.04	0.04	0.00	5	0.10	0.00	0.00	0.00
6	22.16	0.04	0.04	0.00	6	0.07	0.00	0.00	0.00
7	21.78	0.04	0.04	0.00	7	0.04	0.00	0.00	0.00
8	20.36	0.04	0.04	0.00	8	0.03	0.00	0.00	0.00
9	20.08	0.04	0.04	0.00	9	0.03	0.00	0.00	0.00
10	19.44	0.04	0.04	0.00	10	0.03	0.00	0.00	0.00
11	18.63	0.04	0.04	0.00	11	0.02	0.00	0.00	0.00
12	18.33	0.04	0.04	0.00	12	0.02	0.01	0.00	0.00
13	17.44	0.05	0.04	0.00	13	0.00	0.01	0.00	0.00
14	16.86	0.05	0.04	0.00	14	0.00	0.00	0.00	0.00
15	14.19	0.05	0.04	0.00	15	0.00	0.00	0.00	0.00
16	13.14	0.05	0.04	0.00	16	0.00	0.00	0.00	0.00
17	14.40	0.05	0.04	0.00	17	0.00	0.00	0.00	0.00
18	14.61	0.05	0.04	0.00	18	0.00	0.00	0.00	0.00
19	15.00	0.05	0.04	0.00	19	0.00	0.00	0.00	0.00
20	15.03	0.06	0.04	0.00	20	0.00	0.00	0.00	0.00
21	14.69	0.05	0.04	0.00	21	0.00	0.00	0.00	0.00
22	13.87	0.05	0.04	0.00	22	0.00	0.00	0.00	0.00
23	13.41	0.04	0.04	0.00	23	0.00	0.00	0.00	0.00
24	13.15	0.04	0.04	0.00	24	0.00	0.00	0.00	0.00
25	12.68	0.03	0.04	0.00	25	0.00	0.00	0.00	0.00
26	13.21	0.03	0.05	0.00	26	0.00	0.00	0.00	0.00
27	12.55	0.02	0.04	0.00	27	0.00	0.00	0.00	0.00
28	12.33	0.02	0.04	0.00	28	0.00	0.00	0.00	0.00
29	11.84	0.01	0.05	0.00	29	0.00	0.00	0.00	0.00
30	11.68	0.01	0.05	0.00	30	0.00	0.00	0.00	0.00
31	11.93	0.01	0.05	0.00	31	0.00	0.00	0.00	0.00
32	12.01	0.01	0.05	0.00	32	0.00	0.00	0.00	0.00
33	11.61	0.02	0.05	0.00	33	0.00	0.00	0.00	0.00
34	11.48	0.02	0.05	0.00	34	0.00	0.00	0.00	0.00
35	11.21	0.03	0.05	0.00	35	0.00	0.00	0.00	0.00
36	10.86	0.03	0.05	0.00	36	0.00	0.00	0.00	0.00
37	11.04	0.03	0.05	0.00	37	0.00	0.00	0.00	0.00
38	10.57	0.03	0.05	0.00	38	0.00	0.00	0.00	0.00
39	10.47	0.03	0.05	0.00	39	0.00	0.00	0.00	0.00
40	10.09	0.03	0.05	0.00	40	0.00	0.00	0.00	0.00
41	10.01	0.02	0.05	0.00	41	0.00	0.00	0.00	0.00
42	10.28	0.02	0.04	0.00	42	0.00	0.00	0.00	0.00
43	10.36	0.02	0.04	0.00	43	0.00	0.00	0.00	0.00
44	9.56	0.02	0.04	0.00	44	0.00	0.00	0.00	0.00
45	9.74	0.02	0.04	0.00	45	0.00	0.00	0.00	0.00
46	9.49	0.02	0.04	0.00	46	0.00	0.00	0.00	0.00
47	9.61	0.01	0.04	0.00	47	0.00	0.00	0.00	0.00
48	9.47	0.01	0.04	0.00	48	0.00	0.00	0.00	0.00
49	9.49	0.02	0.04	0.00	49	0.00	0.00	0.00	0.00
50	9.57	0.02	0.04	0.00	50	0.00	0.00	0.00	0.00
51	9.31	0.01	0.04	0.00	51	0.00	0.00	0.00	0.00
52	9.29	0.01	0.04	0.00	52	0.00	0.00	0.00	0.00
53	9.10	0.01	0.04	0.00	53	0.00	0.00	0.00	0.00
54	8.84	0.01	0.04	0.00	54	0.00	0.00	0.00	0.00
55	8.60	0.01	0.04	0.00	55	0.00	0.00	0.00	0.00
56	8.42	0.01	0.05	0.00	56	0.00	0.00	0.00	0.00
57	8.42	0.01	0.04	0.00	57	0.00	0.00	0.00	0.00
58	8.13	0.01	0.04	0.00	58	0.00	0.00	0.00	0.00
59	8.03	0.01	0.04	0.00	59	0.00	0.00	0.00	0.00
60	7.92	0.01	0.05	0.00	60	0.00	0.00	0.00	0.00
61	7.66	0.01	0.05	0.00	61	0.00	0.00	0.00	0.00
62	7.33	0.01	0.04	0.00	62	0.00	0.01	0.00	0.00
63	7.36	0.04	0.05	0.00	63	0.00	0.01	0.00	0.00
64	7.24	0.01	0.05	0.00	64	0.00	0.01	0.00	0.00
65	7.26	0.01	0.05	0.00	65	0.00	0.01	0.00	0.00
66	7.15	0.01	0.05	0.00	66	0.00	0.01	0.00	0.00
67	7.12	0.01	0.05	0.00	67	0.00	0.02	0.00	0.00
68	7.48	0.00	0.05	0.00	68	0.00	0.02	0.00	0.00
69	7.92	0.00	0.05	0.00	69	0.00	0.02	0.00	0.00
70	7.76	0.01	0.05	0.00	70	0.00	0.02	0.00	0.00
71	7.38	0.01	0.05	0.00	71	0.00	0.02	0.00	0.00
72	7.07	0.01	0.05	0.00	72	0.00	0.02	0.00	0.00
73	7.38	0.01	0.06	0.00	73	0.00	0.02	0.00	0.00
74	6.72	0.00	0.06	0.00	74	0.00	0.02	0.00	0.00
75	6.79	0.00	0.06	0.00	75	0.00	0.02	0.00	0.00
76	7.07	0.00	0.						

Step 5 - 4 SCFM Deep - 9/29/2022

Time min	Elevation									
	MW-21-1S ft amsl	MW-21-2S ft amsl	MW-21-3S ft amsl	MW-21-4S ft amsl	Time min	MW-21-1D ft amsl	MW-21-2D ft amsl	MW-21-3D ft amsl	MW-21-4D ft amsl	
0	214.88	215.53	213.94	214.53	0	215.61	214.92	215.14	214.95	
1	214.87	215.53	213.95	214.53	1	215.60	214.98	215.14	214.94	
2	214.91	215.65	213.89	214.53	2	215.76	215.03	215.24	215.00	
3	214.95	215.77	213.83	214.53	3	215.91	215.08	215.32	215.08	
4	215.00	215.83	213.75	214.53	4	216.00	215.14	215.38	215.13	
5	215.05	215.88	213.70	214.53	5	216.07	215.20	215.45	215.16	
6	215.09	215.93	213.64	214.53	6	216.13	215.24	215.50	215.19	
7	215.14	215.97	213.60	214.53	7	216.17	215.27	215.53	215.22	
8	215.17	215.99	213.57	214.53	8	216.18	215.31	215.57	215.23	
9	215.20	216.00	213.53	214.53	9	216.20	215.32	215.58	215.25	
10	215.23	216.02	213.51	214.53	10	216.20	215.34	215.61	215.26	
11	215.25	216.03	213.49	214.53	11	216.22	215.36	215.62	215.28	
12	215.28	216.03	213.47	214.53	12	216.22	215.37	215.62	215.27	
13	215.30	216.05	213.46	214.53	13	216.22	215.37	215.63	215.28	
14	215.32	216.04	213.45	214.53	14	216.22	215.38	215.64	215.28	
15	215.34	216.04	213.45	214.53	15	216.23	215.38	215.64	215.28	
16	215.36	216.05	213.45	214.53	16	216.24	215.39	215.64	215.30	
17	215.37	216.05	213.45	214.53	17	216.24	215.39	215.65	215.29	
18	215.39	216.05	213.45	214.53	18	216.23	215.41	215.64	215.29	
19	215.40	216.06	213.44	214.53	19	216.23	215.41	215.64	215.30	
20	215.42	216.06	213.43	214.53	20	216.25	215.40	215.64	215.30	
21	215.42	216.06	213.45	214.53	21	216.23	215.41	215.65	215.30	
22	215.44	216.05	213.45	214.53	22	216.24	215.41	215.65	215.30	
23	215.45	216.07	213.46	214.53	23	216.21	215.40	215.65	215.29	
24	215.46	216.04	213.47	214.53	24	216.16	215.39	215.63	215.28	
25	215.45	216.04	213.49	214.53	25	216.16	215.38	215.61	215.28	
26	215.45	216.03	213.51	214.53	26	216.13	215.37	215.60	215.28	
27	215.45	216.02	213.50	214.53	27	216.13	215.37	215.60	215.28	
28	215.46	216.01	213.53	214.53	28	216.13	215.36	215.58	215.26	
29	215.46	216.00	213.53	214.53	29	216.12	215.35	215.59	215.25	
30	215.47	216.00	213.53	214.53	30	216.11	215.35	215.58	215.26	
31	215.47	215.99	213.54	214.53	31	216.11	215.35	215.58	215.25	
32	215.49	215.99	213.54	214.53	32	216.11	215.34	215.57	215.25	
33	215.49	216.00	213.55	214.53	33	216.11	215.34	215.56	215.25	
34	215.49	215.99	213.55	214.53	34	216.10	215.34	215.57	215.26	
35	215.51	215.99	213.55	214.53	35	216.10	215.33	215.57	215.25	
36	215.52	216.00	213.56	214.53	36	216.11	215.34	215.56	215.26	
37	215.51	215.99	213.56	214.53	37	216.10	215.33	215.57	215.26	
38	215.53	215.99	213.55	214.53	38	216.11	215.34	215.57	215.26	
39	215.54	215.99	213.55	214.53	39	216.11	215.34	215.57	215.27	
40	215.54	215.99	213.55	214.53	40	216.12	215.34	215.57	215.26	
41	215.54	216.00	213.55	214.53	41	216.12	215.34	215.57	215.28	
42	215.55	216.00	213.55	214.53	42	216.12	215.33	215.57	215.27	
43	215.54	216.00	213.55	214.53	43	216.11	215.33	215.57	215.27	
44	215.55	216.00	213.56	214.53	44	216.12	215.34	215.57	215.27	
45	215.56	215.97	213.55	214.53	45	216.12	215.33	215.57	215.27	
46	215.55	215.98	213.55	214.53	46	216.10	215.34	215.56	215.26	
47	215.55	215.98	213.57	214.53	47	216.11	215.33	215.56	215.26	
48	215.56	215.98	213.55	214.53	48	216.11	215.33	215.56	215.26	
49	215.56	215.97	213.56	214.53	49	216.11	215.33	215.57	215.26	
50	215.56	215.97	213.57	214.53	50	216.11	215.33	215.56	215.27	
51	215.55	215.97	213.56	214.53	51	216.11	215.34	215.56	215.26	
52	215.57	215.98	213.56	214.53	52	216.11	215.33	215.57	215.26	
53	215.57	215.98	213.57	214.53	53	216.10	215.33	215.57	215.27	

Step 5 - 4 SCFM Deep - 9/29/2022

Dissolved Oxygen									
Time min	MW-21-1S mg/L	MW-21-2S mg/L	MW-21-3S mg/L	MW-21-4S mg/L	Time min	MW-21-1D mg/L	MW-21-2D mg/L	MW-21-3D mg/L	MW-21-4D mg/L
0	6.68	0.00	0.06	0.00	0	0.00	0.01	0.00	0.00
1	7.57	0.00	0.06	0.00	1	0.00	0.01	0.00	0.00
2	8.33	0.00	0.06	0.00	2	0.00	0.01	0.00	0.00
3	7.03	0.00	0.06	0.00	3	0.00	0.01	0.00	0.00
4	6.55	0.00	0.06	0.00	4	0.00	0.01	0.00	0.00
5	6.05	0.00	0.05	0.00	5	0.00	0.01	0.00	0.00
6	5.59	0.00	0.05	0.00	6	0.00	0.01	0.00	0.00
7	5.25	0.00	0.05	0.00	7	0.00	0.01	0.00	0.00
8	5.07	0.00	0.05	0.00	8	0.00	0.01	0.00	0.00
9	5.21	0.00	0.05	0.00	9	0.00	0.02	0.00	0.00
10	5.23	0.00	0.05	0.00	10	0.00	0.02	0.00	0.00
11	5.21	0.00	0.05	0.00	11	0.00	0.02	0.00	0.00
12	5.25		0.05	0.00	12	0.00	0.02	0.00	0.00
13	5.27		0.05	0.00	13	0.00	0.02	0.00	0.00
14	5.49		0.05	0.00	14	0.00	0.02	0.00	0.00
15	5.46		0.05	0.00	15	0.00	0.02	0.00	0.00
16	5.69		0.05	0.00	16	0.00	0.02	0.00	0.00
17	5.83		0.05	0.00	17	0.00	0.02	0.00	0.00
18	5.64		0.05	0.00	18	0.00	0.02	0.00	0.00
19	5.49		0.05	0.00	19	0.00	0.02	0.00	0.00
20	5.21		0.05	0.00	20	0.00	0.01	0.00	0.00
21	4.79		0.05	0.00	21	0.00	0.01	0.00	0.00
22	4.54		0.05	0.00	22	0.00	0.01	0.00	0.00
23	4.47	0.00	0.05	0.00	23	0.00	0.01	0.00	0.00
24	5.04	0.00	0.05	0.00	24	0.00	0.01	0.00	0.00
25	5.34	0.00	0.05	0.00	25	0.00	0.01	0.00	0.00
26	5.58	0.00	0.05	0.00	26	0.00	0.01	0.00	0.00
27	5.76	0.00	0.05	0.00	27	0.00	0.01	0.00	0.00
28	5.89	0.00	0.05	0.00	28	0.00	0.01	0.00	0.00
29	5.94	0.00	0.05	0.00	29	0.00	0.01	0.00	0.00
30	6.05	0.01	0.04	0.00	30	0.00	0.01	0.00	0.00
31	6.18	0.01	0.04	0.00	31	0.00	0.01	0.00	0.00
32	6.34	0.00	0.04	0.00	32	0.00	0.01	0.00	0.00
33	6.47	0.00	0.04	0.00	33	0.00	0.01	0.00	0.00
34	6.40	0.00	0.04	0.00	34	0.00	0.01	0.00	0.00
35	6.53	0.00	0.04	0.00	35	0.00	0.01	0.00	0.00
36	6.60	0.00	0.04	0.00	36	0.00	0.01	0.00	0.00
37	6.81	0.00	0.04	0.00	37	0.00	0.00	0.00	0.00
38	6.93	0.00	0.04	0.00	38	0.00	0.01	0.00	0.00
39	6.92	0.00	0.04	0.00	39	0.00	0.01	0.00	0.00
40	6.82	0.00	0.04	0.00	40	0.00	0.01	0.00	0.00
41	6.82	0.00	0.04	0.00	41	0.00	0.01	0.00	0.00
42	6.81	0.00	0.04	0.00	42	0.00	0.01	0.00	0.00
43	6.74	0.00	0.04	0.00	43	0.00	0.01	0.00	0.00
44	6.69	0.00	0.04	0.00	44	0.00	0.01	0.00	0.00
45	6.70	0.00	0.04	0.00	45	0.00	0.01	0.00	0.00
46	6.61	0.00	0.04	0.00	46	0.00	0.01	0.00	0.00
47	6.16	0.00	0.04	0.00	47	0.00	0.01	0.00	0.00
48	5.72	0.00	0.04	0.00	48	0.00	0.01	0.00	0.00
49	5.42	0.00	0.04	0.00	49	0.00	0.01	0.00	0.00
50	5.33	0.00	0.04	0.00	50	0.00	0.01	0.00	0.00
51	5.21	0.00	0.04	0.00	51	0.00	0.01	0.00	0.00
52	5.09	0.00	0.04	0.00	52	0.00	0.01	0.00	0.00
53	4.98	0.00	0.04	0.00	53	0.00	0.01	0.00	0.00

Appendix C
Step Test Results
Shepley's Hill Landfill
Former Fort Devens Army Installation
Devens, Massachusetts

Step 6 -8 SCFM Deep - 9/29/2022

Time min	Elevation									
	MW-21-1S ft amsl	MW-21-2S ft amsl	MW-21-3S ft amsl	MW-21-4S ft amsl	Time min	MW-21-1D ft amsl	MW-21-2D ft amsl	MW-21-3D ft amsl	MW-21-4D ft amsl	
0	215.57	215.97	213.56	214.53	0	216.12	215.34	215.55	215.27	
1	215.57	215.98	213.57	214.53	1	216.12	215.32	215.57	215.27	
2	215.59	216.00	213.53	214.53	2	216.11	215.45	215.61	215.27	
3	215.67	216.22	213.38	214.53	3	216.52	215.56	215.75	215.40	
4	215.76	216.39	213.24	214.53	4	216.65	215.66	215.89	215.50	
5	215.83	216.52	213.12	214.53	5	216.77	215.74	216.01	215.58	
6	215.88	216.58	213.03	214.53	6	216.83	215.83	216.09	215.62	
7	215.94	216.64	212.96	214.53	7	216.88	215.88	216.16	215.67	
8	215.96	216.67	212.92	214.53	8	216.91	215.92	216.20	215.68	
9	216.00	216.69	212.88	214.53	9	216.92	215.97	216.23	215.70	
10	216.02	216.71	212.86	214.53	10	216.95	215.99	216.25	215.71	
11	216.04	216.72	212.84	214.53	11	216.94	216.00	216.27	215.73	
12	216.06	216.74	212.81	214.53	12	216.95	216.02	216.29	215.74	
13	216.07	216.75	212.81	214.53	13	216.96	216.04	216.30	215.75	
14	216.08	216.75	212.81	214.53	14	216.96	216.04	216.32	215.77	
15	216.10	216.76	212.78	214.53	15	216.96	216.04	216.31	215.77	
16	216.11	216.77	212.77	214.53	16	216.97	216.06	216.33	215.78	
17	216.13	216.78	212.79	214.53	17	216.98	216.07	216.32	215.79	
18	216.11	216.78	212.78	214.53	18	216.98	216.06	216.33	215.79	
19	216.13	216.78	212.77	214.53	19	216.98	216.08	216.34	215.78	
20	216.13	216.78	212.78	214.53	20	216.99	216.07	216.33	215.79	
21	216.14	216.78	212.77	214.53	21	216.98	216.07	216.33	215.78	
22	216.15	216.78	212.77	214.53	22	216.98	216.07	216.34	215.79	
23	216.16	216.79	212.77	214.53	23	216.99	216.06	216.34	215.80	
24	216.14	216.78	212.79	214.53	24	216.98	216.08	216.33	215.79	
25	216.15	216.77	212.78	214.53	25	216.98	216.08	216.31	215.79	
26	216.15	216.78	212.77	214.53	26	216.97	216.08	216.33	215.79	
27	216.15	216.77	212.77	214.53	27	216.96	216.06	216.33	215.79	
28	216.16	216.78	212.78	214.53	28	216.98	216.07	216.33	215.80	
29	216.15	216.78	212.77	214.53	29	216.98	216.08	216.33	215.80	
30	216.15	216.78	212.77	214.53	30	216.98	216.08	216.35	215.80	
31	216.16	216.78	212.77	214.53	31	216.98	216.08	216.34	215.82	
32	216.15	216.78	212.77	214.53	32	216.98	216.09	216.33	215.81	
33	216.15	216.78	212.77	214.53	33	217.00	216.08	216.34	215.81	
34	216.16	216.78	212.77	214.53	34	216.98	216.07	216.34	215.81	
35	216.15	216.79	212.77	214.53	35	216.98	216.08	216.34	215.82	
36	216.17	216.77	212.78	214.53	36	216.98	216.07	216.33	215.80	
37	216.16	216.77	212.77	214.53	37	216.98	216.07	216.33	215.81	
38	216.15	216.76	212.78	214.53	38	216.99	216.08	216.32	215.80	
39	216.15	216.77	212.79	214.53	39	216.97	216.05	216.32	215.79	
40	216.15	216.76	212.78	214.53	40	216.98	216.07	216.32	215.80	
41	216.15	216.76	212.78	214.53	41	216.98	216.06	216.32	215.80	
42	216.15	216.76	212.79	214.53	42	216.98	216.05	216.32	215.80	
43	216.16	216.77	212.79	214.53	43	216.99	216.05	216.33	215.81	
44	216.15	216.76	212.78	214.53	44	216.99	216.06	216.31	215.80	
45	216.15	216.76	212.79	214.53	45	216.98	216.06	216.32	215.81	
46	216.15	216.76	212.78	214.53	46	216.97	216.05	216.33	215.82	
47	216.16	216.76	212.78	214.53	47	216.98	216.06	216.31	215.81	
48	216.15	216.77	212.80	214.53	48	216.98	216.04	216.31	215.82	
49	216.15	216.75	212.78	214.53	49	216.99	216.05	216.32	215.81	
50	216.16	216.75	212.78	214.53	50	216.98	216.06	216.31	215.80	
51	216.16	216.75	212.79	214.53	51	216.97	216.05	216.31	215.81	
52	216.14	216.74	212.80	214.53	52	216.97	216.05	216.31	215.79	
53	216.13	216.75	212.80	214.53	53	216.96	216.04	216.31	215.80	
54	216.14	216.74	212.80	214.53	54	216.97	216.03	216.31	215.80	
55	216.04	216.73	212.80	214.53	55	216.97	216.04	216.30	215.79	
56	216.20	216.73	212.80	214.53	56	216.97	216.04	216.30	215.79	
57	216.11	216.72	212.82	214.53	57	216.96	216.03	216.30	215.79	
58	216.11	216.71	212.80	214.53	58	216.97	216.03	216.30	215.79	
59	216.07	216.72	212.82	214.53	59	216.97	216.04	216.30	215.80	

Appendix C
Step Test Results
Shepley's Hill Landfill
Former Fort Devens Army Installation
Devens, Massachusetts

Step 6 -8 SCFM Deep - 9/29/2022

Dissolved Oxygen									
Time min	MW-21-1S mg/L	MW-21-2S mg/L	MW-21-3S mg/L	MW-21-4S mg/L	Time min	MW-21-1D mg/L	MW-21-2D mg/L	MW-21-3D mg/L	MW-21-4D mg/L
0	4.91	0.00	0.04	0.00	0	0.00	0.01	0.00	0.00
1	4.83	0.00	0.04	0.00	1	0.00	0.00	0.00	0.00
2	4.81	0.00	0.04	0.00	2	0.00	0.00	0.00	0.00
3	4.84	0.00	0.04	0.00	3	0.00	0.00	0.00	0.00
4	4.43	0.00	0.04	0.00	4	0.00	0.00	0.00	0.00
5	4.16	0.00	0.04	0.00	5	0.00	0.00	0.00	0.00
6	3.82	0.00	0.04	0.00	6	0.00	0.00	0.00	0.00
7	3.72	0.00	0.04	0.00	7	0.00	0.00	0.00	0.00
8	3.73	0.00	0.04	0.00	8	0.00	0.00	0.00	0.00
9	3.44	0.00	0.04	0.00	9	0.00	0.00	0.00	0.00
10	2.99	0.00	0.04	0.00	10	0.00	0.01	0.00	0.00
11	2.72	0.00	0.04	0.00	11	0.00	0.01	0.00	0.00
12	2.62	0.00	0.04	0.00	12	0.00	0.01	0.00	0.00
13	2.71	0.00	0.04	0.00	13	0.00	0.01	0.00	0.00
14	2.58	0.00	0.04	0.00	14	0.00	0.01	0.00	0.00
15	2.93	0.00	0.04	0.00	15	0.00	0.01	0.00	0.00
16	2.96	0.00	0.04	0.00	16	0.00	0.01	0.00	0.00
17	2.93	0.00	0.04	0.00	17	0.00	0.00	0.00	0.00
18	2.80	0.00	0.04	0.00	18	0.00	0.00	0.00	0.00
19	2.73	0.00	0.04	0.00	19	0.00	0.00	0.00	0.00
20	2.66	0.00	0.04	0.00	20	0.00	0.00	0.00	0.00
21	2.51	0.00	0.04	0.00	21	0.00	0.00	0.00	0.00
22	2.41	0.00	0.05	0.00	22	0.00	0.00	0.00	0.00
23	2.39	0.00	0.05	0.00	23	0.00	0.00	0.00	0.00
24	2.32	0.00	0.04	0.00	24	0.00	0.00	0.00	0.00
25	2.48	0.00	0.05	0.00	25	0.00	0.00	0.00	0.00
26	2.57	0.00	0.05	0.00	26	0.00	0.00	0.00	0.00
27	2.66	0.00	0.04	0.00	27	0.00	0.00	0.00	0.00
28	2.67	0.00	0.04	0.00	28	0.00	0.00	0.00	0.00
29	2.75	0.00	0.04	0.00	29	0.00	0.00	0.00	0.00
30	2.86	0.00	0.05	0.00	30	0.00	0.00	0.00	0.00
31	3.03	0.00	0.04	0.00	31	0.00	0.00	0.00	0.00
32	3.09	0.00	0.04	0.00	32	0.00	0.00	0.00	0.00
33	3.29	0.00	0.04	0.00	33	0.00	0.00	0.00	0.00
34	3.54	0.00	0.04	0.00	34	0.00	0.00	0.00	0.00
35	3.84	0.00	0.04	0.00	35	0.00	0.00	0.00	0.00
36	4.07	0.00	0.04	0.00	36	0.00	0.00	0.00	0.00
37	4.39	0.00	0.04	0.00	37	0.00	0.00	0.00	0.00
38	4.64	0.00	0.04	0.00	38	0.00	0.00	0.00	0.00
39	4.92	0.00	0.04	0.00	39	0.00	0.00	0.00	0.00
40	5.16	0.00	0.04	0.00	40	0.00	0.00	0.00	0.00
41	5.29	0.00	0.04	0.00	41	0.00	0.00	0.00	0.00
42	5.41	0.00	0.04	0.00	42	0.00	0.00	0.00	0.00
43	5.61	0.00	0.04	0.00	43	0.00	0.00	0.00	0.00
44	5.91	0.00	0.04	0.00	44	0.00	0.00	0.00	0.00
45	6.20	0.00	0.04	0.00	45	0.00	0.00	0.00	0.00
46	6.30	0.00	0.04	0.00	46	0.00	0.00	0.00	0.00
47	6.31	0.00	0.04	0.00	47	0.00	0.00	0.00	0.00
48	6.61	0.00	0.04	0.00	48	0.00	0.00	0.00	0.00
49	7.81	0.00	0.04	0.00	49	0.00	0.00	0.00	0.00
50	7.61	0.00	0.05	0.00	50	0.00	0.00	0.00	0.00
51	7.36	0.00	0.04	0.00	51	0.00	0.00	0.00	0.00
52	7.46	0.00	0.05	0.00	52	0.00	0.00	0.00	0.00
53	8.14	0.00	0.05	0.00	53	0.00	0.00	0.00	0.00
54	8.27	0.00	0.05	0.00	54	0.00	0.00	0.00	0.00
55	8.58	0.00	0.05	0.00	55	0.00	0.00	0.00	0.00
56	10.33	0.00	0.05	0.00	56	0.00	0.00	0.00	0.00
57	12.16	0.00	0.05	0.00	57	0.00	0.00	0.00	0.00
58	13.49	0.00	0.05	0.00	58	0.00	0.00	0.00	0.00
59	12.32	0.00	0.05	0.00	59	0.00	0.00	0.00	0.00

Appendix C
Step Test Results
Shepley's Hill Landfill
Former Fort Devens Army Installation

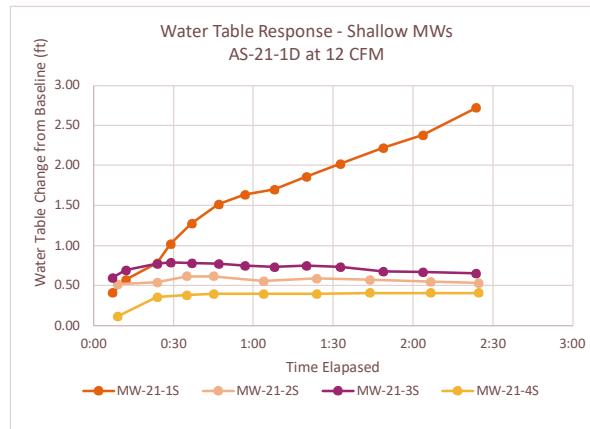
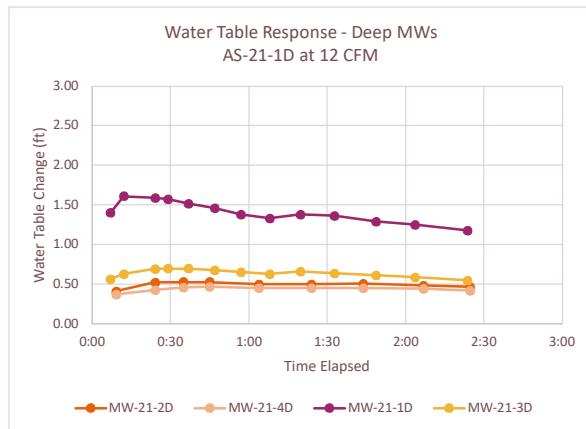
Testing - 12 SCFM at AS-21-1D

Date: 12/6/2021

Personnel GS and DB

Time	Distance From AS-21-1D: Distance From AS-21-2D: Elapsed Time	MW-21-1D	MW-21-1S	MW-21-3S	MW-21-3D
		3.00 27.00 DTW ft bmp	6.00 21.00 DTW ft bmp	16.50 23.00 DTW ft bmp	18.50 18.00 DTW ft bmp
Baseline		15.86	15.72	15.06	14.40
13:11	System On				
13:18	0:07	14.46	1.40	14.46	0.60
13:23	0:12	14.25	1.61	14.37	0.69
13:35	0:24	14.27	1.59	14.29	0.77
13:40	0:29	14.29	1.57	14.27	0.79
13:48	0:37	14.34	1.52	14.28	0.78
13:58	0:47	14.40	1.46	14.29	0.77
14:08	0:57	14.48	1.38	14.31	0.75
14:19	1:08	14.53	1.33	14.33	0.73
14:31	1:20	14.48	1.38	14.31	0.75
14:44	1:33	14.50	1.36	14.33	0.73
15:00	1:49	14.57	1.29	14.38	0.68
15:15	2:04	14.61	1.25	14.39	0.67
15:35	2:24	14.68	1.18	14.41	0.65
		13.00	2.72	13.85	0.55

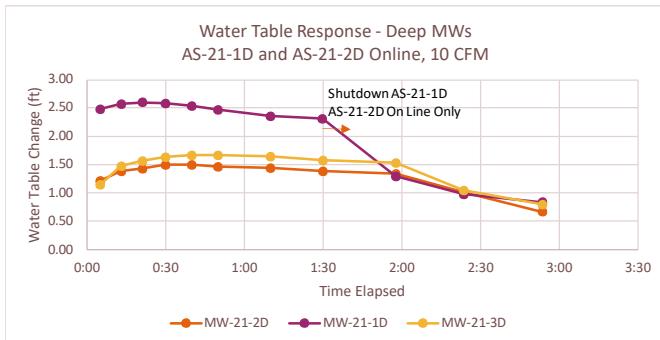
Time	Distance From AS-21-1D: Distance From AS-21-2D: Elapsed Time	SHM-10-06	MW-21-2S	MW-21-2D	MW-21-4S	MW-21-4D
		59.00 32.00 DTW ft bmp	24.50 13.50 DTW ft bmp	30.00 12.00 DTW ft bmp	39.50 44.00 DTW ft bmp	39.50 41.50 DTW ft bmp
Baseline		18.72	14.59	14.81	14.02	13.77
13:20	0:09	18.56	0.16	14.40	0.41	13.40
13:35	0:24	18.47	0.25	14.29	0.52	13.34
13:46	0:35	18.43	0.29	14.28	0.53	13.31
13:56	0:45	18.41	0.31	14.28	0.53	13.30
14:15	1:04	18.41	0.31	14.31	0.50	13.32
14:35	1:24	18.41	0.31	14.31	0.50	13.32
14:55	1:44	18.41	0.31	14.30	0.51	13.32
15:18	2:07	18.41	0.31	14.33	0.48	13.33
15:36	2:25	18.41	0.31	14.34	0.47	13.35
		14.06	0.53	13.61	0.41	0.42



Appendix C
Step Test Results
Shepley's Hill Landfill
Former Fort Devens Army Installation

Dec 7, AS-21-1D and AS-21-2D on at 10 CFM

Time	Distance From AS-21-1D: Distance From AS-21-2D: Elapsed Time	MW-21-1D		MW-21-2D		MW-21-3D		18.50		MW-21-1S Recovery Post ID Shutdown DTW ft bmp
		DTW ft bmp	Rise feet	DTW ft bmp	Rise feet	DTW ft bmp	Rise feet	Elapsed Time		
12:34	Baseline	3.00	16.20	25.50	14.99	15.00	14.61			
12:39	0:05	27.00	14.06	12.00	13.77	18.00	13.46			
12:47	0:13		13.72	2.48	13.60	1.39	13.13			
12:55	0:21		13.63	2.57	13.56	1.43	13.04			
13:04	0:30		13.60	2.60	13.49	1.50	12.98			
13:14	0:40		13.62	2.58	13.49	1.50	12.94			
13:24	0:50		13.66	2.54	13.52	1.47	12.94			
13:44	1:10		13.73	2.47	13.55	1.44	12.96			
14:04	1:30		13.84	2.36	13.60	1.39	13.03			
14:30	1:56	AS-21-1D Shutdown, AS-21-2D on Line					13.08			
14:32	1:58		14.90	1.30	13.98	1.01	13.56	0:28	14.43	
14:58	2:24		15.22	0.98	14.23	0.76	13.81	0:58	15.35	
15:28	2:54		15.36	0.84	14.32	0.67	13.91			



Appendix D

Groundwater Sampling Logs

Groundwater Sampling Form



Project Number 30048392 **Well ID** MW-21-1D **Date** 08/18/2021

Project Name/Location	Ft. Devens		Weather(°F)	84 °F, Sunny, winds at 0 mph.			
Measuring Pt. Description	Top of Inner Casing		Screen Setting (ft-bmp)	–	Casing Diameter (in)	2	Well Casing Material
Static Water Level (ft-bmp)	15.91		Total Depth (ft-bmp)	69	Water Column(ft)	53.09	Gallons in Well
MP Elevation		Pump Intake (ft-bmp)	64	Purge Method	Low-Flow		Sample Method
Sample Time	10:50		Volumes Purged	0.53	Sample ID	MW-21-1D-Baseline MW-21-1D-Baseline-	Sampled by
Purge Start	10:15		Gallons Purged	4.53	Replicate/Code No.		
Purge End		12:30					

Time	Minutes Elapsed	Total Elapsed Minutes	Rate mL/min	Depth to Water (ft)	Gallons Purged	pH (standard units)	Conductivity (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temperature °C	Appearance		
											Color	Odor	
10:20	0	0	120	15.95	0.16	6.19	0.418	13.1	0.16	17.6	-63.9	Clear	None
10:25	5	5	120	15.96	0.32	6.18	0.416	7.2	0.41	17	-64.4	Clear	None
10:30	5	10	120	15.96	0.48	6.24	0.414	6.96	0.47	16.8	-55.2	Clear	None
10:35	5	15	120	15.96	0.63	6.29	0.403	7.65	0.11	16.2	-67.4	Clear	None
10:40	5	20	120	15.96	0.79	6.35	0.404	8.31	0.08	16.2	-72.1	Clear	None
10:45	5	25	120	15.96	0.95	6.38	0.404	8.4	0.08	16	-74	Clear	None

Constituent Sampled	Container	Number	Preservative
Total Organic Carbon	40 mL Glass	6	H2SO4
Total Metals	250 mL Plastic	3	HNO3
Dissolved Metals (0.45µm Filter)	250 mL Plastic	3	HNO3
COD	250 mL Plastic	3	H2SO4
BOD5, Alkalinity, TDS	1L Plastic	6	None
Anions	250 mL Plastic	3	None

Comments: Ferrous Iron 56.2 mg/L. Diluted to a 20:1 ratio. 20 parts distilled water to 1 part sample. New Well. No lock. MS/MSD collected. Dissolved metals were field filtered.

Well Casing Volume Conversion

Well diameter (inches) = gallons per foot $1 = 0.04 \quad 1.5 = 0.09 \quad 2.5 = 0.26 \quad 3.5 = 0.50 \quad 6 = 1.47$
 $1.25 = 0.06 \quad 2 = 0.16 \quad 3 = 0.37 \quad 4 = 0.65$

Well Information

Well Location:

Well Locked at Arrival: no

Condition of Well: Good condition

Well Locked at Departure: no

Well Completion: Stick-up

Key Number To Well: NA

ft-bmp = feet below measuring point

in = inches

ft = feet

mL/min = milliliters per minute

mS/cm = millisiemens per centimeter

NTU = Nephelometric Turbidity Unit

mg/L = milligrams per liter

mV = milliv

Groundwater Sampling Form

Project Number	30048392	Well ID	MW-21-1S	Date	8/18/2021
----------------	----------	---------	----------	------	-----------

Project Number	30048392	Well ID	MW-21-1S	Date	8/18/2021		
Project Name/Location		Ft. Devens	Weather(°F)	84 °F, Sunny, winds at 0 mph.			
Measuring Pt. Description	Top of Inner Casing	Screen Setting (ft-bmp)	–	Casing Diameter (in)	2	Well Casing Material	PVC
Static Water Level (ft-bmp)	15.53	Total Depth (ft-bmp)	54	Water Column(ft)	38.47	Gallons in Well	6.25
MP Elevation		Pump Intake (ft-bmp)	49	Purge Method	Low-Flow	Sample Method	
Sample Time	09:05	Volumes Purged	0.49	Sample ID	MW-21-1S-Baseline MW-21-1S-Baseline-	Sampled by	Spencer Gust
Purge Start	08:35	Gallons Purged	3.08	Replicate/Code No.			
Purge End	10:00						

Time	Minutes Elapsed	Total Elapsed Minutes	Rate mL/min	Depth to Water (ft)	Gallons Purged	pH (standard units)	Conductivity (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temperature °C	Appearance		
											Color	Odor	
08:40	0	0	160	15.96	0.21	6.5	0.488	4.07	1.33	13.2	-22.2	Clear	None
08:45	5	5	145	16.06	0.40	6.23	0.476	4.18	0.57	13.3	-22	Clear	None
08:50	5	10	145	16.06	0.59	6.18	0.475	7.15	0.36	13.4	-32.4	Clear	None
08:55	5	15	145	16.06	0.79	6.21	0.472	6.85	0.27	13.3	-33	Clear	None
09:00	5	20	145	16.06	0.98	6.25	0.477	7.1	0.14	13.2	-40.7	Clear	None

Constituent Sampled	Container	Number	Preservative
Total Organic Carbon	40 mL Glass	2	H2SO4
Total Metals	250 mL Plastic	1	HNO3
Dissolved Metals (0.45µm Filter)	250 mL Plastic	1	HNO3
COD	250 mL Plastic	1	NaHSO4
BOD5, Alkalinity, TDS	1L Plastic	2	None
Anions	250 mL Plastic	1	None

Comments: Ferrous iron 60.6 mg/L. Diluted to 20:1. 20 parts distilled water to 1 part sample. New Well. Dissolved metals were field filtered.

Well Casing Volume Conversion

Well diameter (inches) = gallons per foot $1 = 0.04 \quad 1.5 = 0.09 \quad 2.5 = 0.26 \quad 3.5 = 0.50 \quad 6 = 1.47$
 $1.25 = 0.06 \quad 2 = 0.16 \quad 3 = 0.37 \quad 4 = 0.65$

Well Information

Well Location:

Well Locked at Arrival: no

Condition of Well: Good condition

Well Locked at Departure: no

Well Completion: Stick-up

Key Number To Well: NA

ft-bmp = feet below measuring point

in = inches

ft = feet

mL/min = milliliters per minute

mS/cm = millisiemens per centimeter

NTU = Nephelometric Turbidity Unit

mg/L = milligrams per liter

mV = milliv

Groundwater Sampling Form



Project Number 30048392 **Well ID** MW-21-2D **Date** 8/19/2021

Project Name/Location	Ft. Devens	Weather(°F)	81 °F, Heavy Rain, NW winds at 5 mph.			
Measuring Pt. Description	Top of Inner Casing	Screen Setting (ft-bmp)	–	Casing Diameter (in)	2	Well Casing Material
Static Water Level (ft-bmp)	14.94	Total Depth (ft-bmp)	74	Water Column(ft)	59.06	Gallons in Well
MP Elevation		Pump Intake (ft-bmp)	69	Purge Method	Low-Flow	Sample Method
Sample Time	10:40	Volumes Purged	0.41	Sample ID	MW-21-2D-Baseline MW-21-2D-Baseline-FF	Sampled by Spencer Gust
Purge Start	09:05	Gallons Purged	3.96	Replicate/Code No.		

Purge End 11:00

Time	Minutes Elapsed	Total Elapsed Minutes	Rate mL/min	Depth to Water (ft)	Gallons Purged	pH (standard units)	Conductivity (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temperature °C	Appearance		
											Color	Odor	
09:50	0	0	120	14.96	1.43	6.81	0.308	16.1	0.06	14.5	-96.5	Brown	None
09:55	5	5	120	14.96	1.59	6.75	0.311	20	0.09	15.2	-97.2	Brown	None
10:00	5	10	120	14.96	1.74	6.78	0.306	17	0.06	14.4	-99.7	Brown	None
10:15	15	25	120	14.96	2.22	6.75	0.307	16.7	0.03	14.9	-102.7	Brown	None
10:30	15	40	120	14.96	2.69	6.76	0.308	15.8	0.01	14.7	-104.2	Brown	None
10:35	5	45	120	14.96	2.85	6.77	0.307	14.5	0.02	15.1	-105.3	Brown	None

Constituent Sampled

	Container	Number	Preservative
Total Organic Carbon	40 mL Glass	2	H2SO4
Total Metals	250 mL Plastic	1	HNO3
Dissolved Metals (0.45µm Filter)	250 mL Plastic	1	HNO3
COD	250 mL Plastic	1	H2SO4
BOD5, Alkalinity, TDS	1L Plastic	2	None
Anions	250 mL Plastic	1	None

Comments: Ferrous Iron 51.6 mg/L. Diluted to a 20:1 Ratio. 20 parts distilled water to 1 part sample. Issues with heavy rain lead to gaps in the sampling. Dissolved metals were field filtered.

Well Casing Volume Conversion

Well diameter (inches) = gallons per foot $1 = 0.04 \cdot 1.5 = 0.09 \cdot 2.5 = 0.26 \cdot 3.5 = 0.50 \cdot 6 = 1.47$
 $1.25 = 0.06 \cdot 2 = 0.16 \cdot 3 = 0.37 \cdot 4 = 0.65$

Well Information

Well Location:

Well Locked at Arrival: no

Condition of Well: Good condition

Well Locked at Departure: no

Well Completion: Stick-up

Key Number To Well: NA

ft-bmp = feet below measuring point

in = inches

ft = feet

mL/min = milliliters per minute

mS/cm = millisiemens per centimeter

NTU = Nephelometric Turbidity Unit

mg/L = milligrams per liter

mV = milliv

Groundwater Sampling Form

Project Number	30048392	Well ID	MW-21-2S	Date	08/20/2021
----------------	----------	---------	----------	------	------------

Project Name/Location		Ft. Devens	Weather(°F)	72 °F, Light Rain, NW winds at 3 mph.			
Measuring Pt. Description	Top of Inner Casing	Screen Setting (ft-bmp)	–	Casing Diameter (in)	2	Well Casing Material	PVC
Static Water Level (ft-bmp)	14.44	Total Depth (ft-bmp)	59	Water Column(ft)	44.56	Gallons in Well	7.24
MP Elevation		Pump Intake (ft-bmp)	54	Purge Method	Low-Flow	Sample Method	
Sample Time	10:35	Volumes Purged	0.64	Sample ID	MW-21-2S-Baseline MW-21-2S-Baseline-FF	Sampled by	Spencer Gust
Purge Start	9:45	Gallons Purged	4.63	Replicate/Code No.			
Purge End	11:11						

Time	Minutes Elapsed	Total Elapsed Minutes	Rate mL/min	Depth to Water (ft)	Gallons Purged	pH (standard units)	Conductivity (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temperature °C	Appearance		
											Color	Odor	
09:50	0	0	120	14.45	0.16	11.35	0.89	10.58	0.06	16	-146.9	Blue Green with a color change to brown part way through the sample.	Mild
09:55	5	5	120	14.45	0.32	11.36	0.79	12.57	5.83	16.6	-166.8	Blue Green with a color change to brown part way through the sample.	Mild
10:00	5	10	120	14.45	0.48	11.4	0.74	10.37	0.15	16.5	-179.5	Blue Green with a color change to brown part way through the sample.	Mild
10:05	5	15	120	14.45	0.63	11.44	0.71	13.82	0	17.3	-196.5	Blue Green with a color change to brown part way through the sample.	Mild

ft-bmp = feet below measuring point

in = inches

ft = feet

mL/min = milliliters per minute

mS/cm = millisiemens per centimeter

NTU = Nephelometric Turbidity Unit

mg/L = milligrams per liter

mV = milliv

Groundwater Sampling Form

10:10	5	20	120	14.45	0.79	11.62	0.74	11.68	0	15.4	-210.6	Blue Green with a color change to brown part way through the sample.	Mild
10:15	5	25	120	14.45	0.95	11.51	0.68	13	0	14.3	-218.8	Blue Green with a color change to brown part way through the sample.	Mild
10:20	5	30	120	14.45	1.11	11.49	0.7	11	0	14.6	-225.1	Blue Green with a color change to brown part way through the sample.	Mild
10:25	5	35	120	14.45	1.27	11.53	0.69	11.35	0	14.3	-215.3	Blue Green with a color change to brown part way through the sample.	Mild
10:30	5	40	120	14.45	1.43	11.59	0.71	11.14	0	14.4	-208.1	Blue Green with a color change to brown part way through the sample.	Mild

Constituent Sampled

Total Organic Carbon

Total Metals

Dissolved Metals (0.45µm Filter)

COD

ft-bmp = feet below measuring point

in = inches

ft = feet

mL/min = milliliters per minute

mS/cm = millisiemens per centimeter

NTU = Nephelometric Turbidity Unit

mg/L = milligrams per liter

Container

40 mL Glass

250 mL Plastic

250 mL Plastic

250 mL Plastic

Number

2

1

1

1

Preservative

H2SO4

HNO3

HNO3

H2SO4

mV = milliv

Groundwater Sampling Form



BOD, Alkalinity, TDS	1L Plastic	2	None
Anions	250 mL Plastic	1	None

Comments: Ferrous Iron 30.2 mg/L. Diluted to a 20:1 ratio. 20 parts distilled water to 1 part sample. Dissolved metals were field filtered.

Well Casing Volume Conversion

Well diameter (inches) = gallons per foot
1 = 0.04 1.5 = 0.09 2.5 = 0.26 3.5 = 0.50 6 = 1.47
1.25 = 0.06 2 = 0.16 3 = 0.37 4 = 0.65

Well Information

Well Location:

Well Locked at Arrival: no

Condition of Well: Good condition

Well Locked at Departure: no

Well Completion: Stick-up

Key Number To Well: NA

ft-bmp = feet below measuring point

in = inches

ft = feet

mL/min = milliliters per minute

mS/cm = millisiemens per centimeter

NTU = Nephelometric Turbidity Unit

mg/L = milligrams per liter

mV = milliv

Groundwater Sampling Form



Project Number 30048392 **Well ID** MW-21-3D **Date** 08/20/2021

Project Name/Location	Ft. Devens	Weather(°F)		72 °F, Light Rain, NW winds at 3 mph.			
Measuring Pt. Description	Top of Inner Casing	Screen Setting (ft-bmp)	–	Casing Diameter (in)	2	Well Casing Material	PVC
Static Water Level (ft-bmp)	14.24	Total Depth (ft-bmp)	73.5	Water Column(ft)	59.26	Gallons in Well	9.63
MP Elevation		Pump Intake (ft-bmp)	68.5	Purge Method	Low-Flow	Sample Method	
Sample Time	12:20	Volumes Purged	0.27	Sample ID	MW-21-3D-Baseline MW-21-3D-Baseline-FF	Sampled by	Spencer Gust
Purge Start	11:35	Gallons Purged	2.58	Replicate/Code No.			
Purge End		12:45					

Time	Minutes Elapsed	Total Elapsed Minutes	Rate mL/min	Depth to Water (ft)	Gallons Purged	pH (standard units)	Conductivity (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temperature °C	Appearance		
											Color	Odor	
11:40	0	0	130	14.36	0.17	7.06	0.417	5.13	0.1	15	-101.2	Clear	None
11:45	5	5	130	14.36	0.34	6.9	0.411	7.26	0.09	14.8	-104.2	Clear	None
11:50	5	10	130	14.36	0.52	6.81	0.406	9.85	0.1	15	-107.9	Clear	None
11:55	5	15	130	14.36	0.69	6.77	0.403	11.1	0.07	14.8	-109.1	Clear	None
12:00	5	20	130	14.36	0.86	6.72	0.403	9.04	0.08	14.8	-108.2	Clear	None
12:05	5	25	130	14.36	1.03	6.66	0.399	11.4	0.05	14.7	-107.3	Clear	None
12:10	5	30	130	14.36	1.20	6.63	0.402	11.16	0.05	14.8	-108.1	Clear	None
12:15	5	35	130	14.36	1.37	6.64	0.397	12.1	0.03	14.8	-109.6	Clear	None

Constituent Sampled	Container	Number	Preservative
Total Organic Carbon	40 mL Glass	2	H2SO4
Total Metals	250 mL Plastic	1	HNO3
Dissolved Metals (0.45µm Filter)	250 mL Plastic	1	HNO3
COD	250 mL Plastic	1	H2SO4
BOD5, Alkalinity, TDS	1L Plastic	2	None
Anions	250 mL Plastic	1	None

Comments: Ferrous Iron 57.2 mg/L. Diluted to a 20:1 ratio. 20 parts distilled water to 1 part sample. Dissolved metals were field filtered.

Well Casing Volume Conversion

Well diameter (inches) = gallons per foot $1 = 0.04 \quad 1.5 = 0.09 \quad 2.5 = 0.26 \quad 3.5 = 0.50 \quad 6 = 1.47$
 $1.25 = 0.06 \quad 2 = 0.16 \quad 3 = 0.37 \quad 4 = 0.65$

Well Information

Well Location:

Well Locked at Arrival: no

Condition of Well: Good condition

Well Locked at Departure: no

Well Completion: Stick-up

Key Number To Well: NA

ft-bmp = feet below measuring point

in = inches

ft = feet

mL/min = milliliters per minute

mS/cm = millisiemens per centimeter

NTU = Nephelometric Turbidity Unit

mg/L = milligrams per liter

mV = milliv

Groundwater Sampling Form



Project Number 30048392 **Well ID** MW-21-4D **Date** 08/25/2021

Project Name/Location	Ft. Devens	Weather(°F)	90 °F, Sunny, NW winds at 1 mph.		
Measuring Pt. Description	Top of Inner Casing	Screen Setting (ft-bmp)	—	Casing Diameter (in)	2
Static Water Level (ft-bmp)	13.3	Total Depth (ft-bmp)	72	Water Column(ft)	58.7
MP Elevation		Pump Intake (ft-bmp)	67	Purge Method	Low-Flow
Sample Time	11:35	Volumes Purged	0.50	Sample ID	MW-21-4D-Baseline MW-21-4D-Baseline-
Purge Start	11:00	Gallons Purged	4.76	Replicate/ Code No.	AS-DUP-Baseline AS-DUP-Baseline-FF
Purge End		12:30			

Time	Minutes Elapsed	Total Elapsed Minutes	Rate mL/min	Depth to Water (ft)	Gallons Purged	pH (standard units)	Conductivity (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temperature °C	Appearance		
											Color	Odor	
11:05	0	0	200	13.35	0.26	6.3	0.347	40.6	0.08	15.7	-91.3	Brown	None
11:10	5	5	200	13.35	0.53	6.38	0.342	35.7	0.04	15.4	-99.4	Brown	None
11:15	5	10	200	13.35	0.79	6.43	0.344	31	0.13	15.5	-102.9	Brown	None
11:20	5	15	200	13.35	1.06	6.49	0.341	19.8	0.11	15	-105.5	Brown	None
11:25	5	20	200	13.35	1.32	6.51	0.34	21.6	0.07	15	-106.8	Brown	None
11:30	5	25	200	13.35	1.59	6.55	0.344	23.4	0.06	15.2	-108.6	Brown	None

Constituent Sampled	Container	Number	Preservative
Total Organic Carbon	40 mL Glass	4	H2SO4
Total Metals	250 mL Plastic	2	HNO3
Dissolved Metals (0.45µm Filter)	250 mL Plastic	2	HNO3
COD	250 mL Plastic	2	H2SO4
BOD5, Alkalinity, TDS	1L Plastic	4	None
Anions	250 mL Plastic	2	None

Comments: Ferrous Iron 42.2 mg/L. Diluted to a 20:1 ratio. 20 parts distilled water to 1 part sample. Dissolved metals were field filtered.

Well Casing Volume Conversion

Well diameter (inches) = gallons per foot $1 = 0.04 \cdot 1.5 = 0.09 \cdot 2.5 = 0.26 \cdot 3.5 = 0.50 \cdot 6 = 1.47$
 $1.25 = 0.06 \cdot 2 = 0.16 \cdot 3 = 0.37 \cdot 4 = 0.65$

Well Information

Well Location:

Well Locked at Arrival: no

Condition of Well: Good condition

Well Locked at Departure: no

Well Completion: Stick-up

Key Number To Well: NA

ft-bmp = feet below measuring point

in = inches

ft = feet

mL/min = milliliters per minute

mS/cm = millisiemens per centimeter

NTU = Nephelometric Turbidity Unit

mg/L = milligrams per liter

mV = milliv

Groundwater Sampling Form



Project Number 30048392 **Well ID** MW-21-4S **Date** 08/25/2021

Project Name/Location	Ft. Devens	Weather(°F)	90 °F, Sunny, NW winds at 1 mph.			
Measuring Pt. Description	Top of Inner Casing	Screen Setting (ft-bmp)	–	Casing Diameter (in)	2	Well Casing Material
Static Water Level (ft-bmp)	13.66	Total Depth (ft-bmp)	57	Water Column(ft)	43.34	Gallons in Well
MP Elevation		Pump Intake (ft-bmp)	52	Purge Method	Low-Flow	Sample Method
Sample Time	14:15	Volumes Purged	0.38	Sample ID	MW-21-4S-Baseline MW-21-4S-Baseline-FF	Sampled by Spencer Gust
Purge Start	13:50	Gallons Purged	2.64	Replicate/Code No.		
Purge End		14:20				

Time	Minutes Elapsed	Total Elapsed Minutes	Rate mL/min	Depth to Water (ft)	Gallons Purged	pH (standard units)	Conductivity (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temperature °C	Appearance		
											Color	Odor	
13:55	0	0	240	13.74	0.32	6.29	0.477	4.34	0.64	15.7	-69.2	Clear	None
14:00	5	5	200	13.74	0.58	6.07	0.45	4.09	0.23	14.9	-60.4	Clear	None
14:05	5	10	200	13.74	0.85	6.14	0.451	2.84	0.14	14.7	-63.3	Clear	None
14:10	5	15	200	13.74	1.11	6.21	0.452	4.51	0.08	14.5	-66	Clear	None

Constituent Sampled	Container	Number	Preservative
Total Organic Carbon	40 mL Glass	2	H2SO4
Total Metals	250 mL Plastic	1	HNO3
Dissolved Metals (0.45µm Filter)	250 mL Plastic	1	HNO3
COD	250 mL Plastic	1	H2SO4
BOD5, Alkalinity, TDS	1L Plastic	2	None
Anions	250 mL Plastic	1	None

Comments: Ferrous Iron 60.8 mg/L. Diluted to a 20:1 ratio. 20 parts distilled water to 1 part sample. Dissolved metals were field filtered.

Well Casing Volume Conversion

Well diameter (inches) = gallons per foot
 $1 = 0.04 \quad 1.5 = 0.09 \quad 2.5 = 0.26 \quad 3.5 = 0.50 \quad 6 = 1.47$
 $1.25 = 0.06 \quad 2 = 0.16 \quad 3 = 0.37 \quad 4 = 0.65$

Well Information

Well Location:

Well Locked at Arrival: no

Condition of Well: Good condition

Well Locked at Departure: no

Well Completion: Stick-up

Key Number To Well: NA

ft-bmp = feet below measuring point

in = inches

ft = feet

mL/min = milliliters per minute

mS/cm = millisiemens per centimeter

NTU = Nephelometric Turbidity Unit

mg/L = milligrams per liter

mV = milliv

Groundwater Sampling Form

Project Number	30048392	Well ID	MW-21-3S	Date	08/25/2021
----------------	----------	---------	----------	------	------------

Project Name/Location	Ft. Devens	Weather(°F)	72 °F, Sunny, NW winds at 1 mph.			
Measuring Pt. Description	Top of Inner Casing	Screen Setting (ft-bmp)	–	Casing Diameter (in)	2	Well Casing Material
Static Water Level (ft-bmp)	14.5	Total Depth (ft-bmp)	58.5	Water Column(ft)	44	Gallons in Well
MP Elevation		Pump Intake (ft-bmp)	53.5	Purge Method	Low-Flow	Sample Method
Sample Time		Volumes Purged	0.70	Sample ID	MW-21-3S-Baseline MW-21-3S-Baseline-FF	Sampled by Spencer Gust
Purge Start		Gallons Purged	5.02	Replicate/Code No.		

Purge End	10:30
-----------	-------

Time	Minutes Elapsed	Total Elapsed Minutes	Rate mL/min	Depth to Water (ft)	Gallons Purged	pH (standard units)	Conductivity (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temperature °C	Appearance		
											Color	Odor	
09:10	0	0	200	14.6	0.26	6.25	0.452	13.36	2.01	14.9	-50.5	Brown	None
09:15	5	5	200	14.6	0.53	6.17	0.448	6.51	0.56	14.6	-46.8	Brown	None
09:20	5	10	200	14.6	0.79	6.19	0.444	6.54	0.2	14.4	-26.7	Brown	None
09:25	5	15	200	14.6	1.06	6.22	0.443	1.82	0.16	14.4	-32.4	Brown	None
09:30	5	20	200	14.6	1.32	6.28	0.442	4.49	0.11	14.3	-46.2	Brown	None
09:35	5	25	200	14.6	1.59	6.33	0.441	6.31	0.07	14.2	-42.9	Brown	None
09:40	5	30	200	14.6	1.85	6.4	0.443	7.16	0.34	14.5	-51.3	Brown	None
09:45	5	35	200	14.6	2.11	6.48	0.443	6.78	0.09	14.4	-36.9	Brown	None
09:50	5	40	200	14.6	2.38	6.47	0.443	6.91	0.11	14.4	-47.8	Brown	None
09:55	5	45	200	14.6	2.64	6.43	0.443	7.14	0.42	14.5	-54.4	Brown	None
10:00	5	50	200	14.6	2.91	6.48	0.444	7.18	0.34	14.6	-58.9	Brown	None

Constituent Sampled	Container	Number	Preservative
Total Organic Carbon	40 mL Glass	2	H2SO4
Dissolved Metals, Total Metals	250 mL Plastic	1	HNO3
Dissolved Metals (0.45µm Filter)	250 mL Plastic	1	HNO3
COD	250 mL Plastic	1	H2SO4
BOD5, Alkalinity, TDS	1L Plastic	2	None
Anions	250 mL Plastic	1	None

Comments: Ferrous iron 65.8 mg/L. Diluted to a ratio of 20:1. 20 parts distilled water to 1 part sample. Dissolved metals were field filtered.

Well Casing Volume Conversion

Well diameter (inches) = gallons per foot $1 = 0.04 \quad 1.5 = 0.09 \quad 2.5 = 0.26 \quad 3.5 = 0.50 \quad 6 = 1.47$
 $1.25 = 0.06 \quad 2 = 0.16 \quad 3 = 0.37 \quad 4 = 0.65$

Well Information

Well Location:

Well Locked at Arrival: no

Condition of Well: Good condition

Well Locked at Departure: no

Well Completion: Stick-up

Key Number To Well: NA

ft-bmp = feet below measuring point

in = inches

ft = feet

mL/min = milliliters per minute

mS/cm = millisiemens per centimeter

NTU = Nephelometric Turbidity Unit

mg/L = milligrams per liter

mV = milliv

Groundwater Sampling Form



Project Number 30048392 **Well ID** SHM-10-06 **Date** 08/26/2021

Project Name/Location	Ft. Devens	Weather(°F)	79 °F, Sunny, NW winds at 2 mph.		
Measuring Pt. Description	Top of Inner Casing	Screen Setting (ft-bmp)	–	Casing Diameter (in)	2
Static Water Level (ft-bmp)	18.55	Total Depth (ft-bmp)	82.38	Water Column(ft)	63.83
MP Elevation		Pump Intake (ft-bmp)	77.38	Purge Method	Low-Flow
Sample Time	10:40	Volumes Purged	0.38	Sample ID	SHM-10-06-Baseline SHM-10-06-Baseline-FF
Purge Start	09:40	Gallons Purged	3.94	Replicate/Code No.	
Purge End	11:13				

Time	Minutes Elapsed	Total Elapsed Minutes	Rate mL/min	Depth to Water (ft)	Gallons Purged	pH (standard units)	Conductivity (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temperature °C	Appearance		
											Color	Odor	
09:45	0	0	200	18.59	0.26	6.38	0.429	4.86	0.24	14.7	-94.8	Clear	None
09:50	5	5	200	18.59	0.53	6.31	0.449	4.94	0.21	16.7	-73.5	Clear	None
09:55	5	10	180	18.59	0.77	6.4	0.456	5.51	0.27	16.9	-102.6	Clear	None
10:00	5	15	180	18.59	1.00	6.48	0.451	6.93	0.18	16.5	-108.4	Clear	None
10:05	5	20	200	18.59	1.27	6.49	0.449	5.69	0.14	16.7	-109.2	Clear	None
10:10	5	25	200	18.59	1.53	6.54	0.451	8.27	0.14	16.9	-104.3	Clear	None
10:15	5	30	200	18.59	1.80	6.56	0.425	4.33	0.14	14.4	-100.6	Clear	None
10:20	5	35	200	18.59	2.06	6.5	0.42	7.2	0.07	14.3	-102.8	Clear	None
10:25	5	40	200	18.59	2.32	6.5	0.422	4.19	0.05	14.4	-104.7	Clear	None
10:30	5	45	200	18.59	2.59	6.54	0.422	4.29	0.03	14.4	-106.5	Clear	None
10:35	5	50	200	18.59	2.85	6.56	0.422	4.65	0.03	14.4	-107.6	Clear	None

Constituent Sampled	Container	Number	Preservative
Total Organic Carbon	40 mL Glass	2	H2SO4
Total Metals	250 mL Plastic	1	HNO3
Dissolved Metals (0.45µm Filter)	250 mL Plastic	1	HNO3
COD	250 mL Plastic	1	H2SO4
BOD5, Alkalinity, TDS	1L Plastic	2	None
Anions	250 mL Plastic	1	None

Comments: Ferrous Iron 48.0 mg/L. Diluted to 20:1 ratio. 20 parts distilled water to 1 part sample. Dissolved metals were field filtered.

Well Casing Volume Conversion

Well diameter (inches) = gallons per foot $1 = 0.04 \cdot 1.5 = 0.09 \cdot 2.5 = 0.26 \cdot 3.5 = 0.50 \cdot 6 = 1.47$
 $1.25 = 0.06 \cdot 2 = 0.16 \cdot 3 = 0.37 \cdot 4 = 0.65$

Well Information

Well Location:

Well Locked at Arrival: yes

Condition of Well: Good condition

Well Locked at Departure: yes

Well Completion: Stick-up

Key Number To Well: NA

ft-bmp = feet below measuring point

in = inches

ft = feet

mL/min = milliliters per minute

mS/cm = millisiemens per centimeter

NTU = Nephelometric Turbidity Unit

mg/L = milligrams per liter

mV = milliv

Groundwater Sampling Form



Project Number	30048392	Well ID	MW-21-1D	Date	11/04/2021
Project Name/Location	USACE NE Devens Seed TO 8a JV		Weather(°F)	28.0 degrees F and Clear. The wind is blowing N/NW at 3.4 mph.	
Measuring Pt. Description	Top of Inner Casing	MP Elevation	Casing Diameter (in)	2	Well Casing Material
Static Water Level (ft-bmp)	13.98	Total Depth (ft-bmp)	71.49	Water Column (ft)	57.51
Purge Start	10:00	Pump Intake (ft-bmp)	66.49	Purge Method	Low-Flow
Purge End	10:55	Volumes Purged	0.28	Sample ID	MW-21-1D
Sample Time	10:55	Gallons Purged	2.62	Replicate/Code No.	NA
				Sample Type	Grab

Time	Minutes Elapsed	Total Elapsed Minutes	Rate mL/min	Depth to Water (ft)	Gallons Purged	pH (standard units)	Conductivity (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temperature °C	Appearance		
											Color	Odor	
10:05	0	0	180	14.48	0.24	6.04	0.341	19.8	4.53	10.9	89.7	--	--
10:10	5	5	180	14.60	0.48	6.03	0.34	14.1	2.97	10.9	68.4	--	--
10:15	5	10	180	14.62	0.71	6.09	0.351	11.2	1.97	11.4	45.2	--	--
10:25	10	20	180	14.62	1.19	6.19	3.82	10.04	0.99	11.1	12.9	--	--
10:35	10	30	180	14.62	1.66	6.2	0.41	8.98	1.12	10.9	-2.8	--	--
10:40	5	35	180	14.62	1.90	6.33	0.397	9.98	1.58	10.9	0.8	--	--
10:45	5	40	180	14.62	2.14	6.29	0.387	9.61	1.63	10.9	-1.3	--	--
10:50	5	45	180	14.62	2.38	6.27	0.386	9.02	1.59	10.9	-4.9	Clear	None

Constituent Sampled	Container	Number	Preservative
See COC	NA	NA	NA

Comments:	Note: Sampler is red green color blind. Initial purge appearance - clear; initial purge odor - none. Final purge appearance - clear; final purge odor - none. PID - MiniRAE300 - SN: 592-000725 Turbidity Meter - LaMotte 2020WE - SN: 898-1711 Hach 850 colorimeter - SN:070150C51713 - instrument limit is 3.30mg/L No dilution: Ferrous Fe - >3.30mg/L; total Fe - >3.30mg/L Dilution factor of 10: Ferrous Fe - 2.55mg/L (direct instrument reading) Dilution factor of 20: Total Fe - 1.42mg/L (direct instrument reading)
-----------	---

Well Casing Volume Conversion	Well diameter (inches) = gallons per foot 1 = 0.04; 1.5 = 0.09; 2.5 = 0.26; 3.5 = 0.50; 6 = 1.47 1.25 = 0.06; 2 = 0.16; 3 = 0.37; 4 = 0.65
-------------------------------	--

Well Information	Well Location: South of ATP	Well Locked at Arrival: yes
Condition of Well:	Good condition	Well Locked at Departure: yes

ft-bmp = feet below measuring point in = inches ft = feet mL/min = milliliters per minute	mS/cm = millSiemens per centimeter NTU = Nephelometric Turbidity Unit mg/L = milligrams per liter	mV = millivolts °F = degrees Fahrenheit °C = degrees Celsius
--	---	--

Turbidity SN: 898-1711
See page 1 for rest of SN/EQWP.
Calibrated 11/5
at 8:30 AM

Page 4 of 5
Date 11/5/2021

Groundwater Sampling Log

Project No. 300 48392, 07F

Well ID MW-21-2S

Project Name/Location Devens SHL - Air Sparce Pilot

Weather Sunny-Cold
Well Material PVC
 SS

Measuring Pt. TOIC Screen Interval (ft-bmp) 52.2 Casing Diameter (in.) 2 in

Static Water Level (ft-bmp) 13.34 Total Depth (ft-bmp) 62.2 Water Column/
Gallons in Well 48.86 ft or 7.82 gal

MP Elevation Pump Intake (ft-bmp) 57.2 Purge Method: Low Flow Sample Method Grab

Pump On/Off 10:10 AM Volume Purged (gal) 3.98 Peristaltic
Submersible
Other

Sample Time: Label Start 11:50 AM Replicate/ Code No.

PID: 0.7 ppm
Ferrous Iron: 0.76 mg/L > Diluted x5 or 4:1 ratio
Total Iron: 0.84 mg/L Not yet cal'd.

Sampled by Grace Shocker

Time	Minutes Elapsed	Rate (mL/min)	Depth to Water (ft)	Volume Purged (mL)	pH (SU)	Cond. (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp. (°C)	Redox (mV)	Appearance	
											Color	Odor
10:15	5	180	12.82	900	7.24	0.74	38.1	15.66	8.6	168.9	Light Yellow	No
10:20	10	180	12.82	1800	6.98	0.704	40.2	14.33	9.1	158.5	Light Yellow	No
10:25	15	180	12.92	2700	6.83	0.675	44.3	13.62	9.2	136.5	Light Yellow	No
10:30	20	180	12.82	3600	6.73	0.662	31.9	12.39	9.1	126.0	Light Yellow	No
10:35	25	180	12.86	4500	6.76	0.645	21.3	12.40	9.2	104.5	Light Yellow	No
10:40	30	180	12.9	5400	6.79	0.620	18.5	10.60	9.3	72.9	No	No
10:45	35	160	12.93	6200	6.60	0.568	22.8	8.20	9.3	29.4	No	No
10:50	40	160	12.96	7000	6.62	0.563	14.3	8.56	9.5	15.0	No	No
10:55	45	180	12.97	7900	6.63	0.559	14.0	8.34	9.5	-0.7	No	No
11:00	50	150	13.15	8650	6.64	0.505	12.1	6.92	9.7	-16.4	No	No
11:05	55	160	13.36	9450	6.58	0.512	14.3	7.13	9.8	-22.7	No	No
11:10	60	160	13.40	10,250	6.56	0.519	11.7	7.10	9.8	-26.0	No	No
11:15	65	160	13.42	11,050	6.55	0.502	9.78	6.82	9.8	-31.6	No	No
11:20	70	160	13.44	11,850	6.57	0.494	11.9	6.18	9.8	-41.9	No	No
11:25	75	160	13.44	12,650	6.62	0.475	8.89	6.76	9.8	-44.8	No	No
11:30	80	160	13.44	13,450	6.57	0.455	7.62	4.88	9.8	-53.8	No	No

Constituents Sampled	Container	Number	Preservative
See CDC			

Well Casing Volumes

Gallons/Foot
1" = 0.04
1.25" = 0.06

1.5" = 0.09
2" = 0.16

2.5" = 0.26
3" = 0.37

3.5" = 0.50
4" = 0.65

6" = 1.47

Well Information

Well Location:	Well Locked at Arrival: <input checked="" type="checkbox"/> / <input type="checkbox"/> No
Condition of Well:	Well Locked at Departure: <input checked="" type="checkbox"/> / <input type="checkbox"/> No
Well Completion: Flush Mount / Stick Up	Key Number To Well:

Groundwater Sampling Log

Project No. 30048392: 07F

Well ID MW-21-3S

Page 2 of 5

Date 11/4/2021

Project Name/Location Devens

Weather ~~Sunny~~

Weather Sunny

Well Material ✓ PVC
 SS

Measuring Pt. Description	Screen Interval (ft-bmp)	51.3	Casing Diameter (in.)	2	Well Material
Static Water Level (ft-bmp)	TDIC	13.47	Water Column/ Gallons in Well	47.83 ft - 7.45 gal	PVC SS
MP Elevation	Total Depth (ft-bmp)	61.3	Purge Method:	Low Flow	Sample Method
Pump On/Off	Pump Intake (ft-bmp)	56.3	Peristaltic	✓	Grab
	Volume Purged (gal)	2.38	Submersible		Other

Sample Time: Label _____ Replicate/ _____ Other _____
Start 2:00 pm Code No. _____
End 2:30 pm

PID : 0.4 ppm
Ferrous Iron: 0.06 mg/L
Total Iron: 0.35 mg/L > Not diluted
Sampled by Grace Shucker

Well Casing Volumes

Gallons/Foot $1'' = 0.04$
 $1.25'' = 0.06$

$$5'' = 0.26 \quad 3.5'' = 0.50 \quad 6'' = 1.47$$

Number

Proprietary

Well Information

Well Information

Well Location:

Condition of Well: _____

Well Locked at Arrival: Yes / No
Well Locked at Departure: Yes / No
Key Number To Well:

Groundwater Sampling Log

 Project No. 30048392.07F

 Well ID MW-21-3D

 Page 3 of 5

 Date 11/4/2021

 Project Name/Location Devens

 Weather Sunny

 Measuring Pt. T01C Screen Interval (ft-bmp) 65.9

 Casing Diameter (in.) 2

 Well Material PVC SS

 Static Water Level (ft-bmp) 13.15 Total Depth (ft-bmp) 75.9

 Water Column/
Gallons in Well (62.75 ft - 10.04 gal)

 MP Elevation Pump Intake (ft-bmp) 70.9

 Purge Method: Low Flow Sample Method Grab

 Pump On/Off 15:40 Volume Purged (gal) 3.14

 Peristaltic
Submersible
Other

 Sample Time: Label Start 17:00 Replicate/Code No.

 PID: ND
 Ferrous Iron: 0.81 mg/L Sampled by Grace Shacter
 Total Iron: 2.16 mg/L > Iron diluted x5 or 4:1 ratio
 Not yet calculated

Time	Minutes Elapsed	Rate (mL/min)	Depth to Water (ft)	Volume Purged (mL)	pH (SU)	Cond. (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp. (°C)	Redox (mV)	Appearance	
											Color	Odor
15:45	5	170	13.15	850	7.07	0.546	28.2	3.64	8.8	-40.7	No	No
15:50	10	170	13.15	1700	6.87	0.528	32.7	0.64	8.5	-55.8	No	No
15:55	15	170	13.15	2550	6.83	0.510	30.7	0.45	8.3	-64.1	"	"
16:00	20	170	13.15	3400	6.70	0.506	36.10	0.35	8.5	-70.1	"	"
16:05	25	170	13.15	4250	6.68	0.505	35.4	0.27	8.7	-72.8	"	"
16:10	30	170	13.15	5100	6.66	0.506	38.5	0.25	8.7	-75.4	"	"
16:15	35	170	13.15	5950	6.61	0.506	41.1	0.23	8.3	-77.2	"	"
16:20	40	170	13.15	6800	6.56	0.507	35.4	0.21	8.1	-78.8	"	"
16:25	45	170	13.15	7650	6.52	0.500	26.0	0.18	8.2	-80.1	"	"
16:30	50	170	13.15	8500	6.48	0.491	20.3	0.18	8.2	-80.7	"	"
16:35	55	170	13.15	9350	6.52	0.489	21.8	0.20	8.2	-81.3	"	"
16:40	60	170	13.15	10200	6.51	0.488	13.1	0.23	8.3	-81.4	"	"
16:45	65	170	13.15	11050	6.51	0.486	13.46	0.24	8.2	-82.0	"	"
16:50	70	170	13.15	11900	6.52	0.484	13.23	0.25	8.2	-80.1	"	"

Constituents Sampled
Container
Number
Preservative
See COC
Well Casing Volumes

 Gallons/Foot 1" = 0.04 1.5" = 0.09 2.5" = 0.26 3.5" = 0.50 6" = 1.47
 1.25" = 0.06 2" = 0.16 3" = 0.37 4" = 0.65

Well Information

Well Location:		Well Locked at Arrival:	<input checked="" type="checkbox"/> / <input type="checkbox"/> Yes
Condition of Well:		Well Locked at Departure:	<input checked="" type="checkbox"/> / <input type="checkbox"/> No
Well Completion:	Flush Mount / Stick Up	Key Number To Well:	<input checked="" type="checkbox"/> / <input type="checkbox"/> Yes

Groundwater Sampling Form



Project Number	30048392	Well ID	MW-21-4S	Date	11/04/2021
Project Name/Location	USACE NE Devens Seed TO 8a JV		Weather(°F)	46.9 degrees F and Clear. The wind is blowing undefined at 0.0 mph.	
Measuring Pt. Description	Top of Inner Casing	MP Elevation	Casing Diameter (in)	2	Well Casing Material
Static Water Level (ft-bmp)	12.58	Total Depth (ft-bmp)	59.8	Water Column (ft)	47.22
Purge Start	13:15	Pump Intake (ft-bmp)	54.8	Purge Method	Low-Flow
Purge End	14:05	Volumes Purged	0.34	Sample ID	MW-21-4S
Sample Time	14:05	Gallons Purged	2.64	Replicate/Code No.	NA
				Sample Type	Grab

Time	Minutes Elapsed	Total Elapsed Minutes	Rate mL/min	Depth to Water (ft)	Gallons Purged	pH (standard units)	Conductivity (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temperature °C	Appearance		
											Color	Odor	
13:20	0	0	200	12.70	0.26	6.15	0.652	19.8	1.5	11.7	-34.1	--	--
13:25	5	5	200	12.70	0.53	6.11	0.658	15.7	0.81	11.2	-41.6	--	--
13:30	5	10	200	12.70	0.79	6.22	0.654	12.2	0.67	11.2	-42.6	--	--
13:35	5	15	200	12.70	1.06	6.23	0.663	8.9	0.61	11.2	-40.3	--	--
13:40	5	20	200	12.70	1.32	6.23	0.649	2.73	0.55	11.1	-42.2	--	--
13:45	5	25	200	12.70	1.59	6.24	0.646	2.98	0.54	11.1	-42.1	--	--
13:55	10	35	200	12.70	2.11	6.26	0.65	2.48	0.5	11.1	-43.6	--	--
14:00	5	40	200	12.70	2.38	6.28	0.648	2.39	0.49	11.1	-43.9	Clear	None

Constituent Sampled	Container	Number	Preservative
See COC	NA	NA	NA

Comments:	Note: Sampler is red green color blind. PID - MiniRAE300 - SN: 592-000725 Turbidity Meter - LaMotte 2020WE - SN: 898-1711 Initial purge appearance - clear; initial purge odor - none. Final purge appearance - clear; final purge odor - none. Hach 850 colorimeter - SN:070150C51713 - using dilution factor of 5 for both ferrous and total Fe readings. Ferrous Fe - 1.25mg/L (direct instrument reading); total Fe - >3.30mg/L (direct instrument reading).
-----------	--

Well Casing Volume Conversion	
Well diameter (inches) = gallons per foot	1 = 0.04; 1.5 = 0.09; 2.5 = 0.26; 3.5 = 0.50; 6 = 1.47 1.25 = 0.06; 2 = 0.16; 3 = 0.37; 4 = 0.65

Well Information	
Well Location: South of ATP	Well Locked at Arrival: yes
Condition of Well: Good condition	Well Locked at Departure: yes

ft-bmp = feet below measuring point in = inches ft = feet mL/min = milliliters per minute	mS/cm = millisiemens per centimeter NTU = Nephelometric Turbidity Unit mg/L = milligrams per liter	mV = millivolts °F = degrees Fahrenheit °C = degrees Celsius
--	--	--

Groundwater Sampling Form



Project Number	30048392	Well ID	MW-21-4D	Date	11/04/2021
Project Name/Location	USACE NE Devens Seed TO 8a JV		Weather(°F)	48.0 degrees F and Clear. The wind is blowing SE at 3.4 mph.	
Measuring Pt. Description	Top of Inner Casing	MP Elevation	Casing Diameter (in)	2	Well Casing Material
Static Water Level (ft-bmp)	12.37	Total Depth (ft-bmp)	74.78	Water Column (ft)	62.41
Purge Start	15:25	Pump Intake (ft-bmp)	69.78	Purge Method	Low-Flow
Purge End	16:05	Volumes Purged	0.21	Sample ID	MW-21-4D
Sample Time	16:05	Gallons Purged	2.11	Replicate/Code No.	NA
				Sample Type	Grab

Time	Minutes Elapsed	Total Elapsed Minutes	Rate mL/min	Depth to Water (ft)	Gallons Purged	pH (standard units)	Conductivity (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temperature °C	Appearance		
											Color	Odor	
15:30	0	0	200	12.48	0.26	6.64	0.552	17.4	0.58	11.2	-80.6	--	--
15:35	5	5	200	12.52	0.53	6.62	0.52	11.21	0.37	10.8	-91.6	--	--
15:40	5	10	200	12.52	0.79	6.6	0.52	2.21	0.29	10.8	-93.5	--	--
15:45	5	15	200	12.52	1.06	6.61	0.52	1.1	0.26	10.7	-97.2	--	--
15:50	5	20	200	12.52	1.32	6.62	0.53	0.99	0.18	10.7	-98	--	--
15:55	5	25	200	12.52	1.59	6.61	0.521	1.07	0.18	10.7	-98.6	--	--
16:00	5	30	200	12.52	1.85	6.61	0.521	0.99	0.17	10.7	-98.1	Clear	None

Constituent Sampled	Container	Number	Preservative
See COC	NA	NA	NA

Comments:	Note: Sampler is red green color blind. Initial purge appearance - clear; initial purge odor - none. Final purge appearance - clear; final purge odor - none. Turbidity Meter - LaMotte 2020WE - SN: 898-1711 PID - MiniRAE300 - SN: 592-000725 Hach 850 colorimeter - SN:070150C51713 - Using dilution factor of 5 for both ferrous and total Fe readings. Ferrous Fe - .92mg/L (direct instrument reading); total Fe - 1.70mg/L (direct instrument reading).
-----------	--

Well Casing Volume Conversion	
Well diameter (inches) = gallons per foot	1 = 0.04; 1.5 = 0.09; 2.5 = 0.26; 3.5 = 0.50; 6 = 1.47 1.25 = 0.06; 2 = 0.16; 3 = 0.37; 4 = 0.65

Well Location:	South of ATP	Well Locked at Arrival:	yes
Condition of Well:	Good condition	Well Locked at Departure:	yes
Well Completion:	Stick-up	Key Number To Well:	2006

ft-bmp = feet below measuring point in = inches ft = feet mL/min = milliliters per minute	mS/cm = millisiemens per centimeter NTU = Nephelometric Turbidity Unit mg/L = milligrams per liter	mV = millivolts °F = degrees Fahrenheit °C = degrees Celsius
--	--	--

Site

GROUND-WATER SAMPLING LOG

Sampling Personnel: Grace Shockey
Client / Job Number: 30548392
Weather: Overcast

Well ID: SHM-10-00

Date: 11/22/2021

Date: 11/25/18
Time In: 9:25

Time Out: 1:18

Well Information

Depth to NAPL (TIC): (feet) LNAPL or DNAPL (circle if applies)
Depth to Water (TIC) 18.31 (feet)
Total Depth (TIC) 80.95 (feet)
Length of Water Column: 62.64 (feet)
Volume of Water in Well: 6.39 (gal)
Screen Length: 10 (ft)
Tubing Intake Depth: 75.95 (ft TIC)

Well Type:	Flushmount	Stick-Up	
Well Material:	Stainless Steel	PVC	
Well Locked:	Yes	No	
Measuring Point Marked:	Yes	No	
Well Diameter:	1"	2"	Other:

Purging Information

Purging Method:	Bailer	Peristaltic	Bladder	Other:
Tubing/Bailer Material:	St. Steel	Polyethylene	Teflon	Other:
Sampling Method:	Bailer-VOCS only	Peristaltic	Bladder	Other:
Duration of Pumping:	(min)	9:51 - 10:54		
Average Pumping Rate:	(ml/min)	162	Water-Quality Meter Type:	(Y) / (N)
Total Volume Removed:	(gal)	2.739	Did well go dry:	Yes (Y) / No (N)

Conversion Factors				
gal / ft. of water	1" ID	2" ID	4" ID	6" ID
	0.041	0.163	0.653	1.469
1 gal = 3,785 L = 3785 mL = 0.1337 cubic feet				

Unit Stability			
pH	DO	Cond.	ORP
±0.1	± 10%	± 3.0%	± 10 mV

Sonde Serial Number:

Sampling Information

Sampling Information		#	Laboratory
Analyses			
Sample ID:	SHM-10-06- ^{ent 2}	Sample Time:	10:40
MS/MSD:	Yes	No	
Duplicate:	Yes	No	
Duplicate ID	BD _____	Dup. Time:	
Rinse Blank	RBGW _____		
Chain of Custody Signed By:			

Problems / Observations

Ferrous Fe: 28.0 mg/L
Total Fe: 63.6 mg/L

Initial Purge:

Final Purge:

MinifAE 3600

PID: SN 592-601595

0 ppm

YSF SN: 19F103281

DR/820 Colorimeter

MW-21-1S - Event #2

11:04 - 12:09

11/23/2021

DTW: 15.16 ft

PJD: 0 ppm

Total Depth: 57.5 ft

Ferrous Fe: 0.04 mg/L

Water Column: 42.34 ft

Total Fe: 0.07 mg/L

Vol in well: 6.90 gal

Sample Time: 11:42

Pump On: 11:08

Pump Rate: 180 mL/min

Pump Off: 12:05

Stick-Up, PVC, 2" diameter

Total Vol Purged: 2.71

Time	11:13	11:18	11:23	11:28	11:33	11:38
Vol Pump	900	1800	2700	3600	4500	5400
Rate (ml/min)	180	180	180	180	180	180
DTW	15.79	15.86	15.84	15.78	15.77	15.77
pH	6.91	6.87	6.86	6.84	6.83	6.84
Temp °C	9.5	9.6	9.4	9.5	9.6	9.6
Cond. (ms/cm)	0.293	0.294	0.293	0.292	0.292	0.291
DO (mg/L)	8.07	8.15	8.28	8.27	8.34	8.25
ORP (mV)	-53.5	-57.0	-56.0	-54.0	-52.8	-53.6
Turb. (NTU)	285.31	472.3	308.11	182.22	149.83	153.24

MW-21-1D - Event #2

12:16-13:24

11/23/2021

DTW: 15.52 ft

PID: 0 ppm

Total Depth: 71.52 ft

Ferrous Fe: 0.9 mg/L

Water Col.: 56 ft

Total Fe: 2.6 mg/L

Vol. in Well: 9.128 gal

Sample Time: 13:03

Pump On: 12:19

Pump Rate: 174 mL/min

Pump Off: 13:20

Stick Up, PVC, 2" diameter

Total Vol Purged: 2.80 gal

Time	12:24	12:29	12:34	12:39	12:44	12:49	12:54	12:59	13:04
Vol Purg (mL)	870	1740	2610	3480	4350	5220	6090	6960	
Rate (mL/min)	174	174	174	174	174	174	174	174	
DTW	15.55	15.55	15.55	15.54	15.53	15.53	15.53	15.52	
pH	6.44	6.30	6.27	6.25	6.24	6.24	6.23	6.23	
Temp °C	9.7	9.8	9.7	9.9	9.5	9.6	9.6	9.6	
Cond. (mS/cm)	0.273	0.270	0.263	0.263	0.262	0.264	0.263	0.265	
DO (mg/L)	2.99	2.35	2.37	2.34	2.30	2.28	2.22	2.30	
ORP (mV)	-55.5	-60.4	-58.3	-58.6	-54.9	-53.9	-53.7	-55.0	
Turb. (NTU)	303.38	416.48	159.08	62.71	159.73	218.41	230.13	215.52	

MW-21-2S - Event #2

9:19 AM - ~~to~~ 11:02

11/23/2021

DTW : 14.35 ft

PID: 0 ppm

Total Depth: 62.14 ft

Ferric Fe: 2.6 mg/L

Water Column: 47.79

Total Fe: 3.9 mg/L

Volume in Well: 7.79 gal

Sample Time: 10:47

Pump On: 9:34 AM

Pump Rate: 140 mL/min

Pump Off: ~~to~~ 11:01 AM

Stick Up, PVC, 2" Diameter

Total Vol Purgd: 3.22 gal

Pump stopped
briefly

Time	9:39	9:44	9:49	9:54	9:59	10:04	10:09	10:14	10:19	10:24	10:29	10:34
Vol Purgd (ml)	700	1400	2100	2800	3500	4200	4900	5600	6300	7000	7700	8400
Rate (mL/min)	140	140	140	140	140	140	140	140	140	140	140	140
DTW	14.35	14.35	14.35	14.35	14.35	14.35	14.35	14.35	14.35	14.35	14.35	14.35
pH	6.61	6.49	6.44	6.40	6.37	6.36	6.37	6.36	6.35	6.40	6.40	6.36
Temp °C	9.7	9.4	9.8	9.9	10.0	10.0	10.1	10.0	10.1	9.7	9.6	9.6
Cond. (mS/cm)	0.388	0.377	0.353	0.328	0.325	0.320	0.322	0.301	0.302	0.314	0.313	0.301
DO (mg/L)	5.81	5.19	4.86	4.26	3.87	3.62	3.77	3.65	3.59	3.91	3.86	3.43
ORP (mV)	-59.0	-58.5	-65.9	-74.6	-70.4	-76.3	-78.9	-80.9	-77.6	-73.1	-76.8	-80.0
Turb. (NTU)	205.6	155.56	177.93	201.55	264.12	203.86	24.53	25.99	23.93	158.57	189.97	346.76

Cont.

Time	10:38	10:41	10:44
Vol Purgd	9100	9800	10,500
Rate	140	140	140
DTW	14.35	14.34	14.35
pH	6.31	6.28	6.30
Temp	9.7	9.7	9.7
Cond.	0.298	0.305	0.295
DO	3.22	3.01	3.06
ORP	-78.5	-73.7	-75.6
Turb	186.31	196.44	193.61

• Pump dried briefly as shown above

• See 11/22 Wells for equipment serial #'s

Groundwater Sampling Form



Project Number	30048392	Well ID	MW-21-2D	Date	11/22/2021 12:00:00 AM
Project Name/Location	USACE NE Devens Seed TO 8a JV		Weather(°F)	51.1 degrees F and Partly Cloudy. The wind is blowing W/NW at 6.9 mph.	
Measuring Pt. Description	Top of Inner Casing	MP Elevation	Casing Diameter (in)	2	Well Casing Material PVC
Static Water Level (ft-bmp)	14.30	Total Depth (ft-bmp)	76.22	Water Column (ft)	61.92 Gallons in Well 10.06
Purge Start	13:55	Pump Intake (ft-bmp)	71.22	Purge Method Low-Flow	Purge Equipment Peristaltic
Purge End	14:55	Volumes Purged	0.24	Sample ID MW-21-2D	Sampled by Desmond Bedard
Sample Time	14:55	Gallons Purged	2.38	Replicate/Code No. NA	Sample Type Grab

Time	Minutes Elapsed	Total Elapsed Minutes	Rate mL/min	Depth to Water (ft)	Gallons Purged	pH (standard units)	Conductivity (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temperature °C	Redox (mV)	Appearance	
												Color	Odor
14:00	0	0	150	14.32	0.20	6.49	0.292	7.33	1.1	11.7	-55.6	--	--
14:05	5	5	150	14.32	0.40	6.55	0.29	14.98	0.65	11.6	-71.9	--	--
14:10	5	10	150	14.32	0.59	6.55	0.292	16.64	0.6	11.5	-75.9	--	--
14:15	5	15	150	14.32	0.79	6.59	0.29	11.03	0.53	11.5	-80.1	--	--
14:20	5	20	150	14.32	0.99	6.6	0.29	12.3	0.49	11.3	-81.7	--	--
14:25	5	25	150	14.32	1.19	11.6	0.289	13.49	0.49	11.2	-82.5	--	--
14:30	5	30	150	14.32	1.39	6.6	0.29	13.33	0.52	11.3	-81.9	--	--
14:35	5	35	150	14.32	1.59	6.6	0.29	18.87	0.46	11.3	-82.7	--	--
14:40	5	40	150	14.32	1.78	6.59	0.29	16.67	0.43	11.3	-83.4	--	--
14:45	5	45	150	14.32	1.98	6.6	0.29	16.44	0.42	11.3	-84.4	--	--
14:50	5	50	150	14.32	2.18	6.61	0.29	16.39	0.42	11.3	-84.8	Clear	None

Constituent Sampled	Container	Number	Preservative
See COC	NA	NA	NA

ft-bmp = feet below measuring point
 in = inches
 ft = feet
 mL/min = milliliters per minute

mS/cm = millSiemens per centimeter
 NTU = Nephelometric Turbidity Unit
 mg/L = milligrams per liter

mV = millivolts
 °F = degrees Fahrenheit
 °C = degrees Celsius

Groundwater Sampling Form



Comments: Note: Sampler is red/green color blind.

PID = MiniRAE 3000 SN: 592-601595.

Colorimeter = HACH DR850 SN: 070150C51713.
Direct instrument reading with DF of 10 - ferrous Fe = 2.21mg/L
Direct instrument reading with DF of 10 - total Fe = >3.30mg/L

Initial purge appearance - clear; initial purge odor - none.

Final purge appearance - clear; final purge odor - none.

Well Casing Volume Conversion

Well diameter (inches) = gallons per foot 1 = 0.04; 1.5 = 0.09; 2.5 = 0.26; 3.5 = 0.50; 6 = 1.47
 1.25 = 0.06; 2 = 0.16; 3 = 0.37; 4 = 0.65

Well Information

Well Location:

Well Locked at Arrival:

Condition of Well:

Well Locked at Departure:

Well Completion: NA

Key Number To Well: NA

ft-bmp = feet below measuring point
in = inches
ft = feet
mL/min = milliliters per minute

mS/cm = millisiemens per centimeter
NTU = Nephelometric Turbidity Unit
mg/L = milligrams per liter

mV = millivolts
°F = degrees Fahrenheit
°C = degrees Celsius

MW-21-3S

DTW - 14.48 ft

Total Depth - 61.3 ft

PID - 0 ppm

Ferrous Fe: 5.0 mg/L

Total Fe: 6.6

13:30 - 14:57

11/22/2021

Rate (ml/min)

Duration: 13:41 - 14:45

(Pump on)

Total Volume Purgd: 3.11 gal

Sample Time: 14:30

Water Column: 46.82 ft

Volume in well: 7.63 gal

Time:	13:46	13:51	13:56	14:01	14:06	14:11	14:16	14:21	14:26	14:31
Vol. Purgd (ml)	920	1840	2760	3680	4600	5520	6440	7360		
Rate (ml/min)	184	184	184	184	184	184	184	184		
DTW	14.53	14.54	14.54	14.54	14.54	14.54	14.54	14.54		
pH	6.39	6.35	6.31	6.30	6.29	6.28	6.27	6.26		
Temp. °C	10.9	10.8	10.8	10.7	10.7	10.7	10.6	10.6		
Conduct. (μS/cm)	0.282	0.277	0.258	0.249	0.254	0.244	0.242	0.243		
DO (mg/L)	10.92	10.51	9.24	8.47	9.90	8.26	8.07	8.11		
ORP (mV)	-75.0	-85.0	-93.2	-94.5	-98.0	-101.4	-101.7	-100.4		
Turb. (NTU)	314.8	302.8	295.6	105.32	319.54	270.34	286.24	291.5		

Groundwater Sampling Form



Project Number 30048392 **Well ID** MW-21-4S **Date** 11/22/2021 12:00:00 AM

Project Name/Location	USACE NE Devens Seed TO 8a JV		Weather(°F)	51.1 degrees F and Clear. The wind is blowing W at 8.1 mph.			
Measuring Pt. Description	Top of Inner Casing		MP Elevation		Casing Diameter (in)	2	Well Casing Material
Static Water Level (ft-bmp)	13.59	Total Depth (ft-bmp)		59.8	Water Column (ft)	46.21	Gallons in Well
Purge Start	09:45	Pump Intake (ft-bmp)		54.8	Purge Method	Low-Flow	Purge Equipment
Purge End	10:25	Volumes Purged		0.22	Sample ID	MW-21-4S-EVENT#2	Sampled by
Sample Time	10:25	Gallons Purged		1.65	Replicate/Code No.	MW-21-4S-EVENT#2-MS and MW-21-4S-EVENT#2-MSD	Sample Type

Time	Minutes Elapsed	Total Elapsed Minutes	Rate mL/min	Depth to Water (ft)	Gallons Purged	pH (standard units)	Conductivity (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temperature °C	Redox (mV)	Appearance	
												Color	Odor
09:50	0	0	200	13.63	0.26	6.23	0.472	280.3	1.63	11.3	-52.3	--	--
09:55	5	5	150	13.63	0.46	6.24	0.473	174.97	1.18	11.5	-49.2	--	--
10:00	5	10	150	13.63	0.66	6.25	0.476	136.2	1.14	11.5	-49.3	--	--
10:05	5	15	150	13.63	0.86	6.27	0.481	130.22	1.14	11.6	-50.6	--	--
10:10	5	20	150	13.63	1.06	6.28	0.484	159.3	1.16	11.6	-51.2	--	--
10:15	5	25	150	13.63	1.25	6.29	0.486	155.74	1.19	11.6	-50.2	--	--
10:20	5	30	150	13.63	1.45	6.31	0.485	156.76	1.25	11.6	-47.9	Yellow	None

Comments: Note: Sampler is red/green color blind.

PID = MiniRAE 3000 SN: 592-601595.

Colorimeter = HACH DR850 SN: 070150C51713.

Direct instrument reading with DF of 10 - ferrous Fe = 1.51mg/L

Direct instrument reading with DF of 20 - total Fe = 1.38mg/L

Initial purge appearance - yellow haze; initial purge odor - none.

Final purge appearance - yellow haze; final purge odor - none.

Well Casing Volume Conversion

Well diameter (inches) = gallons per foot $1 = 0.04; 1.5 = 0.09; 2.5 = 0.26; 3.5 = 0.50; 6 = 1.47$
 $1.25 = 0.06; 2 = 0.16; 3 = 0.37; 4 = 0.65$

ft-bmp = feet below measuring point
in = inches
ft = feet
mL/min = milliliters per minute

mS/cm = millSiemens per centimeter
NTU = Nephelometric Turbidity Unit
mg/l = milligrams per liter

mV = millivolts
°F = degrees Fahrenheit
°C = degrees Celsius

Groundwater Sampling Form



Well Information

Well Location:

Well Locked at Arrival:

Condition of Well:

Well Locked at Departure:

Well Completion: NA

Key Number To Well: NA

ft-bmp = feet below measuring point
in = inches
ft = feet
mL/min = milliliters per minute

mS/cm = millSiemens per centimeter
NTU = Nephelometric Turbidity Unit
mg/L = milligrams per liter

mV = millivolts
°F = degrees Fahrenheit
°C = degrees Celsius

Groundwater Sampling Form



Project Number	30048392	Well ID	MW-21-4D	Date	11/22/2021 12:00:00 AM
Project Name/Location	USACE NE Devens Seed TO 8a JV	Weather(°F)			
Measuring Pt. Description	Top of Inner Casing	MP Elevation	Casing Diameter (in)	2	Well Casing Material PVC
Static Water Level (ft-bmp)	13.31	Total Depth (ft-bmp)	74.78	Water Column (ft)	61.47
Purge Start	12:05	Pump Intake (ft-bmp)	69.78	Purge Method	Low-Flow
Purge End	12:50	Volumes Purged	0.18	Sample ID	MW-21-4D-EVENT#2
Sample Time	12:50	Gallons Purged	1.78	Replicate/Code No.	NA
				Sample Type	Grab

Time	Minutes Elapsed	Total Elapsed Minutes	Rate mL/min	Depth to Water (ft)	Gallons Purged	pH (standard units)	Conductivity (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temperature °C	Appearance		
											Color	Odor	
12:10	0	0	150	13.32	0.20	6.73	0.468	17.78	1.76	12.1	-97.8	--	--
12:15	5	5	150	13.32	0.40	6.62	0.468	16.11	0.67	11.7	-98.8	--	--
12:20	5	10	150	13.32	0.59	6.61	0.469	16.46	0.61	11.7	-99.5	--	--
12:25	5	15	150	13.32	0.79	6.61	0.471	11.21	0.56	11.7	-101	--	--
12:30	5	20	150	13.32	0.99	6.6	0.472	8.55	0.54	11.6	-102.2	--	--
12:35	5	25	150	13.32	1.19	6.6	0.471	7.54	0.51	11.7	-103.1	--	--
12:40	5	30	150	13.32	1.39	6.6	0.471	7.79	0.5	11.6	-103.4	--	--
12:45	5	35	150	13.32	1.59	6.6	0.471	7.76	0.49	11.6	-103.5	Clear	None

Constituent Sampled	Container	Number	Preservative
See COC	NA	NA	NA

Comments: Note: Sampler is red/green color blind.
 PID = MiniRAE 3000 SN: 592-601595.

Colorimeter = HACH DR850 SN: 070150C51713.
 Direct instrument reading with DF of 10 - ferrous Fe = 2.83mg/L
 Direct instrument reading with DF of 20 - total Fe = >3.30mg/L

Initial purge appearance - clear; initial purge odor - none.

Final purge appearance - clear; final purge odor - none.

Well Casing Volume Conversion

ft-bmp = feet below measuring point
 in = inches
 ft = feet
 mL/min = milliliters per minute

mS/cm = millisiemens per centimeter
 NTU = Nephelometric Turbidity Unit
 mg/L = milligrams per liter

mV = millivolts
 °F = degrees Fahrenheit
 °C = degrees Celsius

Groundwater Sampling Form



Well diameter (inches) = gallons per foot 1 = 0.04; 1.5 = 0.09; 2.5 = 0.26; 3.5 = 0.50; 6 = 1.47
1.25 = 0.06; 2 = 0.16; 3 = 0.37; 4 = 0.65

Well Information

Well Location:

Well Locked at Arrival:

Condition of Well:

Well Locked at Departure:

Well Completion: NA

Key Number To Well: NA

ft-bmp = feet below measuring point
in = inches
ft = feet
mL/min = milliliters per minute

mS/cm = millSiemens per centimeter
NTU = Nephelometric Turbidity Unit
mg/L = milligrams per liter

mV = millivolts
°F = degrees Fahrenheit
°C = degrees Celsius

Groundwater Sampling Log

Project No.	30048392		Well ID	SHM-10-06 - Event #3		Date	12/13/2021	
Project Name/Location	SHL AS Pilot Test Devns					Weather	Overcast	
Measuring Pt. Description	Screen Interval (ft-bmp)	71.27	Casing Diameter (in.)	2"		Well Material	PVC	
Static Water Level (ft-bmp)	18.98	Total Depth (ft-bmp)	81.27	Water Column/ Gallons in Well	62.29', 9.97 gal		SS	
MP Elevation		Pump Intake (ft-bmp)	~710.27	Purge Method:	Peristaltic	Sample Method	Grab	
Pump On/Off	9:57 - 10:49	Volume Purged (gal)		Submersible				
Sample Time:	Label SHM-10-06	-Event #3	Replicate/	Other				
Start	10:33	Code No.						
End	10:42							
Sampled by Grace She								

Sampled by Grace Shucker

Constituents Sampled	Container	Number	Preservative
Total Metals	_____	_____	_____
Dissolved Metals	_____	_____	_____
Alkalinity	_____	_____	_____
TDS	_____	_____	_____
YSI SN: 19F101438	_____	_____	_____

Well Casing Volumes					
Gallons/Foot	1" = 0.04 1.25" = 0.06	1.5" = 0.09 2" = 0.16	2.5" = 0.26 3" = 0.37	3.5" = 0.50 4" = 0.65	6" = 1.47

Groundwater Sampling Log

Project No.	30048392		Well ID	MW-21-1S -Event #3	Page <u>2</u> of <u>2</u>
Project Name/Location	SHL ASP:bf Devns				Date <u>12/14/2021</u>
Measuring Pt. Description	Screen Interval (ft-bmp)	~47.5	Casing Diameter (in.)	2"	Weather
Static Water Level (ft-bmp)	<u>16.05</u>	Total Depth (ft-bmp)	57.5	Water Column/ Gallons in Well	41.45', 6.632 gal
MP Elevation	Pump Intake (ft-bmp)	~52.5	Purge Method:	Peristaltic <input checked="" type="checkbox"/>	Sample Method
Pump On/Off	Pump On/Off Time	11:16-12:23	Volume Purged (gal)	11,256 gal	Grab
Sample Time:	Label	Replicate/Code No.		Submersible <input type="checkbox"/>	
	Start	12:03		Other <input type="checkbox"/>	
	End	12:15			
					Sampled by <u>Grace Stock</u>

Constituents Sampled	Container	Number	Preservative
See page 1			
PID = 0.0 ppm			

Well Casing Volumes					
Gallons/Foot	1" = 0.04	1.5" = 0.09	2.5" = 0.26	3.5" = 0.50	6" = 1.47
	1.25" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65	

Well Information

Well Location: _____ Well Locked at Arrival: Yes / No
Condition of Well: Very Good Well Locked at Departure: Yes / No
Well Completion: Flush Mount / Stick Up Key Number To Well: 200c

Groundwater Sampling Log

Project No.	30048392		Well ID	MW-21-1D - Event #3	Page <u>1</u> of <u>1</u>
Project Name/Location	SHL AS Pilot Devns		Date	12/14/2021	
Measuring Pt. Description	Screen Interval (ft-bmp)	~(61.5)	Casing Diameter (in.)	2"	Weather Sunny
Static Water Level (ft-bmp)	Total Depth (ft-bmp)	16.37	Water Column/ Gallons in Well	71.5	PVC
MP Elevation	Pump Intake (ft-bmp)	~(66.5)	Purge Method:	55.13', 8.82 gal	SS
Pump On/Off	Volume Purged (gal)	9:55-11:01	Peristaltic	10,956 gal	Grab
Sample Time:	Label Start	Replicate/ Code No.	Submersible	Other	Sample Method
	End				Sampled by Grace Shuck

Sampled by Grace Shuckler

Constituents Sampled

Alkalinity, TDS, Total Metals,
Dissolved Metals, BOD

Container

Number

Preservative

ProQuatroSYI SN: 21G103950

La Motte Turb SN:5005-4214

850 Colorimeter SN: 070150C51713

PID = 0.0 ppm

Well Casing Volumes

Gallons/Foot $1^{\prime \prime} = 0.04$
 $1.25^{\prime \prime} = 0.06$

$$1.5^\circ = 0.09$$

$$3^\circ = 0.37$$

$$4^\circ = 0.65$$

$$6'' = 1.47$$

Well Information

Well Location:

Condition of Well:

Very good

Well Locked at Arrival:

Yes / No

Yes / No

200e

Groundwater Sampling Form



Project Number	30048392	Well ID	MW-21-2S	Date	12/14/2021
Project Name/Location	USACE NE Devens Seed TO 8a JV		Weather(°F)	48.0 degrees F and Clear. The wind is blowing NW at 11.4 mph.	
Measuring Pt. Description	Top of Inner Casing	MP Elevation	Casing Diameter (in)	2	Well Casing Material
Static Water Level (ft-bmp)	14.82	Total Depth (ft-bmp)	62.11	Water Column (ft)	47.29
Purge Start	12:25	Pump Intake (ft-bmp)	57.11	Purge Method	Low-Flow
Purge End	13:10	Volumes Purged	0.25	Sample ID	MW-21-2S-EVENT#3
Sample Time	13:10	Gallons Purged	1.92	Replicate/Code No.	NA
				Sample Type	Grab

Time	Minutes Elapsed	Total Elapsed Minutes	Rate mL/min	Depth to Water (ft)	Gallons Purged	pH (standard units)	Conductivity (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temperature °C	Appearance		
											Color	Odor	
12:30	0	0	250	14.84	0.33	6.58	0.496	74.2	5.39	11.5	56.1	--	--
12:40	10	10	150	14.84	0.73	6.64	0.311	57.9	4.83	11.5	40.9	--	--
12:45	5	15	150	14.84	0.92	6.64	0.443	31.3	4.6	11.6	39.8	--	--
12:50	5	20	150	14.84	1.12	6.65	0.415	21.3	4.22	11.6	36.3	--	--
12:55	5	25	150	14.84	1.32	6.66	0.401	18.2	4.09	11.6	36.6	--	--
13:00	5	30	150	14.84	1.52	6.67	0.399	17.7	4.07	11.6	34.7	--	--
13:05	5	35	150	14.84	1.69	6.66	0.398	17.9	4.04	11.6	34.8	Clear	None

Constituent Sampled	Container	Number	Preservative
See COC	NA	4	NA

Comments:	PID: MiniRAE 3000 - SN: 592-911951 Note: Sampler is red/green color blind. Initial purge appearance - slight yellow (checked with G. Sheckler) haze; initial purge odor - none. Final purge appearance - clear and colorless; final purge odor - none. Colorimeter: Hach DR 850 - SN: 070150C51713 Direct instrument ferrous iron reading with DF=4: 0.66mg/L Direct instrument total iron reading with DF=4: 1.03 mg/L
-----------	---

Well Casing Volume Conversion

Well diameter (inches) = gallons per foot $1 = 0.04; 1.5 = 0.09; 2.5 = 0.26; 3.5 = 0.50; 6 = 1.47$
 $1.25 = 0.06; 2 = 0.16; 3 = 0.37; 4 = 0.65$

Well Information

Well Location:	Well Locked at Arrival:
Condition of Well:	Well Locked at Departure:
Well Completion: NA	Key Number To Well: NA

ft-bmp = feet below measuring point
in = inches
ft = feet
mL/min = milliliters per minute

mS/cm = millisiemens per centimeter
NTU = Nephelometric Turbidity Unit
mg/L = milligrams per liter

mV = millivolts
°F = degrees Fahrenheit
°C = degrees Celsius

Groundwater Sampling Form



Project Number	30048392	Well ID	MW-21-2D	Date	12/14/2021
Project Name/Location	USACE NE Devens Seed TO 8a JV		Weather(°F)	36.0 degrees F and Clear. The wind is blowing undefined at 0.0 mph.	
Measuring Pt. Description	Top of Inner Casing	MP Elevation	Casing Diameter (in)	2	Well Casing Material
Static Water Level (ft-bmp)	15.20	Total Depth (ft-bmp)	76.16	Water Column (ft)	60.96
Purge Start	10:25	Pump Intake (ft-bmp)	71.16	Purge Method	Low-Flow
Purge End	11:15	Volumes Purged	0.20	Sample ID	MW-21-2D-EVENT#3
Sample Time	11:15	Gallons Purged	1.98	Replicate/Code No.	AS-DUP-EVENT#3
Sample Type	Grab				

Time	Minutes Elapsed	Total Elapsed Minutes	Rate mL/min	Depth to Water (ft)	Gallons Purged	pH (standard units)	Conductivity (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temperature °C	Appearance		
											Color	Odor	
10:40	0	0	150	15.20	0.59	6.16	0.227	111.2	6.47	11.4	66.4	--	--
10:45	5	5	150	15.20	0.79	6.22	0.237	89.3	5.93	11.5	53	--	--
10:50	5	10	150	15.20	0.99	6.36	0.236	89.7	6.25	11.5	49.1	--	--
10:55	5	15	150	15.20	1.19	6.31	0.237	88.9	6.49	11.5	53.3	--	--
11:05	10	25	150	15.20	1.59	6.26	0.236	90.2	6.52	11.5	54.3	--	--
11:10	5	30	150	15.20	1.78	6.26	0.236	91.3	6.66	11.5	54.5	Yellow	None

Constituent Sampled	Container	Number	Preservative
See COC	NA	4	NA

Comments:	PID: MiniRAE 3000 - SN: 592-911951 Note: Sampler is red/green color blind. Initial purge appearance - mild yellow (check with G. Sheckler) haze; initial purge odor - none. Final purge appearance - mild yellow (checked with G. Sheckler) haze; final purge odor - none. Colorimeter: Hach DR 850 - SN: 070150C51713 Direct instrument ferrous iron reading with no dilution: 1.48mgL Direct instrument total iron reading with DF=5: 0.97mg/L
-----------	--

Well Casing Volume Conversion
Well diameter (inches) = gallons per foot $1 = 0.04; 1.5 = 0.09; 2.5 = 0.26; 3.5 = 0.50; 6 = 1.47$ $1.25 = 0.06; 2 = 0.16; 3 = 0.37; 4 = 0.65$

Well Information
Well Location:
Condition of Well:
Well Completion: NA
Well Locked at Arrival:
Well Locked at Departure:
Key Number To Well: NA

ft-bmp = feet below measuring point in = inches ft = feet mL/min = milliliters per minute	mS/cm = millisiemens per centimeter NTU = Nephelometric Turbidity Unit mg/L = milligrams per liter	mV = millivolts °F = degrees Fahrenheit °C = degrees Celsius
--	--	--

Groundwater Sampling Log

Project No.	<u>30048392</u>	Well ID	<u>MW-21-3S</u> - Event #3	Date	<u>12/13</u>	
Project Name/Location	<u>SHL Air Sparge Pilot Test Devens</u>			Weather	<u>Sunny</u>	
Measuring Pt. Description	Screen Interval (ft-bmp)	<u>51 - 61</u>	Casing Diameter (in.)	<u>2"</u>	Well Material	<u>S</u>
Static Water Level (ft-bmp)	<u>15.41</u>	Total Depth (ft-bmp)	<u>61.21</u>	Water Column/ Gallons in Well	<u>45.8", 7.328</u>	
MP Elevation	Pump Intake (ft-bmp)		<u>56.21</u>	Purge Method:	<u>Peristaltic</u>	
Pump On/Off	Volume Purged (gal)		<u>10200 mL</u>	<u>Submersible</u>	Sample Method	
Sample Time: Label	Event #3			<u>Other</u>	<u>Grab</u>	
Start	<u>14:25</u>	Code No.				
End	<u>14:40</u>					
Sampled by <u>Grace</u>						

Sampled by Grace Sheller

Constituents Sampled	Container	Number	Preservative
YSI SN: 19F101436			

Well Casing Volumes

Gallons/Foot $1'' = 0.04$
 $1.25'' = 0.06$

9

$$3'' = 0.37$$

$$3.5'' = 0.50$$

$$6'' = 1.47$$

Well Information

Well Location:

Condition of Well:

Very Good

Well Locked at Arrival:

Yes

No

Condition of Well.

Well Completion:

Flush Mount

Stick Up

Well Locked at Departure:

Yes

No

Key Number To Well: 2006

Key Number To Well: 2006

Groundwater Sampling Log

Project No.	30048392		Well ID	MW-21-3D - Event #3	Date	12/14/2021
Project Name/Location	SHL AS Pilot Drivens				Weather	Sunny
Measuring Pt. Description	Screen Interval (ft-bmp)	~65.37	Casing Diameter (in.)	2"	Well Material	<input checked="" type="checkbox"/> PVC <input type="checkbox"/> SS
Static Water Level (ft-bmp)	14.63	Total Depth (ft-bmp)	75.37	Water Column/ Gallons in Well	10.74', 9,7184 gal	
MP Elevation		Pump Intake (ft-bmp)	~70.37	Purge Method:	<input type="checkbox"/> Peristaltic <input checked="" type="checkbox"/> Submersible <input type="checkbox"/> Other	Sample Method
Pump On/Off	12:44 - 13:45	Volume Purged (gal)	10,492 mL			Grab
Sample Time:	Label	Replicate/ Code No.				
Start	13:25					
End	13:42					
Sampled by Grace Sher						

Well Casing Volumes					
Gallons/Foot	1" = 0.04	1.5" = 0.09	2.5" = 0.26	3.5" = 0.50	6" = 1.47
	1.25" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65	

Well Information

Well Information		Well Location:	Well Locked at Arrival:	Yes / No
Condition of Well:		V good	Well Locked at Departure:	Yes / No
Well Completion:		Flush Mount / Stick Up	Key Number To Well:	2006

Groundwater Sampling Log

Project No.	<u>30048392</u>	Well ID	<u>MW-21-4S -Event #3</u>	Page	<u>of</u>		
Project Name/Location	<u>SHL Air Sparge Pilot Test Devens</u>			Date	<u>12/13/21</u>		
Measuring Pt. Description	Screen Interval (ft-bmp)	<u>49.74</u>	Casing Diameter (in.)	<u>2"</u>	Weather	<u>Sunny</u>	
Static Water Level (ft-bmp)	<u>14.12</u>	Total Depth (ft-bmp)	<u>59.74</u>	Water Column/ Gallons in Well	<u>45.62', 7.299 gal</u>	Well Material	<input checked="" type="checkbox"/> PVC <input type="checkbox"/> SS
MP Elevation		Pump Intake (ft-bmp)	<u>54.74</u>	Purge Method:	<input type="checkbox"/> Peristaltic <input checked="" type="checkbox"/> Submersible <input type="checkbox"/> Other	Sample Method	<u>Grab</u>
Pump On/Off	<u>12:41 - 13:36</u>	Volume Purged (gal)					
Sample Time:	Label MW-21-4S-Event #3 Replicate/ Start <u>13:21</u> Code No. End <u>13:34</u>			Sampled by <u>Grace Shockey</u>			

Well Casing Volumes

Gallons/Foot	1" = 0.04	1.5" = 0.09	2.5" = 0.26	3.5" = 0.50	6" = 1.47
	1" = 0.10	1.5" = 0.16	2.5" = 0.33	3.5" = 0.60	6" = 1.47

Wall Information

Well Information
Well Location: _____ Well Locked at Arrival: Yes / No
Condition of Well: Very Good Well Locked at Departure: Yes / No
Well Completion: Flush Mount / Stick Up Key Number To Well: 2006

Ferrars Fe	Total Fe	DTW (Day 2)
0.60 0.04	0.19	15.94
0.60	3.10	16.58
		15.00
		15.20
0.8	2.2	15.52
20.7	43.2	14.87
3.0	4.4	14.22
17.4	71.2	14.00
16.6	54.8	

~~System Off~~ System Off - 8:33 System On - 14:55
(mg/L)

	DTWA	PID (ppm)	Ferric Fe	Total Fe
MW-21-1S	15.05	0.0		
MW-21-1D	16.3	0.0		
MW-21-2S	15.18	0.0		
MW-21-2D	15.6	0.0		
MW-21-3S	15.24	0.0	0.8	2.2
MW-21-3D	15.22	0.0		
M-21-4S	14.0	0.0	3.0	4.4
MW-21-4D	14.11	0.0	17.4	71.2
SHM-10-06	18.98	0.0	16.6	54.8

Minirae 3000 SN: PGM7320 592-911951

YSI SN: 19F101438

YSI SN: 21G103950

Turb# SN: 5005-4214

YS1 Pro Plus DSN: 18H100353

MinIRAE3000 PID → SN: 592- 913073

Geo tech Turbidity Meter -> SN: 21073404



**Design & Consultancy
for natural and
built assets**

Groundwater Sampling Log

Project No.	30048342.07F		Well ID	SHM-10-06	Date	12/28/2021	
Project Name/Location	Devers AS Pilot				Weather	Cloudy; 34°F; Windy	
Measuring Pt. Description	601C	Screen Interval (ft-bmp)	71.35-81.35	Casing Diameter (in.)	1.5	Well Material	<input checked="" type="checkbox"/> PVC <input type="checkbox"/> SS
Static Water Level (ft-bmp)	18.41	Total Depth (ft-bmp)	81.35	Water Column/ Gallons in Well			
MP Elevation		Pump Intake (ft-bmp)	76.35	Purge Method:	Low flow	Sample Method	Grab
Pump On/Off	13:15	Volume Purged (gal)		Peristaltic	<input checked="" type="checkbox"/>		
Sample Time:	Label 14:05	Replicate/ Code No.	N/A	Submersible	<input type="checkbox"/>		
Start				Other	<input type="checkbox"/>		
End							
				PTD @ 100 ft/min = 100 ft			Sampled by D Bedard

Constituents Sampled

See 10c

Container

Number

Page 41

Hach Colorimeter →
(SN:070150(51413))

Well Casing Volumes

Well Casing Volumes

$$1.5'' = 0.09$$
$$2'' = 0.16$$

$$2.5'' = 0.26$$
$$3'' = 0.37$$

$$3.5" = 0.50$$

6" = 147

Well Information

Well Location:

Condition of Well:

Well Completion: Flush Mount / Stick Up

Well Locked at Arrival: Yes _____ / No _____

Well Locked at Departure: Yes / No

Key Number To Well:

YSJ Pro Plus -DSN: Z16-100170

Geotech Turbidimeter - SN: 21073404

MiniRAE 3000 PID+DSN: 592-913073



**Design & Consultancy
for natural and
built assets**

Groundwater Sampling Log

Project No.	30048392.07F		Well ID	MW-21-1S	Date	12/29/21	
Project Name/Location	Devers AS Pilot		Weather	Overcast; 38°F			
Measuring Pt. Description	toic	Screen Interval (ft-bmp)	47.44-57.44	Casing Diameter (in.)	2	Well Material	<input checked="" type="checkbox"/> PVC <input type="checkbox"/> SS
Static Water Level (ft-bmp)	14.90	Total Depth (ft-bmp)	57.44	Water Column/ Gallons in Well			
MP Elevation		Pump Intake (ft-bmp)	52.44	Purge Method:	Low Slow <input checked="" type="checkbox"/> Peristaltic Submersible Other	Sample Method	Grab
Pump On/Off	11:00/11:35	Volume Purged (gal)					
Sample Time:	Label Start End	11:35	Replicate/ Code No.	N/A			Sampled by D Bedard
PID at well head = non detect							

Constituents Sampled	Container	Number	Preservative
See COL	_____	_____	_____
Hach DR850 (colorimeter) (SN: 070150 (5/73))	→ Total iron direct instrument reading with no dilution = No detection Ferrous iron direct instrument reading with no dilution = No detection	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

Well Casing Volumes

Gallons/Foot $1'' = 0.04$
 $1.25'' = 0.06$

$$2'' = 0.16$$

$$2.5" = 0.26$$
$$3" = 0.37$$

$$3.5" = 0.50$$

$$6'' = 1.47$$

Well Information

Well Information:

Well Location:	____		Well Locked at Arrival:	Yes	/	No
Condition of Well:	____		Well Locked at Departure:	Yes	/	No
Well Completion:	Flush Mount	/	Stick Up	Key Number To Well:		

YSI ProPlus - DSN: 216-100170
PID = MiniRAE 3000 - DSN: 592-913073

Geotech turbidimeter - PSN: 21073404

 ARCADIS

**Design & Consultancy
for natural and
built assets**

Groundwater Sampling Log

Well Casing Volumes					
Gallons/Foot	1" = 0.04	1.5" = 0.08	2.5" = 0.26	3.5" = 0.50	6" = 1.47
1.25" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65		

Well Information

Well Location: _____ Well Locked at Arrival: Yes / No
Condition of Well: _____ Well Locked at Departure: Yes / No
Well Completion: Flush Mount / Stick Up Key Number To Well: _____

YSI Pro Plus → SN: 18H100353

PJD = MiniRAE 3000 - DSN: 592-913073

Geotech turbidity meter -DSN: 21073404



Groundwater Sampling Log

Constituents Sampled	Container	Number	Preservative
See (OC)			
Colorimeter → Hach Dr 850 → DSN: 070150 C 51713	Total Fe direct instrument reading w/ OF/20 = 2.01 → Ferrous Fe direct instrument reading w/ OF/20 = 1.70		

Well Casing Volumes	1" = 0.04	1.5" = 0.09	2.5" = 0.26	3.5" = 0.50	6" = 1.47
Gallons/Foot	1" = 0.04	1.5" = 0.09	2.5" = 0.26	3.5" = 0.50	6" = 1.47

Well Information

Well Information

Well Location:			Well Locked at Arrival:	Yes	/	No
Condition of Well:			Well Locked at Departure:	Yes	/	No
Well Completion:	Flush Mount	/	Stick Up	Key Number To Well:		

Groundwater Sampling Form



Project Number	30048392	Well ID	SHM-10-06			Date	01/19/2022
Project Name/Location	USACE NE Devens Seed TO 8a JV		Weather(°F)	43 °F, Partly cloudy, NE winds at 16 mph.			
Measuring Pt. Description	Top of Inner Casing	MP Elevation	Casing Diameter (in)	1.5	Well Casing Material	PVC	
Static Water Level (ft-bmp)	19.38	Total Depth (ft-bmp)	79.3	Water Column (ft)	59.92	Gallons in Well	5.48
Purge Start	14:10	Pump Intake (ft-bmp)	74.3	Purge Method	Low-Flow	Purge Equipment	Peristaltic
Purge End	15:12	Volumes Purged	Sample ID	SHM-10-06-Event 5	Sampled by	Grace Scheckler	
Sample Time	15:05	Gallons Purged	Replicate/Code No.	NA	Sample Type	Grab	

Time	Minutes Elapsed	Total Elapsed Minutes	Rate mL/min	Depth to Water (ft)	Gallons Purged	pH (standard units)	Conductivity (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temperature °C	Appearance		
											Color	Odor	
14:24	0	0	172	19.50	0.64	6.44	0.486	137.9	0.99	10.4	-100.3	--	--
14:28	4	4	172	19.50	0.82	6.45	0.484	177.5	0.97	10.2	-101.4	--	--
14:54	26	30	172	19.50	2.00	6.48	0.477	52.4	0.85	10.1	-106	--	--
15:02	8	38	172	19.50	2.36	6.49	0.48	57.8	0.83	10.1	-107.2	Yellow	None

Constituent Sampled	Container	Number	Preservative
Dissolved Metals	250mL HDPE Plastic	1	HNO3
Total Metals	250mL HDPE Plastic	1	HNO3
Total Alkalinity, Total Dissolv	500 mL Plastic	1	HNO3

Comments: Ferrous Iron 23.4 mg/L
Total Iron > 66.6 mg/L

Well Casing Volume Conversion

Well diameter (inches) = gallons per foot $1 = 0.04; 1.5 = 0.09; 2.5 = 0.26; 3.5 = 0.50; 6 = 1.47$
 $1.25 = 0.06; 2 = 0.16; 3 = 0.37; 4 = 0.65$

Well Information

Well Location:	Well Locked at Arrival: yes
Condition of Well: Good condition	Well Locked at Departure: yes
Well Completion: Stick-up	Key Number To Well: 2006

ft-bmp = feet below measuring point
in = inches
ft = feet
mL/min = milliliters per minute

mS/cm = millisiemens per centimeter
NTU = Nephelometric Turbidity Unit
mg/L = milligrams per liter

mV = millivolts
°F = degrees Fahrenheit
°C = degrees Celsius

Groundwater Sampling Form



Project Number	30048392	Well ID	MW-21-1S	Date	01/19/2022
Project Name/Location	USACE NE Devens Seed TO 8a JV		Weather(°F)	39 °F, Sunny, NE winds at 18 mph.	
Measuring Pt. Description	Top of Inner Casing	MP Elevation	Casing Diameter (in)	2	Well Casing Material
Static Water Level (ft-bmp)	16.36	Total Depth (ft-bmp)	57.4	Water Column (ft)	41.04
Purge Start	12:46	Pump Intake (ft-bmp)	52.4	Purge Method	Low-Flow
Purge End	13:43	Volumes Purged	Sample ID	MW-21-1S-Event 5	Sampled by Grace Sheckler
Sample Time	13:29	Gallons Purged	Replicate/Code No.	NA	Sample Type Grab

Time	Minutes Elapsed	Total Elapsed Minutes	Rate mL/min	Depth to Water (ft)	Gallons Purged	pH (standard units)	Conductivity (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temperature °C	Appearance		
											Color	Odor	
12:54	0	0	172	16.86	0.36	6.59	0.211	234.8	11.14	8.9	171.2	--	--
13:01	7	7	172	16.89	0.68	6.46	0.209	60.3	10.36	9.1	185.4	--	--
13:07	6	13	172	16.89	0.95	6.39	0.206	46.5	10	9.1	189.1	--	--
13:14	7	20	172	16.88	1.27	6.36	0.206	68.2	9.7	9.2	190.6	--	--
13:21	7	27	172	16.88	1.59	6.32	0.205	54.1	10.13	9.3	197.5	Clear	None

Constituent Sampled	Container	Number	Preservative
Dissolved Metals	250mL HDPE Plastic	1	HNO3
Total Metals	250mL HDPE Plastic	1	HNO3
Total Alkalinity, Total Dissolv	500 mL Plastic	1	None
BOD	1L Plastic	1	None

Comments: Ferrous Iron = 0.09 mg/L
Total Iron = 0.12 mg/L

Well Casing Volume Conversion

Well diameter (inches) = gallons per foot 1 = 0.04; 1.5 = 0.09; 2.5 = 0.26; 3.5 = 0.50; 6 = 1.47
 1.25 = 0.06; 2 = 0.16; 3 = 0.37; 4 = 0.65

Well Information		
Well Location:	Well Locked at Arrival:	yes
Condition of Well: Good condition	Well Locked at Departure:	yes
Well Completion: Stick-up	Key Number To Well:	2006

ft-bmp = feet below measuring point
in = inches
ft = feet
mL/min = milliliters per minute

mS/cm = millisiemens per centimeter
NTU = Nephelometric Turbidity Unit
mg/L = milligrams per liter

mV = millivolts
°F = degrees Fahrenheit
°C = degrees Celsius

Groundwater Sampling Form



Project Number	30048392	Well ID	MW-21-1D	Date	01/19/2022
Project Name/Location	USACE NE Devens Seed TO 8a JV		Weather(°F)	39 °F, Sunny, NE winds at 18 mph.	
Measuring Pt. Description	Top of Inner Casing	MP Elevation	Casing Diameter (in)	2	Well Casing Material PVC
Static Water Level (ft-bmp)	16.89	Total Depth (ft-bmp)	71.55	Water Column (ft)	54.66 Gallons in Well 8.88
Purge Start	10:30	Pump Intake (ft-bmp)	66.55	Purge Method Low-Flow	Purge Equipment Peristaltic
Purge End	12:08	Volumes Purged	Sample ID	MW-21-1D-Event 5	Sampled by Grace Scheckler
Sample Time	11:48	Gallons Purged	Replicate/Code No.	MW-21-1D-Event 5-Dup	Sample Type Grab

Time	Minutes Elapsed	Total Elapsed Minutes	Rate mL/min	Depth to Water (ft)	Gallons Purged	pH (standard units)	Conductivity (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temperature °C	Appearance		
											Color	Odor	
10:40	0	0	174	16.81	0.46	6.72	0.362	262.9	7	8.2	40.3	--	--
10:49	9	9	174	16.78	0.87	6.34	0.349	235.6	7.31	8.4	51.3	--	--
10:55	6	15	174	16.76	1.15	6.28	0.347	152.9	7.93	8.6	54.3	--	--
11:02	7	22	174	16.76	--	6.27	0.343	375	8.11	8.6	55	--	--
11:08	6	28	174	16.76	1.75	6.26	0.343	202.6	9.71	8.8	57.2	--	--
11:15	7	35	174	16.76	2.07	6.26	0.339	147.2	8.5	8.8	56.2	--	--
11:19	4	39	174	16.76	2.26	6.27	0.338	171.3	8.69	8.7	59.3	--	--
11:25	6	45	174	16.76	2.53	6.26	0.339	60.1	8.84	8.8	58	Clear	None

Constituent Sampled	Container	Number	Preservative
Dissolved Metals	250mL HDPE Plastic	2	HNO3
Total Metals	250mL HDPE Plastic	2	HNO3
Total Alkalinity, Total Dissolv	500 mL Plastic	2	None
BOD	1L Plastic	2	None

Comments: Ferrous Iron = 1.49 mg/L
Total Iron = 4.9 mg/L

Well Casing Volume Conversion

Well diameter (inches) = gallons per foot 1 = 0.04; 1.5 = 0.09; 2.5 = 0.26; 3.5 = 0.50; 6 = 1.47
1.25 = 0.06; 2 = 0.16; 3 = 0.37; 4 = 0.65

Well Information	
Well Location:	Well Locked at Arrival: yes
Condition of Well: Good condition	Well Locked at Departure: yes
Well Completion: Stick-up	Key Number To Well: 2006

ft-bmp = feet below measuring point
in = inches
ft = feet
mL/min = milliliters per minute

mS/cm = millisiemens per centimeter
NTU = Nephelometric Turbidity Unit
mg/L = milligrams per liter

mV = millivolts
°F = degrees Fahrenheit
°C = degrees Celsius

Groundwater Sampling Form



Project Number	30048392	Well ID	MW-21-2S	Date	01/20/2022
Project Name/Location	USACE NE Devens Seed TO 8a JV		Weather(°F)	35 °F, Overcast, SE winds at 7 mph.	
Measuring Pt. Description	Top of Inner Casing	MP Elevation	Casing Diameter (in)	2	Well Casing Material
Static Water Level (ft-bmp)	14.68	Total Depth (ft-bmp)	62.12	Water Column (ft)	47.44
Purge Start	11:50	Pump Intake (ft-bmp)	57.12	Purge Method	Low-Flow
Purge End	12:49	Volumes Purged	Sample ID	MW-21-2S-Event 5	Sampled by Grace Sheckler
Sample Time	12:35	Gallons Purged	Replicate/Code No.	NA	Sample Type Grab

Time	Minutes Elapsed	Total Elapsed Minutes	Rate mL/min	Depth to Water (ft)	Gallons Purged	pH (standard units)	Conductivity (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temperature °C	Appearance		
											Color	Odor	
11:59	0	0	180	14.69	0.43	6.35	0.42	206.8	5.51	9.2	59.2	--	--
12:05	6	6	180	14.69	0.71	6.35	0.381	227.3	5.42	9.1	54.4	--	--
12:11	6	12	180	14.69	1.00	6.34	0.356	229	5.63	9.2	50.2	--	--
12:18	7	19	180	14.69	1.33	6.35	0.323	111.2	6.09	9.2	45.7	--	--
12:23	5	24	172	14.69	1.56	6.36	0.304	106.4	6.32	9.3	43.4	--	--
12:28	5	29	172	14.69	1.79	6.34	0.305	117.9	6.55	9.2	44.4	Clear	None

Constituent Sampled	Container	Number	Preservative
Dissolved Metals	250mL HDPE Plastic	1	HNO3
Total Metals	250mL HDPE Plastic	1	HNO3
Total Alkalinity, Total Dissolv	500 mL Plastic	1	None
BOD	1L Plastic	1	None

Comments: Ferrous Iron = 1.65 mg/L
Totally Iron = 3.1

Well Casing Volume Conversion

Well diameter (inches) = gallons per foot 1 = 0.04; 1.5 = 0.09; 2.5 = 0.26; 3.5 = 0.50; 6 = 1.47
1.25 = 0.06; 2 = 0.16; 3 = 0.37; 4 = 0.65

Well Information

Well Location:	Well Locked at Arrival: yes
Condition of Well: Good condition	Well Locked at Departure: yes
Well Completion: Stick-up	Key Number To Well: 2006

ft-bmp = feet below measuring point
in = inches
ft = feet
mL/min = milliliters per minute

mS/cm = millisiemens per centimeter
NTU = Nephelometric Turbidity Unit
mg/L = milligrams per liter

mV = millivolts
°F = degrees Fahrenheit
°C = degrees Celsius

Groundwater Sampling Form



Project Number	30048392	Well ID	MW-21-2D	Date	01/20/2022
Project Name/Location	USACE NE Devens Seed TO 8a JV		Weather(°F)	36 °F, Partly Sunny, SE winds at 11 mph.	
Measuring Pt. Description	Top of Inner Casing	MP Elevation	Casing Diameter (in)	2	Well Casing Material PVC
Static Water Level (ft-bmp)	14.89	Total Depth (ft-bmp)	76.15	Water Column (ft)	61.26
Purge Start	12:50	Pump Intake (ft-bmp)	71.15	Purge Method	Low-Flow
Purge End	13:55	Volumes Purged		Sample ID	MW-21-2D-Event 5
Sample Time	13:38	Gallons Purged		Replicate/Code No.	NA
				Sample Type	Grab

Time	Minutes Elapsed	Total Elapsed Minutes	Rate mL/min	Depth to Water (ft)	Gallons Purged	pH (standard units)	Conductivity (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temperature °C	Appearance		
											Color	Odor	
12:56	0	0	114	14.91	0.18	6.56	0.16	180.5	7.74	9.1	144	--	--
13:01	5	5	114	14.91	0.33	6.25	0.16	144.1	7.6	9.1	165.1	--	--
13:05	4	9	114	14.91	0.45	6.14	0.159	30.9	7.38	9.1	174.1	--	--
13:11	6	15	114	14.90	0.63	6.04	0.157	111.1	7.53	8.6	182.5	--	--
13:17	6	21	114	14.90	0.81	5.98	0.155	140.7	7.8	8.3	189.8	--	--
13:23	6	27	114	14.90	0.99	5.95	0.154	129.7	7.74	7.5	192.5	Clear	None

Constituent Sampled	Container	Number	Preservative
Dissolved Metals	250mL HDPE Plastic	1	HNO3
Total Metals	250mL HDPE Plastic	1	HNO3
Total Alkalinity, Total Dissolv	500 mL Plastic	1	None
BOD	1L Plastic	1	None

Comments: Ferrous Iron = 0.09 mg/L
 Total Iron = 1.04
 Peri pump batteries were dying/dead while sampling this well, flow rate was not consistent and had to use car battery to finish collecting samples since the courier was here

Well Casing Volume Conversion

Well diameter (inches) = gallons per foot $1 = 0.04; 1.5 = 0.09; 2.5 = 0.26; 3.5 = 0.50; 6 = 1.47$
 $1.25 = 0.06; 2 = 0.16; 3 = 0.37; 4 = 0.65$

Well Information

Well Location:	Well Locked at Arrival: yes
Condition of Well: Good condition	Well Locked at Departure: yes
Well Completion: Stick-up	Key Number To Well: 2006

ft-bmp = feet below measuring point
 in = inches
 ft = feet
 mL/min = milliliters per minute

mS/cm = millisiemens per centimeter
 NTU = Nephelometric Turbidity Unit
 mg/L = milligrams per liter

mV = millivolts
 °F = degrees Fahrenheit
 °C = degrees Celsius

Groundwater Sampling Form



Project Number	30048392	Well ID	MW-21-3S	Date	01/20/2022
Project Name/Location	USACE NE Devens Seed TO 8a JV		Weather(°F)	34 °F, Overcast, E winds at 6 mph.	
Measuring Pt. Description	Top of Inner Casing	MP Elevation	Casing Diameter (in)	2	Well Casing Material
Static Water Level (ft-bmp)	15.17	Total Depth (ft-bmp)	61.31	Water Column (ft)	46.14
Purge Start	09:56	Pump Intake (ft-bmp)	56.31	Purge Method	Low-Flow
Purge End	10:40	Volumes Purged	Sample ID	MW-21-3S-Event 5	Sampled by Grace Sheckler
Sample Time	10:33	Gallons Purged	Replicate/Code No.	NA	Sample Type Grab

Time	Minutes Elapsed	Total Elapsed Minutes	Rate mL/min	Depth to Water (ft)	Gallons Purged	pH (standard units)	Conductivity (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temperature °C	Appearance		
											Color	Odor	
10:01	0	0	180	15.23	0.24	7.02	0.243	217.6	14.53	9	154.9	--	--
10:07	6	6	180	15.24	0.52	6.43	0.246	234.4	14.59	9.2	152.3	--	--
10:12	5	11	180	15.24	0.76	6.19	0.245	145.1	11.79	9.3	139.4	--	--
10:18	6	17	180	15.24	1.05	6.09	0.24	87.6	11.51	9.3	132.4	--	--
10:22	4	21	180	15.24	1.24	6.05	0.238	76	11.34	9.4	129.6	--	--
10:28	6	27	180	15.24	1.52	6.02	0.236	74.2	11.22	9.4	125.8	Clear	None

Constituent Sampled	Container	Number	Preservative
Dissolved Metals	250mL HDPE Plastic	1	HNO3
Total Metals	250mL HDPE Plastic	1	HNO3
Total Alkalinity, Total Dissolv	500 mL Plastic	1	None

Comments: Well cap was off prior to opening
Ferrous Iron = 0.26 mg/L
Total Iron = 0.29 mg/L

Well Casing Volume Conversion

Well diameter (inches) = gallons per foot $1 = 0.04; 1.5 = 0.09; 2.5 = 0.26; 3.5 = 0.50; 6 = 1.47$
 $1.25 = 0.06; 2 = 0.16; 3 = 0.37; 4 = 0.65$

Well Information	
Well Location:	Well Locked at Arrival: yes
Condition of Well: Good condition	Well Locked at Departure: yes
Well Completion: Stick-up	Key Number To Well: 2006

ft-bmp = feet below measuring point
in = inches
ft = feet
mL/min = milliliters per minute

mS/cm = millisiemens per centimeter
NTU = Nephelometric Turbidity Unit
mg/L = milligrams per liter

mV = millivolts
°F = degrees Fahrenheit
°C = degrees Celsius

Groundwater Sampling Form



Project Number	30048392	Well ID	MW-21-3D	Date	01/20/2022
Project Name/Location	USACE NE Devens Seed TO 8a JV		Weather(°F)	34 °F, Overcast, SE winds at 7 mph.	
Measuring Pt. Description	Top of Inner Casing	MP Elevation	Casing Diameter (in)	2	Well Casing Material
Static Water Level (ft-bmp)	14.50	Total Depth (ft-bmp)	75.76	Water Column (ft)	61.26
Purge Start	10:50	Pump Intake (ft-bmp)	70.76	Purge Method	Low-Flow
Purge End	11:43	Volumes Purged		Sample ID	MW-21-3D-Event 5
Sample Time	11:31	Gallons Purged		Replicate/Code No.	NA
				Sample Type	Grab

Time	Minutes Elapsed	Total Elapsed Minutes	Rate mL/min	Depth to Water (ft)	Gallons Purged	pH (standard units)	Conductivity (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temperature °C	Appearance		
											Color	Odor	
10:56	0	0	150	14.52	0.24	6.3	0.454	114.2	1.58	8.9	-86.3	--	--
11:02	6	6	150	14.52	0.48	6.31	0.448	103.4	1.27	8.7	-91.9	--	--
11:11	9	15	150	14.50	0.83	6.29	0.45	70	1.17	8.7	-92.5	--	--
11:16	5	20	150	14.50	1.03	6.3	0.434	62.1	1.17	8.3	-90.7	--	--
11:20	4	24	150	14.50	1.19	6.27	0.426	52.8	1.16	8	-82.7	--	--
11:28	8	32	150	14.50	1.51	6.24	0.416	44.7	1.18	7.3	-83.1	Yellow	None

Constituent Sampled	Container	Number	Preservative
Dissolved Metals	250mL HDPE Plastic	1	HNO3
Total Metals	250mL HDPE Plastic	1	HNO3
Total Alkalinity, Total Dissolv	500 mL Plastic	1	None

Comments: Ferrous Iron = 19.2 mg/L
Total Iron = 53.4

Well Casing Volume Conversion

Well diameter (inches) = gallons per foot 1 = 0.04; 1.5 = 0.09; 2.5 = 0.26; 3.5 = 0.50; 6 = 1.47
1.25 = 0.06; 2 = 0.16; 3 = 0.37; 4 = 0.65

Well Information		
Well Location:	Well Locked at Arrival:	yes
Condition of Well: Good condition	Well Locked at Departure:	yes
Well Completion: Stick-up	Key Number To Well:	2006

ft-bmp = feet below measuring point
in = inches
ft = feet
mL/min = milliliters per minute

mS/cm = millisiemens per centimeter
NTU = Nephelometric Turbidity Unit
mg/L = milligrams per liter

mV = millivolts
°F = degrees Fahrenheit
°C = degrees Celsius

Groundwater Sampling Form



Project Number	30048392	Well ID	MW-21-4S	Date	01/19/2022
Project Name/Location	USACE NE Devens Seed TO 8a JV		Weather(°F)	39.9 degrees F and Partly Cloudy. The wind is blowing S/SW at 10.3 mph.	
Measuring Pt. Description	Top of Inner Casing	MP Elevation	Casing Diameter (in)	2	Well Casing Material
Static Water Level (ft-bmp)	14.68	Total Depth (ft-bmp)	59.8	Water Column (ft)	45.12
Purge Start	13:50	Pump Intake (ft-bmp)	54.8	Purge Method	Low-Flow
Purge End	15:05	Volumes Purged	0.59	Sample ID	MW-21-4S
Sample Time	15:05	Gallons Purged	4.36	Replicate/Code No.	NA
				Sample Type	Grab

Time	Minutes Elapsed	Total Elapsed Minutes	Rate mL/min	Depth to Water (ft)	Gallons Purged	pH (standard units)	Conductivity (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temperature °C	Redox (mV)	Appearance	
												Color	Odor
13:55	0	0	220	14.68	0.29	6.21	0.438	134.2	8.49	9.3	128.9	--	--
15:00	65	65	220	14.68	4.07	5.19	0.434	19.6	7.53	8.8	202.3	Clear	None

Constituent Sampled	Container	Number	Preservative
See COC	NA	NA	NA

Comments: Note: Field parameters were not recorded during purging because sampler was helping the trucker remove the trailer from the Site during purging - parameters assumed stabilized.
 Note: Sampler is red/green colorblind.
 Initial purge appearance - yellow ; initial purge odor - none.
 Final purge appearance - clear; final purge odor - none.
 DR900 colorimeter direct instrument readings (each with no dilution) - Total Iron = .13mg/L; Ferrous Iron = .02mg/L.

Well Casing Volume Conversion

Well diameter (inches) = gallons per foot 1 = 0.04; 1.5 = 0.09; 2.5 = 0.26; 3.5 = 0.50; 6 = 1.47
 1.25 = 0.06; 2 = 0.16; 3 = 0.37; 4 = 0.65

Well Information

Well Location:	Well Locked at Arrival:
Condition of Well:	Well Locked at Departure:
Well Completion: NA	Key Number To Well: NA

ft-bmp = feet below measuring point
 in = inches
 ft = feet
 mL/min = milliliters per minute

mS/cm = millisiemens per centimeter
 NTU = Nephelometric Turbidity Unit
 mg/L = milligrams per liter

mV = millivolts
 °F = degrees Fahrenheit
 °C = degrees Celsius

Groundwater Sampling Form



Project Number	30048392	Well ID	MW-21-4D	Date	01/19/2022
Project Name/Location	USACE NE Devens Seed TO 8a JV		Weather(°F)	34.0 degrees F and Mostly Cloudy.	
Measuring Pt. Description	Top of Inner Casing	MP Elevation	Casing Diameter (in)	2	Well Casing Material
Static Water Level (ft-bmp)	14.32	Total Depth (ft-bmp)	74.77	Water Column (ft)	60.45
Purge Start	12:19	Pump Intake (ft-bmp)	69.77	Purge Method	Low-Flow
Purge End	12:54	Volumes Purged	0.22	Sample ID	MW-21-4D-EVENT#5
Sample Time	12:54	Gallons Purged	2.18	Replicate/Code No.	NA
				Sample Type	Grab

Time	Minutes Elapsed	Total Elapsed Minutes	Rate mL/min	Depth to Water (ft)	Gallons Purged	pH (standard units)	Conductivity (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temperature °C	Appearance		
											Color	Odor	
12:24	0	0	150	14.33	0.20	6.57	0.407	25.1	0.81	8.7	-73.4	--	--
12:29	5	5	250	14.33	0.53	6.6	0.386	16.7	0.63	8.6	-81.4	--	--
12:34	5	10	250	14.33	0.86	6.62	0.377	18.3	0.57	8.6	-85.3	--	--
12:39	5	15	250	14.33	1.19	6.62	0.376	14.3	0.56	8.5	-86.2	--	--
12:44	5	20	250	14.33	1.52	6.63	0.378	14.3	0.53	8.6	-87.5	--	--
12:49	5	25	250	14.33	1.85	6.63	0.379	14.2	0.52	8.6	-88.4	Clear	None

Constituent Sampled	Container	Number	Preservative
See COC	NA	NA	NA

Comments: Note: Sampler is red/green colorblind.
Initial purge appearance - clear; initial purge odor - none.
Final purge appearance - clear; final purge odor - none.

DR900 colorimeter direct instrument readings (each with Dilution Factor of 20) - Total Iron = 3.18mg/L; Ferrous Iron = 1.75mg/L

Well Casing Volume Conversion

Well diameter (inches) = gallons per foot 1 = 0.04; 1.5 = 0.09; 2.5 = 0.26; 3.5 = 0.50; 6 = 1.47
1.25 = 0.06; 2 = 0.16; 3 = 0.37; 4 = 0.65

Well Location:	Well Locked at Arrival:
Condition of Well:	Well Locked at Departure:
Well Completion: NA	Key Number To Well: NA

ft-bmp = feet below measuring point
in = inches
ft = feet
mL/min = milliliters per minute

mS/cm = millisiemens per centimeter
NTU = Nephelometric Turbidity Unit
mg/L = milligrams per liter

mV = millivolts
°F = degrees Fahrenheit
°C = degrees Celsius

Groundwater Sampling Form



Project Number	30048392		Well ID	SHM-10-06		Date	02/17/2022						
Project Name/Location	USACE NE Devens Seed TO 8a JV			Weather(°F)	60 degrees F and Clear. The wind is blowing NE at 16 mph.								
Measuring Pt. Description	Top of Inner Casing	Screen Setting (ft-bmp)	--	Casing Diameter (in)	1.5	Well Casing Material	PVC						
Static Water Level (ft-bmp)	18.74	Total Depth (ft-bmp)	77.76	Water Column(ft)	59.02	Gallons in Well	5.39						
MP Elevation		Pump Intake (ft-bmp)	72.76	Purge Method	Low-Flow	Sample Method							
Sample Time	11:26	Volumes Purged		Sample ID	SHM-10-06	Sampled by	Grace Scheckler						
Purge Start	10:34	Gallons Purged		Replicate/Code No.	SHM-10-06-Event 6-MS(MSD)								
Purge End	12:04												
Time	Minutes Elapsed	Total Elapsed Minutes	Rate mL/min	Depth to Water (ft)	Gallons Purged	pH (standard units)	Conductivity (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temperature °C	Redox (mV)	Appearance	
												Color	Odor
10:39	0	0	150	18.79	0.20	6.78	0.548	57.53	2.57	11.1	-281.9	Clear	None
10:46	7	7	150	18.79	0.48	6.55	0.527	131.16	1.45	11.1	-325.9	Clear	None
10:54	8	15	150	18.79	0.79	6.49	0.532	38.21	1.09	11	-341.6	Clear	None
10:59	5	20	150	18.79	0.99	6.47	0.53	79.32	1	10.9	-350	Clear	None
11:06	7	27	150	18.79	1.27	6.44	0.529	23.44	0.93	10.9	-348.6	Clear	None
11:13	7	34	150	18.79	1.55	6.46	0.533	52.98	0.89	11.2	-352.7	Clear	None
11:20	7	41	150	18.79	1.82	6.47	0.53	36.65	0.84	10.9	-351.4	Clear	None

Constituent Sampled	Container	Number	Preservative
Alkalinity, Anions, Total Dissol	250mL HDPE Plastic	2	None
Dissolved Metals	250mL HDPE Plastic	3	HNO3
Total Metals	250mL HDPE Plastic	3	HNO3
Total Organic Carbon	40 mL Glass	6	H2SO4

Comments: Ferrous Iron = 31.4
Total Iron = 58.2

Well Casing Volume Conversion

Well diameter (inches) = gallons per foot $1 = 0.04 \quad 1.5 = 0.09 \quad 2.5 = 0.26 \quad 3.5 = 0.50 \quad 6 = 1.47$
 $1.25 = 0.06 \quad 2 = 0.16 \quad 3 = 0.37 \quad 4 = 0.65$

Well Information

Well Location: SHL	Well Locked at Arrival: yes
Condition of Well: Good condition	Well Locked at Departure: yes
Well Completion: Stick-up	Key Number To Well: 2006

ft-bmp = feet below measuring point
in = inches
ft = feet
mL/min = milliliters per minute

mS/cm = millisiemens per centimeter
NTU = Nephelometric Turbidity Unit
mg/L = milligrams per liter

mV = millivolts
°F = degrees Fahrenheit
°C = degrees Celsius

Groundwater Sampling Form



Project Number	30048392	Well ID	MW-21-1S	Date	02/16/2022
Project Name/Location	USACE NE Devens Seed TO 8a JV		Weather(°F)	30s °F, Windy, winds at mph.	
Measuring Pt. Description	Top of Inner Casing	MP Elevation	Casing Diameter (in)	2	Well Casing Material
Static Water Level (ft-bmp)	15.35	Total Depth (ft-bmp)	55.4	Water Column (ft)	40.05
Purge Start	12:05	Pump Intake (ft-bmp)	50.4	Purge Method	Low-Flow
Purge End	13:15	Volumes Purged	Sample ID	MW-21-1S-Event 6	Sampled by Grace Sheckler
Sample Time	12:50	Gallons Purged	Replicate/Code No.	NA	Sample Type Grab

Time	Minutes Elapsed	Total Elapsed Minutes	Rate mL/min	Depth to Water (ft)	Gallons Purged	pH (standard units)	Conductivity (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temperature °C	Appearance		
											Color	Odor	
12:11	0	0	140	15.68	0.22	7.11	0.317	35.96	2.76	7.9	-338.4	--	--
12:16	5	5	140	15.68	0.41	6.89	0.326	73.63	1.52	7.8	-409.1	--	--
12:21	5	10	140	15.57	0.59	6.75	0.331	26.2	1.16	8.4	-441.3	--	--
12:29	8	18	140	15.68	0.89	6.66	0.332	77.71	0.96	8.6	-460.7	--	--
12:33	4	22	140	15.68	--	6.64	0.331	52.23	0.89	8.6	-455.8	--	--
12:38	5	27	140	15.68	--	6.62	0.329	2.32	0.89	8.5	-441.5	--	--
12:43	5	32	140	15.68	--	6.58	0.329	50.27	0.84	8.7	-394.3	Clear	None

Constituent Sampled	Container	Number	Preservative
Alkalinity, Anions, Total Dissol	250mL HDPE Plastic	2	None
Dissolved Metals	250mL HDPE Plastic	1	HNO3
Total Metals	250mL HDPE Plastic	1	HNO3
BOD	1L Plastic	1	None
Total Organic Carbon	40 mL Glass	2	H2SO4

Comments: Total Iron =ND
Ferrous Iron = 0.07 mg/L

Well Casing Volume Conversion

Well diameter (inches) = gallons per foot 1 = 0.04; 1.5 = 0.09; 2.5 = 0.26; 3.5 = 0.50; 6 = 1.47
1.25 = 0.06; 2 = 0.16; 3 = 0.37; 4 = 0.65

Well Information	
Well Location: SHL	Well Locked at Arrival: yes
Condition of Well: Good condition	Well Locked at Departure: yes
Well Completion: Stick-up	Key Number To Well: 2006

ft-bmp = feet below measuring point
in = inches
ft = feet
mL/min = milliliters per minute

mS/cm = millisiemens per centimeter
NTU = Nephelometric Turbidity Unit
mg/L = milligrams per liter

mV = millivolts
°F = degrees Fahrenheit
°C = degrees Celsius

Groundwater Sampling Form



Project Number	30048392	Well ID	MW-21-1D	Date	02/16/2022
Project Name/Location	USACE NE Devens Seed TO 8a JV		Weather(°F)	30s °F, Windy, winds at mph.	
Measuring Pt. Description	Top of Inner Casing	MP Elevation	Casing Diameter (in)	2	Well Casing Material
Static Water Level (ft-bmp)	15.68	Total Depth (ft-bmp)	71.1	Water Column (ft)	55.42
Purge Start	10:13	Pump Intake (ft-bmp)	66.1	Purge Method	Low-Flow
Purge End	11:21	Volumes Purged	Sample ID	MW-21-1D-Event 6	Sampled by Grace Sheckler
Sample Time	10:57	Gallons Purged	Replicate/Code No.	NA	Sample Type Grab

Time	Minutes Elapsed	Total Elapsed Minutes	Rate mL/min	Depth to Water (ft)	Gallons Purged	pH (standard units)	Conductivity (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temperature °C	Appearance		
											Color	Odor	
10:23	0	0	160	15.70	0.42	6.07	0.415	133.17	3.55	9.1	-221.4	--	--
10:33	10	10	160	15.70	0.85	6.06	0.42	187.18	4.27	9	-207.2	--	--
10:38	5	15	160	15.70	1.06	6.06	0.422	193.6	4.27	9.3	-208	--	--
10:43	5	20	160	15.70	1.27	6.07	0.421	163.44	4.43	9	-194.9	--	--
10:49	6	26	160	15.70	1.52	6.05	0.421	182.93	4.6	8.9	-193.5	--	--
10:53	4	30	160	15.70	1.69	6.09	0.424	137.11	4.64	9.1	-188.2	Clear	None

Constituent Sampled	Container	Number	Preservative
Alkalinity, Anions, Total Dissol	250mL HDPE Plastic	2	None
Dissolved Metals	250mL HDPE Plastic	1	HNO3
Total Metals	250 mL Glass	1	HNO3
Total Organic Carbon	40 mL Glass	2	H2SO4
BOD	1L Plastic	1	None

Comments: Ferrous Iron = 0.6 mg/L
Total Iron = ND

Well Casing Volume Conversion

Well diameter (inches) = gallons per foot $1 = 0.04; 1.5 = 0.09; 2.5 = 0.26; 3.5 = 0.50; 6 = 1.47$
 $1.25 = 0.06; 2 = 0.16; 3 = 0.37; 4 = 0.65$

Well Information

Well Location: SHL	Well Locked at Arrival: yes
Condition of Well: Good condition	Well Locked at Departure: yes
Well Completion: Stick-up	Key Number To Well: 2006

ft-bmp = feet below measuring point
in = inches
ft = feet
mL/min = milliliters per minute

mS/cm = millisiemens per centimeter
NTU = Nephelometric Turbidity Unit
mg/L = milligrams per liter

mV = millivolts
°F = degrees Fahrenheit
°C = degrees Celsius

Groundwater Sampling Form



Project Number	30048392	Well ID	MW-21-2S	Date	02/16/2022
Project Name/Location	USACE NE Devens Seed TO 8a JV		Weather(°F)	35.0 degrees F and Clear. The wind is blowing S/SW at 10.3 mph.	
Measuring Pt. Description	Top of Inner Casing	MP Elevation	Casing Diameter (in)	2	Well Casing Material
Static Water Level (ft-bmp)	14.46	Total Depth (ft-bmp)	62.12	Water Column (ft)	47.66
Purge Start	09:55	Pump Intake (ft-bmp)	57.12	Purge Method	Low-Flow
Purge End	10:40	Volumes Purged	0.34	Sample ID	MW-21-2S-EVENT#6
Sample Time	10:40	Gallons Purged	2.62	Replicate/Code No.	NA
				Sample Type	Grab

Time	Minutes Elapsed	Total Elapsed Minutes	Rate mL/min	Depth to Water (ft)	Gallons Purged	pH (standard units)	Conductivity (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temperature °C	Appearance		
											Color	Odor	
10:00	0	0	220	14.50	0.29	6.48	0.617	18.19	1.99	8.2	115.4	--	--
10:05	5	5	220	14.50	0.58	6.47	0.599	19.23	2.18	8.1	115	--	--
10:15	10	15	220	14.50	1.16	6.47	0.526	17.42	5.76	8.2	126.1	--	--
10:20	5	20	220	14.50	1.45	6.46	0.506	16.99	6.39	8.3	133.7	--	--
10:25	5	25	220	14.50	1.74	6.46	0.48	17.22	6.86	8.4	142.2	--	--
10:30	5	30	220	14.50	2.03	6.45	0.467	17.03	7.34	8.3	151.2	--	--
10:35	5	35	220	14.50	2.32	6.45	0.465	17.18	7.53	8.5	155.9	Clear	None

Constituent Sampled	Container	Number	Preservative
See COC	NA	7	NA

Comments:	PID —> MiniRAE 3000 - SN:592-914328 Note: Sampler is red/green color blind. Initial purge appearance - clear; initial purge odor - none. Final purge appearance - clear; final purge odor - none. DR900 colorimeter direct instrument readings—> ferrous iron with no dilution = non detect; total iron with no dilution = non detect.
-----------	--

Well Casing Volume Conversion

Well diameter (inches) = gallons per foot $1 = 0.04; 1.5 = 0.09; 2.5 = 0.26; 3.5 = 0.50; 6 = 1.47$
 $1.25 = 0.06; 2 = 0.16; 3 = 0.37; 4 = 0.65$

Well Information	Well Location:	Well Locked at Arrival:
Condition of Well:		Well Locked at Departure:
Well Completion: NA		Key Number To Well: NA

ft-bmp = feet below measuring point
in = inches
ft = feet
mL/min = milliliters per minute

mS/cm = millisiemens per centimeter
NTU = Nephelometric Turbidity Unit
mg/L = milligrams per liter

mV = millivolts
°F = degrees Fahrenheit
°C = degrees Celsius

Groundwater Sampling Form



Project Number	30048392	Well ID	MW-21-2D	Date	02/16/2022
Project Name/Location	USACE NE Devens Seed TO 8a JV		Weather(°F)	36.1 degrees F and Clear. The wind is blowing S/SW at 10.3 mph.	
Measuring Pt. Description	Top of Inner Casing	MP Elevation	Casing Diameter (in)	2	Well Casing Material
Static Water Level (ft-bmp)	14.68	Total Depth (ft-bmp)	76.16	Water Column (ft)	61.48
Purge Start	11:40	Pump Intake (ft-bmp)	71.16	Purge Method	Low-Flow
Purge End	12:25	Volumes Purged	0.29	Sample ID	MW-21-2D-EVENT#6
Sample Time	12:25	Gallons Purged	2.85	Replicate/Code No.	NA
				Sample Type	Grab

Time	Minutes Elapsed	Total Elapsed Minutes	Rate mL/min	Depth to Water (ft)	Gallons Purged	pH (standard units)	Conductivity (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temperature °C	Redox (mV)	Appearance	
												Color	Odor
11:45	0	0	240	14.71	0.32	6.77	0.197	15.77	8.88	9.1	165.6	--	--
11:50	5	5	240	14.71	0.63	6.74	0.195	14.89	8.81	8.9	170.8	--	--
11:55	5	10	240	14.71	0.95	6.48	0.198	14.33	8.04	8.8	184.8	--	--
12:00	5	15	240	14.71	1.27	6.14	0.202	14.21	6.17	8.8	181.9	--	--
12:05	5	20	240	14.71	1.59	6.07	0.205	9.41	5.48	8.8	170.6	--	--
12:10	5	25	240	14.71	1.90	6.06	0.206	8.92	5.33	8.9	170.9	--	--
12:15	5	30	240	14.71	2.22	6.04	0.207	8.32	5.41	8.8	169.9	--	--
12:20	5	35	240	14.71	2.54	6.03	0.207	8.12	5.55	8.9	170.2	Clear	None

Constituent Sampled	Container	Number	Preservative
See COC	NA	7	NA

Comments:	PID —> MiniRAE 3000 - SN:592-914328 Note: Sampler is red/green color blind. Initial purge appearance - clear; initial purge odor - none. Final purge appearance - clear; final purge odor - none. DR900 colorimeter direct instrument readings—> ferrous iron with no dilution = .23mg/L; total iron with no dilution = .36mg/L
-----------	---

Well Casing Volume Conversion

Well diameter (inches) = gallons per foot $1 = 0.04; 1.5 = 0.09; 2.5 = 0.26; 3.5 = 0.50; 6 = 1.47$
 $1.25 = 0.06; 2 = 0.16; 3 = 0.37; 4 = 0.65$

Well Location:	Well Locked at Arrival:
Condition of Well:	Well Locked at Departure:
Well Completion: NA	Key Number To Well: NA

ft-bmp = feet below measuring point
in = inches
ft = feet
mL/min = milliliters per minute

mS/cm = millisiemens per centimeter
NTU = Nephelometric Turbidity Unit
mg/L = milligrams per liter

mV = millivolts
°F = degrees Fahrenheit
°C = degrees Celsius

Groundwater Sampling Form



Project Number	30048392	Well ID	MW-21-3S	Date	02/16/2022
Project Name/Location	USACE NE Devens Seed TO 8a JV		Weather(°F)	30s °F, Windy, winds at mph.	
Measuring Pt. Description	Top of Inner Casing	MP Elevation	Casing Diameter (in)	2	Well Casing Material
Static Water Level (ft-bmp)	14.86	Total Depth (ft-bmp)	61.3	Water Column (ft)	46.44
Purge Start	13:50	Pump Intake (ft-bmp)	56.3	Purge Method	Low-Flow
Purge End	14:49	Volumes Purged	Sample ID	MW-21-3S-Event 6	Sampled by Grace Sheckler
Sample Time	14:35	Gallons Purged	Replicate/Code No.	NA	Sample Type Grab

Time	Minutes Elapsed	Total Elapsed Minutes	Rate mL/min	Depth to Water (ft)	Gallons Purged	pH (standard units)	Conductivity (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temperature °C	Appearance		
											Color	Odor	
13:54	0	0	140	14.90	0.15	7.37	0.264	65.93	10.8	8.2	-74.2	--	--
14:00	6	6	140	14.90	0.37	6.87	0.263	125.44	10.73	8.5	-94.2	--	--
14:05	5	11	140	14.90	0.55	6.69	0.254	171.99	10.79	8.6	-99.8	--	--
14:10	5	16	140	14.90	0.74	6.57	0.244	274.48	10.9	8.6	-97.6	--	--
14:14	4	20	140	14.90	0.89	6.49	0.243	114.36	10.92	8.4	-94.6	--	--
14:19	5	25	140	14.90	1.07	6.44	0.234	111.29	11.02	8.5	-93.9	--	--
14:23	4	29	140	14.90	1.22	6.4	0.231	28.43	10.99	8.5	-91.3	--	--
14:28	5	34	140	14.90	1.41	6.37	0.23	148.23	11	8.6	-88.9	Clear	None

Constituent Sampled	Container	Number	Preservative
Alkalinity, Anions, Total Dissol	250mL HDPE Plastic	2	None
Dissolved Metals	250mL HDPE Plastic	1	HNO3
Total Metals	250mL HDPE Plastic	1	HNO3
Total Organic Carbon	40 mL Glass	2	H2SO4

Comments: Ferrous Fe = 0.06 mg/l
Total Fe = 0.13 mg/l

Well Casing Volume Conversion

Well diameter (inches) = gallons per foot 1 = 0.04; 1.5 = 0.09; 2.5 = 0.26; 3.5 = 0.50; 6 = 1.47
1.25 = 0.06; 2 = 0.16; 3 = 0.37; 4 = 0.65

Well Location: SHL	Well Locked at Arrival: yes
Condition of Well: Good condition	Well Locked at Departure: yes
Well Completion: Stick-up	Key Number To Well: 2006

ft-bmp = feet below measuring point
in = inches
ft = feet
mL/min = milliliters per minute

mS/cm = millisiemens per centimeter
NTU = Nephelometric Turbidity Unit
mg/L = milligrams per liter

mV = millivolts
°F = degrees Fahrenheit
°C = degrees Celsius

Groundwater Sampling Form



Project Number	30048392	Well ID	MW-21-3D	Date	02/16/2022
Project Name/Location	USACE NE Devens Seed TO 8a JV		Weather(°F)	37.2 degrees F and Clear. The wind is blowing S/SW at 10.3 mph.	
Measuring Pt. Description	Top of Inner Casing	MP Elevation	Casing Diameter (in)	2	Well Casing Material
Static Water Level (ft-bmp)	14.22	Total Depth (ft-bmp)	75.75	Water Column (ft)	61.53
Purge Start	13:24	Pump Intake (ft-bmp)	70.75	Purge Method	Low-Flow
Purge End	14:19	Volumes Purged	0.29	Sample ID	MW-21-3D-EVENT#6
Sample Time	14:19	Gallons Purged	2.91	Replicate/Code No.	NA
				Sample Type	Grab

Time	Minutes Elapsed	Total Elapsed Minutes	Rate mL/min	Depth to Water (ft)	Gallons Purged	pH (standard units)	Conductivity (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temperature °C	Appearance		
											Color	Odor	
13:29	0	0	200	14.25	0.26	6.49	0.43	134.28	1.24	8.9	-7.1	--	--
13:34	5	5	200	14.25	0.53	6.51	0.436	51.29	0.82	8.9	-12.3	--	--
13:39	5	10	200	14.25	0.79	6.52	0.435	39.58	0.86	8.7	-14.8	--	--
13:49	10	20	200	14.25	1.32	6.53	0.421	36.55	0.89	9.3	-16.4	--	--
13:54	5	25	200	14.25	1.59	6.53	0.415	28.27	0.92	8.8	-15.5	--	--
13:59	5	30	200	14.25	1.85	6.52	0.41	34.12	0.96	9.2	-13.2	--	--
14:04	5	35	200	14.25	2.11	6.52	0.412	29.96	0.99	9.3	-13	--	--
14:09	5	40	200	14.25	2.38	6.5	0.409	30.71	1.04	9.3	-12.9	--	--
14:14	5	45	200	14.25	2.64	6.5	0.391	30.22	1.03	9.3	-14.2	Yellow	None

Constituent Sampled	Container	Number	Preservative
See COC	NA	6	NA

Comments:	PID —> MiniRAE 3000 - SN:592-914328 Note: Sampler is red/green color blind. Initial purge appearance - yellow; initial purge odor - none. Final purge appearance - yellow; final purge odor - none. DR900 colorimeter direct instrument readings—> ferrous iron with a dilution factor of 20 = 1.38mg/L; total iron with a dilution factor of 20 = 1.65mg/L
-----------	---

Well Casing Volume Conversion

Well diameter (inches) = gallons per foot	1 = 0.04; 1.5 = 0.09; 2.5 = 0.26; 3.5 = 0.50; 6 = 1.47 1.25 = 0.06; 2 = 0.16; 3 = 0.37; 4 = 0.65
---	---

Well Information	Well Location: _____	Well Locked at Arrival: _____
Condition of Well: _____	Well Locked at Departure: _____	Key Number To Well: NA
Well Completion: NA	_____	_____

ft-bmp = feet below measuring point in = inches ft = feet mL/min = milliliters per minute	mS/cm = millisiemens per centimeter NTU = Nephelometric Turbidity Unit mg/L = milligrams per liter	mV = millivolts °F = degrees Fahrenheit °C = degrees Celsius
--	--	--

Groundwater Sampling Form



Project Number	30048392		Well ID	MW-21-4S			Date	02/17/2022					
Project Name/Location	USACE NE Devens Seed TO 8a JV			Weather(°F)	40s F, heavy winds, overcast.								
Measuring Pt. Description	Top of Inner Casing	Screen Setting (ft-bmp)	--	Casing Diameter (in)	2	Well Casing Material	PVC						
Static Water Level (ft-bmp)	13.97	Total Depth (ft-bmp)	59.8	Water Column(ft)	45.83	Gallons in Well	7.45						
MP Elevation		Pump Intake (ft-bmp)	54.8	Purge Method	Low-Flow	Sample Method	Low-Flow						
Sample Time	12:55	Volumes Purged	0.43	Sample ID	MW-21-4S-EVENT#6	Sampled by	Desmond Bedard						
Purge Start	12:15	Gallons Purged	3.17	Replicate/Code No.									
Purge End	12:55												
Time	Minutes Elapsed	Total Elapsed Minutes	Rate mL/min	Depth to Water (ft)	Gallons Purged	pH (standard units)	Conductivity (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temperature °C	Redox (mV)	Appearance	
												Color	Odor
12:20	0	0	300	14.09	0.40	6.01	0.449	151.22	1.93	11.1	65.4	Clear	None
12:30	10	10	300	14.09	1.19	6	0.447	93.82	1.39	11.1	34.2	Clear	None
12:35	5	15	300	14.09	1.59	6	0.444	37.98	1.26	11	31.4	Clear	None
12:40	5	20	300	14.09	1.98	6	0.439	17.13	1.04	11.2	29.5	Clear	None
12:45	5	25	300	14.09	2.38	5.99	0.436	16.46	0.97	11.2	28.3	Clear	None
12:50	5	30	300	14.09	2.77	5.99	0.434	15.88	0.94	11.1	29.2	Clear	None

Constituent Sampled	Container	Number	Preservative
See COC	NA	5	NA

Comments: PID —> MiniRAE 3000 - SN:592-914328
 Note: Sampler is red/green color blind.
 Initial purge appearance - yellow; initial purge odor - none.
 Final purge appearance - clear; final purge odor - none.
 DR900 colorimeter direct instrument readings—> ferrous iron with dilution factor of 10 = .40mg/L; total iron with dilution factor of 10 = .84mg/L.

Well Casing Volume Conversion

Well diameter (inches) = gallons per foot $1 = 0.04 \quad 1.5 = 0.09 \quad 2.5 = 0.26 \quad 3.5 = 0.50 \quad 6 = 1.47$
 $1.25 = 0.06 \quad 2 = 0.16 \quad 3 = 0.37 \quad 4 = 0.65$

Well Information

Well Location:	Well Locked at Arrival:
Condition of Well:	Well Locked at Departure:
Well Completion: NA	Key Number To Well: NA

ft-bmp = feet below measuring point
 in = inches
 ft = feet
 mL/min = milliliters per minute

mS/cm = millisiemens per centimeter
 NTU = Nephelometric Turbidity Unit
 mg/L = milligrams per liter

mV = millivolts
 °F = degrees Fahrenheit
 °C = degrees Celsius

Groundwater Sampling Form



Project Number	30048392		Well ID	MW-21-4D		Date	02/17/2022						
Project Name/Location	USACE NE Devens Seed TO 8a JV			Weather(°F)	45.0 degrees F and Clear. The wind is blowing S/SW at 12.7mph								
Measuring Pt. Description	Top of Inner Casing	Screen Setting (ft-bmp)	--	Casing Diameter (in)	2	Well Casing Material	PVC						
Static Water Level (ft-bmp)	13.7	Total Depth (ft-bmp)	74.77	Water Column(ft)	61.07	Gallons in Well	9.92						
MP Elevation		Pump Intake (ft-bmp)	69.77	Purge Method	Low-Flow	Sample Method	Low-Flow						
Sample Time	11:10	Volumes Purged	0.22	Sample ID	MW-21-4D-EVENT#6	Sampled by	Desmond Bedard						
Purge Start	10:30	Gallons Purged	2.22	Replicate/Code No.	AS-DUP-EVENT#6								
Purge End	11:10												
Time	Minutes Elapsed	Total Elapsed Minutes	Rate mL/min	Depth to Water (ft)	Gallons Purged	pH (standard units)	Conductivity (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temperature °C	Redox (mV)	Appearance	
												Color	Odor
10:35	0	0	210	13.72	0.28	6.65	0.271	23.86	0.83	11.1	-88.9	Clear	None
10:40	5	5	210	13.72	0.55	6.66	0.258	36.91	0.42	11	-104.3	Clear	None
10:45	5	10	210	13.72	0.83	6.68	0.255	19.16	0.33	10.9	-107.6	Clear	None
10:50	5	15	210	13.72	1.11	6.67	0.256	22.56	0.24	11.1	-110.4	Clear	None
11:00	10	25	210	13.72	1.66	6.66	0.261	23.17	0.2	11.1	-111.2	Clear	None
11:05	5	30	210	13.72	1.94	6.65	0.268	21.99	0.19	11.1	-111.9	Clear	None

Constituent Sampled	Container	Number	Preservative
See COC	NA	10	NA

Comments: PID —> MiniRAE 3000 - SN:592-914328
 Note: Sampler is red/green color blind.
 Initial purge appearance - clear; initial purge odor - none.
 Final purge appearance - clear; final purge odor - none.
 DR900 colorimeter direct instrument readings—> ferrous iron with dilution factor of 20 = .56mg/L; total iron with dilution factor of 20 = .87mg/L

Well Casing Volume Conversion

Well diameter (inches) = gallons per foot $1 = 0.04 \quad 1.5 = 0.09 \quad 2.5 = 0.26 \quad 3.5 = 0.50 \quad 6 = 1.47$
 $1.25 = 0.06 \quad 2 = 0.16 \quad 3 = 0.37 \quad 4 = 0.65$

Well Information

Well Location:	Well Locked at Arrival:
Condition of Well:	Well Locked at Departure:
Well Completion: NA	Key Number To Well: NA

ft-bmp = feet below measuring point
 in = inches
 ft = feet
 mL/min = milliliters per minute

mS/cm = millisiemens per centimeter
 NTU = Nephelometric Turbidity Unit
 mg/L = milligrams per liter

mV = millivolts
 °F = degrees Fahrenheit
 °C = degrees Celsius