ROCKY MOUNTAIN ARSENAL

2024 RCRA Landfills and Groundwater Monitoring Report

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U.S. Department of the Army
Shell Oil Company

Prepared by:

Navarro Research and Engineering, Inc.

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TABLE OF CONTENTS

SECTION **PAGE**

TABLES

FIGURES

APPENDICES

LIST OF ACRONYMS

ACB	Articulated Concrete Block
ALR	Action Leakage Rate
AMA	Army Maintained Area
CUSUM	Cumulative Sum
ELF	Enhanced Hazardous Waste Landfill
HWL	Hazardous Waste Landfill
ICs	Indicator Compounds
LCS	Leachate Collection System
LDS	Leak Detection System
LGMR	Landfills and Groundwater Monitoring Report
LRCH	Leachate Riser Control House
LS/LF	Leachate Storage and Loadout Facility
Navarro	Navarro Research and Engineering, Inc.
NRAP	Non-Routine Action Plan
O&M	Operations and Maintenance
OCN	O&M Change Notice
PCGMP	Post-Closure Groundwater Monitoring Plan
PCGMR	Post-Closure Groundwater Monitoring Report
PCWMP	Post-Closure Wastewater Management Plan
PCP	Post-Closure Plan
RCRA	Resource Conservation and Recovery Act
RMA	Rocky Mountain Arsenal
SOP	Standard Operating Procedure
UFS	Unconfined Flow System

EXECUTIVE SUMMARY

This *2024 Resource Conservation and Recovery Act* (RCRA) *Landfills and Groundwater Monitoring Report* (LGMR) for the Rocky Mountain Arsenal (RMA) Federal Facility Site was prepared in accordance with the *Hazardous Waste Landfill* (HWL) *Post-Closure Plan* (PCP), Revision 4 (Navarro 2019) and the *Enhanced Hazardous Waste Landfill* (ELF) PCP, Revision 1 (Navarro 2020). The purpose of this report is to provide a summary of post-closure care activities that occurred during the 2024 reporting period of May 1, 2023, through April 30, 2024, and to provide recommendations for post-closure care during the 2025 reporting period of May 1, 2024, through April 30, 2025.

The Army contracted Navarro Research and Engineering, Inc. (Navarro) to inspect, repair, and maintain the HWL and ELF facilities in accordance with the respective PCPs.

The HWL and ELF remained in good condition throughout this reporting period. Routine inspections, maintenance, repairs, and groundwater monitoring activities were performed as necessary and in accordance with the PCPs. There were two Non-Routine Actions required, and four Operations and Maintenance Change Notices initiated to modify the PCPs.

The HWL and ELF PCPs include compliance standards for Action Leakage Rate, soil cover thickness loss, and impacts on groundwater quality. Evaluations of landfill performance relative to these compliance standards determined that both landfills met all compliance standards. Therefore, no corrective measures were necessary, and none are planned for the reporting period of 2025.

One unresolved issue from this reporting period will be carried over to the 2025 reporting period. Operations and Maintenance Change Notice (OCN)-HWL-2023-001 and OCN-ELF-2023-001 document the closure of well 25122 and the installation of replacement well 25222. Both OCNs are pending approval by the regulatory agencies.

The costs for operating, inspecting, and maintaining the HWL and ELF over the reporting period, including groundwater sampling, Leachate Collection System (LCS)/Leak Detection System (LDS) sampling, LCS/LDS operations and maintenance, and wastewater disposal, totaled $457,339. The budget for the period of December 2023 to November 2024 is $572,000.

1.0 INTRODUCTION AND METHODOLOGY

This *2024 Resource Conservation and Recovery Act* (RCRA) *Landfills and Groundwater Monitoring Report* (LGMR) for the Rocky Mountain Arsenal (RMA) Federal Facility Site was prepared in accordance with the *Hazardous Waste Landfill* (HWL) *Post-Closure Plan* (PCP), Revision 4 (Navarro 2019) and the *Enhanced Hazardous Waste Landfill* (ELF) PCP, Revision 1 (Navarro 2020).

The purpose of this report is to provide a summary of post-closure care activities that occurred during the 2024 reporting period of May 1, 2023, through April 30, 2024, and to provide recommendations for the post-closure care during the 2025 reporting period of May 1, 2024, through April 30, 2025. Groundwater, Leachate Collection System (LCS), and Leak Detection System (LDS) analytical data presented in this report was collected between January 1, 2023, and December 31, 2023. This report addresses all components of the HWL and ELF facilities. Refer to the HWL PCP and ELF PCP for additional detail regarding each component. Figure 1.0-1 illustrates the location of the HWL Army Maintained Area (AMA) and ELF AMA within the Rocky Mountain Arsenal National Wildlife Refuge.

The Army contracted Navarro Research and Engineering, Inc. (Navarro) to inspect, repair, and maintain the HWL and ELF facilities in accordance with the respective PCPs.

2.0 CAP INSPECTIONS AND MAINTENANCE

Type I inspections were conducted quarterly, Type II inspections semiannually, and post-storm inspections after significant rain events. All cap inspections were performed in accordance with Standard Operating Procedure (SOP) HWL-001 and SOP-ELF-001 presented in Appendix A of the respective PCPs. A summary of inspections is provided in Table 2.0-1.

Table 2.0-1: Cap Inspections

Date	Inspection Type	Note
June 21, 2023	Post-Storm	2.92” of rain fell on May 11, 2023. 1.23” of rain fell on June 4, 2023.
July 19, 2023	Type I	Regularly scheduled quarterly inspection.
October 12, 2023	Type II	Regularly scheduled semiannual inspection.
January 3, 2024	Type I	Regularly scheduled quarterly inspection.
April 4, 2024	Type II	Regularly scheduled semiannual inspection.

Completed HWL and ELF cap inspection forms are provided in Appendices B-1 and B-2 of this report. Summaries of HWL and ELF inspection observations and repairs are provided in Tables 2.0-2 and 2.0-4, respectively. Summaries of HWL and ELF vegetation management are provided in Tables 2.0-3 and 2.0-5, respectively.

Figure 2.0-1 illustrates the locations of routine activities performed on the HWL cap and surrounding areas, while Figure 2.0-2 shows the locations of routine maintenance and repair

activities performed on the ELF cap and surrounding areas. Documentation of maintenance activities is provided in Appendices C-1 and C-2 of this report.

Table 2.0-2: HWL Inspection Observations and Repairs

Inspection Item	Observation	Action
Erosion rills or gullies	None	N/A
Sheet erosion or plant pedestalling	None	N/A
Depressions, ponding areas, sedimentation, or other conditions that could interrupt cap drainage	None	N/A
Surface salts, crusting, or evidence of compaction	None	N/A
Excessive animal trails or tire tracks/ruts	None	N/A
Burrowing animal holes (localized burrows greater than 3 inches in diameter, or widespread burrows of any size)	None	N/A
Seepage, differential settlement, cracking, subsidence, sliding, creep, or other signs of slope instability	None	N/A
Intrusive damage such as unplanned excavation, drilling, grading, damage to engineering or access controls, vandalism	None	N/A
Bare area or areas of poor growth greater than 100 square feet	None	N/A
Areas of poor vigor, disease, over grazing, stress, burned, or discoloration greater than 100 square feet	None	N/A
Deep rooted, noxious or undesirable weeds	None	N/A
The perimeter fence is damaged	None	N/A
Debris has collected along the perimeter fence	None	N/A

Inspection Item	Observation	Action
Warning signs are not legible from 25 feet	None	N/A
Damage to the Access Road such as potholes, washouts or burrowing	The access road to the HWL LCS/LDS4 manhole has a washout. (Inspection Form: 7/19/23)	Graded the access road to repair erosion in July of 2023.
Cap perimeter survey monuments appear to be disturbed (Inspect every five years, in conjunction with the CERCLA Five Year Review for legibility and to confirm record locations)	Not inspected during this reporting period.	Next inspection required in 2025.
Erosion rills or gullies, or burrowing animal holes around the LCS/LDS manholes	None	N/A
Leachate Storage/Load Out Facility (LS/LF) Building secondary containment is damaged or not intact. Storage tanks are leaking.	None	N/A
Damage to monitoring wells	None	N/A
Impeded drainage or ponding in a channel or downchute	None	N/A
Excessive siltation in a channel or downchute	None	N/A
Debris present in a channel or downchute	Tumbleweeds observed in some of the channels. (Inspection Form: 4/10/23)	Addressed in May 2023. A subcontractor used a skid steer with mower attachment to remove tumbleweeds from the channels, downchutes and fence line.
Erosion rills or gullies in a channel or downchute	None	N/A
Areas of degraded Articulated Concrete Block (ACB) or extensively cracked grout around ACB	None	N/A
Subsidence or undercutting of the downchutes or perimeter drainage channels	None	N/A

Inspection Item	Observation	Action
Damaged box culverts	None	N/A

The maintenance items listed below are focused on routine vegetation management to facilitate effective operations and maintenance (O&M) of the HWL. These maintenance items were observed independently of routinely scheduled inspections due to the timing of seasonal growth.

Table 2.0-3: HWL Vegetation Management

Target Species	Action	Date
Thistles, bindweed, kochia	Spot sprayed with the herbicides Escort® mixed with Vision®	June 2023
Cheatgrass	Broadcast sprayed with the herbicide Rejuvra®	September 2023
All species	Ground clear herbicide Plainview SC® was broadcast sprayed to working surfaces.	October 2023
Kochia and Russian thistle	Mowed annual weedy species and removed standing litter.	October 2023

Table 2.0-4: ELF Inspection Observations and Repairs

Inspection Item	Observation	Action
Erosion rills or gullies	None	N/A
Sheet erosion or plant pedestalling	None	N/A
Depressions, ponding areas, sedimentation, or other conditions that could interrupt cap drainage	None	N/A
Surface salts, crusting, or evidence of compaction	None	N/A
Excessive animal trails or tire tracks/ruts	None	N/A
Burrowing animal holes (localized burrows greater than 3 inches in diameter, or widespread burrows of any size)	None	N/A

Inspection Item	Observation	Action
Seepage, differential settlement, cracking, subsidence, sliding, creep, or other signs of slope instability	None	N/A
Intrusive damage such as unplanned excavation, drilling, grading, damage to engineering or access controls, vandalism	None	N/A
Anchor Trench Drain outfalls exhibit flow, erosion, seepage, moisture or bare/ sparse vegetation.	None	N/A
Bare area or areas of poor growth greater than 100 square feet	None	N/A
Areas of poor vigor, disease, over grazing, stress, burned, or discoloration greater than 100 square feet	None	N/A
Deep rooted, noxious or undesirable weeds	Cheatgrass localized around EM-ELF01. (Inspection Form: 4/4/24)	Weed Control is ongoing.
The perimeter fence is damaged	None	N/A
Debris has collected along the perimeter fence	None	N/A
Warning signs are not legible from 25 feet	None	N/A
Damage to the Access Road such as potholes, washouts or burrowing	None	N/A
Cap perimeter survey monuments appear to be disturbed (Inspect every five years, in conjunction with the CERCLA Five Year Review for legibility and to confirm record locations)	Not inspected during this reporting period	Next inspection required in 2025.
Erosion rills or gullies, or burrowing animal holes around the Leachate Riser Control House (LRCH) Buildings	None	N/A

Inspection Item	Observation	Action
LS/LF Building secondary containment is damaged or not intact. Storage tanks are leaking.	None	N/A
Damage to monitoring wells	None	N/A
Impeded drainage or ponding in a channel or downchute	None	N/A
Excessive siltation in a channel or downchute	None	N/A
Debris present in a channel or downchute	Tumbleweeds observed again in some of the channels. (Inspection Form: 4/10/23)	Addressed in May 2023. A subcontractor used a skid steer with mower attachment to remove tumbleweeds from the channels and downchutes.
Erosion rills or gullies in a channel or downchute	None	N/A
Areas of degraded ACB or extensively cracked grout around ACB	None	N/A
Subsidence or undercutting of the downchutes or perimeter drainage channels	None	N/A
Damaged box culverts	None	N/A

The maintenance items listed below are focused on routine vegetation management to facilitate effective O&M of the ELF. These maintenance items were observed independently of routinely scheduled inspections due to the timing of seasonal growth.

Table 2.0-5: ELF Vegetation Management

Target Species	Action	Date
Thistles, bindweed, kochia	Spot sprayed with the herbicides Escort® mixed with Vision®	June 2023
Cheatgrass	Broadcast sprayed with the herbicide Rejuvra®	September 2023
All species	Ground clear herbicide Plainview SC® was broadcast sprayed to working surfaces.	October 2023
Kochia and Russian thistle	Mowed annual weedy species and removed standing litter.	October 2023

2.1 Precipitation

Precipitation data were collected from a rain gauge located near the Lime Basins RCRA-Equivalent Cover in Section 36, which is located approximately 1.5 miles south of the HWL and ELF. Total precipitation measured at the rain gauge between May 1, 2023, and April 30, 2024, was 24.6 inches. Precipitation data for the reporting period is provided in Appendix A. Significant rain events, greater than 1.0 inches in 24 hours, occurred on May 11, 2023 (2.92 inches), June 4, 2023 (1.23 inches), and April 27, 2024 (1.27 inches).

2.2 Vegetation

Established areas of seeded vegetation on the HWL and ELF caps continue to do well and provide substantial cover, limiting soil erosion. Much of the growth of annual weedy species that has occurred in the past has been controlled or naturally diminished. Perennial grass species have been successfully established due to the lack of competition by weedy species. On the top of the HWL, cool season grass species, especially Western Wheatgrass (*Pascopyrum smithii*) continue to dominate the plant community. Blue grama (*Chondrosum gracil*), buffalo grass (*Buchloe dactyloides)*, and alkali sacaton (*Sporobolus airoides*) are common warm season grass species on both landfills. Broadleaf weedy species, especially Kochia (*Bassia scoparia*) and Russian thistle (*Salsola tragus*), that were abundant in localized areas in previous years have also diminished in both stature and extent. Cheatgrass (*Bromus tectorum*), is also much less abundant on the ELF and appears to have been controlled effectively by herbicide treatment. These cheatgrass control efforts have led to an increase of perennial grass establishment on portions of the ELF that have historically been sparsely covered by perennial seeded species, such as the landfill's south slope.

The oscillations in plant community composition and production associated with early successional communities or highly disturbed areas have been reduced in the maturing plant community after fifteen growing seasons. Most of the area has developed a stable and sustainable plant community.

2.3 Non-Routine Actions

There were two Non-Routine Action Plans (NRAP) applicable to the HWL and/or the ELF for this reporting period and these are included in Appendix G.

NRAP-2023-001 (Navarro 2023a) documents that the instrument used to analyze samples for cyanide was inoperable at the analytical laboratory, and thus several groundwater samples from the HWL and ELF well networks had sample hold times expire. It was ultimately determined that it was unlikely that cyanide would be present above the reporting limit in the affected samples and that missing the cyanide data for 2023 does not adversely impact the ability to determine if the landfills are affecting groundwater quality. The NRAP was signed and approved by the regulatory agencies in May of 2023.

NRAP-2023-003 (Navarro 2023e) documents that the dieldrin concentration in a sample collected from well 25194 on July 17, 2023, was above the 2023 Prediction Limit. The recommended actions were to continue routine quarterly sampling of well 25194, evaluate the dieldrin concentrations using an intrawell comparison and Mann-Kendall trend analysis, and report the conclusions in the annual HWL Post-Closure Groundwater Monitoring Report

(PCGMR). The NRAP was signed and approved by the regulatory agencies in September of 2023.

2.4 O&M Change Notices

There were four O&M Change Notices (OCNs) for either the HWL or ELF that were prepared during this reporting period and these are included in Appendix H.

OCN-HWL-2023-001 (Navarro 2023c) and OCN-ELF-2023-001 (Navarro 2023d) document that well 25122 was compromised and could not provide the water level data required to support mapping of the potentiometric surface. The OCNs provide technical specifications for the closure of well 25122 and the installation of replacement well 25222. Additional information regarding the handling of soil cuttings was requested by the EPA. These OCNs were not approved during this reporting period.

OCN-HWL-2024-001 (Navarro 2024b) and OCN-ELF-2024-001 (Navarro 2024a) changed the records management requirements found in the HWL and ELF PCPs to comply with the Army's paperless records management system. These changes included the conversion of paper forms to fillable PDF forms. Other administrative changes included an updated mailing address for the Army Project Manager and the replacement of references to Tri-County Health Department with Adams County Health Department. These OCNs were approved by the regulatory agencies in April of 2024.

3.0 LCS & LDS OPERATIONS AND MONITORING

Quarterly inspections were performed of the HWL and ELF LCS and LDS wastewater conveyance systems in accordance with the *Post-Closure Wastewater Management Plans* (PCWMP), presented in Appendix C of the respective PCPs.

Sump levels for the LCS and LDS sumps, and tank levels in the LS/LF building were recorded monthly in accordance with the HWL and ELF PCWMPs. The monthly flow summaries for all HWL and ELF sumps are provided in Appendix E of this report.

Wastewater was sampled from the HWL LCS and LDS sumps in accordance with the *HWL Post-Closure Groundwater Monitoring Plan* (PCGMP), presented in Appendix B of the HWL PCP Revision 4 (Navarro 2019). Analytical results and data evaluation for HWL LCS and LDS wastewater sampling are presented in the 2023 HWL PCGMR, provided in Appendix F-1 of this report.

The ELF sumps did not require sampling during this reporting period.

3.1 Wastewater Conveyance Systems Inspections and Maintenance

Wastewater conveyance systems inspection dates are shown in Table 3.1-1. Summaries of the inspection results are presented in Tables 3.1-2 and 3.1-3. Inspection documentation is provided in Appendices B-1 and B-2 of this report and Wastewater O&M Reports are provided in Appendices C-1 and C-2 of this report.

Table 3.1-1: Wastewater Conveyance System Inspections

Date	Inspection Type	Note
July 6, 2023	Wastewater Conveyance System	Regularly scheduled quarterly inspection.
October 11, 2023	Wastewater Conveyance System	Regularly scheduled quarterly inspection.
January 3, 2024	Wastewater Conveyance System	Regularly scheduled quarterly inspection.
April 2, 2024	Wastewater Conveyance System	Regularly scheduled quarterly inspection.

Table 3.1-2: HWL Wastewater Conveyance System Observations and Actions

Inspection Item	Observation	Action
Warning signs are not legible (Confined Space, Buried Pipe/Conduit, etc.)	None	N/A
Extreme temperature inside LCS/LDS manholes	None	N/A
Excessive liquid in LCS/LDS manholes	None	N/A
Improper operation/condition of LCS/LDS pumps or instrumentation	None	N/A
Improper operation/condition of lift station pumps or instrumentation	None	N/A
Excessive liquid in lift station secondary containment	None	N/A
Blockage of leachate collection or leak detection discharge piping	None	N/A
Collapse of leachate collection or leak detection sump riser pipe	None	N/A
LS/LF tank levels are above high level set points.	None	N/A
Indication of leaks in the indoor piping system in the LS/LF.	None	N/A
Indication that the LS/LF secondary containment is damaged or inadequate.	None	N/A
Heating system in the LS/LF is malfunctioning.	None	N/A

Table 3.1-3: ELF Wastewater Conveyance System Observations and Actions

Inspection Item	Observation	Action
Improper operation/condition of instrumentation and valves	None	N/A
Improper operation of leachate collection and leak detection pumps	None	N/A
Excessive liquid in LRCHs or LS/LF.	None	N/A
Blockage of leachate collection leak detection discharge piping	None	N/A
Collapse of leachate collection or leak detection sump riser pipe	None	N/A
Flow meters or level indicators are malfunctioning.	None	N/A
LS/LF tank levels are above high level set points.	None	N/A
Indication of leaks in the indoor piping system in the LRCHS or LS/LF.	None	N/A
Indication that the LS/LF secondary containment is damaged or inadequate.	None	N/A
Heating system in the LRCHs or LS/LF is malfunctioning.	None	N/A

In addition to the quarterly wastewater conveyance system inspections, the following routine inspections, maintenance, and repair activities were performed on the HWL and ELF LCS/LDS components.

- Performed quarterly inspections for grounding and tool safety inspections and first aid kits.
- Performed monthly inspections on emergency lights and fire extinguishers.
- Performed weekly LS/LF tank inspections.
- Transferred wastewater from the HWL LCS/LDS sumps to the Lift Station, and then to the storage tanks in the LS/LF building as needed.
- Clean Harbors collected wastewater for off-site shipment and disposal.
- Pumped the LS/LF floor sump due to storm water accumulation, as necessary.
- Reset the GFI buttons on the HWL sump panels, as necessary.

- Performed a visual inspection of the LS/LF building due to electrical grid failure and the remote monitoring system being down. A daily inspection was performed from May 27 through May 29 until power was restored on May 30.
- Replaced parts for the leak detection system after power loss was restored. Replaced zone splitters for Zones-1, 2, 3, 12, and 14, and Zone-bypass connector for Z-1. A new moisture detection sensor for Zone-2 was also replaced.
- Replaced Program Logic Control cards for HWL sumps LCS/LDS1 and HWL sumps LCS/LDS3.
- Installed new water level probe for HWL sump LCS3.
- Replaced a bad zone splitter for Zone 8 at the HWL.
- The Program Logic Controller at the Lift Station faulted and was repaired by reprogramming.

3.2 Wastewater Management Quantities

A total of 19,582 gallons of wastewater was pumped out of the HWL sumps between May 2023 and April 2024. That equates to a 0.46 percent increase in wastewater production compared to the previous period of May 2022 to April 2023 when 19,493 gallons of wastewater were removed from the sumps. The Army expects the overall trend in the HWL wastewater production to decrease in the following years.

The Army continued investigating alternative disposal methods for the leachate after analytical data demonstrated that the leachate is suitable for land disposal. The leachate will be land disposed during the reporting period for the 2025 LGMR.

An annual wastewater generation forecast for the HWL through 2065 is provided as Figure 3.2-1.

3.3 LCS/LDS Wastewater Quality

Sump samples were collected when the wastewater levels reached their respective High Level at each of the HWL sumps. All samples were shipped to Applied Research and Development Laboratory in Mount Vernon, Illinois for analysis. Refer to Table 3.3-1 for HWL sump sample dates and triggers.

The ELF sumps were not sampled in 2023 because the wastewater levels were not high enough to require sampling.

Table 3.3-1: HWL LCS & LDS Sump Sample Events (2023 Calendar Year)

Date	Sump							
	LCS1	LDS1	LCS2	LDS2	LCS3	LDS3	LCS4	LDS4
February 2023			High Level		High Level		High Level	
April 2023	High Level							
July 2023			High Level					
November 2023	High Level	High Level						

The HWL wastewater analytical results and conclusions are available in the 2023 HWL PCGMR, provided as Appendix F-1 of this report. The LCS sample results were consistent with wastes placed in the HWL. The indicator compounds (ICs) detected in the HWL LDS sumps were below the prediction limit for the respective compounds. There were no LDS analytical results that required regulatory agency notification per the HWL PCP.

4.0 GROUNDWATER MONITORING

The PCGMPs were implemented as presented in Appendix B of the HWL PCP and ELF PCP. Groundwater monitoring was performed quarterly in 2023. Analytical results and data evaluation for post-closure groundwater sampling performed during the 2023 calendar year are presented in the PCGMRs provided in Appendices F-1 and F-2 of this report. Section 5.3 of this report addresses aspects of groundwater monitoring that are relevant to compliance determination.

Groundwater flow in the footprint of the Corrective Action Management Unit is generally to the north and northwest. No significant variations in groundwater flow directions have been identified during post-closure monitoring, therefore the current monitoring network is sufficient to identify the landfills' potential impacts on groundwater quality.

In the 2023 LGMR (Navarro 2023b), the Army stated that well 25122 was compromised and could not provide the water level data required to support mapping of the potentiometric surface. Therefore, the Army recommended that well 25122 be closed, removed from the monitoring network, and replaced by a new well. In October of 2023 well 25122 was closed and replacement well 25222 was installed in accordance with the technical requirement of OCN-HWL-2023-001 (Navarro 2023c) and OCN-ELF-2023-001 (Navarro 2023d). In November of 2023, the EPA requested soil characterization data prior to agreeing to on-site surface disposal of the drill cuttings from well 25122. The EPA's request is under discussion among the working group and resolution is pending. In 2024 the Army will prepare another pair of OCNs to the HWL PCP and ELF PCP to remove well 25122 from the landfills' groundwater level monitoring networks and add well 25222 to the networks.

5.0 COMPLIANCE DETERMINATION

The HWL and ELF PCPs include compliance standards for Action Leakage Rate (ALR), soil cover thickness loss, and impacts on groundwater quality. Evaluations of landfill performance relative to these compliance standards are provided in the following subsections.

5.1 Action Leakage Rate

The ALR is the liquid flow rate that, when withdrawn from the LDS sumps, warrants follow-up actions. The average daily flow rates for the HWL and ELF LDS sumps were calculated using monthly flow rate data, then those values were compared with the ALRs identified in the *Post-Closure Action Leakage Rate/Response Action Plans* presented in Appendix D of the HWL PCP and ELF PCP, respectively. Appendix E of this report provides the monthly flow summaries used to calculate the average daily flow rates for each sump.

5.1.1 HWL ALR Evaluation

In all cases, the average daily flow rates of the HWL LDS sumps were much lower than the ALR and the Non-Routine Action trigger level of 85 percent of the ALR. Hence, the performance standards and Non-Routine Action trigger levels for HWL leak detection liquids were not exceeded.

The ALR values were not exceeded at any point during the reporting period for any of the HWL LDS sumps. Therefore, the compliance standard was met.

5.1.2 ELF ALR Evaluation

In all cases the average daily flow rates of the ELF LDS sumps were much less than the ALR and the Non-Routine Action trigger levels of 50 and 85 percent of the ALR. Hence, the performance standards and Non-Routine Action trigger levels for ELF leak detection liquids were not exceeded.

The ALR values were not exceeded at any point during the reporting period for any of the ELF LDS sumps. Therefore, the compliance standard was met.

5.2 Soil Cover Thickness Loss

Erosion/settlement monuments were measured on the HWL and ELF during the Type II inspections to quantify soil thickness loss. Soil thickness loss measurements are included in the Type II inspection forms provided in Appendices B-1 and B-2 of this report.

5.2.1 HWL Soil Cover Thickness Loss Evaluation

The measured soil thickness loss for all nine monuments on the HWL in the fall of 2023 and spring of 2024 ranged from 0.0 to 2.0 inches, which is within the historical range of the HWL monuments. These values are less than the Non-Routine Action trigger level of 0.4 feet (or 4.8 inches) and the compliance level of 1.0 foot. Therefore, the compliance standard for soil cover thickness loss was met.

During this reporting period the soil cover thickness loss values followed the typical seasonal pattern of larger values in the fall and lesser values in the spring, with occasional exceptions. These same seasonal fluctuations have been consistently observed across all landfills and covers

at RMA. The lower values in the spring have generally been attributed to freeze/thaw cycles loosening soil near the surface, resulting in vertical expansion.

5.2.2 ELF Soil Cover Thickness Loss Evaluation

The measured soil thickness loss for all eight monuments on the ELF in the fall of 2023 and spring of 2024 ranged from 1.0 to 3.25 inches, which is within the historical range of the ELF monuments. These values are less than the Non-Routine Action trigger level of 0.4 feet (or 4.8 inches) and the compliance level of 1.0 foot. Therefore, the compliance standard for soil cover thickness loss was met.

During this reporting period the soil cover thickness loss values followed the same seasonal pattern as described in Section 5.2.1, above. Springtime values were as much as 0.5 inch less than the respective fall measurements.

5.2.3 Monument Survey Evaluation

Each monument's location was surveyed semiannually to assess potential movement of the caps. While there is no compliance standard related to changes in monument position, this information is valuable for assessing the stability of the landfills. Survey data are included in Appendix D of this report. The position of each monument was quantitatively compared to the original location documented in the construction records and the coordinates recorded during the previous survey. This dual comparison identifies both long-term and short-term movement of each monument. A summary of the evaluations is shown in Table 5.2.3-1.

Table 5.2.3-1: Monument Survey Evaluation

Landfill	Number of Monuments	Long-Term Change in Location (ft)		Short-Term Change in Location (ft)	
		Vertical Average	Horizontal Average	Vertical Average	Horizontal Average
HWL	9	-0.4	0.2	0.1	0.1
ELF	8	-0.3	0.1	0.1	0.1

In general, the most significant change in each monument's location has been a decrease in the vertical coordinate since construction was completed. Minor variations, generally less than half a foot, have been recorded in the horizontal plane.

Evaluation of the survey results did not indicate subsidence or creep of the HWL or ELF caps.

5.3 Impacts on Groundwater Quality

5.3.1 HWL Impacts on Groundwater Quality

Dieldrin was the only IC detected in the downgradient Unconfined Flow System (UFS) wells (25087 and 25194). The prediction limit for dieldrin was exceeded in well 25194 in July of 2023. The regulatory agencies were notified of the exceedance via NRAP-2023-003 (Navarro 2023e). Concentrations returned to below the prediction limit in October of 2023. The combined Shewhart-Cumulative Sum (CUSUM) control chart for dieldrin in well 25194 showed concentrations did not exceed the control limit, and the calculated CUSUM did not exceed the

control limit, thus supporting the general downward trend in dieldrin concentrations in groundwater at this location.

Based on the statistical evaluations and trend analysis presented in the 2023 HWL PCGMR provided as Appendix F-1 of this report, groundwater quality in the vicinity of the HWL has not been affected by operations, closure, or post-closure O&M of the landfill. Therefore, the compliance standard for impacts on groundwater quality was met.

5.3.2 ELF Impacts on Groundwater Quality

Lead was the only IC detected in the downgradient UFS wells. Lead was detected in well 26099 during the second quarter of 2023 but was below the prediction limit. No ICs exceeded the prediction limits in 2023.

Based on the statistical evaluation presented in the 2023 ELF PCGMR provided as Appendix F-2 of this report, groundwater quality in the vicinity of the ELF has not been affected by operations, closure, or post-closure O&M of the landfill. Therefore, the compliance standard for impacts on groundwater quality was met.

6.0 RECOMMENDATIONS AND CORRECTIVE MEASURES

The O&M of the landfills in accordance with the HWL PCP and ELF PCP was effective, therefore, the Army recommends continuing the routine inspections, monitoring, and maintenance as required by the plans.

Resolution of the EPA's concerns regarding wells 25122 and 25222 as described in Section 2.4, and subsequent approval of OCN-HWL-2023-001 and OCN-ELF-2023-001, are also recommended.

The HWL and ELF met all compliance standards; therefore, no corrective measures were necessary, and none are planned for the reporting period of 2025.

7.0 COSTS AND BUDGETS

Table 7.0-1 shows the costs incurred between May 2023 and April 2024, as well as the current budgets established for O&M of the HWL and ELF.

Table 7.0-1: Costs and Budgets

Landfill	Costs		Budgets	
	Incurred	Period	Value	Period
HWL	$304,804	May 2023 – Apr 2024	$358,000	Dec 2023 – Nov 2024
ELF	$152,535	May 2023 – Apr 2024	$214,000	Dec 2023 – Nov 2024
TOTAL	$457,339		$572,000	

8.0 CONCLUSIONS

Based on the information presented in this report, the HWL and ELF were inspected and maintained in accordance with the HWL and ELF PCPs, and both landfills are in compliance with all standards. No corrective measures are required.

9.0 REFERENCES

Navarro (Navarro Research and Engineering, Inc.)

2024a (Mar 21) OCN-ELF-2024-001.

2024b (Apr 1) OCN-HWL-2024-001.

2023a (May 10) NRAP-2023-001.

2023b (Jun 21) *2023 RCRA Landfills and Groundwater Monitoring Report.* Revision 0.

2023c (Sep 13) OCN-HWL-2023-001.

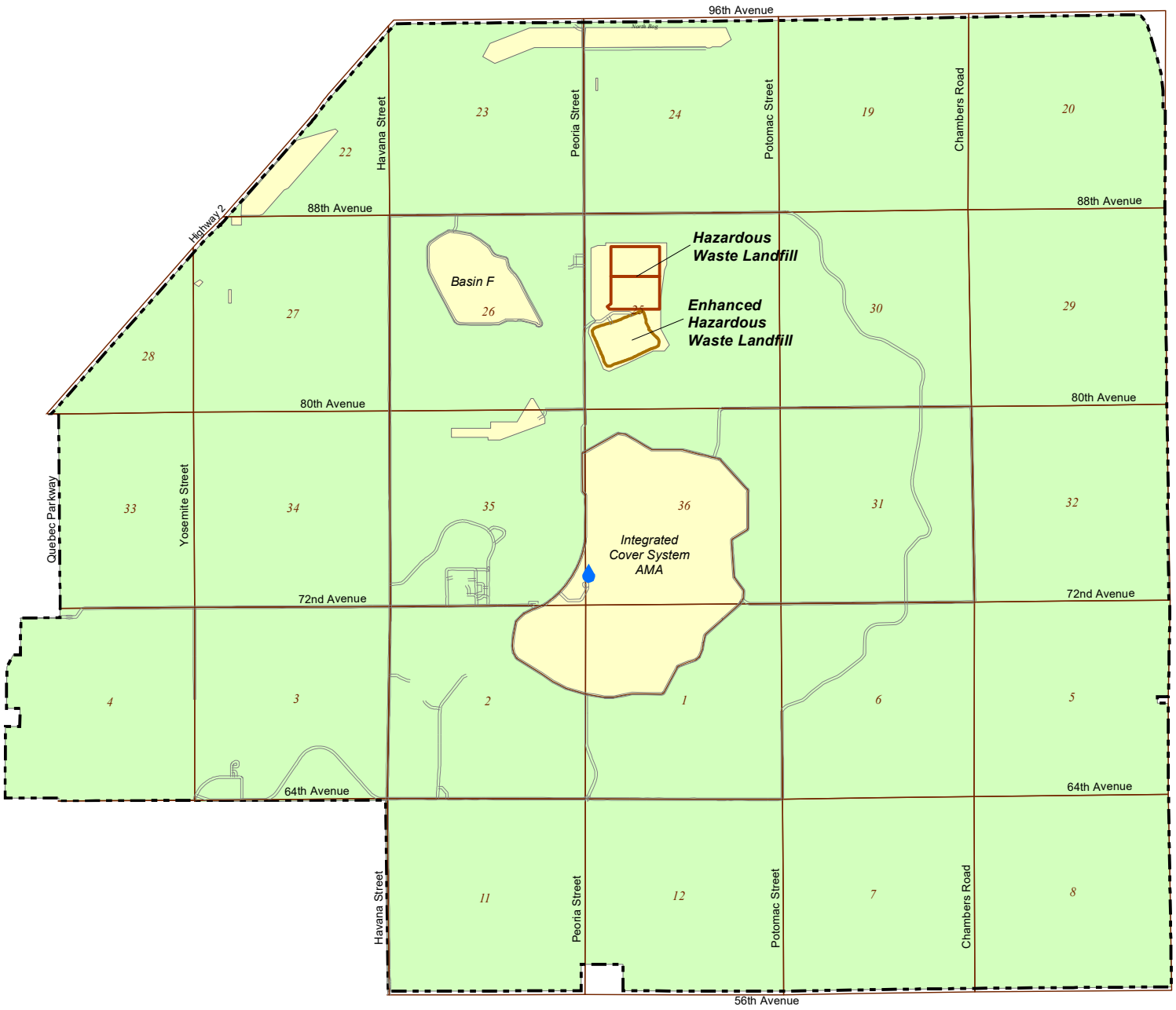
2023d (Sep 13) OCN-ELF-2023-001.

2023e (Sep 25) NRAP-2023-003.

2020 (Apr 2) *Enhanced Hazardous Waste Landfill Post-Closure Plan*. Revision 1.

2019 (Dec 9) *Hazardous Waste Landfill Post-Closure Plan*. Revision 4.

FIGURES



Legend

- Rocky Mountain Arsenal Boundary
- Section Lines
- USFWS Managed Area
- Army Maintained Area
- Paved Roads
- Rain Gauge

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Figure 1.0-1

Site Location Map

M:projects\HWLandELFRoutineAndNonRoutineMaintenanceActivities\2024\
02/12/24 SiteLocationMap_Fig1.0-1_HWL.mxd

Legend

- Erosion/Settlement Monument
- Well
- LCS/LDS Manhole
- Channel Flow Line
- Fence
- Gate
- Cattle Guard
- Box Culvert
- Road
- Existing Contours
- Articulated Concrete Block
- Channels and Downchutes
- Mowed
- Cheatgrass Herbicide
- Repaired Erosion
- Ground Clear Herbicide
- Removed Tumbleweeds

N

0 95 190 380 Feet

NAD27-NGVD29 Datum, US Survey Feet,
Colorado North Zone
Sources: U.S. Army, RMA GIS, OMC, Shell/AECOM

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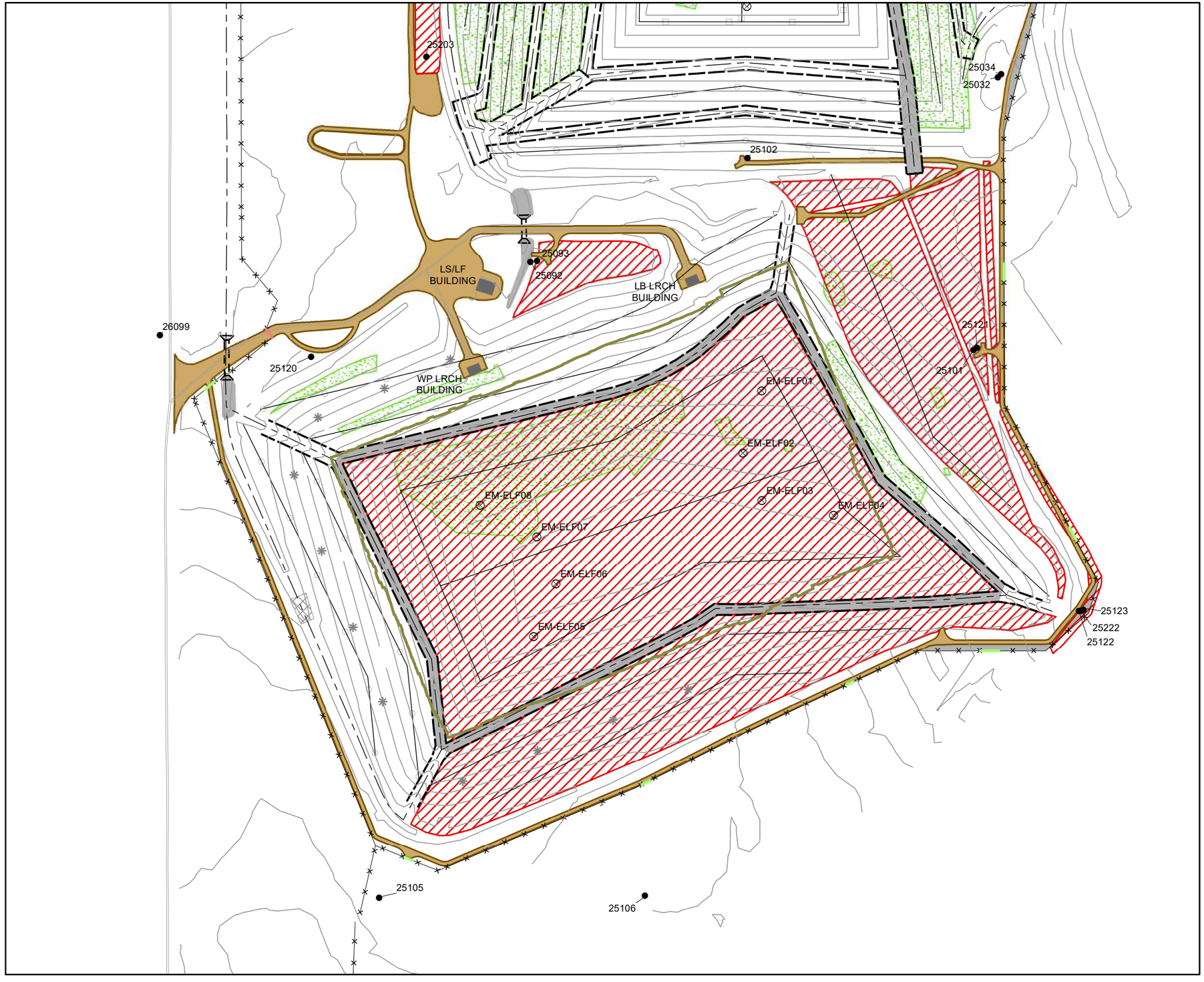
Figure 2.0-1

HWL Routine Activities Map

6/5/2024

M:\projects\HWLandELF_RoutineAndNonRoutineMaintenanceActivities\2024\mxds\HWL_RoutineMaintenanceActivities_May2024.mxd



Legend

- Erosion/Settlement Monument
- Well
- Trench Drain Outfall
- Channel Flow Line
- Fence
- Gate
- Cattle Guard
- Gas Vent Layer
- Perimeter Channel Articulated Concrete Block
- Box Culvert
- Road
- Existing Contours
- Articulated Concrete Block Channels and Downchutes
- Mowed
- Cheatgrass Herbicide
- Ground Clear Herbicide
- Removed Tumbleweeds

N

0 95 190 380

Feet

NAD27-NGVD29 Datum, US Survey Feet,
Colorado North Zone

Sources: U.S. Army, RMA GIS, OMC, Shell/AECOM

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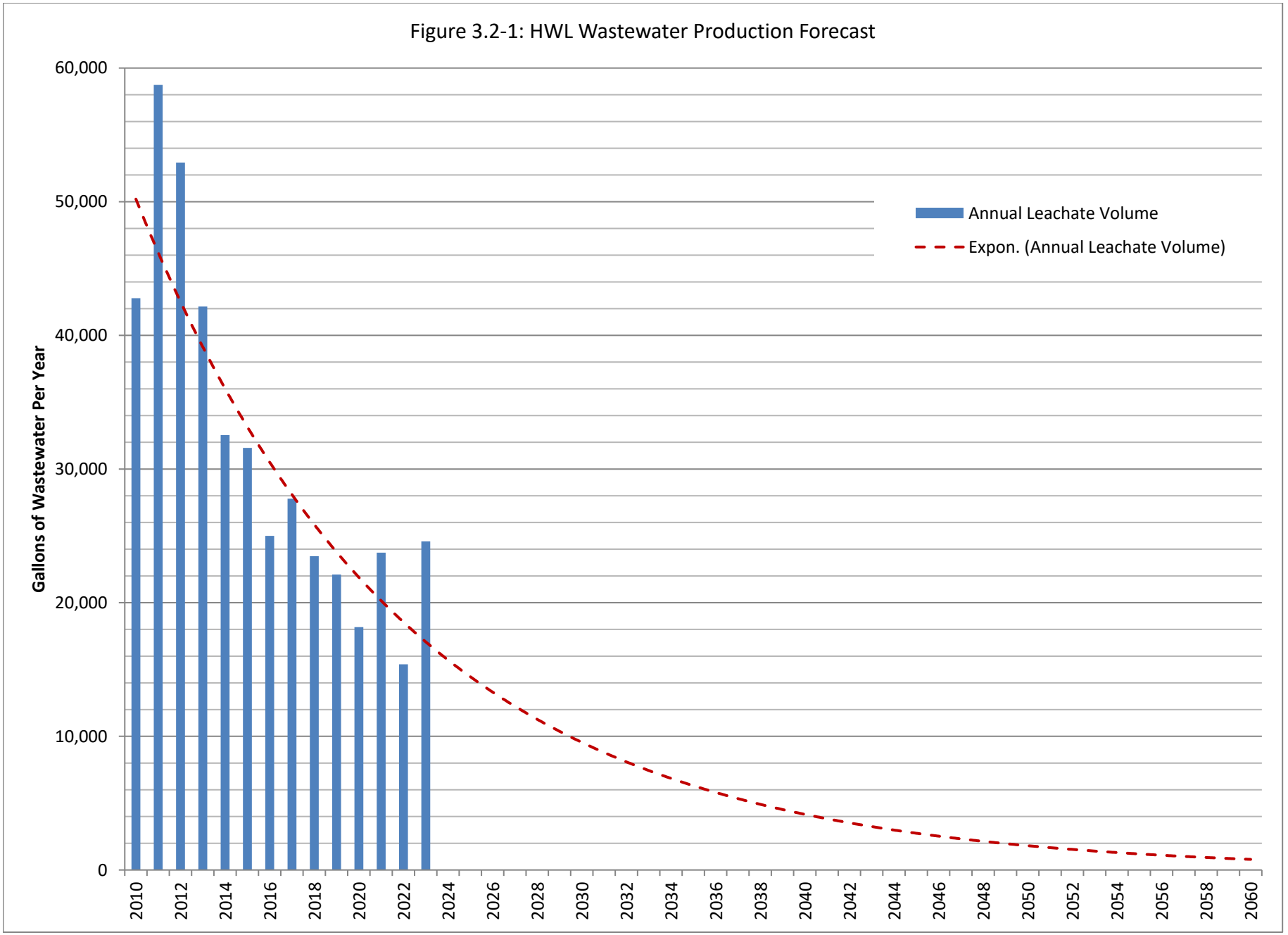
Figure 2.0-2

ELF Routine Activities Map

6/5/2024

M:\projects\HWLandELF_RoutineAndNonRoutineMaintenanceActivities\2024\mxds\ELF_RoutineMaintenanceActivities_May2024.mxd

Figure 3.2-1: HWL Wastewater Production Forecast



APPENDICES

A	Precipitation Data
B-1	HWL Inspection Documentation
B-2	ELF Inspection Documentation
C-1	HWL Maintenance Documentation
C-2	ELF Maintenance Documentation
D	Erosion/Settlement Monument Survey Data
E	Monthly Flow Summaries
F-1	Hazardous Waste Landfill Post-Closure Groundwater Monitoring Report Calendar Year 2023
F-2	Enhanced Hazardous Waste Landfill Post-Closure Groundwater Monitoring Report Calendar Year 2023
G	Non-Routine Action Plans
H	Operations and Maintenance Change Notices
I	Responses to Regulatory Agency Comments

APPENDIX A

Precipitation Data

Appendix A - Precipitation Data (May 1, 2023 through April 30, 2024)

Note 1: The reporting period for this table is May 1, 2023 through April 30, 2024.

Note 2: Data presented in this table were collected from a rain gauge located on the Lime Basins RCRA-Equivalent Cover in Section 35.

Note 3: This table provides precipitation data for all dates when precipitation was recorded. For dates not shown, there was no recorded precipitation.

Note 4: The yellow highlighted box indicates a significant storm event where one inch or greater of rain fell in a 24- hour period.

Date	Daily Precipitation (in)
May 9, 2023	0.01
May 10, 2023	0.62
May 11, 2023	2.92
May 12, 2023	0.85
May 14, 2023	0.28
May 15, 2023	0.02
May 16, 2023	0.22
May 18, 2023	0.14
May 19, 2023	0.01
May 25, 2023	0.11
May 26, 2023	0.37
May 27, 2023	0.42
June 2, 2023	0.46
June 3, 2023	0.24
June 4, 2023	1.23
June 5, 2023	0.05
June 6, 2023	0.01
June 8, 2023	0.99
June 9, 2023	0.01
June 11, 2023	0.14
June 12, 2023	0.09
June 13, 2023	0.03
June 15, 2023	0.40
June 16, 2023	0.26
June 17, 2023	0.01
June 21, 2023	0.62
June 22, 2023	0.15
June 29, 2023	0.63
June 30, 2023	0.21
July 4, 2023	0.91
July 5, 2023	0.07
July 6, 2023	0.01
July 7, 2023	0.08
July 8, 2023	0.03
July 14, 2023	0.21
July 18, 2023	0.06

Date	Daily Precipitation (in)
July 20, 2023	0.53
July 21, 2023	0.11
July 24, 2023	0.36
July 25, 2023	0.07
July 26, 2023	0.43
July 28, 2023	0.01
July 31, 2023	0.12
August 1, 2023	0.03
August 2, 2023	0.50
August 3, 2023	0.30
August 6, 2023	0.02
August 19, 2023	0.20
August 20, 2023	0.01
August 25, 2023	0.62
August 26, 2023	0.20
August 28, 2023	0.01
September 3, 2023	0.27
September 4, 2023	0.01
September 10, 2023	0.09
September 11, 2023	0.12
September 14, 2023	0.26
September 15, 2023	0.17
October 3, 2023	0.01
October 11, 2023	0.02
October 12, 2023	0.01
October 24, 2023	0.03
October 26, 2023	0.02
October 29, 2023	0.06
October 30, 2023	0.30
October 31, 2023	0.04
November 20, 2023	0.03
November 26, 2023	0.17
December 9, 2023	0.09
December 10, 2023	0.01
December 13, 2023	0.01
December 14, 2023	0.04

Appendix A - Precipitation Data (May 1, 2023 through April 30, 2024)

Date	Daily Precipitation (in)
December 23, 2023	0.01
December 24, 2023	0.01
December 26, 2023	0.08
December 27, 2023	0.09
January 8, 2024	0.01
January 9, 2024	0.01
January 16, 2024	0.17
January 17, 2024	0.01
January 26, 2024	0.07
February 2, 2024	0.04
February 3, 2024	0.24
February 4, 2024	0.08
February 5, 2024	0.37
February 6, 2024	0.15
February 11, 2024	0.10
February 12, 2024	0.14
February 17, 2024	0.16
February 27, 2024	0.08
February 28, 2024	0.01
March 8, 2024	0.02
March 13, 2024	0.13
March 14, 2024	0.28
March 15, 2024	0.28
March 16, 2024	0.89
March 24, 2024	0.03
March 25, 2024	0.11
March 26, 2024	0.17
April 1, 2024	0.09
April 2, 2024	0.01
April 16, 2024	0.17
April 18, 2024	0.02
April 19, 2024	0.05
April 20, 2024	0.28
April 21, 2024	0.26
April 25, 2024	0.18
April 26, 2024	0.36
April 27, 2024	1.27
April 28, 2024	0.02
Total:	**24.60"**

APPENDIX B-1

HWL Inspection Documentation

FORM SOP HWL 001-1
HWL CAP TYPE I INSPECTION FORM

Inspector Name(s): K. Hoffman | **Inspection Date(s):** 6-21-23

Field Conditions:
Previous 24-Hour Precipitation: 0 | Weather Conditions: sunny, calm winds, 70s-80's | Acceptable / Unacceptable for Inspection ***(circle one)***

Post-Storm Inspection: Recent Significant Storm Event? ☑ Yes ☐ No

Drive-around inspection performed after significant storm event? ☑ Yes ☐ No ☐ N/A

Drive-around inspection date (taken from Logbook): 5-4-23, 5-15-23, 6-5-23

*Note: Post-storm event inspection items are indicated with a * next to the Inspection Item number.*

Date(s) of Significant Storm Event:	**Total Precipitation (in):**
~~5-10-23~~	~~1.03"~~ ~~KM~~ 6-21-23
5-4-23	2.92"
6-4-23	1.23"

Attachments: ☐ Photographs ☐ Figures ☐ Other:

INSPECTION ITEM	CONDITION IS PRESENT			REPEAT OR CHRONIC CONDITION			OBSERVATION Indicate recommended action, if required.	CONFIRMATION THAT ACTION IS COMPLETE (Initial and Date)
	Y	N	N/A	Y	N	N/A		
1.0 Surface Conditions								
1.1* Erosion rills or gullies		✓				✓	none	
1.2* Sheet erosion or plant pedestalling		✓				✓	none	
1.3* Depressions, ponding areas, sedimentation, or other conditions that could interrupt cap drainage		✓				✓	none	
1.4 Surface salts, crusting, or evidence of compaction			✓			✓	N/A	
1.5 Excessive animal trails or tire tracks/ruts			✓			✓	N/A	
1.6 Burrowing animal holes (localized burrows greater than 3 inches in diameter, or widespread burrows of any size)			✓			✓	N/A	

FORM SOP HWL 001-1
HWL CAP TYPE I INSPECTION FORM

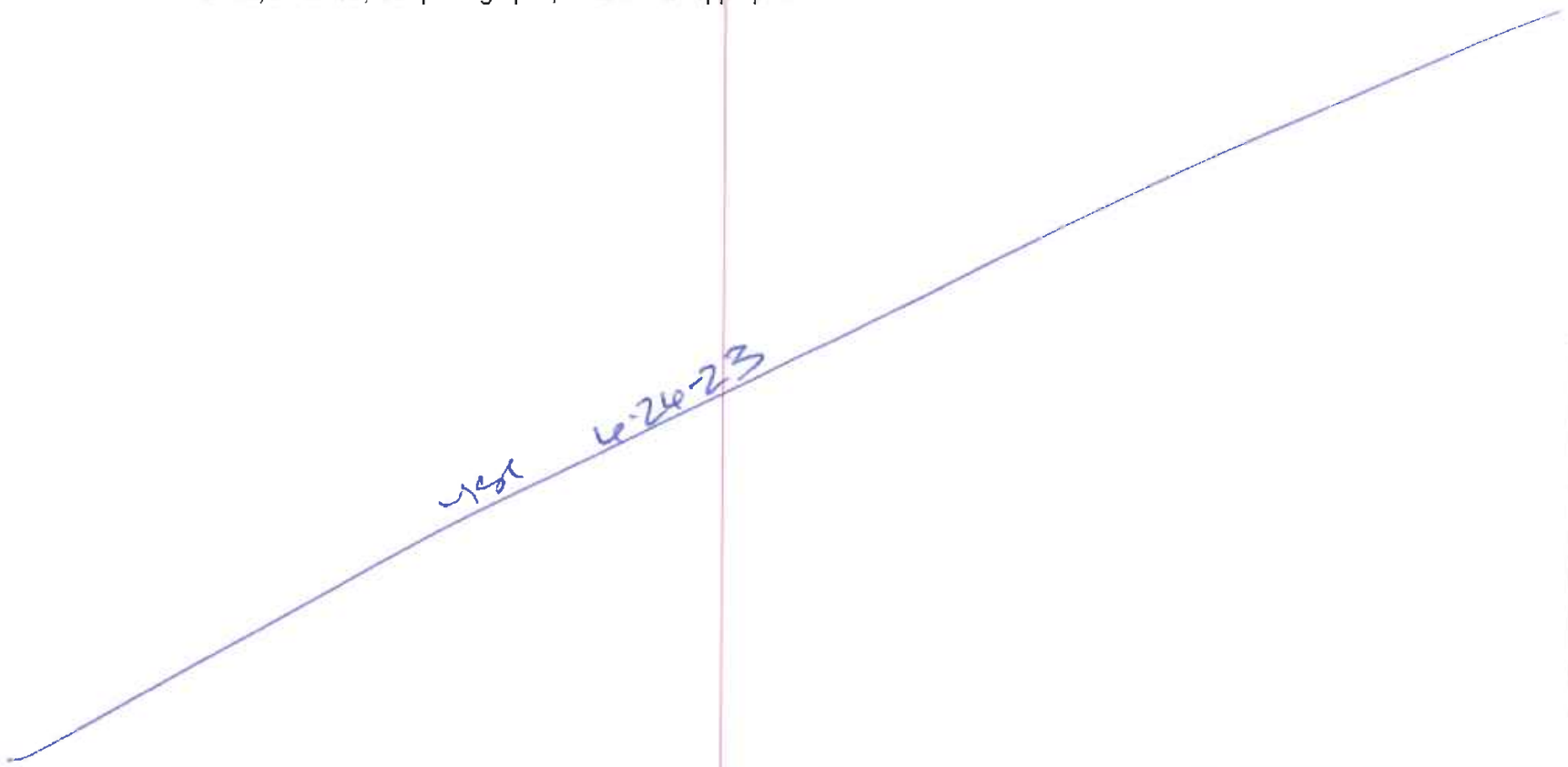
	INSPECTION ITEM	CONDITION IS PRESENT			REPEAT OR CHRONIC CONDITION			OBSERVATION Indicate recommended action, if required.	CONFIRMATION THAT ACTION IS COMPLETE (Initial and Date)
		Y	N	N/A	Y	N	N/A		
1.7*	Seepage, differential settlement, cracking, subsidence, sliding, creep, or other signs of slope instability		✓				✓	none	
1.8	Intrusive damage such as unplanned excavation, drilling, grading, damage to engineering or access controls, vandalism			✓			✓	N/A	
2.0	**Vegetative Cover**								
2.1	Bare area or areas of poor growth greater than 100 square feet			✓			✓	N/A	
2.2	Areas of poor vigor, disease, over grazing, stress, burned, or discoloration greater than 100 square feet			✓			✓	N/A	
3.0	**Engineering and Access Controls**								
3.1	The perimeter fence is damaged			✓			✓	N/A	
3.2	Debris has collected along the perimeter fence			✓			✓	N/A	
3.3	Warning signs are not legible from 25 feet			✓			✓	N/A	
3.4*	Damage to the Access Road such as potholes, washouts or burrowing		✓				✓	none	
4.0	**LCS/LDS and LS/LF Monitoring**								
4.1*	Erosion rills or gullies, or burrowing animal holes around the LCS/LDS manholes		✓				✓	none	

FORM SOP HWL 001-1
HWL CAP TYPE I INSPECTION FORM

	INSPECTION ITEM	CONDITION IS PRESENT			REPEAT OR CHRONIC CONDITION			OBSERVATION Indicate recommended action, if required.	CONFIRMATION THAT ACTION IS COMPLETE (Initial and Date)
		Y	N	N/A	Y	N	N/A		
4.2	LS/LF Building secondary containment is damaged or not intact. Storage tanks are leaking.			✓			✓	N/A	
5.0	**Groundwater Monitoring**								
5.1	Damage to monitoring wells			✓			✓	N/A	
6.0	**Surface Water Controls**								
6.1*	Impeded drainage or ponding in the channel		✓				✓	none	
6.2*	Excessive siltation in the channel		✓				✓	none	
6.3*	Debris present in the channel		✓				✓	none	
6.4*	Erosion rills or gullies in the channel		✓				✓	none	
6.5	Areas of degraded Articulated Concrete Block (ACB) or extensively cracked grout around ACB			✓			✓	N/A	
6.6*	Subsidence or undercutting of the downchutes or perimeter drainage channels		✓				✓	none	
6.7	Damaged box culverts		✓				✓	none	

FORM SOP HWL 001-1
HWL CAP TYPE I INSPECTION FORM

Inspection Notes: For areas with deficiencies, provide identifying labels for deficient areas, descriptions of deficiencies, approximate dimensions of the areas, locations, and photographs, or attach as appropriate.



Inspector		
Name: Kim Hoffman	**Signature:**	**Date:** 6-26-23
Covers Manager Review of Inspection Documentation		
Name: Michael W. Jones	**Signature:**	**Date:** 6/30/23
Covers Manager Confirmation of Completed Actions		
Name: N/A	**Signature:** N/A	**Date:** N/A

FORM SOP HWL 001-1
HWL CAP TYPE I INSPECTION FORM

Inspector Name(s): K. Hoffman **Inspection Date(s):** 7-19-23

Field Conditions:
Previous 24-Hour Precipitation: ∅ Weather Conditions: sunny, calm, mid 80's Acceptable/Unacceptable for Inspection *(circle one)*

Post-Storm Inspection: Recent Significant Storm Event? ☐ Yes ☑ No

Drive-around inspection performed after significant storm event? ☐ Yes ☐ No ☑ N/A

Drive-around inspection date (taken from Logbook): N/A

*Note: Post-storm event inspection items are indicated with a * next to the Inspection Item number.*

Date(s) of Significant Storm Event: N/A

Total Precipitation (in): N/A

Attachments: ☐ Photographs ☐ Figures ☐ Other:

INSPECTION ITEM	CONDITION IS PRESENT			REPEAT OR CHRONIC CONDITION			OBSERVATION Indicate recommended action, if required.	CONFIRMATION THAT ACTION IS COMPLETE (Initial and Date)
	Y	N	N/A	Y	N	N/A		
1.0 Surface Conditions								
1.1* Erosion rills or gullies		✓				✓	none	
1.2* Sheet erosion or plant pedestalling		✓				✓	none	
1.3* Depressions, ponding areas, sedimentation, or other conditions that could interrupt cap drainage		✓				✓	none	
1.4 Surface salts, crusting, or evidence of compaction		✓				✓	none	
1.5 Excessive animal trails or tire tracks/ruts		✓				✓	none	
1.6 Burrowing animal holes (localized burrows greater than 3 inches in diameter, or widespread burrows of any size)		✓				✓	none	

FORM SOP HWL 001-1
HWL CAP TYPE I INSPECTION FORM

	INSPECTION ITEM	CONDITION IS PRESENT			REPEAT OR CHRONIC CONDITION			OBSERVATION Indicate recommended action, if required.	CONFIRMATION THAT ACTION IS COMPLETE (Initial and Date)
		Y	N	N/A	Y	N	N/A		
1.7*	Seepage, differential settlement, cracking, subsidence, sliding, creep, or other signs of slope instability		✓				✓	none	
1.8	Intrusive damage such as unplanned excavation, drilling, grading, damage to engineering or access controls, vandalism		✓				✓	none	
2.0	**Vegetative Cover**								
2.1	Bare area or areas of poor growth greater than 100 square feet		✓				✓	none	
2.2	Areas of poor vigor, disease, over grazing, stress, burned, or discoloration greater than 100 square feet		✓				✓	none	
3.0	**Engineering and Access Controls**								
3.1	The perimeter fence is damaged		✓				✓	none	
3.2	Debris has collected along the perimeter fence		✓				✓	none	
3.3	Warning signs are not legible from 25 feet		✓				✓	none	
3.4*	Damage to the Access Road such as potholes, washouts or burrowing	✓				✓		Note 1.	Repaired in July 2023. MJ 1/18/24
4.0	**LCS/LDS and LS/LF Monitoring**								
4.1*	Erosion rills or gullies, or burrowing animal holes around the LCS/LDS manholes		✓				✓	none	

FORM SOP HWL 001-1
HWL CAP TYPE I INSPECTION FORM

	INSPECTION ITEM	CONDITION IS PRESENT			REPEAT OR CHRONIC CONDITION			OBSERVATION Indicate recommended action, if required.	CONFIRMATION THAT ACTION IS COMPLETE (Initial and Date)
		Y	N	N/A	Y	N	N/A		
4.2	LS/LF Building secondary containment is damaged or not intact. Storage tanks are leaking.		✓				✓	none	
5.0	**Groundwater Monitoring**								
5.1	Damage to monitoring wells		✓				✓	none	
6.0	**Surface Water Controls**								
6.1*	Impeded drainage or ponding in the channel		✓				✓	none	
6.2*	Excessive siltation in the channel		✓				✓	none	
6.3*	Debris present in the channel		✓				✓	none	
6.4*	Erosion rills or gullies in the channel		✓				✓	none	
6.5	Areas of degraded Articulated Concrete Block (ACB) or extensively cracked grout around ACB		✓				✓	none	
6.6*	Subsidence or undercutting of the downchutes or perimeter drainage channels		✓				✓	none	
6.7	Damaged box culverts		✓				✓	none	

FORM SOP HWL 001-1
HWL CAP TYPE I INSPECTION FORM

Inspection Notes: For areas with deficiencies, provide identifying labels for deficient areas, descriptions of deficiencies, approximate dimensions of the areas, locations, and photographs, or attach as appropriate.

Note 1: the access road to HWL LCS/LDS 4 manhole has a washout and would benefit to be graveled.

Inspector		
Name: Kim Hoffman	Signature: Kim Hoffman	Date: 7-25-23
Covers Manager Review of Inspection Documentation		
Name: Michael W. Jones	Signature:	Date: 7/24/23
Covers Manager Confirmation of Completed Actions		
Name: Michael W. Jones	Signature:	Date: 1/18/24

FORM SOP HWL 001-2
HWL CAP TYPE II INSPECTION FORM

Inspector Name(s): K Hoffman, V Stewart | **Inspection Date(s):** 10-12-23

Field Conditions:
Previous 24-Hour Precipitation: 0 Weather Conditions: 50's, overcast, calm wind Acceptable/Unacceptable for Inspection ***(circle one)***

Post-Storm Inspection: Recent Significant Storm Event? ☐ Yes ☑ No
Drive-around inspection performed after significant storm event? ☐ Yes ☐ No ☑ N/A
Drive-around inspection date (taken from Logbook): N/A

Date(s) of Significant Storm Event: N/A

Total Precipitation (in.): N/A

Attachments: ☐ Photographs ☐ Figures ☐ Other: _____

INSPECTION ITEM		CONDITION IS PRESENT			REPEAT OR CHRONIC CONDITION			OBSERVATION Indicate recommended action, if required.	CONFIRMATION THAT ACTION IS COMPLETE (Initial and Date)
		Y	N	N/A	Y	N	N/A		
1.0	**Surface Conditions**								
1.1	Erosion rills or gullies		✓				✓	none	
1.2	Sheet erosion or plant pedestalling		✓				✓	none	
1.3	Depressions, ponding areas, sedimentation, or other conditions that could interrupt cap drainage		✓				✓	none	
1.4	Surface salts, crusting, or evidence of compaction		✓				✓	none	
1.5	Excessive animal trails or tire tracks/ruts		✓				✓	none	
1.6	Burrowing animal holes (localized burrows greater than 3 inches in diameter, or widespread burrows of any size)		✓				✓	none	

8-3

FORM SOP HWL 001-2
HWL CAP TYPE II INSPECTION FORM

INSPECTION ITEM		CONDITION IS PRESENT			REPEAT OR CHRONIC CONDITION			OBSERVATION **Indicate recommended action, if required.**	CONFIRMATION THAT ACTION IS COMPLETE **(Initial and Date)**
		Y	N	N/A	Y	N	N/A		
1.7	Seepage, differential settlement, cracking, subsidence, sliding, creep, or other signs of slope instability		✓				✓	none	
1.8	Intrusive damage such as unplanned excavation, drilling, grading, damage to engineering or access controls, vandalism		✓				✓	none	
2.0	Vegetative Cover								
2.1	Bare area or areas of poor growth greater than 100 square feet		✓				✓	none	
2.2	Areas of poor vigor, disease, over grazing, stress, burned, or discoloration greater than 100 square feet		✓				✓	none	
2.3	Deep rooted, noxious or undesirable weeds		✓				✓	none	
3.0	Engineering and Access Controls								
3.1	The perimeter fence is damaged		✓				✓	none	
3.2	Debris has collected along the perimeter fence		✓				✓	none	
3.3	Warning signs are not legible from 25 feet		✓				✓	none	
3.4	Damage to the Access Road such as potholes, washouts or burrowing		✓				✓	none	

FORM SOP HWL 001-2
HWL CAP TYPE II INSPECTION FORM

	INSPECTION ITEM	CONDITION IS PRESENT			REPEAT OR CHRONIC CONDITION			OBSERVATION Indicate recommended action, if required.	CONFIRMATION THAT ACTION IS COMPLETE (Initial and Date)
		Y	N	N/A	Y	N	N/A		
3.5	Cap perimeter survey monuments appear to be disturbed (Inspect every five years, in conjunction with the CERCLA Five Year Review for legibility and to confirm record locations)			✓			✓	not inspected this year	
4.0	**LCS/LDS and LS/LF Monitoring**								
4.1	Erosion rills or gullies, or burrowing animal holes around the LCS/LDS manholes		✓				✓	none	
4.2	LS/LF Building secondary containment is damaged or not intact. Storage tanks are leaking.		✓				✓	none	
5.0	**Groundwater Monitoring**								
5.1	Damage to monitoring wells		✓				✓	none	
6.0	**Surface Water Controls**								
6.1	Impeded drainage or ponding in a channel or downchute		✓				✓	none	
6.2	Excessive siltation in a channel or downchute		✓				✓	none	
6.3	Debris present in a channel or downchute		✓				✓	none	
6.4	Erosion rills or gullies in a channel or downchute		✓				✓	none	

FORM SOP HWL 001-2
HWL CAP TYPE II INSPECTION FORM

INSPECTION ITEM	CONDITION IS PRESENT			REPEAT OR CHRONIC CONDITION			OBSERVATION Indicate recommended action, if required.	CONFIRMATION THAT ACTION IS COMPLETE (Initial and Date)
	Y	N	N/A	Y	N	N/A		
6.5 Areas of degraded Articulated Concrete Block (ACB) or extensively cracked grout around ACB		✓				✓	none	
6.6 Subsidence or undercutting of the downchutes or perimeter drainage channels		✓				✓	none	
6.7 Damaged box culverts		✓				✓	none	

INSPECTION ITEM	EM-HWL01	EM-HWL02	EM-HWL03	EM-HWL04	EM-HWL05	EM-HWL06	EM-HWL07	EM-HWL08	EM-HWL09
7.0 Erosion/Settlement Monuments: *Inspect monuments for damage and legibility, and record the soil thickness loss, if any.*									
7.1 Was the monument free of damage and legible?	(Y) N	(Y) N	(Y) N	(Y) N	(Y) N	(Y) N	(Y) N	(Y) N	(Y) N
7.2 Measured Soil Thickness Loss (inches)	1	1.5	2	1	0.5	1	1	0.25	1.75

FORM SOP HWL 001-2
HWL CAP TYPE II INSPECTION FORM

Inspection Notes: For areas with deficiencies, provide identifying labels for deficient areas, descriptions of deficiencies, approximate dimensions of the areas, locations, and photographs, or attach as appropriate.

10-16-23

Inspector		
Name: Kim Hoffman	**Signature:** Kim Hoffman	**Date:** 10-16-23
Covers Manager Review of Inspection Documentation		
Name: Michael W. Jones	**Signature:** M. W. J.	**Date:** 10/26/23
Covers Manager Confirmation of Completed Actions		
Name: N/A	**Signature:** N/A	**Date:** N/A

FORM SOP HWL 001-1
HWL CAP TYPE I INSPECTION FORM

Inspector Name(s): M. Jones, K. Hoffman | **Inspection Date(s):** 1-3-24

Field Conditions:
Previous 24-Hour Precipitation: Ø | Weather Conditions: sunny, calm winds, 30's | Acceptable/Unacceptable for Inspection *(circle one)*

Post-Storm Inspection: Recent Significant Storm Event? ☐ Yes ☑ No
Drive-around inspection performed after significant storm event? ☐ Yes ☐ No ☑ N/A
Drive-around inspection date (taken from Logbook): N/A
*Note: Post-storm event inspection items are indicated with a * next to the Inspection Item number.*

Date(s) of Significant Storm Event: N/A

Total Precipitation (in): N/A

Attachments: ☐ Photographs ☐ Figures ☐ Other:

INSPECTION ITEM	CONDITION IS PRESENT			REPEAT OR CHRONIC CONDITION			OBSERVATION Indicate recommended action, if required.	CONFIRMATION THAT ACTION IS COMPLETE (Initial and Date)
	Y	N	N/A	Y	N	N/A		
1.0 Surface Conditions								
1.1* Erosion rills or gullies		✓				✓	none	
1.2* Sheet erosion or plant pedestalling		✓				✓	none	
1.3* Depressions, ponding areas, sedimentation, or other conditions that could interrupt cap drainage		✓				✓	none	
1.4 Surface salts, crusting, or evidence of compaction		✓				✓	none	
1.5 Excessive animal trails or tire tracks/ruts		✓				✓	none	
1.6 Burrowing animal holes (localized burrows greater than 3 inches in diameter, or widespread burrows of any size)		✓				✓	none	

FORM SOP HWL 001-1
HWL CAP TYPE I INSPECTION FORM

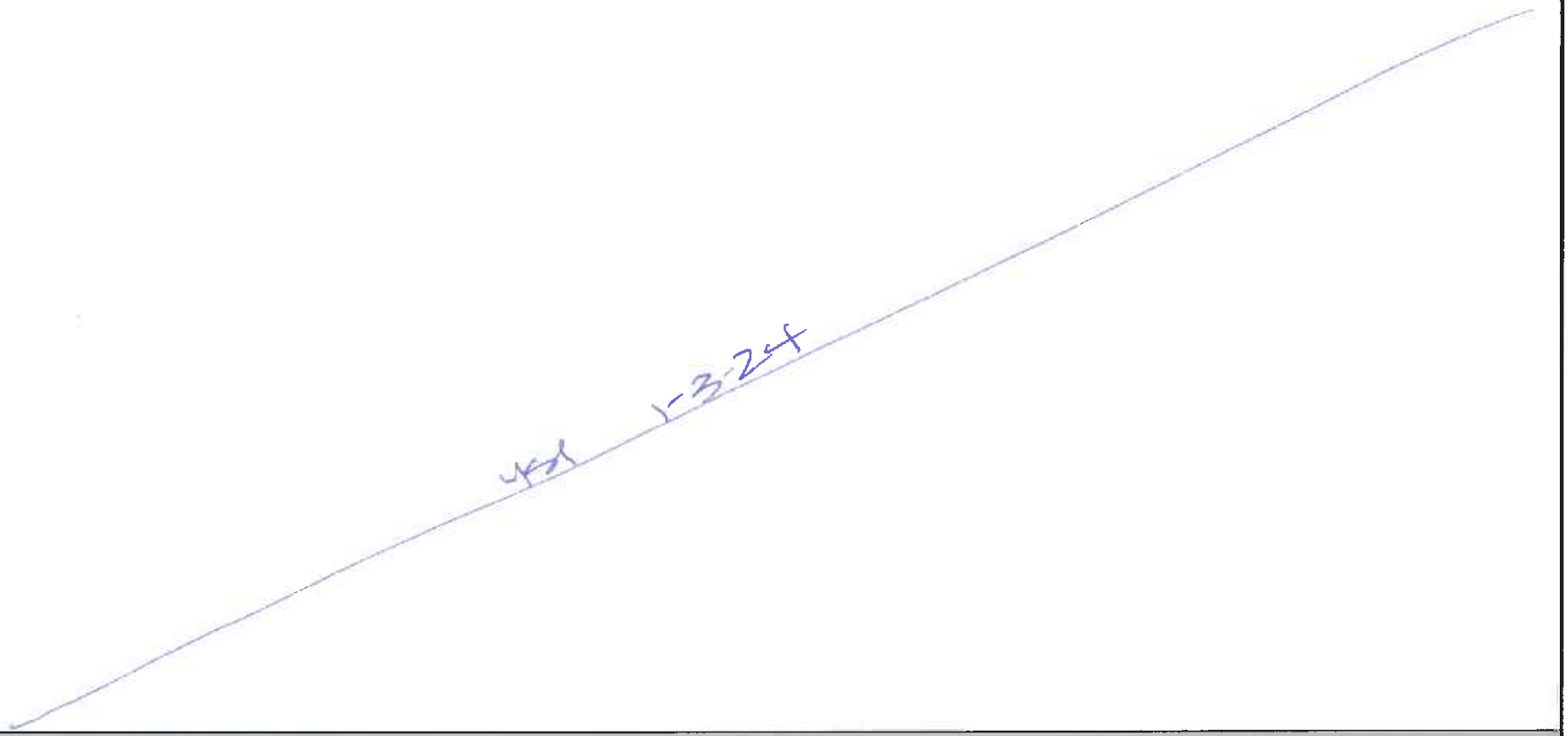
INSPECTION ITEM		CONDITION IS PRESENT			REPEAT OR CHRONIC CONDITION			OBSERVATION Indicate recommended action, if required.	CONFIRMATION THAT ACTION IS COMPLETE (Initial and Date)
		Y	N	N/A	Y	N	N/A		
1.7*	Seepage, differential settlement, cracking, subsidence, sliding, creep, or other signs of slope instability		✓				✓	none	
1.8	Intrusive damage such as unplanned excavation, drilling, grading, damage to engineering or access controls, vandalism		✓				✓	none	
2.0	**Vegetative Cover**								
2.1	Bare area or areas of poor growth greater than 100 square feet		✓				✓	none	
2.2	Areas of poor vigor, disease, over grazing, stress, burned, or discoloration greater than 100 square feet		✓				✓	none	
3.0	**Engineering and Access Controls**								
3.1	The perimeter fence is damaged		✓				✓	none	
3.2	Debris has collected along the perimeter fence		✓				✓	none	
3.3	Warning signs are not legible from 25 feet		✓				✓	none	
3.4*	Damage to the Access Road such as potholes, washouts or burrowing		✓				✓	none	
4.0	**LCS/LDS and LS/LF Monitoring**								
4.1*	Erosion rills or gullies, or burrowing animal holes around the LCS/LDS manholes		✓				✓	none	

FORM SOP HWL 001-1
HWL CAP TYPE I INSPECTION FORM

INSPECTION ITEM		CONDITION IS PRESENT			REPEAT OR CHRONIC CONDITION			OBSERVATION Indicate recommended action, if required.	CONFIRMATION THAT ACTION IS COMPLETE (Initial and Date)
		Y	N	N/A	Y	N	N/A		
4.2	LS/LF Building secondary containment is damaged or not intact. Storage tanks are leaking.		✓				✓	none	
5.0	**Groundwater Monitoring**								
5.1	Damage to monitoring wells		✓				✓	none	
6.0	**Surface Water Controls**								
6.1*	Impeded drainage or ponding in the channel		✓				✓	none	
6.2*	Excessive siltation in the channel		✓				✓	none	
6.3*	Debris present in the channel		✓				✓	none	
6.4*	Erosion rills or gullies in the channel		✓				✓	none	
6.5	Areas of degraded Articulated Concrete Block (ACB) or extensively cracked grout around ACB		✓				✓	none	
6.6*	Subsidence or undercutting of the downchutes or perimeter drainage channels		✓				✓	none	
6.7	Damaged box culverts		✓				✓	none	

FORM SOP HWL 001-1
HWL CAP TYPE I INSPECTION FORM

Inspection Notes: For areas with deficiencies, provide identifying labels for deficient areas, descriptions of deficiencies, approximate dimensions of the areas, locations, and photographs, or attach as appropriate.



Inspector		
Name: Kim Hoffman	**Signature:** Kim Hoffman	**Date:** 1-3-24
Covers Manager Review of Inspection Documentation		
Name: Michael W. Jones	**Signature:** Michael W. Jones	**Date:** 1/18/24
Covers Manager Confirmation of Completed Actions		
Name: N/A	**Signature:** N/A	**Date:** N/A

FORM SOP HWL 001-2
HWL CAP TYPE II INSPECTION FORM

Inspector Name(s): K. Hoffman, V. Seward | **Inspection Date(s):** 4-4-24

Field Conditions:
Previous 24-Hour Precipitation: 0 | Weather Conditions: Sunny, calm winds | Acceptable/Unacceptable for Inspection ***(circle one)***

Post-Storm Inspection: Recent Significant Storm Event? ☐ Yes ☑ No
Drive-around inspection performed after significant storm event? ☐ Yes ☐ No ☑ N/A
Drive-around inspection date (taken from Logbook): N/A

Date(s) of Significant Storm Event: N/A

Total Precipitation (in.): N/A

Attachments: ☐ Photographs ☐ Figures ☐ Other:

INSPECTION ITEM		CONDITION IS PRESENT			REPEAT OR CHRONIC CONDITION			OBSERVATION Indicate recommended action, if required.	CONFIRMATION THAT ACTION IS COMPLETE (Initial and Date)
		Y	N	N/A	Y	N	N/A		
1.0	**Surface Conditions**								
1.1	Erosion rills or gullies		✓				✓	none	
1.2	Sheet erosion or plant pedestalling		✓				✓	none	
1.3	Depressions, ponding areas, sedimentation, or other conditions that could interrupt cap drainage		✓				✓	none	
1.4	Surface salts, crusting, or evidence of compaction		✓				✓	none	
1.5	Excessive animal trails or tire tracks/ruts		✓				✓	none	

FORM SOP HWL 001-2
HWL CAP TYPE II INSPECTION FORM

	INSPECTION ITEM	CONDITION IS PRESENT			REPEAT OR CHRONIC CONDITION			OBSERVATION Indicate recommended action, if required.	CONFIRMATION THAT ACTION IS COMPLETE (Initial and Date)
		Y	N	N/A	Y	N	N/A		
1.6	Burrowing animal holes (localized burrows greater than 3 inches in diameter, or widespread burrows of any size)		✓				✓	none	
1.7	Seepage, differential settlement, cracking, subsidence, sliding, creep, or other signs of slope instability		✓				✓	none	
1.8	Intrusive damage such as unplanned excavation, drilling, grading, damage to engineering or access controls, vandalism		✓				✓	none	
2.0	**Vegetative Cover**								
2.1	Bare area or areas of poor growth greater than 100 square feet		✓				✓	none	
2.2	Areas of poor vigor, disease, over grazing, stress, burned, or discoloration greater than 100 square feet		✓				✓	none	
2.3	Deep rooted, noxious or undesirable weeds		✓				✓	none	
3.0	**Engineering and Access Controls**								
3.1	The perimeter fence is damaged		✓				✓	none	
3.2	Debris has collected along the perimeter fence		✓				✓	none	
3.3	Warning signs are not legible from 25 feet		✓				✓	none	

FORM SOP HWL 001-2
HWL CAP TYPE II INSPECTION FORM

	INSPECTION ITEM	CONDITION IS PRESENT			REPEAT OR CHRONIC CONDITION			OBSERVATION Indicate recommended action, if required.	CONFIRMATION THAT ACTION IS COMPLETE (Initial and Date)
		Y	N	N/A	Y	N	N/A		
3.4	Damage to the Access Road such as potholes, washouts or burrowing		✓				✓	none	
3.5	Cap perimeter survey monuments appear to be disturbed (Inspect every five years, in conjunction with the CERCLA Five Year Review for legibility and to confirm record locations)			✓			✓	not inspected this year	
4.0	**LCS/LDS and LS/LF Monitoring**								
4.1	Erosion rills or gullies, or burrowing animal holes around the LCS/LDS manholes		✓				✓	none	
4.2	LS/LF Building secondary containment is damaged or not intact. Storage tanks are leaking.		✓				✓	none	
5.0	**Groundwater Monitoring**								
5.1	Damage to monitoring wells		✓				✓	none	
6.0	**Surface Water Controls**								
6.1	Impeded drainage or ponding in a channel or downchute		✓				✓	none	
6.2	Excessive siltation in a channel or downchute		✓				✓	none	
6.3	Debris present in a channel or downchute		✓				✓	none	
6.4	Erosion rills or gullies in a channel or downchute		✓				✓	none	

FORM SOP HWL 001-2
HWL CAP TYPE II INSPECTION FORM

INSPECTION ITEM	CONDITION IS PRESENT			REPEAT OR CHRONIC CONDITION			OBSERVATION Indicate recommended action, if required.	CONFIRMATION THAT ACTION IS COMPLETE (Initial and Date)
	Y	N	N/A	Y	N	N/A		
6.5 Areas of degraded Articulated Concrete Block (ACB) or extensively cracked grout around ACB		✓				✓	none	
6.6 Subsidence or undercutting of the downchutes or perimeter drainage channels		✓				✓	none	
6.7 Damaged box culverts		✓				✓	none	

INSPECTION ITEM	EM-HWL01	EM-HWL02	EM-HWL03	EM-HWL04	EM-HWL05	EM-HWL06	EM-HWL07	EM-HWL08	EM-HWL09
7.0 Erosion/Settlement Monuments: *Inspect monuments for damage and legibility, and record the soil thickness loss, if any.*									
7.1 Was the monument free of damage and legible?	(Y) N	(Y) N	(Y) N	(Y) N	(Y) N	(Y) N	(Y) N	(Y) N	(Y) N
7.2 Measured Soil Thickness Loss (inches)	1.5	1.5	1.5	0.5	Ø	0.5	0.75	Ø	1.5

FORM SOP HWL 001-2
HWL CAP TYPE II INSPECTION FORM

Inspection Notes: For areas with deficiencies, provide identifying labels for deficient areas, descriptions of deficiencies, approximate dimensions of the areas, locations, and photographs, or attach as appropriate.

Inspector		
Name: Kiara Hoffman	**Signature:** Kiara Hoffman	**Date:** 4-8-24
Covers Manager Review of Inspection Documentation		
Name: Michael W. Jones	**Signature:** Michael W. Jones	**Date:** 4/17/24
Covers Manager Confirmation of Completed Actions		
Name: N/A	**Signature:** N/A	**Date:** N/A

HWL LCS/LDS AND WASTEWATER CONVEYANCE SYSTEM
QUARTERLY INSPECTION FORM

Inspector Name(s): Kim Hoffmann **Inspection Date(s):** 7-6-23

Attachments: ☐ Photographs ☐ Figures ☐ Other

	INSPECTION ITEM	CONDITION IS PRESENT			REPEAT OR CHRONIC CONDITION			OBSERVATION Indicate recommended action, if required.	CONFIRMATION THAT ACTION IS COMPLETE (Signature and Date)
		Y	N	N/A	Y	N	N/A		
1	Warning signs are not legible (Confined Space, Buried Pipe/Conduit, etc.)		✓				✓		
2	Extreme temperature inside LCS/LDS manholes		✓				✓		
3	Excessive liquid in LCS/LDS manholes		✓				✓		
4	Improper operation/condition of LCS/LDS pumps or instrumentation		✓				✓		
5	Improper operation/condition of lift station pumps or instrumentation		✓				✓		
6	Excessive liquid in lift station secondary containment		✓				✓		
7	Blockage of leachate collection or leak detection discharge piping		✓				✓		
8	Collapse of leachate collection or leak detection sump riser pipe		✓				✓		
9	LS/LF tank levels are above high level set points.		✓				✓		
10	LS/LF tanks are damaged or leaking.		✓				✓		
11	Indication of leaks in the indoor piping system in the LS/LF.		✓				✓		

8.5

HWL LCS/LDS AND WASTEWATER CONVEYANCE SYSTEM
QUARTERLY INSPECTION FORM

12	Indication that the LS/LF secondary containment is damaged or inadequate.		✓				✓		
13	Heating system in the LS/LF is malfunctioning.		✓				✓		

Inspection Notes: For areas with deficiencies, provide identifying labels for deficient areas, descriptions of deficiencies, approximate dimensions of the areas, locations, and photographs, or attach as appropriate.

Inspector		
Name: Kim Hoffman	Signature: Kim Hoffman	Date: 7-26-23
Treatment Operations Manager Review of Inspection Documentation		
Name: Michael W. Jones	Signature:	Date: 7/24/23
Treatment Operations Manager Review of Inspection Documentation		
Name: N/A	Signature: N/A	Date: N/A

HWL LCS/LDS AND WASTEWATER CONVEYANCE SYSTEM
QUARTERLY INSPECTION FORM

Inspector Name(s): K. Hoffman

Inspection Date(s): 10-11-23

Attachments: ☐ Photographs ☐ Figures ☐ Other

	INSPECTION ITEM	CONDITION IS PRESENT			REPEAT OR CHRONIC CONDITION			OBSERVATION Indicate recommended action, if required.	CONFIRMATION THAT ACTION IS COMPLETE (Signature and Date)
		Y	N	N/A	Y	N	N/A		
1	Warning signs are not legible (Confined Space, Buried Pipe/Conduit, etc.)		✓				✓		
2	Extreme temperature inside LCS/LDS manholes		✓				✓		
3	Excessive liquid in LCS/LDS manholes		✓				✓		
4	Improper operation/condition of LCS/LDS pumps or instrumentation		✓				✓		
5	Improper operation/condition of lift station pumps or instrumentation		✓				✓		
6	Excessive liquid in lift station secondary containment		✓				✓		
7	Blockage of leachate collection or leak detection discharge piping		✓				✓		
8	Collapse of leachate collection or leak detection sump riser pipe		✓				✓		
9	LS/LF tank levels are above high level set points.		✓				✓		
10	LS/LF tanks are damaged or leaking.		✓				✓		
11	Indication of leaks in the indoor piping system in the LS/LF.		✓				✓		

KH 10-11-23

HWL LCS/LDS AND WASTEWATER CONVEYANCE SYSTEM
QUARTERLY INSPECTION FORM

12	Indication that the LS/LF secondary containment is damaged or inadequate.		✓				✓		
13	Heating system in the LS/LF is malfunctioning.		✓				✓		

Inspection Notes: For areas with deficiencies, provide identifying labels for deficient areas, descriptions of deficiencies, approximate dimensions of the areas, locations, and photographs, or attach as appropriate.

Inspector		
Name: Kim Hoffman	**Signature:** Kim Hoffman	**Date:** 10-11-23
Treatment Operations Manager Review of Inspection Documentation		
Name: Michael W. Jones	**Signature:**	**Date:** 10/12/23
Treatment Operations Manager Review of Inspection Documentation		
Name: N/A	**Signature:** N/A	**Date:** N/A

HWL LCS/LDS AND WASTEWATER CONVEYANCE SYSTEM
QUARTERLY INSPECTION FORM

Inspector Name(s): K. Hoffman

Inspection Date(s): 1-3-24

Attachments: ☐ Photographs ☐ Figures ☐ Other

	INSPECTION ITEM	CONDITION IS PRESENT			REPEAT OR CHRONIC CONDITION			OBSERVATION Indicate recommended action, if required.	CONFIRMATION THAT ACTION IS COMPLETE (Signature and Date)
		Y	N	N/A	Y	N	N/A		
1	Warning signs are not legible (Confined Space, Buried Pipe/Conduit, etc.)		✓				✓		
2	Extreme temperature inside LCS/LDS manholes		✓				✓		
3	Excessive liquid in LCS/LDS manholes		✓				✓		
4	Improper operation/condition of LCS/LDS pumps or instrumentation		✓				✓		
5	Improper operation/condition of lift station pumps or instrumentation		✓				✓		
6	Excessive liquid in lift station secondary containment		✓				✓		
7	Blockage of leachate collection or leak detection discharge piping		✓				✓		
8	Collapse of leachate collection or leak detection sump riser pipe		✓				✓		
9	LS/LF tank levels are above high level set points.		✓				✓		
10	LS/LF tanks are damaged or leaking.		✓				✓		
11	Indication of leaks in the indoor piping system in the LS/LF.		✓				✓		

KH 1-3-24

HWL LCS/LDS AND WASTEWATER CONVEYANCE SYSTEM
QUARTERLY INSPECTION FORM

12	Indication that the LS/LF secondary containment is damaged or inadequate.		✓				✓		
13	Heating system in the LS/LF is malfunctioning.		✓				✓	YES 1-3-24	

Inspection Notes: For areas with deficiencies, provide identifying labels for deficient areas, descriptions of deficiencies, approximate dimensions of the areas, locations, and photographs, or attach as appropriate.

YES 1-3-24

Inspector		
Name: Kim Hoffman	Signature:	Date: 1-3-24
Treatment Operations Manager Review of Inspection Documentation		
Name: Michael W. Jones	Signature:	Date: 1/18/24
Treatment Operations Manager Review of Inspection Documentation		
Name: N/A	Signature: N/A	Date: N/A

HWL LCS/LDS AND WASTEWATER CONVEYANCE SYSTEM
QUARTERLY INSPECTION FORM

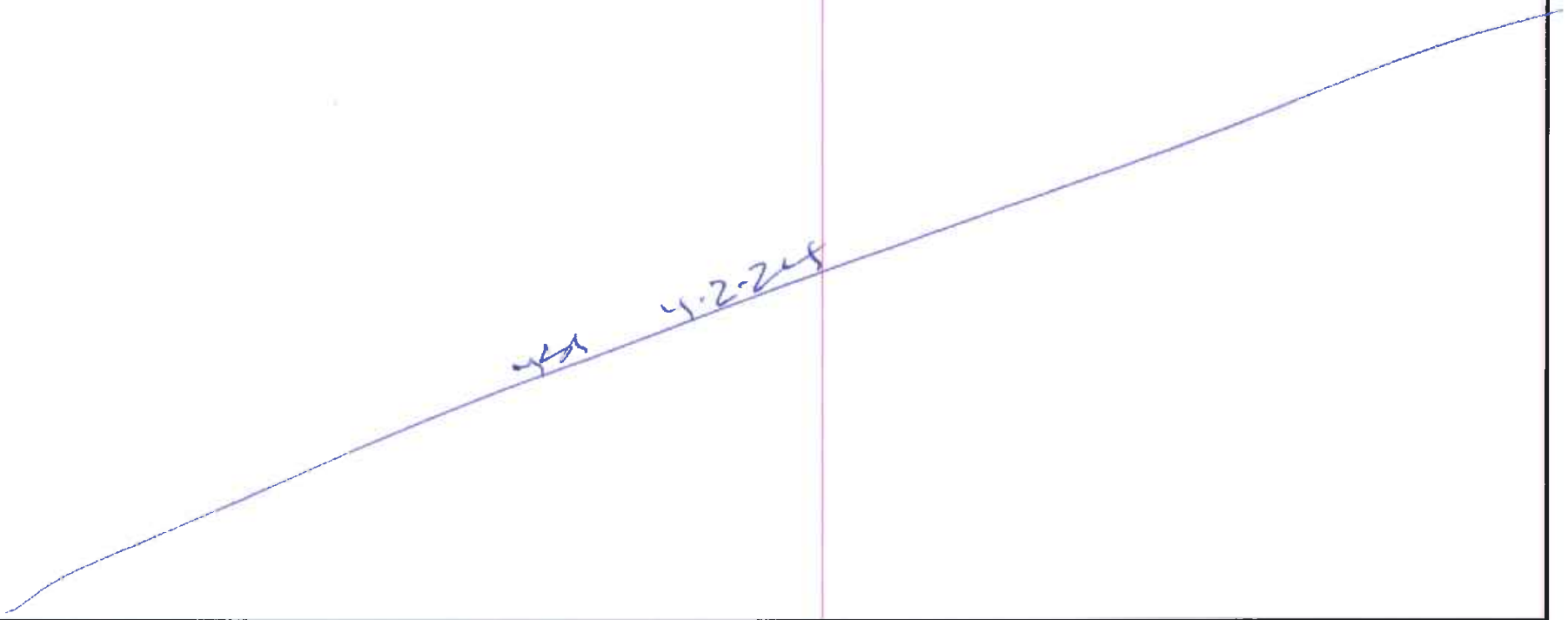
Inspector Name(s): K. Hoffman **Inspection Date(s):** 4-2-24

Attachments: ☐ Photographs ☐ Figures ☐ Other

	INSPECTION ITEM	CONDITION IS PRESENT			REPEAT OR CHRONIC CONDITION			OBSERVATION Indicate recommended action, if required.	CONFIRMATION THAT ACTION IS COMPLETE (Signature and Date)
		Y	N	N/A	Y	N	N/A		
1	Warning signs are not legible (Confined Space, Buried Pipe/Conduit, etc.)		✓				✓		
2	Extreme temperature inside LCS/LDS manholes		✓				✓		
3	Excessive liquid in LCS/LDS manholes		✓				✓		
4	Improper operation/condition of LCS/LDS pumps or instrumentation		✓				✓		
5	Improper operation/condition of lift station pumps or instrumentation		✓				✓		
6	Excessive liquid in lift station secondary containment		✓				✓		
7	Blockage of leachate collection or leak detection discharge piping		✓				✓		
8	Collapse of leachate collection or leak detection sump riser pipe		✓				✓		
9	LS/LF tank levels are above high level set points.		✓				✓		
10	Indication of leaks in the indoor piping system in the LS/LF.		✓				✓		
11	Indication that the LS/LF secondary containment is damaged or inadequate.		✓				✓		
12	Heating system in the LS/LF is malfunctioning.		✓				✓		

HWL LCS/LDS AND WASTEWATER CONVEYANCE SYSTEM
QUARTERLY INSPECTION FORM

Inspection Notes: For areas with deficiencies, provide identifying labels for deficient areas, descriptions of deficiencies, approximate dimensions of the areas, locations, and photographs, or attach as appropriate.



Inspector	
Name: Kim Hoffman	**Signature & Date:** Kim Hoffman 4-2-24
Treatment Operations Manager Review of Inspection Documentation	
Name: Michael W. Jones	**Signature & Date:** 4/17/24
Treatment Operations Manager Review of Inspection Documentation	
Name: N/A	**Signature & Date:** N/A

APPENDIX B-2

ELF Inspection Documentation

FORM SOP ELF 001-1
ELF CAP TYPE I INSPECTION FORM

Inspector Name(s): K. Hoffman

Inspection Date(s): 6-21-23

Field Conditions:
Previous 24-Hour Precipitation: 0

Weather Conditions: Sunny, calm winds, 70's-80's

Acceptable / Unacceptable for Inspection *(circle one)*

Post-Storm Inspection: Recent Significant Storm Event? ☑ Yes ☐ No

Drive-around inspection performed after significant storm event? ☑ Yes ☐ No ☐ N/A

Drive-around inspection date (taken from Logbook): 5-11-23, 5-15-23, 6-5-23

*Note: Post-storm event inspection items are indicated with a * next to the Inspection Item number.*

Date(s) of Significant Storm Event: ~~5-10-23~~ 5-11-23, 6-4-23

Total Precipitation (in): ~~1.63"~~ 2.92", 1.23"

Attachments: ☐ Photographs ☐ Figures ☐ Other: _____

INSPECTION ITEM		CONDITION IS PRESENT			REPEAT OR CHRONIC CONDITION			OBSERVATION Indicate recommended action, if required.	CONFIRMATION THAT ACTION IS COMPLETE (Initial and Date)
		Y	N	N/A	Y	N	N/A		
1.0	**Surface Conditions**								
1.1*	Erosion rills or gullies		✓				✓	none	
1.2*	Sheet erosion or plant pedestalling		✓				✓	none	
1.3*	Depressions, ponding areas, sedimentation, or other conditions that could interrupt cap drainage		✓				✓	none	
1.4	Surface salts, crusting, or evidence of compaction			✓			✓	N/A	
1.5	Excessive animal trails or tire tracks/ruts			✓			✓	N/A	
1.6	Burrowing animal holes (localized burrows greater than 3 inches in diameter, or widespread burrows of any size)			✓			✓	N/A	

FORM SOP ELF 001-1
ELF CAP TYPE I INSPECTION FORM

INSPECTION ITEM		CONDITION IS PRESENT			REPEAT OR CHRONIC CONDITION			OBSERVATION Indicate recommended action, if required.	CONFIRMATION THAT ACTION IS COMPLETE (Initial and Date)
		Y	N	N/A	Y	N	N/A		
1.7*	Seepage, differential settlement, cracking, subsidence, sliding, creep, or other signs of slope instability		✓				✓	none	
1.8	Intrusive damage such as unplanned excavation, drilling, grading, damage to engineering or access controls, vandalism			✓			✓	N/A	
1.9	Anchor Trench Drain outfalls exhibit flow, erosion, seepage, moisture or bare/ sparse vegetation.			✓			✓	N/A	
2.0	**Vegetative Cover**								
2.1	Bare area or areas of poor growth greater than 100 square feet			✓			✓	N/A	
2.2	Areas of poor vigor, disease, over grazing, stress, burned, or discoloration greater than 100 square feet			✓			✓	N/A	
3.0	**Engineering and Access Controls**								
3.1	The perimeter fence is damaged			✓			✓	N/A	
3.2	Debris has collected along the perimeter fence			✓			✓	N/A	
3.3	Warning signs are not legible from 25 feet			✓			✓	N/A	
3.4*	Damage to the Access Road such as potholes, washouts or burrowing		✓				✓	none	

FORM SOP ELF 001-1
ELF CAP TYPE I INSPECTION FORM

INSPECTION ITEM		CONDITION IS PRESENT			REPEAT OR CHRONIC CONDITION			OBSERVATION Indicate recommended action, if required.	CONFIRMATION THAT ACTION IS COMPLETE (Initial and Date)
		Y	N	N/A	Y	N	N/A		
4.0	**LRCH and LS/LF Monitoring**								
4.1*	Erosion rills or gullies, or burrowing animal holes around the LRCH Buildings		✓				✓	none	
4.2	LS/LF Building secondary containment is damaged or not intact. Storage tanks are leaking.			✓			✓	N/A	
5.0	**Groundwater Monitoring**								
5.1	Damage to monitoring wells			✓			✓	N/A	
6.0	**Surface Water Controls**								
6.1*	Impeded drainage or ponding in the channel		✓				✓	none	
6.2*	Excessive siltation in the channel		✓				✓	none	
6.3*	Debris present in the channel		✓				✓	none	
6.4*	Erosion rills or gullies in the channel		✓				✓	none	
6.5	Areas of degraded Articulated Concrete Block (ACB) or extensively cracked grout around ACB			✓			✓	N/A	
6.6*	Subsidence or undercutting of the downchutes or perimeter drainage channels		✓				✓	none	
6.7	Damaged box culverts			✓			✓	N/A	

FORM SOP ELF 001-1
ELF CAP TYPE I INSPECTION FORM

Inspection Notes: For areas with deficiencies, provide identifying labels for deficient areas, descriptions of deficiencies, approximate dimensions of the areas, locations, and photographs, or attach as appropriate.

6-26-23

Inspector		
Name: Kiva Hoffman	**Signature:** Kiva Hoffman	**Date:** 6-26-23
Cover Manager Review of Inspection Documentation		
Name: Michael W. Jones	**Signature:**	**Date:** 6/30/23
Cover Manager Confirmation of Completed Actions		
Name: N/A	**Signature:** N/A	**Date:** N/A

FORM SOP ELF 001-1
ELF CAP TYPE I INSPECTION FORM

Inspector Name(s): K. Hoffman | **Inspection Date(s):** 7-19-23

Field Conditions:
Previous 24-Hour Precipitation: Ø | Weather Conditions: sunny, calm winds, 80's | Acceptable/Unacceptable for Inspection *(circle one)*

Post-Storm Inspection: Recent Significant Storm Event? ☐ Yes ☑ No
Drive-around inspection performed after significant storm event? ☐ Yes ☐ No ☑ N/A
Drive-around inspection date (taken from Logbook): N/A
*Note: Post-storm event inspection items are indicated with a * next to the Inspection Item number.*

Date(s) of Significant Storm Event: N/A

Total Precipitation (in): N/A

Attachments: ☐ Photographs ☐ Figures ☐ Other: _____

INSPECTION ITEM	CONDITION IS PRESENT			REPEAT OR CHRONIC CONDITION			OBSERVATION Indicate recommended action, if required.	CONFIRMATION THAT ACTION IS COMPLETE (Initial and Date)
	Y	N	N/A	Y	N	N/A		
1.0 Surface Conditions								
1.1* Erosion rills or gullies		✓				✓	none	
1.2* Sheet erosion or plant pedestalling		✓				✓	none	
1.3* Depressions, ponding areas, sedimentation, or other conditions that could interrupt cap drainage		✓				✓	none	
1.4 Surface salts, crusting, or evidence of compaction		✓				✓	none	
1.5 Excessive animal trails or tire tracks/ruts		✓				✓	none	
1.6 Burrowing animal holes (localized burrows greater than 3 inches in diameter, or widespread burrows of any size)		✓				✓	none	

FORM SOP ELF 001-1
ELF CAP TYPE I INSPECTION FORM

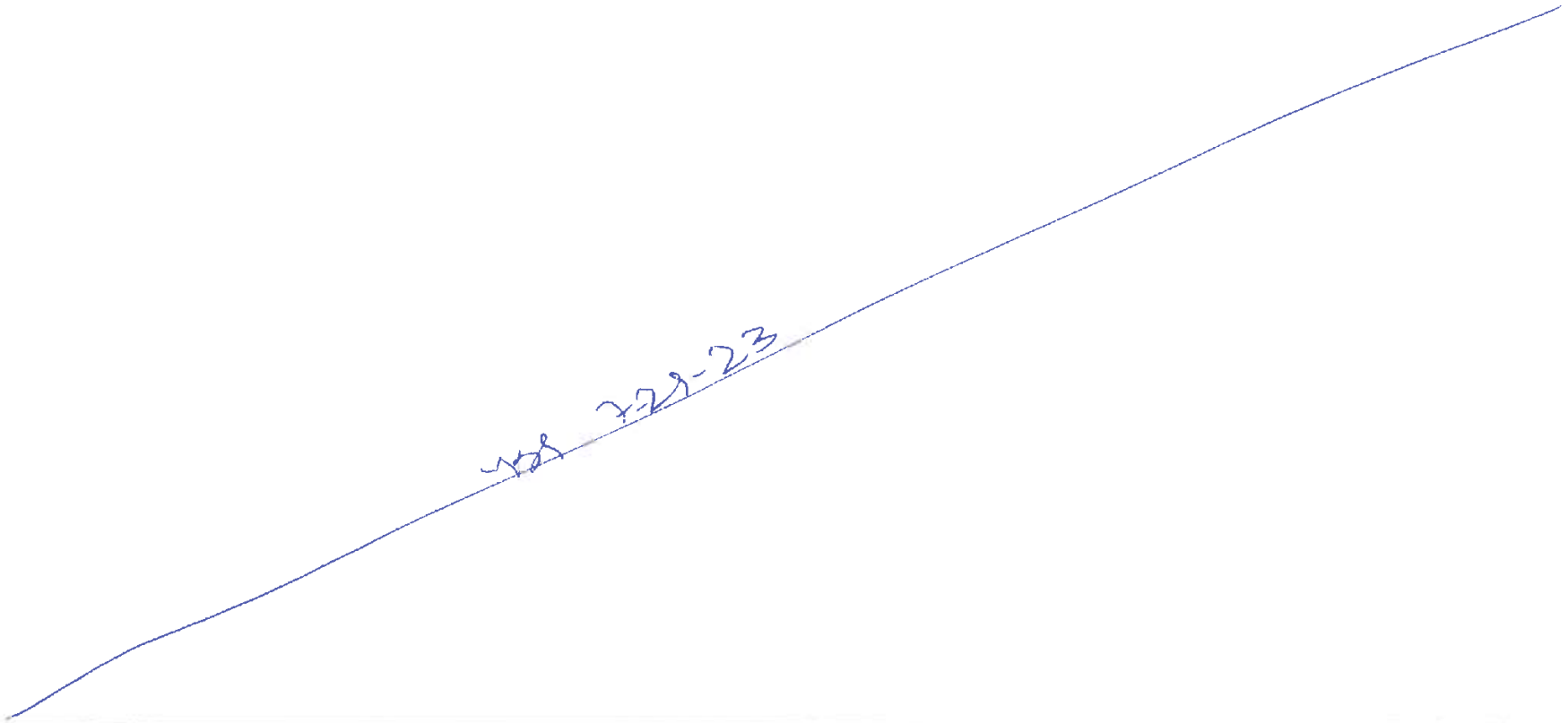
INSPECTION ITEM	CONDITION IS PRESENT			REPEAT OR CHRONIC CONDITION			OBSERVATION Indicate recommended action, if required.	CONFIRMATION THAT ACTION IS COMPLETE (Initial and Date)
	Y	N	N/A	Y	N	N/A		
1.7* Seepage, differential settlement, cracking, subsidence, sliding, creep, or other signs of slope instability		✓				✓	none	
1.8 Intrusive damage such as unplanned excavation, drilling, grading, damage to engineering or access controls, vandalism		✓				✓	none	
1.9 Anchor Trench Drain outfalls exhibit flow, erosion, seepage, moisture or bare/ sparse vegetation.		✓				✓	none	
2.0 Vegetative Cover								
2.1 Bare area or areas of poor growth greater than 100 square feet		✓				✓	none	
2.2 Areas of poor vigor, disease, over grazing, stress, burned, or discoloration greater than 100 square feet		✓				✓	none	
3.0 Engineering and Access Controls								
3.1 The perimeter fence is damaged		✓				✓	none	
3.2 Debris has collected along the perimeter fence		✓				✓	none	
3.3 Warning signs are not legible from 25 feet		✓				✓	none	
3.4* Damage to the Access Road such as potholes, washouts or burrowing		✓				✓	none	

FORM SOP ELF 001-1
ELF CAP TYPE I INSPECTION FORM

INSPECTION ITEM		CONDITION IS PRESENT			REPEAT OR CHRONIC CONDITION			OBSERVATION Indicate recommended action, if required.	CONFIRMATION THAT ACTION IS COMPLETE (Initial and Date)
		Y	N	N/A	Y	N	N/A		
4.0	**LRCH and LS/LF Monitoring**								
4.1*	Erosion rills or gullies, or burrowing animal holes around the LRCH Buildings		✓				✓	none	
4.2	LS/LF Building secondary containment is damaged or not intact. Storage tanks are leaking.		✓				✓	none	
5.0	**Groundwater Monitoring**								
5.1	Damage to monitoring wells		✓				✓	none	
6.0	**Surface Water Controls**								
6.1*	Impeded drainage or ponding in the channel		✓				✓	none	
6.2*	Excessive siltation in the channel		✓				✓	none	
6.3*	Debris present in the channel		✓				✓	none	
6.4*	Erosion rills or gullies in the channel		✓				✓	none	
6.5	Areas of degraded Articulated Concrete Block (ACB) or extensively cracked grout around ACB		✓				✓	none	
6.6*	Subsidence or undercutting of the downchutes or perimeter drainage channels		✓				✓	none	
6.7	Damaged box culverts		✓				✓	none	

FORM SOP ELF 001-1
ELF CAP TYPE I INSPECTION FORM

Inspection Notes: For areas with deficiencies, provide identifying labels for deficient areas, descriptions of deficiencies, approximate dimensions of the areas, locations, and photographs, or attach as appropriate.



Inspector		
Name: Kim Hoffman	**Signature:** Kim Hoffman	**Date:** 7-23-23
Cover Manager Review of Inspection Documentation		
Name: Michael W. Jones	**Signature:** Michael W. Jones	**Date:** 7/24/23
Cover Manager Confirmation of Completed Actions		
Name: N/A	**Signature:** N/A	**Date:** N/A

FORM SOP ELF 001-2
ELF CAP TYPE II INSPECTION FORM

Inspector Name(s): M. Jones	**Inspection Date(s):** 10-12-23

Field Conditions:
Previous 24-Hour Precipitation: 0" Weather Conditions: 90's, overcast, calm winds (Acceptable) Unacceptable for Inspection *(circle one)*

Post-Storm Inspection: Recent Significant Storm Event? ☐ Yes ☑ No
Drive-around inspection performed after significant storm event? ☐ Yes ☐ No ☑ N/A
Drive-around inspection date (taken from Logbook): N/A

Date(s) of Significant Storm Event: N/A

Total Precipitation (in): N/A

Attachments: ☐ Photographs ☐ Figures ☐ Other:

INSPECTION ITEM	CONDITION IS PRESENT			REPEAT OR CHRONIC CONDITION			OBSERVATION Indicate recommended action, if required.	CONFIRMATION THAT ACTION IS COMPLETE (Initial and Date)
	Y	N	N/A	Y	N	N/A		
1.0 Surface Conditions								
1.1 Erosion rills or gullies		✓				✓	none	
1.2 Sheet erosion or plant pedestalling		✓				✓	none	
1.3 Depressions, ponding areas, sedimentation, or other conditions that could interrupt cap drainage		✓				✓	none	
1.4 Surface salts, crusting, or evidence of compaction		✓				✓	none	
1.5 Excessive animal trails or tire tracks/ruts		✓				✓	none	

FORM SOP ELF 001-2
ELF CAP TYPE II INSPECTION FORM

INSPECTION ITEM		CONDITION IS PRESENT			REPEAT OR CHRONIC CONDITION			OBSERVATION Indicate recommended action, if required.	CONFIRMATION THAT ACTION IS COMPLETE
		Y	N	N/A	Y	N	N/A		
1.6	Burrowing animal holes (localized burrows greater than 3 inches in diameter, or widespread burrows of any size)		✓				✓	none	
1.7	Seepage, differential settlement, cracking, subsidence, sliding, creep, or other signs of slope instability		✓				✓	none	
1.8	Intrusive damage such as unplanned excavation, drilling, grading, damage to engineering or access controls, vandalism		✓				✓	none	
1.9	Anchor Trench Drain outfalls exhibit flow, erosion, seepage, moisture or bare/ sparse vegetation.		✓				✓	none	
2.0	**Vegetative Cover**								
2.1	Bare area or areas of poor growth greater than 100 square feet		✓				✓	none	
2.2	Areas of poor vigor, disease, over grazing, stress, burned, or discoloration greater than 100 square feet		✓				✓	none	
2.3	Deep rooted, noxious or undesirable weeds		✓				✓	none	
3.0	**Engineering and Access Controls**								
3.1	The perimeter fence is damaged		✓				✓	none	
3.2	Debris has collected along the perimeter fence		✓				✓	none	

FORM SOP ELF 001-2
ELF CAP TYPE II INSPECTION FORM

INSPECTION ITEM		CONDITION IS PRESENT			REPEAT OR CHRONIC CONDITION			OBSERVATION Indicate recommended action, if required.	CONFIRMATION THAT ACTION IS COMPLETE
		Y	N	N/A	Y	N	N/A		
3.3	Warning signs are not legible from 25 feet		✓				✓	none	
3.4	Damage to the Access Road such as potholes, washouts or burrowing		✓				✓	none	
3.5	Cap perimeter survey monuments appear to be disturbed (Inspect every five years, in conjunction with the CERCLA Five Year Review for legibility and to confirm record locations)			✓			✓	not inspected this year	
4.0	**LRCH and LS/LF Monitoring**								
4.1	Erosion rills or gullies, or burrowing animal holes around the LRCH Buildings		✓				✓	none	
4.2	LS/LF Building secondary containment is damaged or not intact. Storage tanks are leaking.		✓				✓	none	
5.0	**Groundwater Monitoring**								
5.1	Damage to monitoring wells		✓				✓	none	
6.0	**Surface Water Controls**								
6.1	Impeded drainage or ponding in a channel or downchute		✓				✓	none	
6.2	Excessive siltation in a channel or downchute		✓				✓	none	
6.3	Debris present in a channel or downchute		✓				✓	none	

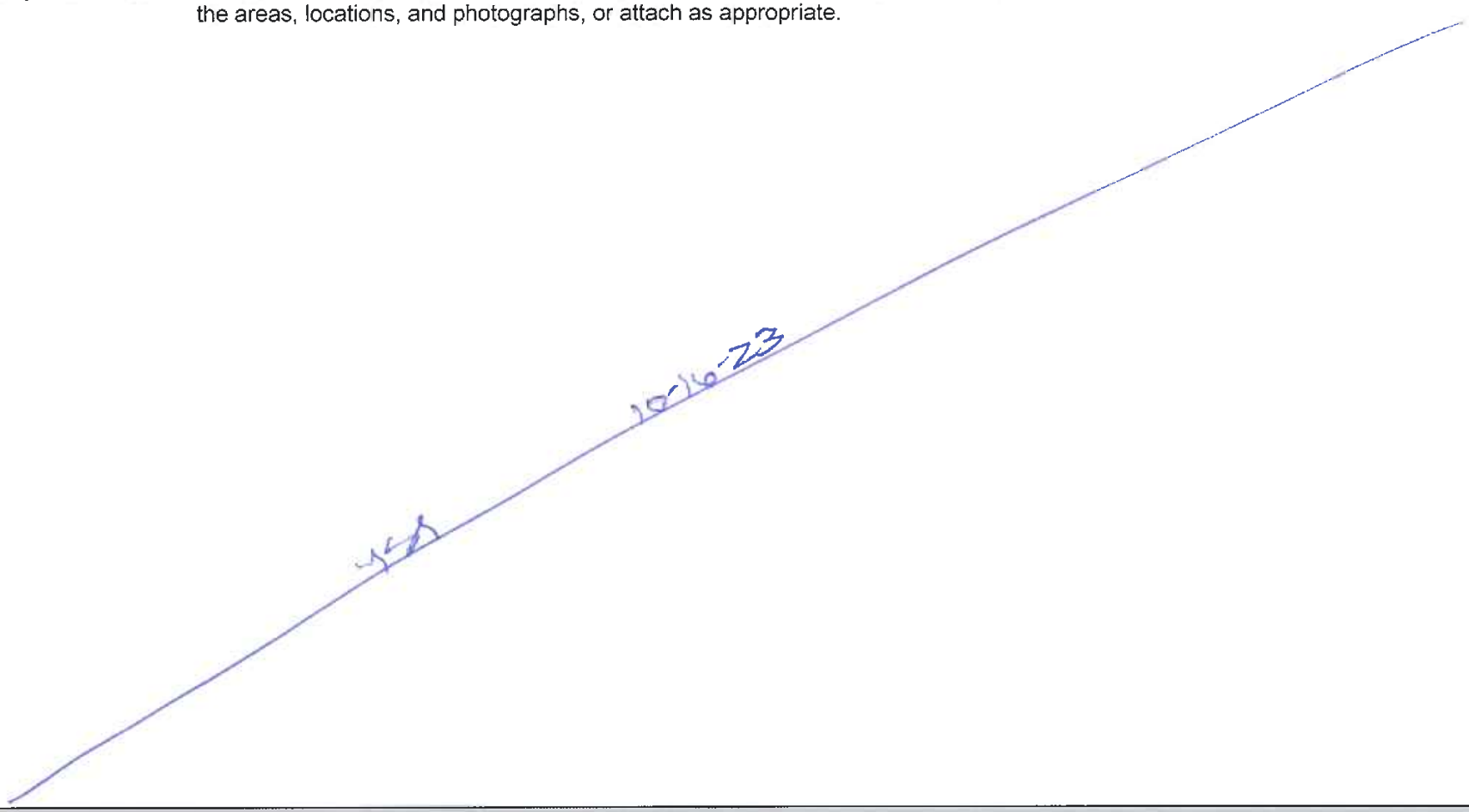
FORM SOP ELF 001-2
ELF CAP TYPE II INSPECTION FORM

INSPECTION ITEM	CONDITION IS PRESENT			REPEAT OR CHRONIC CONDITION			OBSERVATION Indicate recommended action, if required.	CONFIRMATION THAT ACTION IS COMPLETE
	Y	N	N/A	Y	N	N/A		
6.4 Erosion rills or gullies in a channel or downchute		✓				✓	none	
6.5 Areas of degraded Articulated Concrete Block (ACB) or extensively cracked grout around ACB		✓				✓	none	
6.6 Subsidence or undercutting of the downchutes or perimeter drainage channels		✓				✓	none	
6.7 Damaged box culverts		✓				✓	none	

INSPECTION ITEM	EM-ELF01	EM-ELF02	EM-ELF03	EM-ELF04	EM-ELF05	EM-ELF06	EM-ELF07	EM-ELF08
7.0 Erosion/Settlement Monuments: *Inspect monuments for damage and legibility, and record the soil thickness loss, if any.*								
7.1 Was the monument free of damage and legible?	(Y) N	(Y) N	(Y) N	(Y) N	(Y) N	(Y) N	(Y) N	(Y) N
7.2 Measured Soil Thickness Loss (inches)	2.5	3	3.25	2.75	1	2.25	1.25	1.25

FORM SOP ELF 001-2
ELF CAP TYPE II INSPECTION FORM

Inspection Notes: For areas with deficiencies, provide identifying labels for deficient areas, descriptions of deficiencies, approximate dimensions of the areas, locations, and photographs, or attach as appropriate.



Inspector		
Name: [illegible]	**Signature:** [illegible]	**Date:** 10-16-23
Cover Manager Review of Inspection Documentation		
Name: Michael W. Jones	**Signature:** [illegible]	**Date:** 10/26/23
Cover Manager Confirmation of Completed Actions		
Name: N/A	**Signature:** N/A	**Date:** N/A

FORM SOP ELF 001-1
ELF CAP TYPE I INSPECTION FORM

Inspector Name(s): M. Jones, K. Hoffman | **Inspection Date(s):** 1-3-24

Field Conditions:
Previous 24-Hour Precipitation: Ø | Weather Conditions: sunny, calm winds, 30's | Acceptable/Unacceptable for Inspection *(circle one)*

Post-Storm Inspection: Recent Significant Storm Event? ☐ Yes ☑ No
Drive-around inspection performed after significant storm event? ☐ Yes ☐ No ☑ N/A
Drive-around inspection date (taken from Logbook): N/A
*Note: Post-storm event inspection items are indicated with a * next to the Inspection Item number.*

Date(s) of Significant Storm Event: N/A

Total Precipitation (in): N/A

Attachments: ☐ Photographs ☐ Figures ☐ Other: _____

INSPECTION ITEM	CONDITION IS PRESENT			REPEAT OR CHRONIC CONDITION			OBSERVATION Indicate recommended action, if required.	CONFIRMATION THAT ACTION IS COMPLETE (Initial and Date)
	Y	N	N/A	Y	N	N/A		
1.0 Surface Conditions								
1.1* Erosion rills or gullies		✓				✓	none	
1.2* Sheet erosion or plant pedestalling		✓				✓	none	
1.3* Depressions, ponding areas, sedimentation, or other conditions that could interrupt cap drainage		✓				✓	none	
1.4 Surface salts, crusting, or evidence of compaction		✓				✓	none	
1.5 Excessive animal trails or tire tracks/ruts		✓				✓	none	
1.6 Burrowing animal holes (localized burrows greater than 3 inches in diameter, or widespread burrows of any size)		✓				✓	none	

FORM SOP ELF 001-1
ELF CAP TYPE I INSPECTION FORM

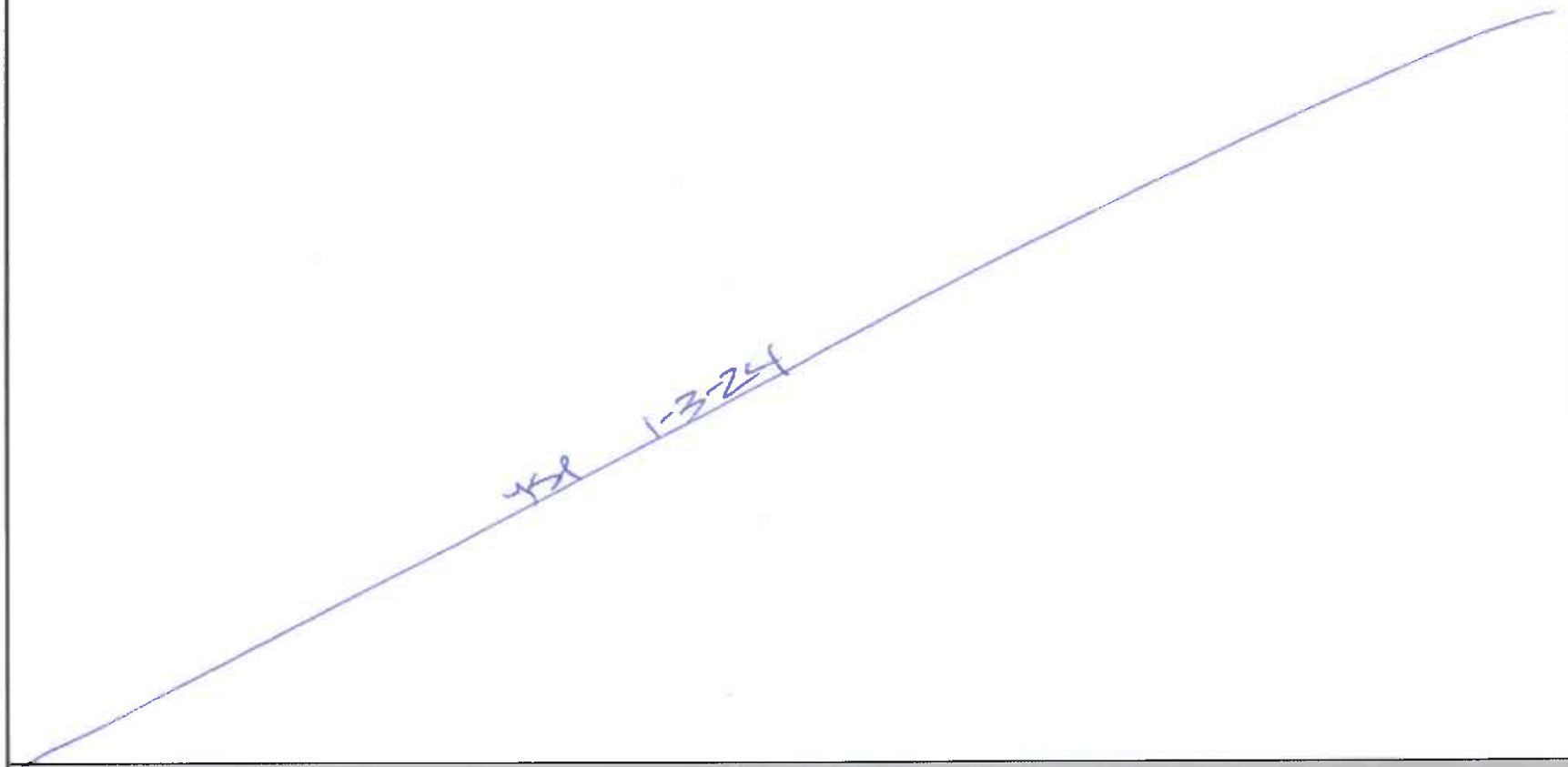
	INSPECTION ITEM	CONDITION IS PRESENT			REPEAT OR CHRONIC CONDITION			OBSERVATION Indicate recommended action, if required.	CONFIRMATION THAT ACTION IS COMPLETE (Initial and Date)
		Y	N	N/A	Y	N	N/A		
1.7*	Seepage, differential settlement, cracking, subsidence, sliding, creep, or other signs of slope instability		✓				✓	none	
1.8	Intrusive damage such as unplanned excavation, drilling, grading, damage to engineering or access controls, vandalism		✓				✓	none	
1.9	Anchor Trench Drain outfalls exhibit flow, erosion, seepage, moisture or bare/ sparse vegetation.		✓				✓	none	
2.0	**Vegetative Cover**								
2.1	Bare area or areas of poor growth greater than 100 square feet		✓				✓	none	
2.2	Areas of poor vigor, disease, over grazing, stress, burned, or discoloration greater than 100 square feet		✓				✓	none	
3.0	**Engineering and Access Controls**								
3.1	The perimeter fence is damaged		✓				✓	none	
3.2	Debris has collected along the perimeter fence		✓				✓	none	
3.3	Warning signs are not legible from 25 feet		✓				✓	none	
3.4*	Damage to the Access Road such as potholes, washouts or burrowing		✓				✓	none	

FORM SOP ELF 001-1
ELF CAP TYPE I INSPECTION FORM

INSPECTION ITEM		CONDITION IS PRESENT			REPEAT OR CHRONIC CONDITION			OBSERVATION Indicate recommended action, if required.	CONFIRMATION THAT ACTION IS COMPLETE (Initial and Date)
		Y	N	N/A	Y	N	N/A		
4.0	**LRCH and LS/LF Monitoring**								
4.1*	Erosion rills or gullies, or burrowing animal holes around the LRCH Buildings		✓				✓	none	
4.2	LS/LF Building secondary containment is damaged or not intact. Storage tanks are leaking.		✓				✓	none	
5.0	**Groundwater Monitoring**								
5.1	Damage to monitoring wells		✓				✓	none	
6.0	**Surface Water Controls**								
6.1*	Impeded drainage or ponding in the channel		✓				✓	none	
6.2*	Excessive siltation in the channel		✓				✓	none	
6.3*	Debris present in the channel		✓				✓	none	
6.4*	Erosion rills or gullies in the channel		✓				✓	none	
6.5	Areas of degraded Articulated Concrete Block (ACB) or extensively cracked grout around ACB		✓				✓	none	
6.6*	Subsidence or undercutting of the downchutes or perimeter drainage channels		✓				✓	none	
6.7	Damaged box culverts		✓				✓	none	

FORM SOP ELF 001-1
ELF CAP TYPE I INSPECTION FORM

Inspection Notes: For areas with deficiencies, provide identifying labels for deficient areas, descriptions of deficiencies, approximate dimensions of the areas, locations, and photographs, or attach as appropriate.



Inspector		
Name: Kim Hoffman	**Signature:** Kim Hoffman	**Date:** 1-3-24
Cover Manager Review of Inspection Documentation		
Name: Michael W. Jones	**Signature:** Michael W. Jones	**Date:** 1/18/24
Cover Manager Confirmation of Completed Actions		
Name: N/A	**Signature:** N/A	**Date:** N/A

FORM SOP ELF 001-2
ELF CAP TYPE II INSPECTION FORM

Inspector Name(s): K. Hoffman, V. Stewart **Inspection Date(s):** 4-4-24

Field Conditions:
Previous 24-Hour Precipitation: 0 Weather Conditions: mostly sunny, warm Acceptable/Unacceptable for Inspection ***(circle one)***

Post-Storm Inspection: Recent Significant Storm Event? ☐ Yes ☑ No
Drive-around inspection performed after significant storm event? ☐ Yes ☐ No ☑ N/A
Drive-around inspection date (taken from Logbook): N/A

Date(s) of Significant Storm Event: N/A

Total Precipitation (in): N/A

Attachments: ☐ Photographs ☐ Figures ☐ Other:

INSPECTION ITEM	CONDITION IS PRESENT			REPEAT OR CHRONIC CONDITION			OBSERVATION Indicate recommended action, if required.	CONFIRMATION THAT ACTION IS COMPLETE (Initial and Date)
	Y	N	N/A	Y	N	N/A		
1.0 Surface Conditions								
1.1 Erosion rills or gullies		✓				✓	none	
1.2 Sheet erosion or plant pedestalling		✓				✓	none	
1.3 Depressions, ponding areas, sedimentation, or other conditions that could interrupt cap drainage		✓				✓	none	
1.4 Surface salts, crusting, or evidence of compaction		✓				✓	none	
1.5 Excessive animal trails or tire tracks/ruts		✓				✓	none	

FORM SOP ELF 001-2
ELF CAP TYPE II INSPECTION FORM

	INSPECTION ITEM	CONDITION IS PRESENT			REPEAT OR CHRONIC CONDITION			OBSERVATION Indicate recommended action, if required.	CONFIRMATION THAT ACTION IS COMPLETE
		Y	N	N/A	Y	N	N/A		
1.6	Burrowing animal holes (localized burrows greater than 3 inches in diameter, or widespread burrows of any size)		✓				✓	none	
1.7	Seepage, differential settlement, cracking, subsidence, sliding, creep, or other signs of slope instability		✓				✓	none	
1.8	Intrusive damage such as unplanned excavation, drilling, grading, damage to engineering or access controls, vandalism		✓				✓	none	
1.9	Anchor Trench Drain outfalls exhibit flow, erosion, seepage, moisture or bare/ sparse vegetation.		✓				✓	none	
2.0	**Vegetative Cover**								
2.1	Bare area or areas of poor growth greater than 100 square feet		✓				✓	none	
2.2	Areas of poor vigor, disease, over grazing, stress, burned, or discoloration greater than 100 square feet		✓				✓	none	
2.3	Deep rooted, noxious or undesirable weeds	✓				✓		cheatgrass localized around ER-01.	Weed control is on-going. MJ 4/17/24
3.0	**Engineering and Access Controls**								
3.1	The perimeter fence is damaged		✓				✓	none	
3.2	Debris has collected along the perimeter fence		✓				✓	none	

FORM SOP ELF 001-2
ELF CAP TYPE II INSPECTION FORM

INSPECTION ITEM	CONDITION IS PRESENT			REPEAT OR CHRONIC CONDITION			OBSERVATION Indicate recommended action, if required.	CONFIRMATION THAT ACTION IS COMPLETE
	Y	N	N/A	Y	N	N/A		
3.3 Warning signs are not legible from 25 feet		✓				✓	none	
3.4 Damage to the Access Road such as potholes, washouts or burrowing		✓				✓	none	
3.5 Cap perimeter survey monuments appear to be disturbed (Inspect every five years, in conjunction with the CERCLA Five Year Review for legibility and to confirm record locations)			✓			✓	not inspected this year	
4.0 LRCH and LS/LF Monitoring								
4.1 Erosion rills or gullies, or burrowing animal holes around the LRCH Buildings		✓				✓	none	
4.2 LS/LF Building secondary containment is damaged or not intact. Storage tanks are leaking.		✓				✓	none	
5.0 Groundwater Monitoring								
5.1 Damage to monitoring wells		✓				✓	none	
6.0 Surface Water Controls								
6.1 Impeded drainage or ponding in a channel or downchute		✓				✓	none	
6.2 Excessive siltation in a channel or downchute		✓				✓	none	
6.3 Debris present in a channel or downchute		✓				✓	none	

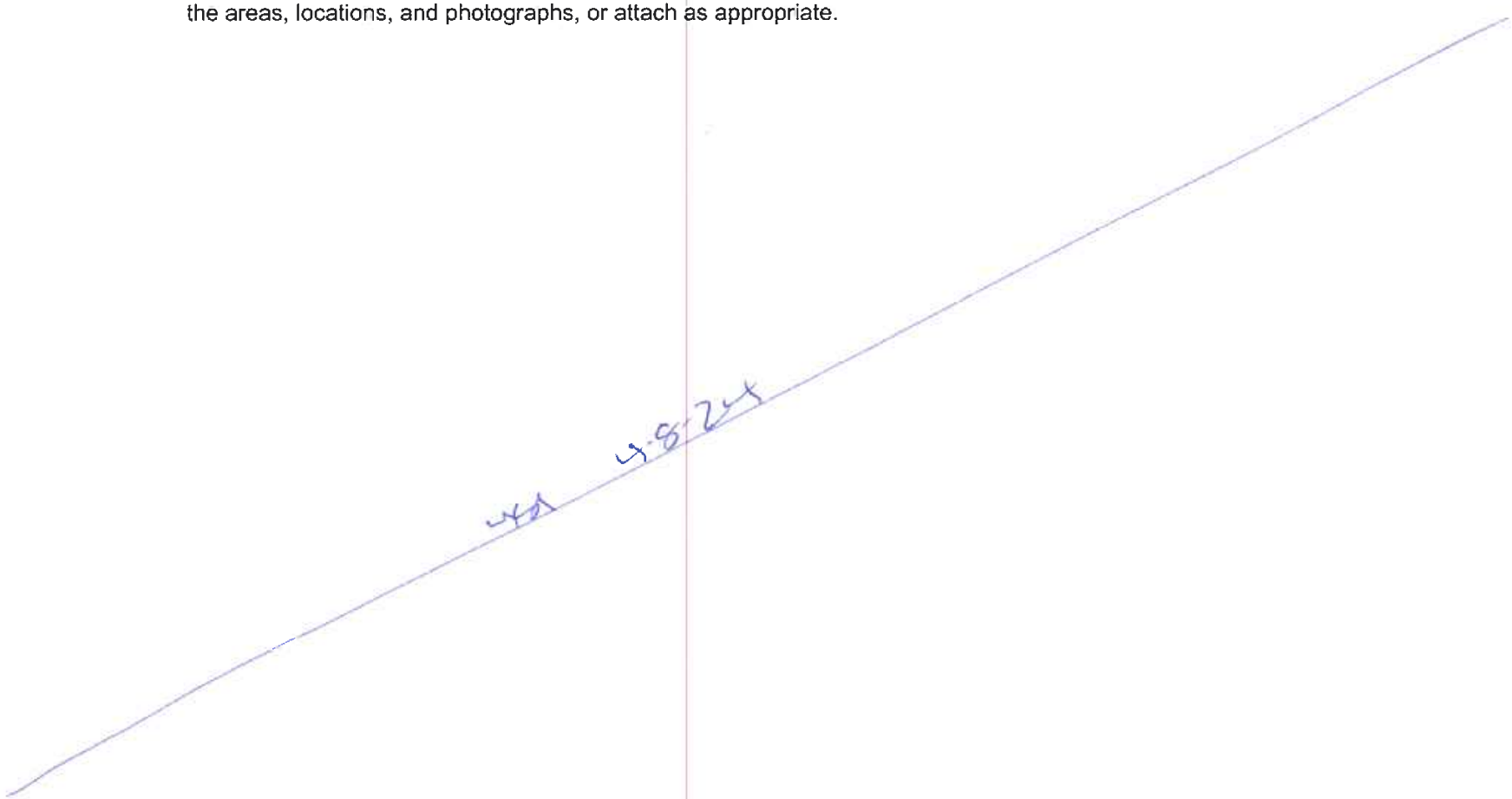
FORM SOP ELF 001-2
ELF CAP TYPE II INSPECTION FORM

INSPECTION ITEM	CONDITION IS PRESENT Y	N	N/A	REPEAT OR CHRONIC CONDITION Y	N	N/A	OBSERVATION Indicate recommended action, if required.	CONFIRMATION THAT ACTION IS COMPLETE
6.4 Erosion rills or gullies in a channel or downchute		✓				✓	none	
6.5 Areas of degraded Articulated Concrete Block (ACB) or extensively cracked grout around ACB		✓				✓	none	
6.6 Subsidence or undercutting of the downchutes or perimeter drainage channels		✓				✓	none	
6.7 Damaged box culverts		✓				✓	none	

INSPECTION ITEM	EM-ELF01	EM-ELF02	EM-ELF03	EM-ELF04	EM-ELF05	EM-ELF06	EM-ELF07	EM-ELF08
7.0 Erosion/Settlement Monuments: *Inspect monuments for damage and legibility, and record the soil thickness loss, if any.*								
7.1 Was the monument free of damage and legible?	(Y) N	(Y) N	(Y) N	(Y) N	(Y) N	(Y) N	(Y) N	(Y) N
7.2 Measured Soil Thickness Loss (inches)	2.5	3	2.75	2.25	0.75	1.75	1.25	0.75

FORM SOP ELF 001-2
ELF CAP TYPE II INSPECTION FORM

Inspection Notes: For areas with deficiencies, provide identifying labels for deficient areas, descriptions of deficiencies, approximate dimensions of the areas, locations, and photographs, or attach as appropriate.



Inspector		
Name: Kim Hoffman	**Signature:**	**Date:** 4-8-24
Cover Manager Review of Inspection Documentation		
Name: Michael W. Jones	**Signature:**	**Date:** 4/17/24
Cover Manager Confirmation of Completed Actions		
Name: N/A	**Signature:** N/A	**Date:** N/A

ELF LCS/LDS AND WASTEWATER CONVEYANCE SYSTEM
QUARTERLY INSPECTION FORM

Inspector Name(s): Kim Hoffman **Inspection Date(s):** 7-6-23

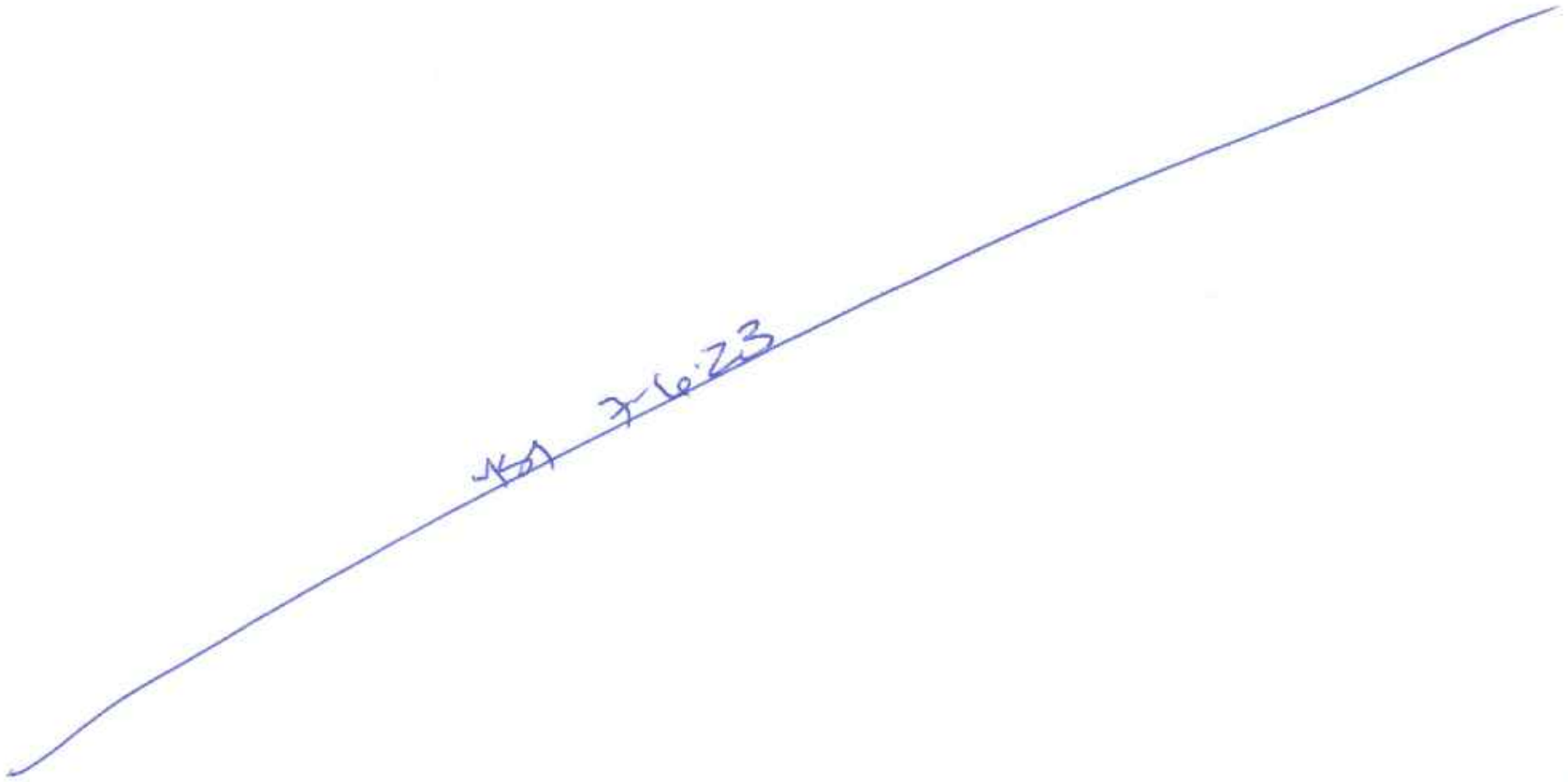
Attachments: ☐ Photographs ☐ Figures ☐ Other

	INSPECTION ITEM	CONDITION IS PRESENT			REPEAT OR CHRONIC CONDITION			OBSERVATION Indicate recommended action, if required.	CONFIRMATION THAT ACTION IS COMPLETE (Signature and Date)
		Y	N	N/A	Y	N	N/A		
1	Improper operation/condition of instrumentation and valves		✓				✓		
2	Improper operation of leachate collection and leak detection pumps		✓				✓		
3	Excessive liquid in LRCHs or LS/LF.		✓				✓		
4	Blockage of leachate collection leak detection discharge piping		✓				✓		
5	Collapse of leachate collection or leak detection sump riser pipe		✓				✓		
6.	Flow meters or level indicators are malfunctioning.		✓				✓		
7.	LS/LF tank levels are above high level set points.		✓				✓		
8.	LS/LF tanks are damaged or leaking.		✓				✓		
9.	Indication of leaks in the indoor piping system in the LRCHS or LS/LF.		✓				✓		
10.	Indication that the LS/LF secondary containment is damaged or inadequate.		✓				✓		
11.	Heating system in the LRCHs or LS/LF is malfunctioning.		✓				✓		

8-6

ELF LCS/LDS AND WASTEWATER CONVEYANCE SYSTEM
QUARTERLY INSPECTION FORM

Inspection Notes: For areas with deficiencies, provide identifying labels for deficient areas, descriptions of deficiencies, approximate dimensions of the areas, locations with GPS coordinates, and photographs, or attach as appropriate.



Inspector		
Name: Kim Hoffman	**Signature:** Kim Hoffman	**Date:** 7-6-23
Operations Engineer Review of Inspection Documentation		
Name: Michael W. Jones	**Signature:**	**Date:** 7/24/23
Operations Manager Review of Implementation		
Name: N/A	**Signature:** N/A	**Date:** N/A

ELF LCS/LDS AND WASTEWATER CONVEYANCE SYSTEM
QUARTERLY INSPECTION FORM

Inspector Name(s): K Hoffman

Inspection Date(s): 10-10-23

Attachments: ☐ Photographs ☐ Figures ☐ Other

	INSPECTION ITEM	CONDITION IS PRESENT			REPEAT OR CHRONIC CONDITION			OBSERVATION Indicate recommended action, if required.	CONFIRMATION THAT ACTION IS COMPLETE (Signature and Date)
		Y	N	N/A	Y	N	N/A		
1	Improper operation/condition of instrumentation and valves		✓				✓		
2	Improper operation of leachate collection and leak detection pumps		✓				✓		
3	Excessive liquid in LRCHs or LS/LF.		✓				✓		
4	Blockage of leachate collection leak detection discharge piping		✓				✓		
5	Collapse of leachate collection or leak detection sump riser pipe		✓				✓		
6.	Flow meters or level indicators are malfunctioning.		✓				✓		
7.	LS/LF tank levels are above high level set points.		✓				✓		
8.	LS/LF tanks are damaged or leaking.		✓				✓		
9.	Indication of leaks in the indoor piping system in the LRCHS or LS/LF.		✓				✓		
10.	Indication that the LS/LF secondary containment is damaged or inadequate.		✓				✓		
11.	Heating system in the LRCHs or LS/LF is malfunctioning.		✓				✓		

10-11-23

8-6

ELF LCS/LDS AND WASTEWATER CONVEYANCE SYSTEM
QUARTERLY INSPECTION FORM

Inspection Notes: For areas with deficiencies, provide identifying labels for deficient areas, descriptions of deficiencies, approximate dimensions of the areas, locations with GPS coordinates, and photographs, or attach as appropriate.

Inspector		
Name: Kim Hoffman	**Signature:** Kim Hoffman	**Date:** 10-11-23
Operations Engineer Review of Inspection Documentation		
Name: Michael W. Jones	**Signature:**	**Date:** 10/12/23
Operations Manager Review of Implementation		
Name: N/A	**Signature:** N/A	**Date:** N/A

ELF LCS/LDS AND WASTEWATER CONVEYANCE SYSTEM
QUARTERLY INSPECTION FORM

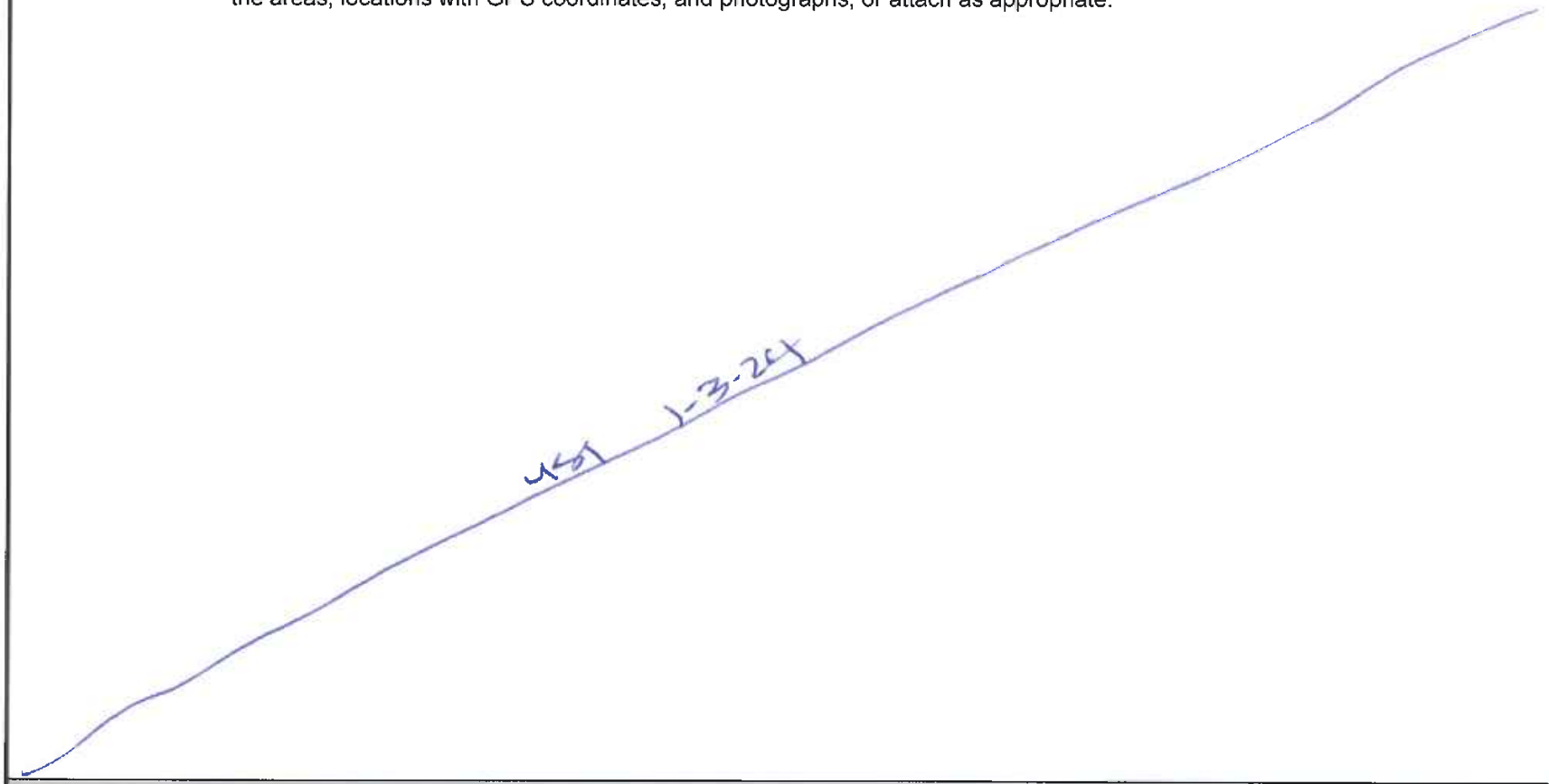
Inspector Name(s): K. Hoffman | **Inspection Date(s):** 1-3-24

Attachments: ☐ Photographs ☐ Figures ☐ Other

	INSPECTION ITEM	CONDITION IS PRESENT			REPEAT OR CHRONIC CONDITION			OBSERVATION Indicate recommended action, if required.	CONFIRMATION THAT ACTION IS COMPLETE (Signature and Date)
		Y	N	N/A	Y	N	N/A		
1	Improper operation/condition of instrumentation and valves		✓				✓		
2	Improper operation of leachate collection and leak detection pumps		✓				✓		
3	Excessive liquid in LRCHs or LS/LF.		✓				✓		
4	Blockage of leachate collection leak detection discharge piping		✓				✓		
5	Collapse of leachate collection or leak detection sump riser pipe		✓				✓		
6.	Flow meters or level indicators are malfunctioning.		✓				✓		
7.	LS/LF tank levels are above high level set points.		✓				✓		
8.	LS/LF tanks are damaged or leaking.		✓				✓		
9.	Indication of leaks in the indoor piping system in the LRCHS or LS/LF.		✓				✓		
10.	Indication that the LS/LF secondary containment is damaged or inadequate.		✓				✓		
11.	Heating system in the LRCHs or LS/LF is malfunctioning.		✓				✓		

ELF LCS/LDS AND WASTEWATER CONVEYANCE SYSTEM
QUARTERLY INSPECTION FORM

Inspection Notes: For areas with deficiencies, provide identifying labels for deficient areas, descriptions of deficiencies, approximate dimensions of the areas, locations with GPS coordinates, and photographs, or attach as appropriate.



Inspector		
Name: Kim Hoffman	**Signature:** Kim Hoffman	**Date:** 1-3-24
Operations Engineer Review of Inspection Documentation		
Name: Michael W. Jones	**Signature:**	**Date:** 1/18/24
Operations Manager Review of Implementation		
Name: N/A	**Signature:** N/A	**Date:** N/A

ELF LCS/LDS AND WASTEWATER CONVEYANCE SYSTEM
QUARTERLY INSPECTION FORM

Inspector Name(s): K. Hoffman

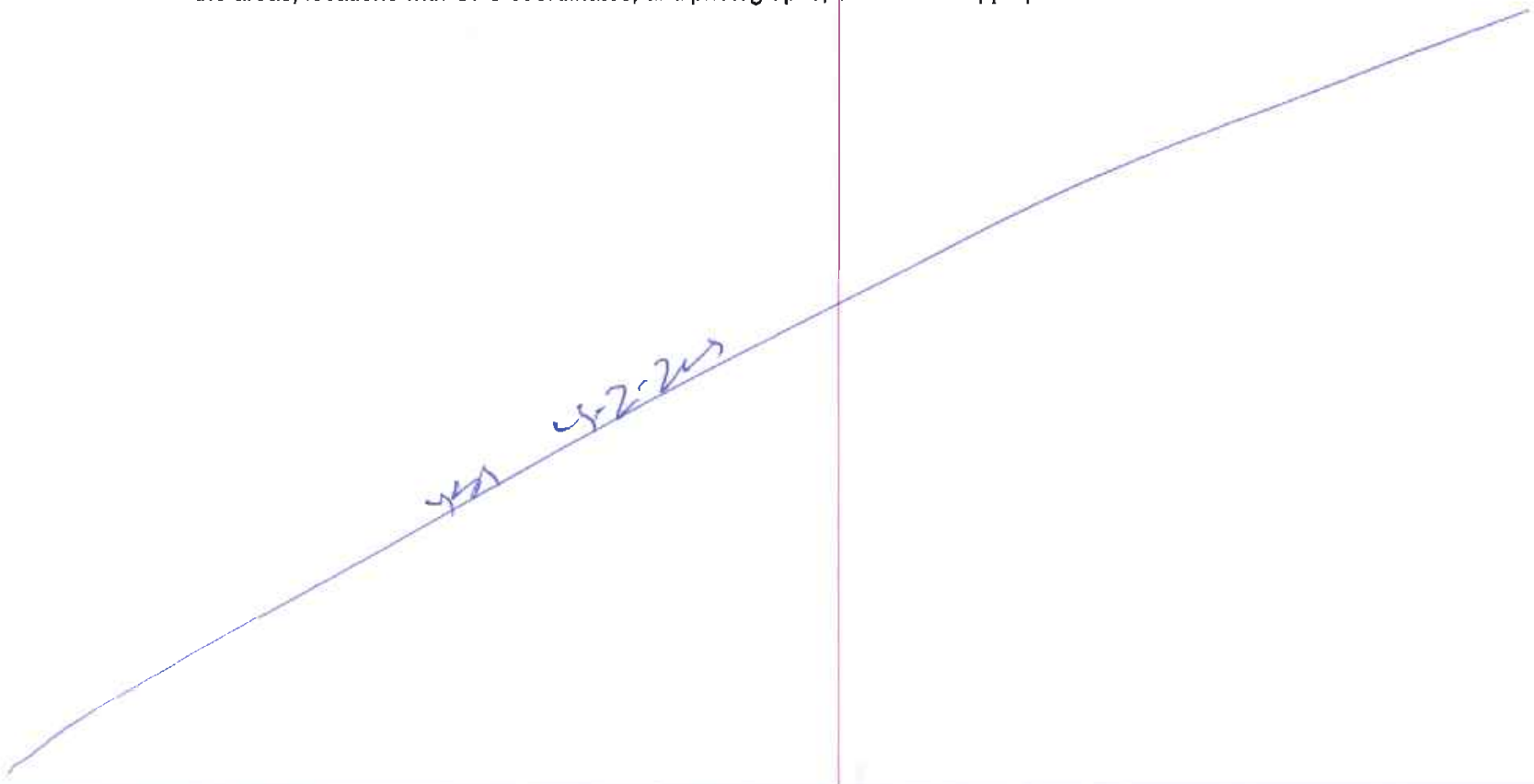
Inspection Date(s): 4-2-24

Attachments: ☐ Photographs ☐ Figures ☐ Other

	INSPECTION ITEM	CONDITION IS PRESENT			REPEAT OR CHRONIC CONDITION			OBSERVATION Indicate recommended action, if required.	CONFIRMATION THAT ACTION IS COMPLETE (Signature and Date)
		Y	N	N/A	Y	N	N/A		
1	Improper operation/condition of instrumentation and valves		✓				✓		
2	Improper operation of leachate collection and leak detection pumps		✓				✓		
3	Excessive liquid in LRCHs or LS/LF.		✓				✓		
4	Blockage of leachate collection leak detection discharge piping		✓				✓		
5	Collapse of leachate collection or leak detection sump riser pipe		✓				✓		
6.	Flow meters or level indicators are malfunctioning.		✓				✓		
7.	LS/LF tank levels are above high level set points.		✓				✓		
8.	Indication of leaks in the indoor piping system in the LRCHS or LS/LF.		✓				✓		
9.	Indication that the LS/LF secondary containment is damaged or inadequate.		✓				✓		
10.	Heating system in the LRCHs or LS/LF is malfunctioning.		✓				✓		

ELF LCS/LDS AND WASTEWATER CONVEYANCE SYSTEM
QUARTERLY INSPECTION FORM

Inspection Notes: For areas with deficiencies, provide identifying labels for deficient areas, descriptions of deficiencies, approximate dimensions of the areas, locations with GPS coordinates, and photographs, or attach as appropriate.



Inspector		
Name: Kim Hoffmann	**Signature:** Kim Hoffmann	**Date:** 4-2-24
Operations Engineer Review of Inspection Documentation		
Name: Michael W. Jones	**Signature:** Michael W. Jones	**Date:** 4/17/24
Operations Manager Review of Implementation		
Name: N/A	Signature: N/A	Date: N/A

APPENDIX C-1

HWL Maintenance Documentation

CONTRACTOR DAILY QUALITY CONTROL REPORT

Project Information	
Subcontractor: N/A	Project: HWL O&M
Task: maintenance	Date: 5/4/23
Weather AM: acceptable field conditions	Weather PM: acceptable field conditions

Activities Inspected and Observed:

OMC used the USFWS tractor and OMC fence cleaner to remove accumulated tumble weeds off of the perimeter fence.

Summary Meetings and Discussions Held or Attended, including Job Safety:

N/A

Comments:

N/A

Additional Documentation Submitted:

N/A

Sign Off:	
Inspector Name: Kim Hoffman	Title/company: Caps and Covers Lead/Navarro
Signature: Kim Hoffman	Date: 6-23-23
Reviewer Name: Mike Jones	Title/company: Caps and Covers Manager/Navarro
Signature:	Date: 6/30/23

CONTRACTOR DAILY QUALITY CONTROL REPORT

Project Information	
Subcontractor: N/A	Project: HWL O&M
Task: maintenance	Date: 5/11/23
Weather AM: acceptable field conditions	Weather PM: acceptable field conditions

Activities Inspected and Observed:

OMC performed a drive around post-storm inspection due to the RMA receiving 1.03" of precipitation in a 24-hour period. No observations were noted.

Summary Meetings and Discussions Held or Attended, including Job Safety:

N/A

Comments:

N/A

Additional Documentation Submitted:

N/A

Sign Off:	
Inspector Name: Kim Hoffman	Title/company: Caps and Covers Lead/Navarro
Signature: [signature]	Date: 6-23-23
Reviewer Name: Mike Jones	Title/company: Caps and Covers Manager/Navarro
Signature: [signature]	Date: 6/30/23

CONTRACTOR DAILY QUALITY CONTROL REPORT

Project Information	
Subcontractor: N/A	Project: HWL O&M
Task: maintenance	Date: 5/15/23
Weather AM: acceptable field conditions	Weather PM: acceptable field conditions

Activities Inspected and Observed:

OMC personnel performed a drive-around post-storm inspection due to the RMA receiving the following precipitation:

5/10/23 0.62"
5/11/23 2.92"
5/12/23 0.85"
5/14/23 0.28"

No observations were noted.

Summary Meetings and Discussions Held or Attended, including Job Safety:

N/A

Comments:

N/A

Additional Documentation Submitted:

N/A

Sign Off:	
Inspector Name: Kim Hoffman	Title/company: Caps and Covers Lead/Navarro
Signature: Kim Hoffman	Date: 6-23-23
Reviewer Name: Mike Jones	Title/company: Caps and Covers Manager/Navarro
Signature:	Date: 6/30/23

CONTRACTOR DAILY QUALITY CONTROL REPORT

Project Information	
Subcontractor: H2	Project: HWL O&M
Task: maintenance	Date: 5/30/23
Weather AM: acceptable field conditions	Weather PM: acceptable field conditions

Activities Inspected and Observed:

H2 used a deck mower mounted to a skidsteer to mow accumulated tumbleweeds. H2 mowed the inlets and outlets of the two concrete box culverts in the west perimeter channel and along the north HWL fenceline.

Summary Meetings and Discussions Held or Attended, including Job Safety:

N/A

Comments:

N/A

Additional Documentation Submitted:

N/A

Sign Off:	
Inspector Name: Kim Hoffman	Title/company: Caps and Covers Lead/Navarro
Signature: Kim Hoffman	Date: 6-23-23
Reviewer Name: Mike Jones	Title/company: Caps and Covers Manager/Navarro
Signature: Mike Jones	Date: 6/30/23

CONTRACTOR DAILY QUALITY CONTROL REPORT

Project Information	
Subcontractor: H2	Project: HWL O&M
Task: maintenance	Date: 5/31/23
Weather AM: acceptable field conditions	Weather PM: acceptable field conditions
Activities Inspected and Observed:	
H2 used a deck mower mounted to a skidsteer to mow accumulated tumbleweeds. H2 mowed around the two east manholes, the northeast and northwest downchutes, the top two ACB lined channels on the east slope, the inlet and outlet of the southeast concrete box culvert, and the inlet of the northeast concrete box culvert.	
Summary Meetings and Discussions Held or Attended, including Job Safety:	
N/A	
Comments:	
N/A	
Additional Documentation Submitted:	
N/A	
Sign Off:	
Inspector Name: Kim Hoffman	Title/company: Caps and Covers Lead/Navarro
Signature: [signature]	Date: 6.22.23
Reviewer Name: Mike Jones	Title/company: Caps and Covers Manager/Navarro
Signature: [signature]	Date: 6/30/23

CONTRACTOR DAILY QUALITY CONTROL REPORT

Project Information	
Subcontractor: H2	Project: HWL O&M
Task: maintenance	Date: 6/1/23
Weather AM: acceptable field conditions	Weather PM: acceptable field conditions
Activities Inspected and Observed:	
H2 used a deck mower mounted to a skidsteer to mow accumulated tumbleweeds. H2 mowed around the northwest manhole, the outlet of the northeast concrete box culvert, and the east perimeter fence line.	
Summary Meetings and Discussions Held or Attended, including Job Safety:	
N/A	
Comments:	
N/A	
Additional Documentation Submitted:	
N/A	
Sign Off:	
Inspector Name: Kim Hoffman	Title/company: Caps and Covers Lead/Navarro
Signature: Kim Hoffman	Date: 6-23-23
Reviewer Name: Mike Jones	Title/company: Caps and Covers Manager/Navarro
Signature:	Date: 6/30/23

CONTRACTOR DAILY QUALITY CONTROL REPORT

Project Information	
Subcontractor: N/A	Project: HWL O&M
Task: maintenance	Date: 6/5/23
Weather AM: acceptable field conditions	Weather PM: acceptable field conditions

Activities Inspected and Observed:

OMC personnel performed a drive around post-storm inspection due to the RMA receiving 1.23" of rain in a 24-hour period on 6/4/23. No observations were noted.

Summary Meetings and Discussions Held or Attended, including Job Safety:

N/A

Comments:

N/A

Additional Documentation Submitted:

N/A

Sign Off:	
Inspector Name: Kim Hoffman	Title/company: Caps and Covers Lead/Navarro
Signature: Kim Hoffman	Date: 6-22-23
Reviewer Name: Mike Jones	Title/company: Caps and Covers Manager/Navarro
Signature:	Date: 6/30/23

CONTRACTOR DAILY QUALITY CONTROL REPORT

Project Information	
Subcontractor: Weed Wranglers	Project: HWL O&M
Task: maintenance	Date: 6/14/23
Weather AM: acceptable field conditions	Weather PM: acceptable field conditions
Activities Inspected and Observed:	
Weed Wranglers sprayed noxious weeds on and around the HWL. Weed Wranglers was given the liberty to inspect the landfill for weeds and spot spray them as necessary. Primarily thistles and bindweed were sprayed using Escort XP®, Vista®, and surfactant.	
Summary Meetings and Discussions Held or Attended, including Job Safety:	
N/A	
Comments:	
N/A	
Additional Documentation Submitted:	
N/A	
Sign Off:	
Inspector Name: Kim Hoffman	Title/company: Caps and Covers Lead/Navarro
Signature: [signature]	Date: 6-23-23
Reviewer Name: Mike Jones	Title/company: Caps and Covers Manager/Navarro
Signature: [signature]	Date: 6/30/23

CONTRACTOR DAILY QUALITY CONTROL REPORT

Project Information	
Subcontractor: N/A	Project: HWL O&M
Task: maintenance	Date: 7/26/23
Weather AM: acceptable field conditions	Weather PM: acceptable field conditions
Activities Inspected and Observed:	
OMC personnel graded the access road to the HWL LCS/LDS4. This road had a washout that was repaired with grading.	
Summary Meetings and Discussions Held or Attended, including Job Safety:	
N/A	
Comments:	
N/A	
Additional Documentation Submitted:	
N/A	
Sign Off:	
Inspector Name: Kim Hoffman	Title/company: Caps and Covers Lead/Navarro
Signature: Kim Hoffman	Date: 12-27-23
Reviewer Name: Mike Jones	Title/company: Caps and Covers Manager/Navarro
Signature: Mike Jones	Date: 1/8/24

CONTRACTOR DAILY QUALITY CONTROL REPORT

Project Information	
Subcontractor: Weed Wranglers	Project: HWL O&M
Task: maintenance	Date: 9/5/23
Weather AM: acceptable field conditions	Weather PM: acceptable field conditions
Activities Inspected and Observed:	
Weed Wranglers began spraying the cheatgrass areas on the HWL. The north and east slopes were completed, and the west slope was started but the technician had to stop due to windy conditions. Weed Wranglers used 5 oz of Rejuvra to spray the cheatgrass areas.	
Summary Meetings and Discussions Held or Attended, including Job Safety:	
N/A	
Comments:	
N/A	
Additional Documentation Submitted:	
N/A	
Sign Off:	
Inspector Name: Kim Hoffman	Title/company: Caps and Covers Lead/Navarro
Signature: Kim Hoffman	Date: 12-27-23
Reviewer Name: Mike Jones	Title/company: Caps and Covers Manager/Navarro
Signature:	Date: 1/8/24

CONTRACTOR DAILY QUALITY CONTROL REPORT

Project Information	
Subcontractor: Weed Wranglers	Project: HWL O&M
Task: maintenance	Date: 9/6/23
Weather AM: acceptable field conditions	Weather PM: acceptable field conditions
Activities Inspected and Observed:	
Weed Wranglers continued spraying the cheatgrass areas on the HWL. The west slope and the top of the HWL were completed today. All 25.87 acres were sprayed with 5 oz of Rejuvra.	
Summary Meetings and Discussions Held or Attended, including Job Safety:	
N/A	
Comments:	
N/A	
Additional Documentation Submitted:	
N/A	
Sign Off:	
Inspector Name: Kim Hoffman	Title/company: Caps and Covers Lead/Navarro
Signature: Kim Hoffman	Date: 12-27-23
Reviewer Name: Mike Jones	Title/company: Caps and Covers Manager/Navarro
Signature:	Date: 1/8/24

CONTRACTOR DAILY QUALITY CONTROL REPORT

Project Information	
Subcontractor: MRC Services	Project: HWL O&M
Task: maintenance	Date: 10/23/23
Weather AM: acceptable field conditions	Weather PM: acceptable field conditions
Activities Inspected and Observed:	
MRC Services mowed weedy areas around the HWL. All areas identified for mowing were complete today.	
Summary Meetings and Discussions **Held or Attended, including Job Safety:**	
N/A	
Comments:	
N/A	
Additional Documentation Submitted:	
N/A	
Sign Off:	
Inspector Name: Kim Hoffman	Title/company: Caps and Covers Lead/Navarro
Signature: Kim Hoffman	Date: 12-27-23
Reviewer Name: Mike Jones	Title/company: Caps and Covers Manager/Navarro
Signature:	Date: 1/8/24

CONTRACTOR DAILY QUALITY CONTROL REPORT

Project Information	
Subcontractor: Weed Wranglers	Project: HWL O&M
Task: maintenance	Date: 10/24/23
Weather AM: acceptable field conditions	Weather PM: acceptable field conditions
Activities Inspected and Observed:	
Weed Wranglers completed the ground clear herbicide application around the HWL. Weed Wranglers applied Plainview SC.	
Summary Meetings and Discussions Held **or Attended, including Job Safety:**	
N/A	
Comments:	
N/A	
Additional Documentation Submitted:	
N/A	
Sign Off:	
Inspector Name: Kim Hoffman	Title/company: Caps and Covers Lead/Navarro
Signature: Kim Hoffman	Date: 12-27-23
Reviewer Name: Mike Jones	Title/company: Caps and Covers Manager/Navarro
Signature:	Date: 1/8/24

NAVARRO

CONTRACTOR DAILY QUALITY CONTROL REPORT

Project Information	
Subcontractor: N/A	Project: HWL O&M
Task: maintenance	Date: 4/30/24
Weather AM: acceptable field conditions	Weather PM: acceptable field conditions
Activities Inspected and Observed:	
Navarro personnel performed a drive around post-storm inspection due to the RMA receiving 1.27" of rain in a 24-hour period on 4/27/24. No observations were noted.	
Summary Meetings and Discussions Held or Attended, including Job Safety:	
N/A	
Comments:	
N/A	
Additional Documentation Submitted:	
N/A	
Sign Off:	
Inspector Name: Kim Hoffman	Title/company: Caps and Covers Lead/Navarro
Signature and Date: Kim Hoffman	Digitally signed by Kim Hoffman DN: cn=Kim Hoffman, o=Navarro Research and Engineering, ou, email=hoffman@navarro-inc.com, c=US Date: 2024.05.02 08:01:52 -05'00'
Reviewer Name: Michael W. Jones	Title/company: Caps and Covers Manager/Navarro
Signature and Date: Michael W. Jones	Digitally signed by Michael W. Jones DN: CN = Michael W. Jones email = jjones@navarro-inc.com O = US OU = Navarro Research and Engineering, Inc. Date: 2024.05.02 09:51:59 -05'00'

Operations and Maintenance Report

Beginning Date 05/01/2023 Ending Date 04/30/2024

Date	Start of Down Time	Plant Down Time (Hrs)	Summary of Significant Events
)5/12/2023		0.00	Pumped floor sump at LSLF due to storm water entering under the garage door and settii sump alarm. RMA has received 3.77" of precipitation in three days. init:kh
)5/27/2023		0.00	Performed a visual inspection of the LSLF building due to electrical grid failure and the re monitoring system being down. No indication of tank leakage. Both tanks are full of leach and the tank levels are too high to measure manually. init:kh
)5/28/2023		0.00	Performed a visual inspection of the LSLF building because of continued power outage. E tanks are full with no indication of leakage. init:kh
)5/29/2023		0.00	Performed a visual inspection of the LSLF building due to continued power outage. Both t are full and there is no leakage observed. init:kh
)5/30/2023		0.00	Power was restored to the landfills and the leak detection system is operational. Daily inspections are no longer necessary. The PLC card for HWL LCS/LDS 3 was replaced. in
)6/12/2023		0.00	Replaced parts for the leak detection system due to lightning strike a few weeks ago that caused ten fuses to blow on power poles. Replaced zone (Z) splitters for Z-1, 2, 3, 12, 14 also Z-bypass connector for Z-1. A new moisture detection sensor for Z-2 was replaced. i
)6/19/2023		0.00	Replaced PLC card for LCS/LDS 1 and again for LCS/LDS 3. init:kh
)6/22/2023		0.00	Installed new EPG probe in HWL LCS3. init:kh
)7/06/2023		0.00	Clean Harbors is onsite to remove leachate from Tank 402. Tank 402 started at 102.8 incl and ended at 6.0 inches. Approximately 4,869 gallons of leachate removed for offsite disposal. Began pumping Lift Station and HWL LCS1 to Tank 402. Tank 402 started at 6 inches and ended at 87.3 inches. Lift Station started at 8.4 feet and ended at 5.7 feet. LC started at 30.6 inches and ended at 14.0 inches. init:kh
)7/10/2023		0.00	Replaced a bad zone splitter in zone-8 at the HWL. init:kh
)7/19/2023		0.00	Clean Harbors was onsite to remove leachate for offiste disposal. Tank 401 started at 104 inces and ended at 9.3 inches. Approximately 4,794 gallons of leachate was removed. ini
)7/21/2023		0.00	Pumped Lift Station and HWL LCS4 to Tanks 401 and 402. Lift station started at 6 feet an ended at 7.3 feet. LCS4 started at 30.4 inches and ended at 11.5 inches. T401 started at inches and ended at 106.5 inches. T402 started at 86.3 inches and ended at 1076 inches init:kh
10/10/2023		0.00	Clean Harbors is oniste to remove leachate for offsite disposal. Tank 402 started at 107.5 inches and ended at 12.0 inches. Approximately 4,804 gallons were removed. init:kh
10/11/2023		0.00	Pumped Lift Station and HWL LCS2 to Tank 402. Tank 402 started at 12.5 inches and enc at 103.3 inches. LCS2 started at 32.8 inches and ended at 7.7 inches. Lift station started 7.6 feet and ended at 6.6 feet. init:kh
10/19/2023		0.00	The PLC at the Lift Station faulted. OMC reprogrammed the PLC and it worked again. init
10/23/2023		0.00	Clean Harbors onsite to remove leachate from Tank 401. Tank 401 started at 105.1 inches and ended at 9.6 inches. Approximately 4,804 gallons of leachate was removed for offsite disposal. init:kh

Operations and Maintenance Report

Beginning Date 05/01/2023 Ending Date 04/30/2024

Date	Start of Down Time	Plant Down Time (Hrs)	Summary of Significant Events
11/07/2023		0.00	Pumped HWL LCS1 and LDS1 to Tank 401. Tank 401 started at 9.4 inches and ended at 101.1 inches. LCS 1 started at 27.2 inches and ended at 12.5 inches. LDS1 started at 18. inches and ended at 10.6 inches. Lift station started at 7.0 feet and ended at 3.4 feet. Cle Harbors removed leachate from Tank 402. T402 started at 102.8 inches and ended at 7.1 inches. Approximately 4,814 gallons of leachate was removed. init:kh
11/14/2023		0.00	Clean Harbors onsite to remove leachate from Tank 401. T401 started at 100.6 inches an ended at 6.4 inches. Approximately 4,738 gallons of leachate was removed for offsite disposal. init:kh
03/19/2024		0.00	Pumped HWL LDS4 and LCS2 to low level after high level sampling event. T401 started a inches and ended at 35.8 inches. Lift Station started at 5.2 feet and ended at 4.9 feet. LD started at 15.0 inches and ended at 1.5 inches. LCS2 started at 29.3 inches and ended at 24.0 inches.
03/20/2024		0.00	Pumped HWL LCS2 and LDS2 to low level after high level sampling event. T401 started a 35.8 inches and ended at 98.5 inches. Lift Station started at 4.9 feet and ended at 2.9 fee LCS2 started at 23.4 inches and ended at 10.0 inches. LDS2 started at 18.1 inches and ended at 9.1 inches.
04/24/2024		0.00	Pumped HWL LCS1 to low level after high level sampling event. LCS1 started at 28.2 incl and ended at 13.4 inches. Lift Station started at 3.8 feet and ended at 3.8 feet. T401 start 97.2 inches and ended at 99.9 inches. T402 started at 6.7 inches and ended at 19.7 inche
04/28/2024		0.00	Pumped LSLF floor sump due to storm water accumulation.
Total Down Time Hours:		**0.00**	

APPENDIX C-2

ELF Maintenance Documentation

CONTRACTOR DAILY QUALITY CONTROL REPORT

Project Information	
Subcontractor: N/A	Project: ELF O&M
Task: maintenance	Date: 5/4/23
Weather AM: acceptable	Weather PM: acceptable

Activities Inspected and Observed:

OMC used the USFWS tractor and OMC fence cleaner to remove accumulated tumble weeds off of the perimeter fence.

Summary Meetings and Discussions Held or Attended, including Job Safety:

N/A

Comments:

N/A

Additional Documentation Submitted:

N/A

Sign Off:	
Inspector Name: Kim Hoffman	Title/company: Landfills and Covers Lead/Navarro
Signature: Kim Hoffman	Date: 6-23-23
Reviewer Name: Michael Jones	Title/company: Landfills and Covers Manager/Navarro
Signature: Michael Jones	Date: 6/30/23

CONTRACTOR DAILY QUALITY CONTROL REPORT

Project Information	
Subcontractor: N/A	Project: ELF O&M
Task: maintenance	Date: 5/11/23
Weather AM: acceptable	Weather PM: acceptable

Activities Inspected and Observed:

OMC performed a drive around post-storm inspection due to the RMA receiving 1.03" of precipitation in a 24-hour period. No observations were noted.

Summary Meetings and Discussions Held or Attended, including Job Safety:

N/A

Comments:

N/A

Additional Documentation Submitted:

N/A

Sign Off:

Inspector Name: Kim Hoffman	Title/company: Landfills and Covers Lead/Navarro
Signature: Kim Hoffman	Date: 6-23-23
Reviewer Name: Michael Jones	Title/company: Landfills and Covers Manager/Navarro
Signature: Michael Jones	Date: 6/30/23

CONTRACTOR DAILY QUALITY CONTROL REPORT

Project Information	
Subcontractor: N/A	Project: ELF O&M
Task: maintenance	Date: 5/15/23
Weather AM: acceptable	Weather PM: acceptable

Activities Inspected and Observed:

OMC used the USFWS tractor and OMC fence cleaner to remove accumulated tumble weeds off of the perimeter fence. OMC personnel performed a drive-around post-storm inspection due to the RMA receiving the following precipitation:

5/10/23 0.62"
5/11/23 2.92"
5/12/23 0.85"
5/14/23 0.28"

No observations were noted.

Summary Meetings and Discussions Held or Attended, including Job Safety:

N/A

Comments:

N/A

Additional Documentation Submitted:

N/A

Sign Off:	
Inspector Name: Kim Hoffman	Title/company: Landfills and Covers Lead/Navarro
Signature: Kim Hoffman	Date: 6-23-23
Reviewer Name: Michael Jones	Title/company: Landfills and Covers Manager/Navarro
Signature:	Date: 6/30/23

CONTRACTOR DAILY QUALITY CONTROL REPORT

Project Information	
Subcontractor: H2	Project: ELF O&M
Task: maintenance	Date: 5/30/23
Weather AM: acceptable	Weather PM: acceptable

Activities Inspected and Observed:

H2 used a deck mower mounted to a skidsteer to mow accumulated tumbleweeds. H2 mowed the north central and northwest grass lined channels on the ELF.

Summary Meetings and Discussions Held or Attended, including Job Safety:

N/A

Comments:

N/A

Additional Documentation Submitted:

N/A

Sign Off:	
Inspector Name: Kim Hoffman	Title/company: Landfills and Covers Lead/Navarro
Signature:	Date: 6-23-23
Reviewer Name: Michael Jones	Title/company: Landfills and Covers Manager/Navarro
Signature:	Date: 6/30/23

CONTRACTOR DAILY QUALITY CONTROL REPORT

Project Information	
Subcontractor: H2	Project: ELF O&M
Task: maintenance	Date: 5/31/23
Weather AM: acceptable	Weather PM: acceptable
Activities Inspected and Observed:	
H2 used a deck mower mounted to a skidsteer to mow accumulated tumbleweeds. H2 mowed the ACB lined terrace channel on the ELF, the ACB lined channel on the road to the northeast corner, and the northwest concrete box culvert.	
Summary Meetings and Discussions Held or Attended, including Job Safety:	
N/A	
Comments:	
N/A	
Additional Documentation Submitted:	
N/A	
Sign Off:	
Inspector Name: Kim Hoffman	Title/company: Landfills and Covers Lead/Navarro
Signature: [signature]	Date: 6-23-23
Reviewer Name: Michael Jones	Title/company: Landfills and Covers Manager/Navarro
Signature: [signature]	Date: 6/30/23

CONTRACTOR DAILY QUALITY CONTROL REPORT

Project Information	
Subcontractor: H2	Project: ELF O&M
Task: maintenance	Date: 6/1/23
Weather AM: acceptable	Weather PM: acceptable

Activities Inspected and Observed:

H2 used a deck mower mounted to a skidsteer to mow accumulated tumbleweeds. H2 mowed the east perimeter fence line.

Summary Meetings and Discussions Held or Attended, including Job Safety:

N/A

Comments:

N/A

Additional Documentation Submitted:

N/A

Sign Off:	
Inspector Name: Kim Hoffman	Title/company: Landfills and Covers Lead/Navarro
Signature: Kim Hoffman	Date: 6-23-23
Reviewer Name: Michael Jones	Title/company: Landfills and Covers Manager/Navarro
Signature: Michael Jones	Date: 6/30/23

CONTRACTOR DAILY QUALITY CONTROL REPORT

Project Information	
Subcontractor: N/A	Project: ELF O&M
Task: maintenance	Date: 6/5/23
Weather AM: acceptable	Weather PM: acceptable
Activities Inspected and Observed:	
OMC personnel performed a drive around post-storm inspection due to the RMA receiving 1.23" of rain in a 24-hour period on 6/4/23. No observations were noted.	
Summary Meetings and Discussions Held or Attended, including Job Safety:	
N/A	
Comments:	
N/A	
Additional Documentation Submitted:	
N/A	
Sign Off:	
Inspector Name: Kim Hoffman	Title/company: Landfills and Covers Lead/Navarro
Signature: Kim Hoffman	Date: 6-23-23
Reviewer Name: Michael Jones	Title/company: Landfills and Covers Manager/Navarro
Signature: Michael Jones	Date: 6/30/23

CONTRACTOR DAILY QUALITY CONTROL REPORT

Project Information	
Subcontractor: Weed Wranglers	Project: ELF O&M
Task: maintenance	Date: 6/14/23
Weather AM: acceptable	Weather PM: acceptable

Activities Inspected and Observed:

Weed Wranglers sprayed noxious weeds on and around the ELF. Weed Wranglers was given the liberty to inspect the landfill for weeds and spot spray them as necessary. Primarily thistles and bindweed were sprayed using Escort XP®, Vista®, and surfactant.

Summary Meetings and Discussions Held or Attended, including Job Safety:

N/A

Comments:

N/A

Additional Documentation Submitted:

N/A

Sign Off:	
Inspector Name: Kim Hoffman	Title/company: Landfills and Covers Lead/Navarro
Signature: [signature]	Date: 6-23-23
Reviewer Name: Michael Jones	Title/company: Landfills and Covers Manager/Navarro
Signature: [signature]	Date: 6/30/23

CONTRACTOR DAILY QUAL'TY CONTROL REPORT

Project Information	
Subcontractor: Weed Wranglers	Project: ELF O&M
Task: maintenance	Date: 9/6/23
Weather AM: acceptable	Weather PM: acceptable
Activities Inspected and Observed:	
Weed Wranglers sprayed all of the cheatgrass areas on the ELF except for the top portions. Weed Wranglers used 5 oz of Rejuvra to apply to the target areas.	
Summary Meetings and Discussions Held or Attended, including Job Safety:	
N/A	
Comments:	
N/A	
Additional Documentation Submitted:	
N/A	
Sign Off:	
Inspector Name: Kim Hoffman	Title/company: Landfills and Covers Lead/Navarro
Signature: Kim Hoffman	Date: 12-27-23
Reviewer Name: Michael Jones	Title/company: Landfills and Covers Manager/Navarro
Signature:	Date: 1/8/24

CONTRACTOR DAILY QUALITY CONTROL REPORT

Project Information	
Subcontractor: Weed Wranglers	Project: ELF O&M
Task: maintenance	Date: 9/7/23
Weather AM: acceptable	Weather PM: acceptable
Activities Inspected and Observed:	
Weed Wranglers sprayed the top of the ELF for cheatgrass. Weed Wranglers used 5 oz of Rejuvra to apply to the target areas, totaling 4.95 acres.	
Summary Meetings and Discussions Held or Attended, including Job Safety:	
N/A	
Comments:	
N/A	
Additional Documentation Submitted:	
N/A	
Sign Off:	
Inspector Name: Kim Hoffman	Title/company: Landfills and Covers Lead/Navarro
Signature: Kim Hoffman	Date: 12-27-23
Reviewer Name: Michael Jones	Title/company: Landfills and Covers Manager/Navarro
Signature:	Date: 1/8/24

CONTRACTOR DAILY QUALITY CONTROL REPORT

Project Information	
Subcontractor: MRC Services	Project: ELF O&M
Task: maintenance	Date: 10/23/23
Weather AM: acceptable	Weather PM: acceptable
Activities Inspected and Observed:	
MRC Services began mowing weedy areas on and around the ELF. The east and north portions of the ELF were mowed today.	
Summary Meetings and Discussions Held or Attended, including Job Safety:	
N/A	
Comments:	
N/A	
Additional Documentation Submitted:	
N/A	
Sign Off:	
Inspector Name: Kim Hoffman	Title/company: Landfills and Covers Lead/Navarro
Signature: [signature]	Date: 12-27-23
Reviewer Name: Michael Jones	Title/company: Landfills and Covers Manager/Navarro
Signature: [signature]	Date: 1/8/24

CONTRACTOR DAILY QUALITY CONTROL REPORT

Project Information	
Subcontractor: MRC Services and Weed Wranglers	Project: ELF O&M
Task: maintenance	Date: 10/24/23
Weather AM: acceptable	Weather PM: acceptable
Activities Inspected and Observed:	
MRC Services mowed the top and south slopes of the ELF. Weed Wranglers completed the ground clear herbicide application around the ELF. Weed Wranglers applied Plainview SC.	
Summary Meetings and Discussions Held or Attended, including Job Safety:	
N/A	
Comments:	
N/A	
Additional Documentation Submitted:	
N/A	
Sign Off:	
Inspector Name: Kim Hoffman	Title/company: Landfills and Covers Lead/Navarro
Signature: [signature]	Date: 12-27-23
Reviewer Name: Michael Jones	Title/company: Landfills and Covers Manager/Navarro
Signature: [signature]	Date: 1/8/24

NAVARRO

CONTRACTOR DAILY QUALITY CONTROL REPORT

Project Information	
Subcontractor: N/A	Project: ELF O&M
Task: maintenance	Date: 4/30/24
Weather AM: acceptable field conditions	Weather PM: acceptable field conditions

Activities Inspected and Observed:

Navarro personnel performed a drive around post-storm inspection due to the RMA receiving 1.27" of rain in a 24-hour period on 4/27/24. No observations were noted.

Summary Meetings and Discussions Held or Attended, including Job Safety:

N/A

Comments:

N/A

Additional Documentation Submitted:

N/A

Sign Off:

Inspector Name: Kim Hoffman	Title/company: Caps and Covers Lead/Navarro
Signature and Date: Kim Hoffman	Digitally signed by Kim Hoffman DN: cn=Kim Hoffman, o=Navarro Research and Engineering, ou, email=khoffman@navarro-inc.com, c=US Date: 2024.05.02 08:05:54 -06'00'
Reviewer Name: Michael W. Jones	Title/company: Caps and Covers Manager/Navarro
Signature and Date: Michael W. Jones	Digitally signed by: Michael W. Jones DN: CN = Michael W. Jones email = jones-m@navarro-inc.com O = US OU = Navarro Research and Engineering Date: 2024.05.02 08:51:13 -06'00'

Operations and Maintenance Report

Beginning Date 05/01/2023 Ending Date 04/30/2024

Date	Start of Down Time	Plant Down Time (Hrs)	Summary of Significant Events
)5/12/2023		0.00	Pumped floor sump at LSLF due to storm water entering under the garage door and settii sump alarm. RMA has received 3.77" of precipitation in three days. init:kh
)5/27/2023		0.00	Performed a visual inspection of the LSLF building due to electrical grid failure and the re monitoring system being down. No indication of tank leakage. Both tanks are full of leach and the tank levels are too high to measure manually. init:kh
)5/28/2023		0.00	Performed a visual inspection of the LSLF building because of continued power outage. E tanks are full with no indication of leakage. init:kh
)5/29/2023		0.00	Performed a visual inspection of the LSLF building due to continued power outage. Both t are full and there is no leakage observed. init:kh
)5/30/2023		0.00	Power was restored to the landfills and the leak detection system is operational. Daily inspections are no longer necessary. The PLC card for HWL LCS/LDS 3 was replaced. in
)6/12/2023		0.00	Replaced parts for the leak detection system due to lightning strike a few weeks ago that caused ten fuses to blow on power poles. Replaced zone (Z) splitters for Z-1, 2, 3, 12, 14 also Z-bypass connector for Z-1. A new moisture detection sensor for Z-2 was replaced. i
)6/19/2023		0.00	Replaced PLC card for LCS/LDS 1 and again for LCS/LDS 3. init:kh
)6/22/2023		0.00	Installed new EPG probe in HWL LCS3. init:kh
)7/06/2023		0.00	Clean Harbors is onsite to remove leachate from Tank 402. Tank 402 started at 102.8 incl and ended at 6.0 inches. Approximately 4,869 gallons of leachate removed for offsite disposal. Began pumping Lift Station and HWL LCS1 to Tank 402. Tank 402 started at 6 inches and ended at 87.3 inches. Lift Station started at 8.4 feet and ended at 5.7 feet. LC started at 30.6 inches and ended at 14.0 inches. init:kh
)7/10/2023		0.00	Replaced a bad zone splitter in zone-8 at the HWL. init:kh
)7/19/2023		0.00	Clean Harbors was onsite to remove leachate for offiste disposal. Tank 401 started at 104 inces and ended at 9.3 inches. Approximately 4,794 gallons of leachate was removed. ini
)7/21/2023		0.00	Pumped Lift Station and HWL LCS4 to Tanks 401 and 402. Lift station started at 6 feet an ended at 7.3 feet. LCS4 started at 30.4 inches and ended at 11.5 inches. T401 started at inches and ended at 106.5 inches. T402 started at 86.3 inches and ended at 1076 inches init:kh
10/10/2023		0.00	Clean Harbors is oniste to remove leachate for offsite disposal. Tank 402 started at 107.5 inches and ended at 12.0 inches. Approximately 4,804 gallons were removed. init:kh
10/11/2023		0.00	Pumped Lift Station and HWL LCS2 to Tank 402. Tank 402 started at 12.5 inches and enc at 103.3 inches. LCS2 started at 32.8 inches and ended at 7.7 inches. Lift station started 7.6 feet and ended at 6.6 feet. init:kh
10/19/2023		0.00	The PLC at the Lift Station faulted. OMC reprogrammed the PLC and it worked again. init
10/23/2023		0.00	Clean Harbors onsite to remove leachate from Tank 401. Tank 401 started at 105.1 inches and ended at 9.6 inches. Approximately 4,804 gallons of leachate was removed for offsite disposal. init:kh

Operations and Maintenance Report

Beginning Date 05/01/2023 Ending Date 04/30/2024

Date	Start of Down Time	Plant Down Time (Hrs)	Summary of Significant Events
11/07/2023		0.00	Pumped HWL LCS1 and LDS1 to Tank 401. Tank 401 started at 9.4 inches and ended at 101.1 inches. LCS 1 started at 27.2 inches and ended at 12.5 inches. LDS1 started at 18. inches and ended at 10.6 inches. Lift station started at 7.0 feet and ended at 3.4 feet. Cle Harbors removed leachate from Tank 402. T402 started at 102.8 inches and ended at 7.1 inches. Approximately 4,814 gallons of leachate was removed. init:kh
11/14/2023		0.00	Clean Harbors onsite to remove leachate from Tank 401. T401 started at 100.6 inches an ended at 6.4 inches. Approximately 4,738 gallons of leachate was removed for offsite disposal. init:kh
03/19/2024		0.00	Pumped HWL LDS4 and LCS2 to low level after high level sampling event. T401 started a inches and ended at 35.8 inches. Lift Station started at 5.2 feet and ended at 4.9 feet. LD started at 15.0 inches and ended at 1.5 inches. LCS2 started at 29.3 inches and ended at 24.0 inches.
03/20/2024		0.00	Pumped HWL LCS2 and LDS2 to low level after high level sampling event. T401 started a 35.8 inches and ended at 98.5 inches. Lift Station started at 4.9 feet and ended at 2.9 fee LCS2 started at 23.4 inches and ended at 10.0 inches. LDS2 started at 18.1 inches and ended at 9.1 inches.
04/24/2024		0.00	Pumped HWL LCS1 to low level after high level sampling event. LCS1 started at 28.2 incl and ended at 13.4 inches. Lift Station started at 3.8 feet and ended at 3.8 feet. T401 start 97.2 inches and ended at 99.9 inches. T402 started at 6.7 inches and ended at 19.7 inche
04/28/2024		0.00	Pumped LSLF floor sump due to storm water accumulation.
Total Down Time Hours:		**0.00**	

APPENDIX D

Erosion/Settlement Monument Survey Data

CHANGE IN HWL EROSION/SETTLEMENT MONUMENT POSITION

	RECORD CONDITION SURVEY				SPRING 2010 SURVEY				FALL 2010 SURVEY				RESULTS					
	Date of survey: 11/12/08				*Date of survey: 4/09/10*				*Date of survey: 9/30/10*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Mon't No.	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM-HWL01	A12276	189773.9	2185140.7	5298.1	A12943	189774.1	2185140.6	5298.0	Ahwlem1	189774.1	2185140.5	5297.9	0.2	-0.2	-0.1	0.0	-0.1	-0.1
EM-HWL02	A12274	189637.3	2184809.8	5302.5	A12944	189637.2	2184809.8	5302.5	Ahwlem2	189637.2	2184809.8	5302.4	-0.1	0.0	-0.1	-0.1	0.1	-0.1
EM-HWL03	A12275	189625.9	2185058.0	5307.8	A12936	189626.0	2185058.0	5307.7	Ahwlem3	189626.0	2185058.1	5307.7	0.1	0.1	-0.1	0.0	0.1	0.0
EM-HWL04	A12277	189570.5	2185177.9	5301.8	A12937	189570.7	2185177.9	5301.6	Ahwlem4	189570.7	2185177.9	5301.6	0.1	0.0	-0.2	0.0	0.0	0.0
EM-HWL05	A12279	189342.2	2184932.0	5311.5	A12942	189342.4	2184932.0	5311.5	Ahwlem5	189342.4	2184931.9	5311.4	0.2	-0.1	-0.1	0.0	-0.1	-0.1
EM-HWL06	A12278	189355.8	2185080.0	5309.2	A12938	189355.9	2185079.9	5309.1	Ahwlem6	189356.0	2185079.9	5309.1	0.2	-0.1	-0.1	0.0	0.0	0.0
EM-HWL07	A12280	189151.0	2184866.7	5310.0	A12941	189150.6	2184866.4	5309.9	Ahwlem7	189150.6	2184866.4	5309.8	-0.4	-0.3	-0.1	0.0	0.0	-0.1
EM-HWL08	A12281	189191.9	2185133.9	5308.0	A12939	189192.2	2185133.8	5308.0	Ahwlem8	189192.2	2185133.8	5308.0	0.3	-0.1	-0.1	0.0	0.0	0.0
EM-HWL09	A12282	189037.2	2184990.5	5306.9	A12940	189037.2	2184990.3	5306.8	Ahwlem9	189037.3	2184990.3	5306.8	0.0	-0.1	-0.1	0.0	0.0	0.0

	RECORD CONDITION SURVEY				FALL 2010 SURVEY				SPRING 2011 SURVEY				RESULTS					
	Date of survey: 11/12/08				*Date of survey: 9/30/10*				*Date of survey: 4/24/11*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Mon't No.	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM-HWL01	A12276	189773.9	2185140.7	5298.1	Ahwlem1	189774.1	2185140.5	5297.9	a1015	189774.1	2185140.6	5297.9	0.2	-0.1	-0.2	0.0	0.0	0.0
EM-HWL02	A12274	189637.3	2184809.8	5302.5	Ahwlem2	189637.2	2184809.8	5302.4	a1016	189637.2	2184809.8	5302.4	-0.1	0.0	-0.1	0.0	0.0	0.0
EM-HWL03	A12275	189625.9	2185058.0	5307.8	Ahwlem3	189626.0	2185058.1	5307.7	a1014	189626.0	2185058.0	5307.6	0.1	0.0	-0.1	0.1	-0.1	-0.1
EM-HWL04	A12277	189570.5	2185177.9	5301.8	Ahwlem4	189570.7	2185177.9	5301.6	a1013	189570.6	2185177.9	5301.6	0.1	0.0	-0.2	-0.1	0.0	0.0
EM-HWL05	A12279	189342.2	2184932.0	5311.5	Ahwlem5	189342.4	2184931.9	5311.4	a1010	189342.3	2184931.9	5311.4	0.1	-0.1	-0.1	0.0	0.0	0.1
EM-HWL06	A12278	189355.8	2185080.0	5309.2	Ahwlem6	189356.0	2185079.9	5309.1	a1011	189356.0	2185079.9	5309.1	0.2	-0.1	-0.1	0.0	0.0	-0.1
EM-HWL07	A12280	189151.0	2184866.7	5310.0	Ahwlem7	189150.6	2184866.4	5309.8	a1009	189150.7	2184866.4	5309.9	-0.4	-0.4	-0.1	0.0	0.0	0.0
EM-HWL08	A12281	189191.9	2185133.9	5308.0	Ahwlem8	189192.2	2185133.8	5308.0	a1012	189192.3	2185133.8	5307.9	0.4	-0.1	-0.1	0.0	0.0	0.0
EM-HWL09	A12282	189037.2	2184990.5	5306.9	Ahwlem9	189037.3	2184990.3	5306.8	a1008	189037.2	2184990.3	5306.8	0.0	-0.2	-0.1	0.0	-0.1	0.0

	RECORD CONDITION SURVEY				SPRING 2011 SURVEY				FALL 2011 SURVEY				RESULTS					
	Date of survey: 11/12/08				*Date of survey: 4/24/11*				*Date of survey: 10/12/11*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Mon't No.	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM-HWL01	A12276	189773.9	2185140.7	5298.1	a1015	189774.1	2185140.6	5297.9	9	189774.0	2185140.6	5297.9	0.1	-0.1	-0.2	-0.1	0.0	0.0
EM-HWL02	A12274	189637.3	2184809.8	5302.5	a1016	189637.2	2184809.8	5302.4	10	189637.2	2184809.8	5302.4	-0.1	0.0	-0.2	0.0	0.0	0.0
EM-HWL03	A12275	189625.9	2185058.0	5307.8	a1014	189626.0	2185058.0	5307.6	7	189625.9	2185058.0	5307.5	0.1	0.0	-0.2	-0.1	0.0	-0.1
EM-HWL04	A12277	189570.5	2185177.9	5301.8	a1013	189570.6	2185177.9	5301.6	8	189570.6	2185177.8	5301.5	0.1	-0.1	-0.2	0.0	0.0	-0.1
EM-HWL05	A12279	189342.2	2184932.0	5311.5	a1010	189342.3	2184931.9	5311.4	6	189342.4	2184931.9	5311.3	0.1	-0.1	-0.2	0.0	0.1	-0.1
EM-HWL06	A12278	189355.8	2185080.0	5309.2	a1011	189356.0	2185079.9	5309.1	5	189355.9	2185079.9	5309.1	0.1	-0.1	-0.1	-0.1	0.0	0.0
EM-HWL07	A12280	189151.0	2184866.7	5310.0	a1009	189150.7	2184866.4	5309.9	2	189150.6	2184866.4	5309.8	-0.4	-0.3	-0.2	0.0	0.0	-0.1
EM-HWL08	A12281	189191.9	2185133.9	5308.0	a1012	189192.3	2185133.8	5307.9	4	189192.2	2185133.7	5307.9	0.3	-0.2	-0.1	-0.1	0.0	0.0
EM-HWL09	A12282	189037.2	2184990.5	5306.9	a1008	189037.2	2184990.3	5306.8	3	189037.2	2184990.3	5306.8	0.0	-0.2	-0.1	0.0	0.0	0.0

	RECORD CONDITION SURVEY				FALL 2011 SURVEY				Spring 2012 SURVEY				RESULTS					
	Date of survey: 11/12/08				*Date of survey: 10/12/11*				*Date of survey: 5/09/12*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Mon't No.	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM-HWL01	A12276	189773.9	2185140.7	5298.1	9	189774.0	2185140.6	5297.9	4322	189774.1	2185140.6	5297.9	0.2	-0.1	-0.2	0.1	0.0	0.0
EM-HWL02	A12274	189637.3	2184809.8	5302.5	10	189637.2	2184809.8	5302.4	4320	189637.2	2184809.8	5302.4	-0.1	0.0	-0.2	0.0	0.0	0.0
EM-HWL03	A12275	189625.9	2185058.0	5307.8	7	189625.9	2185058.0	5307.5	4321	189626.0	2185058.0	5307.6	0.1	0.0	-0.1	0.1	0.0	0.1
EM-HWL04	A12277	189570.5	2185177.9	5301.8	8	189570.6	2185177.8	5301.5	4323	189570.6	2185177.8	5301.6	0.1	-0.1	-0.2	0.0	0.0	0.1
EM-HWL05	A12279	189342.2	2184932.0	5311.5	6	189342.4	2184931.9	5311.3	4319	189342.4	2184931.9	5311.4	0.1	-0.1	-0.1	0.0	0.0	0.1
EM-HWL06	A12278	189355.8	2185080.0	5309.2	5	189355.9	2185079.9	5309.1	4324	189356.0	2185079.8	5309.1	0.2	-0.2	-0.1	0.1	-0.1	0.0
EM-HWL07	A12280	189151.0	2184866.7	5310.0	2	189150.6	2184866.4	5309.8	4318	189150.7	2184866.4	5309.8	-0.3	-0.3	-0.2	0.1	0.0	0.0
EM-HWL08	A12281	189191.9	2185133.9	5308.0	4	189192.2	2185133.7	5307.9	4325	189192.2	2185133.7	5307.9	0.3	-0.2	-0.1	0.0	0.0	0.0
EM-HWL09	A12282	189037.2	2184990.5	5306.9	3	189037.2	2184990.3	5306.8	4317	189037.2	2184990.3	5306.7	0.0	-0.2	-0.2	0.0	0.0	-0.1

	RECORD CONDITION SURVEY				Spring 2012 SURVEY				Fall 2012 SURVEY				RESULTS					
	Date of survey: 11/12/08				*Date of survey: 5/09/12*				*Date of survey: 9/20/12*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Mon't No.	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM-HWL01	A12276	189773.9	2185140.7	5298.1	4322	189774.1	2185140.6	5297.9	n1017	189774.1	2185140.5	5297.9	0.2	-0.2	-0.2	0.0	0.0	0.0
EM-HWL02	A12274	189637.3	2184809.8	5302.5	4320	189637.2	2184809.8	5302.4	n1018	189637.3	2184809.8	5302.3	-0.1	-0.1	-0.2	0.0	-0.1	-0.1
EM-HWL03	A12275	189625.9	2185058.0	5307.8	4321	189626.0	2185058.0	5307.6	n1016	189626.0	2185058.0	5307.5	0.1	0.0	-0.3	0.0	0.0	-0.1
EM-HWL04	A12277	189570.5	2185177.9	5301.8	4323	189570.6	2185177.8	5301.6	n1015	189570.6	2185177.8	5301.5	0.1	-0.1	-0.3	0.0	0.0	-0.1
EM-HWL05	A12279	189342.2	2184932.0	5311.5	4319	189342.4	2184931.9	5311.4	n1014	189342.4	2184931.9	5311.3	0.2	-0.1	-0.2	0.1	0.0	-0.1
EM-HWL06	A12278	189355.8	2185080.0	5309.2	4324	189356.0	2185079.8	5309.1	n1013	189356.0	2185079.8	5309.0	0.2	-0.2	-0.2	0.0	0.0	-0.1
EM-HWL07	A12280	189151.0	2184866.7	5310.0	4318	189150.7	2184866.4	5309.8	n1010	189150.7	2184866.4	5309.7	-0.3	-0.4	-0.2	0.0	0.0	-0.1
EM-HWL08	A12281	189191.9	2185133.9	5308.0	4325	189192.2	2185133.7	5307.9	n1012	189192.3	2185133.7	5307.8	0.4	-0.2	-0.2	0.1	0.0	-0.1
EM-HWL09	A12282	189037.2	2184990.5	5306.9	4317	189037.2	2184990.3	5306.7	n1011	189037.3	2184990.3	5306.7	0.1	-0.2	-0.2	0.1	0.0	0.0

CHANGE IN HWL EROSION/SETTLEMENT MONUMENT POSITION

	RECORD CONDITION SURVEY				Fall 2012 SURVEY				Spring 2013 SURVEY				RESULTS					
	Date of survey: 11/12/08				*Date of survey: 9/20/12*				*Date of survey: 5/07/13*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Mon't No.	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM-HWL01	A12276	189773.9	2185140.7	5298.1	n1017	189774.1	2185140.5	5297.9	EM01	189774.1	2185140.6	5297.8	0.2	-0.1	-0.3	0.0	0.0	-0.1
EM-HWL02	A12274	189637.3	2184809.8	5302.5	n1018	189637.3	2184809.8	5302.3	EM02	189637.2	2184809.8	5302.3	-0.1	0.0	-0.2	0.0	0.0	0.0
EM-HWL03	A12275	189625.9	2185058.0	5307.8	n1016	189626.0	2185058.0	5307.5	EM03	189626.0	2185058.0	5307.5	0.1	0.0	-0.2	0.0	0.0	0.0
EM-HWL04	A12277	189570.5	2185177.9	5301.8	n1015	189570.6	2185177.8	5301.5	EM04	189570.6	2185177.8	5301.5	0.1	-0.1	-0.3	0.0	0.0	0.0
EM-HWL05	A12279	189342.2	2184932.0	5311.5	n1014	189342.4	2184931.9	5311.3	EM05	189342.4	2184931.9	5311.3	0.2	-0.1	-0.2	0.0	0.0	0.0
EM-HWL06	A12278	189355.8	2185080.0	5309.2	n1013	189356.0	2185079.8	5309.0	EM06	189356.0	2185079.9	5309.0	0.2	-0.1	-0.2	0.0	0.1	0.0
EM-HWL07	A12280	189151.0	2184866.7	5310.0	n1010	189150.7	2184866.4	5309.7	EM07	189150.7	2184866.4	5309.7	-0.3	-0.3	-0.2	0.0	0.0	0.0
EM-HWL08	A12281	189191.9	2185133.9	5308.0	n1012	189192.3	2185133.7	5307.8	EM08	189192.3	2185133.8	5307.8	0.4	-0.1	-0.2	0.0	0.1	0.0
EM-HWL09	A12282	189037.2	2184990.5	5306.9	n1011	189037.3	2184990.3	5306.7	EM09	189037.3	2184990.3	5306.7	0.0	-0.2	-0.2	0.0	0.0	0.0

	RECORD CONDITION SURVEY				Spring 2013 SURVEY				Fall 2013 SURVEY				RESULTS					
	Date of survey: 11/12/08				*Date of survey: 5/07/13*				*Date of survey: 9/19/13*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Mon't No.	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM-HWL01	A12276	189773.9	2185140.7	5298.1	EM01	189774.1	2185140.6	5297.8	EM01	189774.1	2185140.6	5297.8	0.2	-0.1	-0.3	0.0	0.0	0.0
EM-HWL02	A12274	189637.3	2184809.8	5302.5	EM02	189637.2	2184809.8	5302.3	EM02	189637.3	2184809.8	5302.3	-0.1	-0.1	-0.3	0.0	0.0	0.0
EM-HWL03	A12275	189625.9	2185058.0	5307.8	EM03	189626.0	2185058.0	5307.5	EM03	189626.0	2185058.0	5307.5	0.1	0.0	-0.3	0.0	0.0	-0.1
EM-HWL04	A12277	189570.5	2185177.9	5301.8	EM04	189570.6	2185177.8	5301.5	EM04	189570.7	2185177.8	5301.4	0.2	-0.1	-0.3	0.0	0.0	-0.1
EM-HWL05	A12279	189342.2	2184932.0	5311.5	EM05	189342.4	2184931.9	5311.3	EM05	189342.4	2184931.9	5311.3	0.2	-0.1	-0.3	0.0	0.0	0.0
EM-HWL06	A12278	189355.8	2185080.0	5309.2	EM06	189356.0	2185079.9	5309.0	EM06	189356.0	2185079.9	5309.0	0.2	-0.2	-0.2	0.0	0.0	0.0
EM-HWL07	A12280	189151.0	2184866.7	5310.0	EM07	189150.7	2184866.4	5309.7	EM07	189150.7	2184866.4	5309.7	-0.4	-0.4	-0.2	0.0	0.0	0.0
EM-HWL08	A12281	189191.9	2185133.9	5308.0	EM08	189192.3	2185133.8	5307.8	EM08	189192.2	2185133.7	5307.8	0.3	-0.2	-0.2	-0.1	-0.1	0.0
EM-HWL09	A12282	189037.2	2184990.5	5306.9	EM09	189037.3	2184990.3	5306.7	EM09	189037.3	2184990.3	5306.7	0.1	-0.2	-0.2	0.1	0.0	0.0

	RECORD CONDITION SURVEY				Fall 2013 SURVEY				Spring 2014 SURVEY				RESULTS					
	Date of survey: 11/12/08				*Date of survey: 9/19/13*				*Date of survey: 5/29/14*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Mon't No.	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM-HWL01	A12276	189773.9	2185140.7	5298.1	EM01	189774.1	2185140.6	5297.8	EM01	189774.1	2185140.7	5297.7	0.3	0.0	-0.4	0.1	0.2	-0.1
EM-HWL02	A12274	189637.3	2184809.8	5302.5	EM02	189637.3	2184809.8	5302.3	EM02	189637.3	2184809.9	5302.2	0.0	0.1	-0.3	0.0	0.1	-0.1
EM-HWL03	A12275	189625.9	2185058.0	5307.8	EM03	189626.0	2185058.0	5307.5	EM03	189626.0	2185058.2	5307.4	0.2	0.2	-0.3	0.0	0.1	0.0
EM-HWL04	A12277	189570.5	2185177.9	5301.8	EM04	189570.7	2185177.8	5301.4	EM04	189570.7	2185178.0	5301.4	0.2	0.1	-0.4	0.0	0.2	0.0
EM-HWL05	A12279	189342.2	2184932.0	5311.5	EM05	189342.4	2184931.9	5311.3	EM05	189342.4	2184932.1	5311.3	0.2	0.1	-0.2	0.0	0.1	0.0
EM-HWL06	A12278	189355.8	2185080.0	5309.2	EM06	189356.0	2185079.9	5309.0	EM06	189356.0	2185080.0	5308.9	0.2	0.0	-0.3	0.0	0.2	-0.1
EM-HWL07	A12280	189151.0	2184866.7	5310.0	EM07	189150.7	2184866.4	5309.7	EM07	189150.7	2184866.6	5309.6	-0.3	-0.2	-0.4	0.0	0.2	-0.1
EM-HWL08	A12281	189191.9	2185133.9	5308.0	EM08	189192.2	2185133.7	5307.8	EM08	189192.3	2185133.9	5307.7	0.4	0.0	-0.3	0.1	0.2	-0.1
EM-HWL09	A12282	189037.2	2184990.5	5306.9	EM09	189037.3	2184990.3	5306.7	EM09	189037.3	2184990.4	5306.6	0.1	0.0	-0.3	0.0	0.2	-0.1

	RECORD CONDITION SURVEY				Spring 2014 SURVEY				Fall 2014 SURVEY				RESULTS					
	Date of survey: 11/12/08				*Date of survey: 5/29/14*				*Date of survey: 10/17/14*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Mon't No.	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM-HWL01	A12276	189773.9	2185140.7	5298.1	EM01	189774.1	2185140.7	5297.7	EM01	189774.1	2185140.7	5297.8	0.2	0.0	-0.3	-0.1	0.0	0.1
EM-HWL02	A12274	189637.3	2184809.8	5302.5	EM02	189637.3	2184809.9	5302.2	EM02	189637.2	2184809.9	5302.3	-0.1	0.1	-0.2	-0.1	0.0	0.1
EM-HWL03	A12275	189625.9	2185058.0	5307.8	EM03	189626.0	2185058.2	5307.4	EM03	189626.0	2185058.1	5307.4	0.1	0.2	-0.3	0.0	0.0	0.0
EM-HWL04	A12277	189570.5	2185177.9	5301.8	EM04	189570.7	2185178.0	5301.4	EM04	189570.6	2185178.0	5301.4	0.1	0.1	-0.4	-0.1	0.0	0.0
EM-HWL05	A12279	189342.2	2184932.0	5311.5	EM05	189342.4	2184932.1	5311.3	EM05	189342.4	2184932.1	5311.3	0.1	0.1	-0.3	0.0	0.0	0.0
EM-HWL06	A12278	189355.8	2185080.0	5309.2	EM06	189356.0	2185080.0	5308.9	EM06	189355.9	2185080.0	5308.9	0.1	0.0	-0.3	0.0	0.0	0.0
EM-HWL07	A12280	189151.0	2184866.7	5310.0	EM07	189150.6	2184866.6	5309.6	EM07	189150.6	2184866.5	5309.7	-0.4	-0.2	-0.3	-0.1	-0.1	0.1
EM-HWL08	A12281	189191.9	2185133.9	5308.0	EM08	189192.3	2185133.9	5307.7	EM08	189192.2	2185133.9	5307.8	0.3	0.0	-0.2	-0.1	0.0	0.1
EM-HWL09	A12282	189037.2	2184990.5	5306.9	EM09	189037.3	2184990.4	5306.6	EM09	189037.2	2184990.4	5306.6	0.0	-0.1	-0.2	-0.1	0.0	0.0

	RECORD CONDITION SURVEY				Fall 2014 SURVEY				Spring 2015 SURVEY				RESULTS					
	Date of survey: 11/12/08				*Date of survey: 10/17/14*				*Date of survey: 5/29/15*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Mon't No.	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM-HWL01	A12276	189773.9	2185140.7	5298.1	EM01	189774.1	2185140.7	5297.8	EM01	189774.1	2185140.7	5297.8	0.3	0.1	-0.2	0.1	0.0	0.0
EM-HWL02	A12274	189637.3	2184809.8	5302.5	EM02	189637.2	2184809.9	5302.3	EM02	189637.3	2184809.9	5302.2	0.0	0.1	-0.3	0.1	0.0	-0.1
EM-HWL03	A12275	189625.9	2185058.0	5307.8	EM03	189626.0	2185058.1	5307.4	EM03	189626.0	2185058.2	5307.4	0.1	0.2	-0.3	0.0	0.0	0.0
EM-HWL04	A12277	189570.5	2185177.9	5301.8	EM04	189570.6	2185178.0	5301.4	EM04	189570.7	2185178.0	5301.5	0.2	0.1	-0.3	0.1	0.0	0.0
EM-HWL05	A12279	189342.2	2184932.0	5311.5	EM05	189342.4	2184932.1	5311.3	EM05	189342.4	2184932.1	5311.3	0.2	0.1	-0.3	0.0	0.0	0.0
EM-HWL06	A12278	189355.8	2185080.0	5309.2	EM06	189355.9	2185080.0	5308.9	EM06	189356.0	2185080.0	5309.0	0.2	0.0	-0.2	0.1	0.0	0.1
EM-HWL07	A12280	189151.0	2184866.7	5310.0	EM07	189150.6	2184866.5	5309.7	EM07	189150.7	2184866.5	5309.7	-0.3	-0.2	-0.2	0.1	0.0	0.1
EM-HWL08	A12281	189191.9	2185133.9	5308.0	EM08	189192.2	2185133.9	5307.8	EM08	189192.2	2185133.9	5307.8	0.3	0.0	-0.2	0.0	0.0	0.0
EM-HWL09	A12282	189037.2	2184990.5	5306.9	EM09	189037.2	2184990.4	5306.6	EM09	189037.2	2184990.4	5306.7	0.0	-0.1	-0.2	0.0	0.0	0.0

CHANGE IN HWL EROSION/SETTLEMENT MONUMENT POSITION

	RECORD CONDITION SURVEY				Spring 2015 SURVEY				Fall 2015 SURVEY				RESULTS					
	Date of survey: 11/12/08				*Date of survey: 5/29/15*				*Date of survey: 12/9/15*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Mon't No.	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM-HWL01	A12276	189773.9	2185140.7	5298.1	EM01	189774.1	2185140.7	5297.8	EM01	189774.1	2185140.7	5297.7	0.3	0.0	-0.4	0.0	0.0	-0.1
EM-HWL02	A12274	189637.3	2184809.8	5302.5	EM02	189637.3	2184809.9	5302.2	EM02	189637.3	2184809.9	5302.2	0.0	0.1	-0.3	0.0	0.0	0.0
EM-HWL03	A12275	189625.9	2185058.0	5307.8	EM03	189626.0	2185058.2	5307.4	EM03	189626.1	2185058.2	5307.4	0.2	0.2	-0.4	0.0	0.0	0.0
EM-HWL04	A12277	189570.5	2185177.9	5301.8	EM04	189570.7	2185178.0	5301.5	EM04	189570.7	2185178.0	5301.3	0.1	0.1	-0.5	0.0	0.0	-0.2
EM-HWL05	A12279	189342.2	2184932.0	5311.5	EM05	189342.4	2184932.1	5311.3	EM05	189342.4	2184932.1	5311.1	0.2	0.1	-0.4	0.0	0.0	-0.1
EM-HWL06	A12278	189355.8	2185080.0	5309.2	EM06	189356.0	2185080.0	5309.0	EM06	189356.0	2185080.0	5308.8	0.2	0.0	-0.4	0.0	0.0	-0.2
EM-HWL07	A12280	189151.0	2184866.7	5310.0	EM07	189150.7	2184866.5	5309.7	EM07	189150.7	2184866.5	5309.6	-0.3	-0.2	-0.4	0.0	0.0	-0.1
EM-HWL08	A12281	189191.9	2185133.9	5308.0	EM08	189192.2	2185133.9	5307.8	EM08	189192.3	2185133.9	5307.6	0.4	0.0	-0.4	0.0	0.0	-0.1
EM-HWL09	A12282	189037.2	2184990.5	5306.9	EM09	189037.2	2184990.4	5306.7	EM09	189037.3	2184990.4	5306.6	0.1	0.0	-0.3	0.1	0.0	-0.1

	RECORD CONDITION SURVEY				Fall 2015 SURVEY				Spring 2016 SURVEY				RESULTS					
	Date of survey: 11/12/08				*Date of survey: 12/9/15*				*Date of survey: 6/20/16*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Mon't No.	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM-HWL01	A12276	189773.9	2185140.7	5298.1	EM01	189774.1	2185140.7	5297.7	EM01	189774.1	2185140.7	5297.7	0.2	0.0	-0.3	0.0	0.0	0.0
EM-HWL02	A12274	189637.3	2184809.8	5302.5	EM02	189637.3	2184809.9	5302.2	EM02	189637.2	2184809.9	5302.2	-0.1	0.1	-0.4	-0.1	0.0	0.0
EM-HWL03	A12275	189625.9	2185058.0	5307.8	EM03	189626.1	2185058.2	5307.4	EM03	189626.0	2185058.2	5307.5	0.1	0.2	-0.3	-0.1	0.0	0.1
EM-HWL04	A12277	189570.5	2185177.9	5301.8	EM04	189570.7	2185178.0	5301.3	EM04	189570.7	2185178.0	5301.4	0.1	0.1	-0.4	0.0	0.0	0.1
EM-HWL05	A12279	189342.2	2184932.0	5311.5	EM05	189342.4	2184932.1	5311.1	EM05	189342.4	2184932.1	5311.3	0.2	0.1	-0.2	-0.1	0.0	0.1
EM-HWL06	A12278	189355.8	2185080.0	5309.2	EM06	189356.0	2185080.0	5308.8	EM06	189356.0	2185079.9	5308.9	0.2	-0.1	-0.3	0.0	-0.1	0.1
EM-HWL07	A12280	189151.0	2184866.7	5310.0	EM07	189150.7	2184866.5	5309.6	EM07	189150.7	2184866.5	5309.7	-0.3	-0.2	-0.3	0.0	0.0	0.1
EM-HWL08	A12281	189191.9	2185133.9	5308.0	EM08	189192.3	2185133.9	5307.6	EM08	189192.2	2185133.9	5307.7	0.3	0.0	-0.3	-0.1	0.0	0.1
EM-HWL09	A12282	189037.2	2184990.5	5306.9	EM09	189037.3	2184990.4	5306.6	EM09	189037.2	2184990.4	5306.6	0.0	0.0	-0.3	-0.1	0.0	0.1

	RECORD CONDITION SURVEY				Spring 2016 SURVEY				Fall 2016 SURVEY				RESULTS					
	Date of survey: 11/12/08				*Date of survey: 6/20/16*				*Date of survey: 1/18/17*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Mon't No.	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM-HWL01	A12276	189773.9	2185140.7	5298.1	EM01	189774.1	2185140.7	5297.7	EM01	189774.1	2185140.6	5297.7	0.2	0.0	-0.4	0.0	0.0	0.0
EM-HWL02	A12274	189637.3	2184809.8	5302.5	EM02	189637.2	2184809.9	5302.2	EM02	189637.2	2184809.9	5302.2	-0.1	0.1	-0.3	0.0	0.0	0.1
EM-HWL03	A12275	189625.9	2185058.0	5307.8	EM03	189626.0	2185058.2	5307.5	EM03	189626.0	2185058.1	5307.5	0.1	0.1	-0.3	0.0	0.0	0.0
EM-HWL04	A12277	189570.5	2185177.9	5301.8	EM04	189570.7	2185178.0	5301.4	EM04	189570.6	2185178.0	5301.4	0.1	0.1	-0.4	0.0	0.0	0.0
EM-HWL05	A12279	189342.2	2184932.0	5311.5	EM05	189342.4	2184932.1	5311.3	EM05	189342.4	2184932.0	5311.2	0.2	0.0	-0.3	0.0	0.0	-0.1
EM-HWL06	A12278	189355.8	2185080.0	5309.2	EM06	189356.0	2185079.9	5308.9	EM06	189355.9	2185080.0	5308.9	0.1	0.0	-0.3	-0.1	0.0	0.0
EM-HWL07	A12280	189151.0	2184866.7	5310.0	EM07	189150.7	2184866.5	5309.7	EM07	189150.6	2184866.5	5309.6	-0.4	-0.2	-0.3	0.0	0.0	-0.1
EM-HWL08	A12281	189191.9	2185133.9	5308.0	EM08	189192.2	2185133.9	5307.7	EM08	189192.2	2185133.9	5307.7	0.3	0.0	-0.3	0.0	0.0	0.0
EM-HWL09	A12282	189037.2	2184990.5	5306.9	EM09	189037.2	2184990.4	5306.6	EM09	189037.2	2184990.4	5306.6	-0.1	-0.1	-0.3	0.0	0.0	0.0

	RECORD CONDITION SURVEY				Fall 2016 SURVEY				Spring 2017 SURVEY				RESULTS					
	Date of survey: 11/12/08				*Date of survey: 6/20/16*				*Date of survey: 5/17/17*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Mon't No.	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM-HWL01	A12276	189773.9	2185140.7	5298.1	EM01	189774.1	2185140.6	5297.7	EM01	189774.1	2185140.7	5297.7	0.2	0.0	-0.4	0.0	0.1	-0.1
EM-HWL02	A12274	189637.3	2184809.8	5302.5	EM02	189637.3	2184809.9	5302.2	EM02	189637.3	2184810.0	5302.2	0.0	0.1	-0.3	0.1	0.0	0.0
EM-HWL03	A12275	189625.9	2185058.0	5307.8	EM03	189626.0	2185058.1	5307.5	EM03	189626.0	2185058.2	5307.4	0.1	0.2	-0.4	0.1	0.1	-0.1
EM-HWL04	A12277	189570.5	2185177.9	5301.8	EM04	189570.6	2185178.0	5301.4	EM04	189570.7	2185178.1	5301.3	0.1	0.2	-0.5	0.1	0.1	-0.1
EM-HWL05	A12279	189342.2	2184932.0	5311.5	EM05	189342.4	2184932.0	5311.2	EM05	189342.4	2184932.1	5311.3	0.2	0.1	-0.3	0.0	0.0	0.0
EM-HWL06	A12278	189355.8	2185080.0	5309.2	EM06	189355.9	2185080.0	5308.9	EM06	189356.0	2185080.0	5308.9	0.2	0.0	-0.3	0.1	0.1	-0.1
EM-HWL07	A12280	189151.0	2184866.7	5310.0	EM07	189150.6	2184866.5	5309.6	EM07	189150.9	2184866.4	5309.5	-0.1	-0.3	-0.4	0.3	-0.1	-0.1
EM-HWL08	A12281	189191.9	2185133.9	5308.0	EM08	189192.2	2185133.9	5307.7	EM08	189192.2	2185133.9	5307.7	0.4	0.0	-0.3	0.0	0.1	-0.1
EM-HWL09	A12282	189037.2	2184990.5	5306.9	EM09	189037.2	2184990.4	5306.5	EM09	189037.2	2184990.5	5306.5	0.0	0.0	-0.3	0.1	0.1	-0.1

	RECORD CONDITION SURVEY				Spring 2017 SURVEY				Fall 2017 SURVEY				RESULTS					
	Date of survey: 11/12/08				*Date of survey: 5/17/17*				*Date of survey: 11/10/17*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Mon't No.	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM-HWL01	A12276	189773.9	2185140.7	5298.1	EM01	189774.1	2185140.7	5297.7	EM01	189774.1	2185140.7	5297.7	0.2	0.0	-0.4	0.0	-0.1	0.1
EM-HWL02	A12274	189637.3	2184809.8	5302.5	EM02	189637.3	2184810.0	5302.2	EM02	189637.2	2184809.9	5302.2	-0.1	0.1	-0.3	0.0	-0.1	0.0
EM-HWL03	A12275	189625.9	2185058.0	5307.8	EM03	189626.0	2185058.2	5307.4	EM03	189626.0	2185058.1	5307.4	0.1	0.1	-0.3	0.0	-0.1	0.1
EM-HWL04	A12277	189570.5	2185177.9	5301.8	EM04	189570.7	2185178.1	5301.3	EM04	189570.6	2185178.0	5301.4	0.1	0.1	-0.3	-0.1	-0.1	0.1
EM-HWL05	A12279	189342.2	2184932.0	5311.5	EM05	189342.4	2184932.1	5311.3	EM05	189342.4	2184932.0	5311.2	0.2	0.0	-0.3	0.0	-0.1	0.0
EM-HWL06	A12278	189355.8	2185080.0	5309.2	EM06	189356.0	2185080.0	5308.9	EM06	189355.9	2185080.0	5308.9	0.2	-0.1	-0.3	0.0	-0.1	0.1
EM-HWL07	A12280	189151.0	2184866.7	5310.0	EM07	189150.9	2184866.4	5309.5	EM07	189150.7	2184866.5	5309.6	-0.3	-0.2	-0.4	-0.3	0.1	0.1
EM-HWL08	A12281	189191.9	2185133.9	5308.0	EM08	189192.2	2185133.9	5307.7	EM08	189192.2	2185133.9	5307.8	0.3	0.0	-0.3	0.0	-0.1	0.1
EM-HWL09	A12282	189037.2	2184990.5	5306.9	EM09	189037.2	2184990.5	5306.5	EM09	189037.3	2184990.4	5306.6	0.0	-0.1	-0.3	0.0	-0.1	0.0

CHANGE IN HWL EROSION/SETTLEMENT MONUMENT POSITION

	RECORD CONDITION SURVEY				Fall 2017 SURVEY				Spring 2018 SURVEY				RESULTS					
	Date of survey: 11/12/08				*Date of survey: 11/10/17*				*Date of survey: 06/18/18*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Mon't No.	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM-HWL01	A12276	189773.9	2185140.7	5298.1	EM01	189774.1	2185140.7	5297.7	EM01	189774.1	2185140.7	5297.7	0.2	0.0	-0.3	0.0	0.0	0.0
EM-HWL02	A12274	189637.3	2184809.8	5302.5	EM02	189637.2	2184809.9	5302.2	EM02	189637.1	2184810.0	5302.2	-0.2	0.1	-0.3	-0.1	0.1	0.0
EM-HWL03	A12275	189625.9	2185058.0	5307.8	EM03	189626.0	2185058.1	5307.4	EM03	189626.0	2185058.2	5307.4	0.1	0.2	-0.4	0.0	0.0	0.0
EM-HWL04	A12277	189570.5	2185177.9	5301.8	EM04	189570.6	2185178.0	5301.4	EM04	189570.6	2185178.0	5301.4	0.0	0.1	-0.3	0.0	0.0	0.0
EM-HWL05	A12279	189342.2	2184932.0	5311.5	EM05	189342.4	2184932.0	5311.2	EM05	189342.3	2184932.1	5311.3	0.1	0.1	-0.2	-0.1	0.1	0.1
EM-HWL06	A12278	189355.8	2185080.0	5309.2	EM06	189355.9	2185080.0	5308.9	EM06	189355.9	2185080.0	5309.0	0.1	0.0	-0.2	0.0	0.0	0.1
EM-HWL07	A12280	189151.0	2184866.7	5310.0	EM07	189150.7	2184866.5	5309.6	EM07	189150.6	2184866.6	5309.6	-0.4	-0.2	-0.4	0.0	0.0	0.0
EM-HWL08	A12281	189191.9	2185133.9	5308.0	EM08	189192.2	2185133.9	5307.8	EM08	189192.2	2185133.9	5307.9	0.3	0.0	-0.2	0.0	0.0	0.1
EM-HWL09	A12282	189037.2	2184990.5	5306.9	EM09	189037.3	2184990.4	5306.6	EM09	189037.2	2184990.4	5306.6	-0.1	0.0	-0.3	-0.1	0.0	0.0

	RECORD CONDITION SURVEY				Spring 2018 SURVEY				Fall 2018 SURVEY				RESULTS					
	Date of survey: 11/12/08				*Date of survey: 06/18/18*				*Date of survey: 12/14/18*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Mon't No.	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM-HWL01	A12276	189773.9	2185140.7	5298.1	EM01	189774.0	2185140.7	5297.7	EM01	189774.1	2185140.7	5297.7	0.2	0.0	-0.3	0.0	0.0	0.1
EM-HWL02	A12274	189637.3	2184809.8	5302.5	EM02	189637.2	2184809.9	5302.2	EM02	189637.1	2184810.0	5302.2	-0.2	0.1	-0.3	0.0	0.0	0.1
EM-HWL03	A12275	189625.9	2185058.0	5307.8	EM03	189626.0	2185058.2	5307.3	EM03	189626.0	2185058.2	5307.4	0.1	0.2	-0.4	0.0	0.0	0.1
EM-HWL04	A12277	189570.5	2185177.9	5301.8	EM04	189570.6	2185178.0	5301.3	EM04	189570.6	2185178.0	5301.4	0.0	0.1	-0.3	0.0	0.0	0.1
EM-HWL05	A12279	189342.2	2184932.0	5311.5	EM05	189342.4	2184932.1	5311.1	EM05	189342.3	2184932.1	5311.3	0.1	0.1	-0.2	-0.1	0.0	0.2
EM-HWL06	A12278	189355.8	2185080.0	5309.2	EM06	189355.9	2185080.0	5308.9	EM06	189355.9	2185080.0	5309.0	0.1	0.0	-0.2	0.0	0.0	0.2
EM-HWL07	A12280	189151.0	2184866.7	5310.0	EM07	189150.6	2184866.5	5309.6	EM07	189150.6	2184866.6	5309.6	-0.4	-0.2	-0.4	0.0	0.0	0.0
EM-HWL08	A12281	189191.9	2185133.9	5308.0	EM08	189192.1	2185133.9	5307.7	EM08	189192.2	2185133.9	5307.9	0.3	0.0	-0.2	0.0	0.0	0.2
EM-HWL09	A12282	189037.2	2184990.5	5306.9	EM09	189037.2	2184990.4	5306.5	EM09	189037.2	2184990.4	5306.6	-0.1	0.0	-0.3	0.0	0.0	0.1

	RECORD CONDITION SURVEY				Fall 2018 SURVEY				Spring 2019 SURVEY				RESULTS					
	Date of survey: 11/12/08				*Date of survey: 12/14/18*				*Date of survey: 05/16/19*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Mon't No.	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM-HWL01	A12276	189773.9	2185140.7	5298.1	EM01	189774.1	2185140.7	5297.7	EM01	189774.0	2185140.7	5297.6	0.2	0.0	-0.5	0.0	0.0	-0.1
EM-HWL02	A12274	189637.3	2184809.8	5302.5	EM02	189637.1	2184810.0	5302.2	EM02	189637.2	2184809.9	5302.1	-0.2	0.1	-0.4	0.0	0.0	-0.1
EM-HWL03	A12275	189625.9	2185058.0	5307.8	EM03	189626.0	2185058.2	5307.4	EM03	189625.9	2185058.2	5307.4	0.0	0.2	-0.4	0.0	0.0	0.0
EM-HWL04	A12277	189570.5	2185177.9	5301.8	EM04	189570.6	2185178.0	5301.4	EM04	189570.6	2185178.1	5301.4	0.1	0.2	-0.4	0.0	0.0	-0.1
EM-HWL05	A12279	189342.2	2184932.0	5311.5	EM05	189342.3	2184932.1	5311.3	EM05	189342.3	2184932.1	5311.2	0.1	0.1	-0.4	0.1	0.0	-0.1
EM-HWL06	A12278	189355.8	2185080.0	5309.2	EM06	189355.9	2185080.0	5309.0	EM06	189355.9	2185080.0	5308.8	0.1	0.0	-0.4	0.0	0.0	-0.2
EM-HWL07	A12280	189151.0	2184866.7	5310.0	EM07	189150.6	2184866.6	5309.6	EM07	189150.6	2184866.5	5309.6	-0.4	-0.2	-0.4	0.0	0.0	0.0
EM-HWL08	A12281	189191.9	2185133.9	5308.0	EM08	189192.2	2185133.9	5307.9	EM08	189192.2	2185133.9	5307.7	0.3	0.0	-0.3	0.0	0.0	-0.2
EM-HWL09	A12282	189037.2	2184990.5	5306.9	EM09	189037.2	2184990.4	5306.6	EM09	189037.2	2184990.4	5306.5	-0.1	0.0	-0.3	0.0	0.0	-0.1

	RECORD CONDITION SURVEY				Spring 2019 SURVEY				Fall 2019 SURVEY				RESULTS					
	Date of survey: 11/12/08				*Date of survey: 05/16/19*				*Date of survey: 01/14/20*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Mon't No.	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM-HWL01	A12276	189773.9	2185140.7	5298.1	EM01	189774.0	2185140.7	5297.6	EM01	189774.0	2185140.7	5297.7	0.1	0.0	-0.4	0.0	0.0	0.1
EM-HWL02	A12274	189637.3	2184809.8	5302.5	EM02	189637.2	2184809.9	5302.1	EM02	189637.2	2184809.9	5302.2	-0.1	0.1	-0.3	0.0	0.0	0.1
EM-HWL03	A12275	189625.9	2185058.0	5307.8	EM03	189625.9	2185058.2	5307.4	EM03	189625.9	2185058.2	5307.4	0.0	0.2	-0.4	0.0	0.0	0.0
EM-HWL04	A12277	189570.5	2185177.9	5301.8	EM04	189570.6	2185178.1	5301.4	EM04	189570.5	2185178.0	5301.3	0.0	0.1	-0.4	-0.1	0.0	0.0
EM-HWL05	A12279	189342.2	2184932.0	5311.5	EM05	189342.3	2184932.1	5311.2	EM05	189342.3	2184932.1	5311.2	0.1	0.1	-0.3	0.0	0.0	0.0
EM-HWL06	A12278	189355.8	2185080.0	5309.2	EM06	189355.9	2185080.0	5308.8	EM06	189355.9	2185080.0	5308.9	0.1	0.0	-0.3	0.0	0.0	0.1
EM-HWL07	A12280	189151.0	2184866.7	5310.0	EM07	189150.6	2184866.6	5309.6	EM07	189150.6	2184866.6	5309.6	-0.4	-0.2	-0.4	0.0	0.0	0.0
EM-HWL08	A12281	189191.9	2185133.9	5308.0	EM08	189192.2	2185133.9	5307.6	EM08	189192.1	2185133.9	5307.6	0.2	0.0	-0.4	-0.1	0.0	-0.1
EM-HWL09	A12282	189037.2	2184990.5	5306.9	EM09	189037.2	2184990.4	5306.5	EM09	189037.2	2184990.4	5306.5	-0.1	0.0	-0.3	0.0	0.0	0.0

	RECORD CONDITION SURVEY				Fall 2019 SURVEY				Spring 2020 SURVEY				RESULTS					
	Date of survey: 11/12/08				*Date of survey: 01/14/20*				*Date of survey: 04/23/20*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Mon't No.	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM-HWL01	A12276	189773.9	2185140.7	5298.1	EM01	189774.0	2185140.7	5297.7	EM01	189774.0	2185140.7	5297.6	0.1	0.0	-0.5	0.0	0.0	0.0
EM-HWL02	A12274	189637.3	2184809.8	5302.5	EM02	189637.2	2184809.9	5302.2	EM02	189637.2	2184809.8	5302.2	-0.1	0.0	-0.4	0.1	-0.1	0.0
EM-HWL03	A12275	189625.9	2185058.0	5307.8	EM03	189625.9	2185058.2	5307.4	EM03	189625.9	2185058.2	5307.4	0.0	0.2	-0.4	0.0	0.0	0.0
EM-HWL04	A12277	189570.5	2185177.9	5301.8	EM04	189570.5	2185178.0	5301.3	EM04	189570.5	2185178.0	5301.3	0.0	0.1	-0.4	0.0	0.0	0.0
EM-HWL05	A12279	189342.2	2184932.0	5311.5	EM05	189342.3	2184932.1	5311.2	EM05	189342.3	2184932.1	5311.1	0.1	0.1	-0.4	0.0	0.0	0.0
EM-HWL06	A12278	189355.8	2185080.0	5309.2	EM06	189355.9	2185080.0	5308.9	EM06	189355.8	2185080.0	5308.9	0.1	0.0	-0.3	-0.1	0.0	0.0
EM-HWL07	A12280	189151.0	2184866.7	5310.0	EM07	189150.6	2184866.6	5309.6	EM07	189150.6	2184866.5	5309.6	-0.4	-0.2	-0.4	0.0	0.0	0.0
EM-HWL08	A12281	189191.9	2185133.9	5308.0	EM08	189192.1	2185133.9	5307.6	EM08	189192.2	2185133.9	5307.7	0.3	0.0	-0.3	0.1	0.0	0.0
EM-HWL09	A12282	189037.2	2184990.5	5306.9	EM09	189037.2	2184990.4	5306.5	EM09	189037.1	2184990.4	5306.5	-0.1	0.0	-0.4	0.0	0.0	0.0

CHANGE IN HWL EROSION/SETTLEMENT MONUMENT POSITION

	RECORD CONDITION SURVEY				Spring 2020 SURVEY				Fall 2020 SURVEY				RESULTS					
	Date of survey: 11/12/08				*Date of survey: 04/23/20*				*Date of survey: 10/01/20*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Mon't No.	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM-HWL01	A12276	189773.9	2185140.7	5298.1	EM01	189774.0	2185140.7	5297.6	EM01	189774.0	2185140.7	5297.7	0.1	0.0	-0.4	0.0	0.0	0.0
EM-HWL02	A12274	189637.3	2184809.8	5302.5	EM02	189637.2	2184809.8	5302.2	EM02	189637.2	2184809.9	5302.1	-0.1	0.1	-0.4	-0.1	0.1	0.0
EM-HWL03	A12275	189625.9	2185058.0	5307.8	EM03	189625.9	2185058.2	5307.4	EM03	189626.0	2185058.2	5307.3	0.1	0.2	-0.4	0.1	-0.1	0.0
EM-HWL04	A12277	189570.5	2185177.9	5301.8	EM04	189570.5	2185178.0	5301.3	EM04	189570.6	2185178.0	5301.3	0.1	0.1	-0.5	0.1	0.0	0.0
EM-HWL05	A12279	189342.2	2184932.0	5311.5	EM05	189342.3	2184932.1	5311.1	EM05	189342.3	2184932.1	5311.2	0.1	0.1	-0.3	0.0	0.0	0.1
EM-HWL06	A12278	189355.8	2185080.0	5309.2	EM06	189355.8	2185080.0	5308.9	EM06	189355.9	2185080.0	5308.9	0.1	0.0	-0.3	0.1	0.0	0.0
EM-HWL07	A12280	189151.0	2184866.7	5310.0	EM07	189150.6	2184866.5	5309.6	EM07	189150.6	2184866.5	5309.6	-0.4	-0.2	-0.4	0.0	0.0	0.0
EM-HWL08	A12281	189191.9	2185133.9	5308.0	EM08	189192.2	2185133.9	5307.7	EM08	189192.1	2185133.9	5307.7	0.2	0.0	-0.4	0.0	0.0	0.0
EM-HWL09	A12282	189037.2	2184990.5	5306.9	EM09	189037.1	2184990.4	5306.5	EM09	189037.2	2184990.4	5306.6	-0.1	-0.1	-0.3	0.0	0.0	0.1

	RECORD CONDITION SURVEY				Fall 2020 SURVEY				Spring 2021 SURVEY				RESULTS					
	Date of survey: 11/12/08				*Date of survey: 10/01/20*				*Date of survey: 05/25/21*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Mon't No.	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM-HWL01	A12276	189773.9	2185140.7	5298.1	EM01	189774.0	2185140.7	5297.7	EM01	189774.0	2185140.7	5297.6	0.1	0.0	-0.5	0.0	0.0	0.0
EM-HWL02	A12274	189637.3	2184809.8	5302.5	EM02	189637.2	2184809.9	5302.1	EM02	189637.2	2184809.9	5302.1	-0.1	0.1	-0.4	0.0	0.0	0.0
EM-HWL03	A12275	189625.9	2185058.0	5307.8	EM03	189626.0	2185058.2	5307.3	EM03	189625.9	2185058.2	5307.4	0.0	0.2	-0.3	0.0	0.0	0.1
EM-HWL04	A12277	189570.5	2185177.9	5301.8	EM04	189570.6	2185178.0	5301.3	EM04	189570.6	2185178.1	5301.4	0.1	0.2	-0.4	0.0	0.0	0.1
EM-HWL05	A12279	189342.2	2184932.0	5311.5	EM05	189342.3	2184932.1	5311.2	EM05	189342.3	2184932.1	5311.2	0.1	0.1	-0.3	0.0	0.0	0.0
EM-HWL06	A12278	189355.8	2185080.0	5309.2	EM06	189355.9	2185080.0	5308.9	EM06	189355.9	2185080.0	5308.8	0.1	0.0	-0.4	0.0	0.0	0.0
EM-HWL07	A12280	189151.0	2184866.7	5310.0	EM07	189150.6	2184866.5	5309.6	EM07	189150.6	2184866.6	5309.6	-0.4	-0.2	-0.3	0.0	0.0	0.0
EM-HWL08	A12281	189191.9	2185133.9	5308.0	EM08	189192.1	2185133.9	5307.7	EM08	189192.2	2185133.9	5307.8	0.3	0.0	-0.3	0.1	0.0	0.1
EM-HWL09	A12282	189037.2	2184990.5	5306.9	EM09	189037.2	2184990.4	5306.6	EM09	189037.2	2184990.4	5306.5	0.0	-0.1	-0.3	0.0	0.0	-0.1

	RECORD CONDITION SURVEY				Spring 2021 SURVEY				Fall 2021 SURVEY				RESULTS					
	Date of survey: 11/12/08				*Date of survey: 05/25/21*				*Date of survey: 12/02/21*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Mon't No.	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM-HWL01	A12276	189773.9	2185140.7	5298.1	EM01	189774.0	2185140.7	5297.6	EM01	189774.1	2185140.6	5297.7	0.2	-0.1	-0.4	0.0	-0.1	0.1
EM-HWL02	A12274	189637.3	2184809.8	5302.5	EM02	189637.2	2184809.9	5302.1	EM02	189637.2	2184809.9	5302.2	-0.1	0.1	-0.3	0.0	0.0	0.1
EM-HWL03	A12275	189625.9	2185058.0	5307.8	EM03	189625.9	2185058.2	5307.4	EM03	189626.0	2185058.1	5307.4	0.1	0.2	-0.4	0.0	0.0	0.0
EM-HWL04	A12277	189570.5	2185177.9	5301.8	EM04	189570.6	2185178.1	5301.4	EM04	189570.6	2185178.0	5301.3	0.0	0.1	-0.4	0.0	0.0	-0.1
EM-HWL05	A12279	189342.2	2184932.0	5311.5	EM05	189342.3	2184932.1	5311.2	EM05	189342.3	2184932.1	5311.1	0.1	0.1	-0.4	0.0	0.0	-0.1
EM-HWL06	A12278	189355.8	2185080.0	5309.2	EM06	189355.9	2185080.0	5308.8	EM06	189355.9	2185080.0	5308.9	0.1	-0.1	-0.3	0.0	-0.1	0.0
EM-HWL07	A12280	189151.0	2184866.7	5310.0	EM07	189150.6	2184866.6	5309.6	EM07	189150.6	2184866.5	5309.6	-0.4	-0.2	-0.4	0.0	-0.1	0.0
EM-HWL08	A12281	189191.9	2185133.9	5308.0	EM08	189192.2	2185133.9	5307.8	EM08	189192.2	2185133.9	5307.7	0.3	0.0	-0.3	0.0	0.1	0.0
EM-HWL09	A12282	189037.2	2184990.5	5306.9	EM09	189037.2	2184990.4	5306.5	EM09	189037.2	2184990.4	5306.6	-0.1	0.0	-0.3	0.0	0.0	0.1

	RECORD CONDITION SURVEY				Fall 2021 SURVEY				Spring 2022 SURVEY				RESULTS					
	Date of survey: 11/12/08				*Date of survey: 12/02/21*				*Date of survey: 05/19/22*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Mon't No.	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM-HWL01	A12276	189773.9	2185140.7	5298.1	EM01	189774.1	2185140.6	5297.7	EM01	189774.0	2185140.7	5297.6	0.1	0.0	-0.5	-0.1	0.1	-0.1
EM-HWL02	A12274	189637.3	2184809.8	5302.5	EM02	189637.2	2184809.9	5302.2	EM02	189637.1	2184809.8	5302.1	-0.2	0.0	-0.4	-0.1	-0.1	-0.1
EM-HWL03	A12275	189625.9	2185058.0	5307.8	EM03	189626.0	2185058.1	5307.4	EM03	189626.0	2185058.1	5307.4	0.1	0.1	-0.4	0.0	0.0	0.0
EM-HWL04	A12277	189570.5	2185177.9	5301.8	EM04	189570.6	2185178.0	5301.3	EM04	189570.6	2185177.9	5301.3	0.1	0.0	-0.4	0.0	-0.1	0.0
EM-HWL05	A12279	189342.2	2184932.0	5311.5	EM05	189342.3	2184932.1	5311.1	EM05	189342.3	2184932.0	5311.2	0.0	0.0	-0.3	0.0	-0.1	0.1
EM-HWL06	A12278	189355.8	2185080.0	5309.2	EM06	189355.9	2185080.0	5308.9	EM06	189355.9	2185080.0	5308.8	0.1	-0.1	-0.4	0.0	0.0	-0.1
EM-HWL07	A12280	189151.0	2184866.7	5310.0	EM07	189150.6	2184866.6	5309.6	EM07	189150.6	2184866.4	5309.6	-0.4	-0.3	-0.4	0.0	0.0	0.0
EM-HWL08	A12281	189191.9	2185133.9	5308.0	EM08	189192.2	2185133.9	5307.7	EM08	189192.2	2185133.8	5307.6	0.3	-0.1	-0.4	0.0	-0.1	-0.1
EM-HWL09	A12282	189037.2	2184990.5	5306.9	EM09	189037.2	2184990.4	5306.6	EM09	189037.2	2184990.4	5306.3	-0.1	-0.1	-0.5	0.0	-0.1	-0.3

	RECORD CONDITION SURVEY				Spring 2022 SURVEY				Fall 2022 SURVEY				RESULTS					
	Date of survey: 11/12/08				*Date of survey: 05/19/22*				*Date of survey: 02/02/23*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Mon't No.	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM-HWL01	A12276	189773.9	2185140.7	5298.1	EM01	189774.0	2185140.7	5297.6	EM01	189773.6	2185140.5	5297.8	-0.3	-0.2	-0.3	-0.4	-0.2	0.2
EM-HWL02	A12274	189637.3	2184809.8	5302.5	EM02	189637.1	2184809.8	5302.1	EM02	189636.6	2184809.7	5302.3	-0.7	-0.1	-0.2	-0.5	-0.2	0.2
EM-HWL03	A12275	189625.9	2185058.0	5307.8	EM03	189626.0	2185058.1	5307.4	EM03	189625.3	2185058.1	5307.5	-0.5	0.1	-0.3	-0.6	0.0	0.1
EM-HWL04	A12277	189570.5	2185177.9	5301.8	EM04	189570.6	2185177.9	5301.3	EM04	189570.0	2185177.9	5301.5	-0.5	0.0	-0.3	-0.5	-0.1	0.1
EM-HWL05	A12279	189342.2	2184932.0	5311.5	EM05	189342.3	2184932.0	5311.2	EM05	189341.8	2184931.9	5311.2	-0.4	-0.1	-0.3	-0.5	-0.1	0.0
EM-HWL06	A12278	189355.8	2185080.0	5309.2	EM06	189355.9	2185080.0	5308.8	EM06	189355.4	2185079.8	5308.9	-0.4	-0.2	-0.3	-0.6	-0.2	0.1
EM-HWL07	A12280	189151.0	2184866.7	5310.0	EM07	189150.6	2184866.4	5309.6	EM07	189150.1	2184866.3	5309.7	-0.9	-0.5	-0.3	-0.5	-0.2	0.0
EM-HWL08	A12281	189191.9	2185133.9	5308.0	EM08	189192.2	2185133.8	5307.6	EM08	189191.6	2185133.7	5307.8	-0.3	-0.2	-0.2	-0.5	-0.1	0.2
EM-HWL09	A12282	189037.2	2184990.5	5306.9	EM09	189037.2	2184990.4	5306.3	EM09	189037.1	2184990.2	5306.7	-0.1	-0.2	-0.2	0.0	-0.1	0.4

CHANGE IN HWL EROSION/SETTLEMENT MONUMENT POSITION

	RECORD CONDITION SURVEY				Fall 2022 SURVEY				Spring 2023 SURVEY				RESULTS					
	Date of survey: 11/12/08				*Date of survey: 02/02/23*				*Date of survey: 06/14/23*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Mon't No.	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM-HWL01	A12276	189773.9	2185140.7	5298.1	EM01	189773.6	2185140.5	5297.8	EM01	189773.6	2185140.5	5297.8	-0.3	-0.1	-0.3	0.0	0.0	0.0
EM-HWL02	A12274	189637.3	2184809.8	5302.5	EM02	189636.6	2184809.7	5302.3	EM02	189636.7	2184809.7	5302.0	-0.6	-0.1	-0.5	0.1	0.1	-0.3
EM-HWL03	A12275	189625.9	2185058.0	5307.8	EM03	189625.3	2185058.1	5307.5	EM03	189625.4	2185058.0	5307.4	-0.5	0.0	-0.4	0.1	-0.1	-0.1
EM-HWL04	A12277	189570.5	2185177.9	5301.8	EM04	189570.0	2185177.9	5301.5	EM04	189570.1	2185177.9	5301.4	-0.4	0.0	-0.4	0.1	0.0	-0.1
EM-HWL05	A12279	189342.2	2184932.0	5311.5	EM05	189341.8	2184931.9	5311.2	EM05	189341.8	2184931.9	5311.2	-0.4	-0.1	-0.3	0.1	0.1	-0.1
EM-HWL06	A12278	189355.8	2185080.0	5309.2	EM06	189355.4	2185079.8	5308.9	EM06	189355.4	2185079.8	5308.8	-0.4	-0.2	-0.4	0.0	0.0	-0.1
EM-HWL07	A12280	189151.0	2184866.7	5310.0	EM07	189150.1	2184866.3	5309.7	EM07	189150.0	2184866.4	5309.5	-1.0	-0.4	-0.4	0.0	0.1	-0.1
EM-HWL08	A12281	189191.9	2185133.9	5308.0	EM08	189191.6	2185133.7	5307.8	EM08	189191.6	2185133.7	5307.7	-0.3	-0.2	-0.3	0.0	0.0	-0.1
EM-HWL09	A12282	189037.2	2184990.5	5306.9	EM09	189037.1	2184990.2	5306.7	EM09	189036.7	2184990.2	5306.5	-0.5	-0.2	-0.4	-0.4	0.0	-0.2

	RECORD CONDITION SURVEY				Spring 2023 SURVEY				Fall 2023 SURVEY				RESULTS					
	Date of survey: 11/12/08				*Date of survey: 06/14/23*				*Date of survey: 01/03/24*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Mon't No.	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM-HWL01	A12276	189773.9	2185140.7	5298.1	EM01	189773.6	2185140.5	5297.8	EM01	189773.9	2185140.7	5297.5	0.0	0.0	-0.5	0.4	0.2	-0.2
EM-HWL02	A12274	189637.3	2184809.8	5302.5	EM02	189636.6	2184809.7	5302.3	EM02	189637.1	2184809.8	5302.0	-0.2	0.0	-0.5	0.5	0.1	-0.3
EM-HWL03	A12275	189625.9	2185058.0	5307.8	EM03	189625.3	2185058.1	5307.5	EM03	189625.9	2185058.0	5307.3	0.0	0.1	-0.4	0.5	0.0	-0.2
EM-HWL04	A12277	189570.5	2185177.9	5301.8	EM04	189570.0	2185177.9	5301.5	EM04	189570.5	2185177.9	5301.2	0.0	0.0	-0.6	0.5	0.1	-0.3
EM-HWL05	A12279	189342.2	2184932.0	5311.5	EM05	189341.8	2184931.9	5311.2	EM05	189342.3	2184932.0	5311.1	0.1	0.0	-0.4	0.5	0.1	-0.1
EM-HWL06	A12278	189355.8	2185080.0	5309.2	EM06	189355.4	2185079.8	5308.9	EM06	189355.8	2185080.0	5308.8	0.0	-0.1	-0.4	0.4	0.1	-0.2
EM-HWL07	A12280	189151.0	2184866.7	5310.0	EM07	189150.1	2184866.3	5309.7	EM07	189150.5	2184866.4	5309.5	-0.5	-0.3	-0.5	0.5	0.2	-0.2
EM-HWL08	A12281	189191.9	2185133.9	5308.0	EM08	189191.6	2185133.7	5307.8	EM08	189192.1	2185133.8	5307.6	0.2	-0.1	-0.5	0.5	0.2	-0.2
EM-HWL09	A12282	189037.2	2184990.5	5306.9	EM09	189037.1	2184990.2	5306.7	EM09	189037.1	2184990.3	5306.4	-0.2	-0.1	-0.5	-0.1	0.1	-0.3

	RECORD CONDITION SURVEY				Fall 2023 SURVEY				Spring 2024 SURVEY				RESULTS					
	Date of survey: 11/12/08				*Date of survey: 01/03/24*				*Date of survey: 04/04/24*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Mon't No.	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM-HWL01	A12276	189773.9	2185140.7	5298.1	EM01	189773.9	2185140.7	5297.5	EM01	189773.9	2185140.7	5297.6	0.05	0.03	-0.45	0.00	-0.01	0.09
EM-HWL02	A12274	189637.3	2184809.8	5302.5	EM02	189637.1	2184809.8	5302.0	EM02	189637.2	2184810.0	5302.1	-0.11	0.13	-0.45	0.09	0.13	0.05
EM-HWL03	A12275	189625.9	2185058.0	5307.8	EM03	189625.9	2185058.0	5307.3	EM03	189625.9	2185058.2	5307.4	0.04	0.17	-0.35	0.05	0.12	0.09
EM-HWL04	A12277	189570.5	2185177.9	5301.8	EM04	189570.5	2185177.9	5301.2	EM04	189570.5	2185178.0	5301.3	-0.01	0.10	-0.45	0.01	0.05	0.10
EM-HWL05	A12279	189342.2	2184932.0	5311.5	EM05	189342.3	2184932.0	5311.1	EM05	189342.3	2184931.9	5311.2	0.05	-0.05	-0.33	-0.06	-0.05	0.08
EM-HWL06	A12278	189355.8	2185080.0	5309.2	EM06	189355.8	2185080.0	5308.8	EM06	189355.8	2185079.9	5308.8	0.05	-0.09	-0.38	0.04	-0.04	0.05
EM-HWL07	A12280	189151.0	2184866.7	5310.0	EM07	189150.5	2184866.4	5309.5	EM07	189150.5	2184866.4	5309.6	-0.46	-0.31	-0.35	0.00	-0.01	0.15
EM-HWL08	A12281	189191.9	2185133.9	5308.0	EM08	189192.1	2185133.8	5307.6	EM08	189192.1	2185133.9	5307.7	0.25	-0.02	-0.36	0.00	0.03	0.09
EM-HWL09	A12282	189037.2	2184990.5	5306.9	EM09	189037.1	2184990.3	5306.4	EM09	189037.1	2184990.3	5306.6	-0.18	-0.13	-0.32	0.01	-0.01	0.14

CHANGE IN ELF EROSION/SETTLEMENT MONUMENT POSITION

RECORD CONDITION SURVEY				FALL 2010 SURVEY				SPRING 2011 SURVEY				RESULTS					
				Date of survey: 9/30/10				*Date of survey: 4/28/11*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM1	188086.9	2185027.4	5287.8	Aelfem1	188086.9	2185027.4	5287.8	a1004	188086.9	2185027.4	5287.8	0.0	-0.1	0.0	0.0	0.0	0.0
EM2	187933.6	2184981.4	5297.1	Aelfem2	187933.6	2184981.5	5297.1	a1005	187933.6	2184981.4	5297.1	0.0	0.0	0.0	0.0	-0.1	0.0
EM3	187817.7	2185028.3	5303.4	Aelfem3	187817.7	2185028.3	5303.4	a1006	187817.8	2185028.3	5303.4	0.1	0.0	0.0	0.0	0.0	0.0
EM4	187781.1	2185204.9	5303.6	Aelfem4	187781.1	2185204.8	5303.6	a1007	187781.2	2185204.8	5303.6	0.1	-0.1	0.0	0.1	0.0	0.0
EM5	187481.5	2184463.0	5302.4	Aelfem5	187481.5	2184463.0	5302.4	a1003	187481.6	2184463.0	5302.3	0.1	0.0	-0.1	0.1	0.0	-0.1
EM6	187611.7	2184518.3	5307.7	Aelfem6	187611.7	2184518.4	5307.6	Monument damage. No survey.				N/A	N/A	N/A	N/A	N/A	N/A
EM7	187727.8	2184471.4	5304.4	Aelfem7	187727.8	2184471.4	5304.4	a1001	187727.9	2184471.4	5304.3	0.1	0.0	-0.1	0.1	0.0	-0.1
EM8	187806.3	2184332.0	5298.2	Aelfem8	187806.3	2184332.0	5298.2	Monument damage. No survey.				N/A	N/A	N/A	N/A	N/A	N/A

RECORD CONDITION SURVEY				SPRING 2011 SURVEY				FALL 2011 SURVEY				RESULTS					
				Date of survey: 4/28/11				*Date of survey: 10/12/11*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM1	188086.9	2185027.4	5287.8	a1004	188086.9	2185027.4	5287.8	11	188087.0	2185027.4	5287.7	0.1	0.0	-0.1	0.0	0.0	-0.1
EM2	187933.6	2184981.4	5297.1	a1005	187933.6	2184981.4	5297.1	12	187933.5	2184981.4	5297.1	0.0	-0.1	0.0	-0.1	0.0	0.0
EM3	187817.7	2185028.3	5303.4	a1006	187817.8	2185028.3	5303.4	13	187817.8	2185028.3	5303.4	0.2	0.0	0.0	0.1	0.0	0.0
EM4	187781.1	2185204.9	5303.6	a1007	187781.2	2185204.8	5303.6	14	187781.2	2185204.8	5303.5	0.1	0.0	-0.1	0.0	0.0	-0.1
EM5	187481.5	2184463.0	5302.4	a1003	187481.6	2184463.0	5302.3	18	187481.5	2184463.0	5302.3	-0.1	0.0	-0.1	-0.1	0.0	0.0
EM6	187611.7	2184518.3	5307.7	Monument damage. No survey.				15	187611.6	2184518.3	5307.6	-0.1	0.0	-0.1	N/A	N/A	N/A
EM7	187727.8	2184471.4	5304.4	a1001	187727.9	2184471.4	5304.3	16	187727.9	2184471.3	5304.3	0.1	-0.1	-0.1	0.0	-0.1	0.0
EM8	187806.3	2184332.0	5298.2	Monument damage. No survey.				17	187806.4	2184331.9	5298.1	0.0	-0.1	-0.1	N/A	N/A	N/A

RECORD CONDITION SURVEY				FALL 2011 SURVEY				Spring 2012 SURVEY				RESULTS					
				Date of survey: 10/12/11				*Date of survey: 5/09/12*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM1	188086.9	2185027.4	5287.8	11	188087.0	2185027.4	5287.7	4309	188087.0	2185027.4	5287.7	0.1	0.0	-0.1	0.0	0.0	0.0
EM2	187933.6	2184981.4	5297.1	12	187933.5	2184981.4	5297.1	4310	187933.6	2184981.4	5297.0	0.0	-0.1	-0.1	0.1	0.0	-0.1
EM3	187817.7	2185028.3	5303.4	13	187817.8	2185028.3	5303.4	4311	187817.7	2185028.3	5303.4	0.0	0.0	0.0	-0.1	0.0	0.0
EM4	187781.1	2185204.9	5303.6	14	187781.2	2185204.8	5303.5	4312	187781.1	2185204.8	5303.5	0.0	0.0	-0.1	-0.1	0.0	0.0
EM5	187481.5	2184463.0	5302.4	18	187481.5	2184463.0	5302.3	4314	187481.5	2184463.0	5302.2	-0.1	0.0	-0.2	0.0	0.0	-0.1
EM6	187611.7	2184518.3	5307.7	15	187611.6	2184518.3	5307.6	4313	187611.7	2184518.3	5307.5	0.0	0.0	-0.2	0.1	0.0	-0.1
EM7	187727.8	2184471.4	5304.4	16	187727.9	2184471.3	5304.3	4315	187727.9	2184471.4	5304.3	0.1	0.0	-0.1	0.0	0.1	0.0
EM8	187806.3	2184332.0	5298.2	17	187806.4	2184331.9	5298.1	4316	187806.4	2184332.0	5298.1	0.0	0.0	-0.1	0.0	0.1	0.0

RECORD CONDITION SURVEY				Spring 2012 SURVEY				Fall 2012 SURVEY				RESULTS					
				Date of survey: 5/09/12				*Date of survey: 9/20/12*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM1	188086.9	2185027.4	5287.8	4309	188087.0	2185027.4	5287.7	n1009	188087.0	2185027.4	5287.7	0.1	-0.1	-0.1	0.0	0.0	-0.1
EM2	187933.6	2184981.4	5297.1	4310	187933.6	2184981.4	5297.0	n1006	187933.6	2184981.4	5297.0	0.0	0.0	-0.1	0.0	0.0	0.0
EM3	187817.7	2185028.3	5303.4	4311	187817.7	2185028.3	5303.4	n1007	187817.7	2185028.3	5303.3	0.1	-0.1	-0.1	0.0	0.0	-0.1
EM4	187781.1	2185204.9	5303.6	4312	187781.1	2185204.8	5303.5	n1008	187781.1	2185204.8	5303.5	0.0	-0.1	-0.1	0.0	0.0	-0.1
EM5	187481.5	2184463.0	5302.4	4314	187481.5	2184463.0	5302.2	n1002	187481.6	2184463.0	5302.1	0.0	0.0	-0.2	0.1	0.0	-0.1
EM6	187611.7	2184518.3	5307.7	4313	187611.7	2184518.3	5307.5	n1003	187611.7	2184518.3	5307.4	0.0	-0.1	-0.3	0.0	0.0	-0.1
EM7	187727.8	2184471.4	5304.4	4315	187727.9	2184471.4	5304.3	n1004	187727.9	2184471.4	5304.2	0.0	-0.1	-0.3	0.0	0.0	-0.2
EM8	187806.3	2184332.0	5298.2	4316	187806.4	2184332.0	5298.1	n1005	187806.4	2184332.0	5298.0	0.1	-0.1	-0.2	0.0	0.0	-0.1

RECORD CONDITION SURVEY				Fall 2012 SURVEY				Spring 2013 SURVEY				RESULTS					
				Date of survey: 9/20/12				*Date of survey: 5/07/13*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM1	188086.9	2185027.4	5287.8	n1009	188087.0	2185027.4	5287.7	EM1	188087.0	2185027.4	5287.7	0.1	0.0	-0.1	0.1	0.1	0.0
EM2	187933.6	2184981.4	5297.1	n1006	187933.6	2184981.4	5297.0	EM2	187933.6	2184981.4	5296.9	0.0	-0.1	-0.2	0.0	0.0	0.0
EM3	187817.7	2185028.3	5303.4	n1007	187817.7	2185028.3	5303.3	EM3	187817.8	2185028.3	5303.3	0.2	-0.1	-0.1	0.1	0.0	0.0
EM4	187781.1	2185204.9	5303.6	n1008	187781.1	2185204.8	5303.5	EM4	187781.3	2185204.9	5303.5	0.2	0.0	-0.1	0.1	0.1	0.1
EM5	187481.5	2184463.0	5302.4	n1002	187481.6	2184463.0	5302.1	EM5	187481.6	2184463.0	5302.2	0.0	0.0	-0.2	0.0	0.1	0.0
EM6	187611.7	2184518.3	5307.7	n1003	187611.7	2184518.3	5307.4	EM6	187611.6	2184518.3	5307.4	-0.1	0.0	-0.3	0.0	0.0	0.0
EM7	187727.8	2184471.4	5304.4	n1004	187727.9	2184471.4	5304.2	EM7	187728.0	2184471.4	5304.2	0.1	0.0	-0.2	0.1	0.0	0.1
EM8	187806.3	2184332.0	5298.2	n1005	187806.4	2184332.0	5298.0	EM8	187806.3	2184332.0	5298.0	0.0	0.0	-0.2	-0.1	0.0	0.0

CHANGE IN ELF EROSION/SETTLEMENT MONUMENT POSITION

RECORD CONDITION SURVEY				Spring 2013 SURVEY				Fall 2013 SURVEY				RESULTS					
				Date of survey: 5/07/13				*Date of survey: 9/19/13*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM1	188086.9	2185027.4	5287.8	EM1	188087.0	2185027.4	5287.7	EM1	188087.1	2185027.4	5287.7	0.1	-0.1	-0.1	0.0	0.0	0.1
EM2	187933.6	2184981.4	5297.1	EM2	187933.6	2184981.4	5296.9	EM2	187933.5	2184981.3	5297.0	0.0	-0.1	-0.1	0.0	0.0	0.0
EM3	187817.7	2185028.3	5303.4	EM3	187817.8	2185028.3	5303.3	EM3	187817.8	2185028.3	5303.3	0.1	-0.1	-0.1	0.0	0.0	0.0
EM4	187781.1	2185204.9	5303.6	EM4	187781.3	2185204.9	5303.5	EM4	187780.9	2185204.9	5303.5	-0.1	0.0	-0.1	-0.3	0.0	0.0
EM5	187481.5	2184463.0	5302.4	EM5	187481.6	2184463.0	5302.2	EM5	187481.4	2184463.0	5302.2	-0.1	-0.1	-0.2	-0.2	-0.1	0.0
EM6	187611.7	2184518.3	5307.7	EM6	187611.6	2184518.3	5307.4	EM6	187611.6	2184518.3	5307.4	-0.1	0.0	-0.3	0.0	0.0	0.0
EM7	187727.8	2184471.4	5304.4	EM7	187728.0	2184471.4	5304.2	EM7	187727.9	2184471.4	5304.2	0.1	0.0	-0.2	0.0	0.0	0.0
EM8	187806.3	2184332.0	5298.2	EM8	187806.3	2184332.0	5298.0	EM8	187806.4	2184331.9	5298.0	0.1	-0.1	-0.1	0.1	-0.1	0.0

RECORD CONDITION SURVEY				Fall 2013 SURVEY				Spring 2014 SURVEY				RESULTS					
				Date of survey: 9/19/13				*Date of survey: 5/29/14*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM1	188086.9	2185027.4	5287.8	EM1	188087.1	2185027.4	5287.7	EM1	188087.0	2185027.5	5287.6	0.1	0.1	-0.2	0.0	0.1	-0.1
EM2	187933.6	2184981.4	5297.1	EM2	187933.5	2184981.3	5297.0	EM2	187933.6	2184981.5	5296.9	0.0	0.0	-0.2	0.1	0.2	-0.1
EM3	187817.7	2185028.3	5303.4	EM3	187817.8	2185028.3	5303.3	EM3	187817.8	2185028.4	5303.2	0.2	0.1	-0.2	0.0	0.2	-0.1
EM4	187781.1	2185204.9	5303.6	EM4	187780.9	2185204.9	5303.5	EM4	187781.3	2185204.9	5303.4	0.2	0.1	-0.2	0.3	0.1	-0.1
EM5	187481.5	2184463.0	5302.4	EM5	187481.4	2184463.0	5302.2	EM5	187481.5	2184463.1	5302.0	0.0	0.1	-0.3	0.1	0.1	-0.1
EM6	187611.7	2184518.3	5307.7	EM6	187611.6	2184518.3	5307.4	EM6	187611.6	2184518.4	5307.3	0.0	0.1	-0.4	0.1	0.1	-0.2
EM7	187727.8	2184471.4	5304.4	EM7	187727.9	2184471.4	5304.2	EM7	187728.0	2184471.5	5304.1	0.1	0.0	-0.4	0.0	0.1	-0.2
EM8	187806.3	2184332.0	5298.2	EM8	187806.4	2184331.9	5298.0	EM8	187806.5	2184332.1	5297.9	0.1	0.1	-0.3	0.1	0.2	-0.2

RECORD CONDITION SURVEY				Spring 2014 SURVEY				Fall 2014 SURVEY				RESULTS					
				Date of survey: 5/29/14				*Date of survey: 10/19/14*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM1	188086.9	2185027.4	5287.8	EM1	188087.0	2185027.5	5287.6	EM1	188087.0	2185027.5	5287.6	0.0	0.0	-0.2	-0.1	-0.1	0.0
EM2	187933.6	2184981.4	5297.1	EM2	187933.6	2184981.5	5296.9	EM2	187933.6	2184981.5	5297.0	0.0	0.0	-0.1	0.0	0.0	0.1
EM3	187817.7	2185028.3	5303.4	EM3	187817.8	2185028.4	5303.2	EM3	187817.7	2185028.4	5303.3	0.1	0.1	-0.1	-0.1	-0.1	0.1
EM4	187781.1	2185204.9	5303.6	EM4	187781.3	2185204.9	5303.4	EM4	187781.1	2185204.9	5303.5	0.1	0.0	-0.1	-0.1	0.0	0.1
EM5	187481.5	2184463.0	5302.4	EM5	187481.5	2184463.1	5302.0	EM5	187481.5	2184463.1	5302.1	0.0	0.1	-0.2	0.0	0.0	0.1
EM6	187611.7	2184518.3	5307.7	EM6	187611.6	2184518.4	5307.3	EM6	187611.6	2184518.4	5307.4	0.0	0.1	-0.3	0.0	0.0	0.1
EM7	187727.8	2184471.4	5304.4	EM7	187728.0	2184471.5	5304.1	EM7	187727.8	2184471.5	5304.1	0.0	0.1	-0.3	-0.2	0.0	0.1
EM8	187806.3	2184332.0	5298.2	EM8	187806.5	2184332.1	5297.9	EM8	187806.4	2184332.1	5298.0	0.1	0.1	-0.2	-0.1	0.0	0.1

RECORD CONDITION SURVEY				Fall 2014 SURVEY				Spring 2015 SURVEY				RESULTS					
				Date of survey: 10/19/14				*Date of survey: 5/29/15*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM1	188086.9	2185027.4	5287.8	EM1	188087.0	2185027.5	5287.6	EM1	188087.0	2185027.5	5287.7	0.1	0.1	-0.1	0.1	0.1	0.0
EM2	187933.6	2184981.4	5297.1	EM2	187933.6	2184981.5	5297.0	EM2	187933.6	2184981.5	5296.9	0.1	0.1	-0.2	0.0	0.0	-0.1
EM3	187817.7	2185028.3	5303.4	EM3	187817.7	2185028.4	5303.3	EM3	187817.8	2185028.4	5303.3	0.1	0.1	-0.1	0.0	0.0	0.0
EM4	187781.1	2185204.9	5303.6	EM4	187781.1	2185204.9	5303.5	EM4	187781.1	2185205.0	5303.5	0.1	0.1	-0.1	0.0	0.1	0.0
EM5	187481.5	2184463.0	5302.4	EM5	187481.5	2184463.1	5302.1	EM5	187481.6	2184463.1	5302.1	0.1	0.1	-0.2	0.1	0.0	0.0
EM6	187611.7	2184518.3	5307.7	EM6	187611.6	2184518.4	5307.4	EM6	187611.7	2184518.4	5307.4	0.0	0.1	-0.3	0.0	0.0	0.0
EM7	187727.8	2184471.4	5304.4	EM7	187727.8	2184471.5	5304.1	EM7	187727.9	2184471.5	5304.2	0.1	0.1	-0.2	0.1	0.0	0.1
EM8	187806.3	2184332.0	5298.2	EM8	187806.4	2184332.1	5298.0	EM8	187806.5	2184332.1	5298.0	0.1	0.1	-0.1	0.1	0.0	0.0

RECORD CONDITION SURVEY				Spring 2015 SURVEY				Fall 2015 SURVEY				RESULTS					
				Date of survey: 5/29/15				*Date of survey: 12/9/15*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM1	188086.9	2185027.4	5287.8	EM1	188087.0	2185027.5	5287.7	EM1	188087.0	2185027.5	5287.5	0.1	0.1	-0.3	0.0	0.0	-0.1
EM2	187933.6	2184981.4	5297.1	EM2	187933.6	2184981.5	5296.9	EM2	187933.6	2184981.5	5296.8	0.0	0.0	-0.3	-0.1	0.0	-0.1
EM3	187817.7	2185028.3	5303.4	EM3	187817.8	2185028.4	5303.3	EM3	187817.9	2185028.4	5303.1	0.2	0.1	-0.3	0.1	0.0	-0.1
EM4	187781.1	2185204.9	5303.6	EM4	187781.1	2185205.0	5303.5	EM4	187781.2	2185205.0	5303.3	0.1	0.1	-0.2	0.1	0.0	-0.1
EM5	187481.5	2184463.0	5302.4	EM5	187481.6	2184463.1	5302.1	EM5	187481.5	2184463.2	5302.0	0.0	0.1	-0.4	-0.1	0.1	-0.2
EM6	187611.7	2184518.3	5307.7	EM6	187611.7	2184518.4	5307.4	EM6	187611.6	2184518.4	5307.2	0.0	0.1	-0.5	0.0	0.1	-0.2
EM7	187727.8	2184471.4	5304.4	EM7	187727.9	2184471.5	5304.2	EM7	187728.0	2184471.5	5304.0	0.1	0.1	-0.4	0.1	0.0	-0.2
EM8	187806.3	2184332.0	5298.2	EM8	187806.5	2184332.1	5298.0	EM8	187806.4	2184332.1	5297.8	0.1	0.0	-0.4	-0.1	0.0	-0.2

CHANGE IN ELF EROSION/SETTLEMENT MONUMENT POSITION

RECORD CONDITION SURVEY				Fall 2015 SURVEY				Spring 2016 SURVEY				RESULTS					
				Date of survey: 12/9/15				*Date of survey: 6/20/16*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM1	188086.9	2185027.4	5287.8	EM1	188087.0	2185027.5	5287.5	EM1	188087.0	2185027.5	5287.6	0.1	0.1	-0.2	-0.1	0.0	0.1
EM2	187933.6	2184981.4	5297.1	EM2	187933.6	2184981.5	5296.8	EM2	187933.6	2184981.5	5296.9	0.0	0.1	-0.2	0.0	0.0	0.1
EM3	187817.7	2185028.3	5303.4	EM3	187817.9	2185028.4	5303.1	EM3	187817.8	2185028.4	5303.2	0.1	0.1	-0.2	-0.1	0.0	0.1
EM4	187781.1	2185204.9	5303.6	EM4	187781.2	2185205.0	5303.3	EM4	187781.1	2185204.9	5303.4	0.0	0.0	-0.2	-0.1	-0.1	0.1
EM5	187481.5	2184463.0	5302.4	EM5	187481.5	2184463.2	5302.0	EM5	187481.6	2184463.1	5302.1	0.0	0.1	-0.3	0.0	-0.1	0.1
EM6	187611.7	2184518.3	5307.7	EM6	187611.6	2184518.4	5307.2	EM6	187611.6	2184518.4	5307.3	0.0	0.1	-0.4	0.0	-0.1	0.1
EM7	187727.8	2184471.4	5304.4	EM7	187728.0	2184471.5	5304.0	EM7	187727.9	2184471.5	5304.1	0.0	0.1	-0.4	-0.1	0.0	0.1
EM8	187806.3	2184332.0	5298.2	EM8	187806.4	2184332.1	5297.8	EM8	187806.4	2184332.1	5297.9	0.1	0.1	-0.3	0.0	0.0	0.0

RECORD CONDITION SURVEY				Spring 2016 SURVEY				Fall 2016 SURVEY				RESULTS					
				Date of survey: 6/20/16				*Date of survey: 1/18/17*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM1	188086.9	2185027.4	5287.8	EM1	188087.0	2185027.5	5287.6	EM1	188087.0	2185027.5	5287.6	0.1	0.0	-0.2	0.0	0.0	0.0
EM2	187933.6	2184981.4	5297.1	EM2	187933.6	2184981.5	5296.9	EM2	187933.6	2184981.5	5296.9	0.0	0.0	-0.2	0.0	0.0	0.1
EM3	187817.7	2185028.3	5303.4	EM3	187817.8	2185028.4	5303.2	EM3	187817.8	2185028.4	5303.2	0.1	0.1	-0.2	0.0	0.0	0.0
EM4	187781.1	2185204.9	5303.6	EM4	187781.1	2185204.9	5303.4	EM4	187781.2	2185204.9	5303.5	0.1	0.1	-0.1	0.0	0.0	0.1
EM5	187481.5	2184463.0	5302.4	EM5	187481.6	2184463.1	5302.1	EM5	187481.6	2184463.1	5302.1	0.0	0.1	-0.3	0.0	0.0	0.0
EM6	187611.7	2184518.3	5307.7	EM6	187611.6	2184518.4	5307.3	EM6	187611.6	2184518.4	5307.4	0.0	0.1	-0.3	0.0	0.0	0.1
EM7	187727.8	2184471.4	5304.4	EM7	187727.9	2184471.5	5304.1	EM7	187727.9	2184471.5	5304.1	0.1	0.1	-0.3	0.0	0.0	0.0
EM8	187806.3	2184332.0	5298.2	EM8	187806.4	2184332.1	5297.9	EM8	187806.4	2184332.1	5298.0	0.1	0.1	-0.2	0.0	0.0	0.1

RECORD CONDITION SURVEY				Fall 2016 SURVEY				Spring 2017 SURVEY				RESULTS					
				Date of survey: 6/20/16				*Date of survey: 05/17/17*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM1	188086.9	2185027.4	5287.8	EM1	188087.0	2185027.5	5287.6	EM1	188087.0	2185027.5	5287.6	0.1	0.1	-0.2	0.0	0.1	0.0
EM2	187933.6	2184981.4	5297.1	EM2	187933.6	2184981.5	5296.9	EM2	187933.7	2184981.6	5296.8	0.1	0.1	-0.2	0.1	0.1	-0.1
EM3	187817.7	2185028.3	5303.4	EM3	187817.8	2185028.4	5303.2	EM3	187817.8	2185028.4	5303.1	0.1	0.1	-0.3	0.0	0.1	-0.1
EM4	187781.1	2185204.9	5303.6	EM4	187781.2	2185204.9	5303.5	EM4	187781.2	2185205.0	5303.4	0.1	0.1	-0.2	0.0	0.0	-0.1
EM5	187481.5	2184463.0	5302.4	EM5	187481.6	2184463.1	5302.1	EM5	187481.6	2184463.1	5302.0	0.1	0.1	-0.4	0.0	0.1	-0.1
EM6	187611.7	2184518.3	5307.7	EM6	187611.6	2184518.4	5307.4	EM6	187611.7	2184518.5	5307.3	0.0	0.2	-0.4	0.1	0.1	-0.1
EM7	187727.8	2184471.4	5304.4	EM7	187727.9	2184471.5	5304.1	EM7	187727.9	2184471.6	5304.1	0.1	0.1	-0.4	0.0	0.1	-0.1
EM8	187806.3	2184332.0	5298.2	EM8	187806.4	2184332.1	5298.0	EM8	187806.4	2184332.1	5297.9	0.1	0.1	-0.3	0.1	0.0	-0.1

RECORD CONDITION SURVEY				Spring 2017 SURVEY				Fall 2017 SURVEY				RESULTS					
				Date of survey: 05/17/17				*Date of survey: 11/10/17*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM1	188086.9	2185027.4	5287.8	EM1	188087.0	2185027.5	5287.6	EM1	188087.0	2185027.5	5287.7	0.1	0.1	-0.1	0.0	0.0	0.1
EM2	187933.6	2184981.4	5297.1	EM2	187933.7	2184981.6	5296.8	EM2	187933.6	2184981.5	5296.9	0.0	0.1	-0.2	-0.1	0.0	0.1
EM3	187817.7	2185028.3	5303.4	EM3	187817.8	2185028.4	5303.1	EM3	187817.7	2185028.4	5303.2	0.1	0.1	-0.2	0.0	-0.1	0.1
EM4	187781.1	2185204.9	5303.6	EM4	187781.2	2185205.0	5303.4	EM4	187781.2	2185204.9	5303.4	0.1	0.0	-0.2	0.0	-0.1	0.1
EM5	187481.5	2184463.0	5302.4	EM5	187481.6	2184463.1	5302.0	EM5	187481.6	2184463.1	5302.1	0.0	0.1	-0.3	0.0	0.0	0.1
EM6	187611.7	2184518.3	5307.7	EM6	187611.7	2184518.5	5307.3	EM6	187611.6	2184518.4	5307.3	0.0	0.1	-0.4	-0.1	-0.1	0.0
EM7	187727.8	2184471.4	5304.4	EM7	187727.9	2184471.6	5304.1	EM7	187727.9	2184471.5	5304.1	0.0	0.1	-0.3	0.0	-0.1	0.1
EM8	187806.3	2184332.0	5298.2	EM8	187806.4	2184332.1	5297.9	EM8	187806.4	2184332.1	5297.9	0.1	0.1	-0.3	0.0	0.0	0.0

RECORD CONDITION SURVEY				Fall 2017 SURVEY				Spring 2018 SURVEY				RESULTS					
				Date of survey: 11/10/17				*Date of survey: 06/18/18*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM1	188086.9	2185027.4	5287.8	EM1	188087.0	2185027.5	5287.7	EM1	188086.9	2185027.5	5287.6	0.0	0.1	-0.2	0.0	0.0	-0.1
EM2	187933.6	2184981.4	5297.1	EM2	187933.6	2184981.5	5296.9	EM2	187933.6	2184981.6	5296.9	0.0	0.1	-0.2	0.0	0.1	0.0
EM3	187817.7	2185028.3	5303.4	EM3	187817.7	2185028.4	5303.2	EM3	187817.7	2185028.4	5303.1	0.0	0.1	-0.3	-0.1	0.1	-0.1
EM4	187781.1	2185204.9	5303.6	EM4	187781.2	2185204.9	5303.4	EM4	187781.1	2185205.0	5303.4	0.0	0.1	-0.2	-0.1	0.1	-0.1
EM5	187481.5	2184463.0	5302.4	EM5	187481.6	2184463.1	5302.1	EM5	187481.5	2184463.2	5302.0	-0.1	0.2	-0.4	-0.1	0.1	-0.1
EM6	187611.7	2184518.3	5307.7	EM6	187611.6	2184518.4	5307.3	EM6	187611.6	2184518.5	5307.2	-0.1	0.2	-0.5	-0.1	0.1	-0.1
EM7	187727.8	2184471.4	5304.4	EM7	187727.9	2184471.5	5304.1	EM7	187727.8	2184471.6	5304.0	0.0	0.2	-0.5	0.0	0.1	-0.1
EM8	187806.3	2184332.0	5298.2	EM8	187806.4	2184332.1	5297.9	EM8	187806.3	2184332.2	5297.8	0.0	0.1	-0.4	-0.1	0.1	-0.1

CHANGE IN ELF EROSION/SETTLEMENT MONUMENT POSITION

RECORD CONDITION SURVEY				Spring 2018 SURVEY				Fall 2018 SURVEY				RESULTS					
				Date of survey: 06/18/18				*Date of survey: 12/14/18*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM1	188086.9	2185027.4	5287.8	EM1	188086.9	2185027.5	5287.6	EM1	188086.9	2185027.5	5287.6	0.0	0.1	-0.2	0.0	0.0	0.0
EM2	187933.6	2184981.4	5297.1	EM2	187933.6	2184981.6	5296.9	EM2	187933.5	2184981.5	5296.8	0.0	0.1	-0.3	0.0	0.0	0.0
EM3	187817.7	2185028.3	5303.4	EM3	187817.7	2185028.4	5303.1	EM3	187817.7	2185028.4	5303.2	0.1	0.1	-0.2	0.0	0.0	0.0
EM4	187781.1	2185204.9	5303.6	EM4	187781.1	2185205.0	5303.4	EM4	187781.1	2185205.0	5303.4	0.0	0.1	-0.2	0.0	0.0	0.0
EM5	187481.5	2184463.0	5302.4	EM5	187481.5	2184463.2	5302.0	EM5	187481.5	2184463.1	5302.0	0.0	0.1	-0.4	0.0	-0.1	0.0
EM6	187611.7	2184518.3	5307.7	EM6	187611.6	2184518.5	5307.2	EM6	187611.6	2184518.4	5307.2	-0.1	0.1	-0.5	0.0	-0.1	0.0
EM7	187727.8	2184471.4	5304.4	EM7	187727.8	2184471.6	5304.0	EM7	187727.8	2184471.6	5304.0	0.0	0.1	-0.4	0.0	-0.1	0.0
EM8	187806.3	2184332.0	5298.2	EM8	187806.3	2184332.2	5297.8	EM8	187806.3	2184332.1	5297.8	0.0	0.1	-0.3	0.0	-0.1	0.1

RECORD CONDITION SURVEY				Fall 2018 SURVEY				Spring 2019 SURVEY				RESULTS					
				Date of survey: 12/14/18				*Date of survey: 05/16/19*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM1	188086.9	2185027.4	5287.8	EM1	188086.9	2185027.5	5287.6	EM1	188086.9	2185027.5	5287.6	0.0	0.1	-0.2	0.0	0.0	0.0
EM2	187933.6	2184981.4	5297.1	EM2	187933.5	2184981.5	5296.8	EM2	187933.6	2184981.5	5296.8	0.0	0.1	-0.3	0.0	0.0	0.0
EM3	187817.7	2185028.3	5303.4	EM3	187817.7	2185028.4	5303.2	EM3	187817.7	2185028.4	5303.2	0.1	0.1	-0.3	0.0	0.0	0.0
EM4	187781.1	2185204.9	5303.6	EM4	187781.1	2185205.0	5303.4	EM4	187781.1	2185205.0	5303.4	0.0	0.1	-0.2	0.0	0.0	0.0
EM5	187481.5	2184463.0	5302.4	EM5	187481.5	2184463.1	5302.0	EM5	187481.5	2184463.1	5302.0	0.0	0.1	-0.4	0.0	0.0	0.0
EM6	187611.7	2184518.3	5307.7	EM6	187611.6	2184518.4	5307.2	EM6	187611.6	2184518.5	5307.2	-0.1	0.1	-0.5	0.0	0.0	0.0
EM7	187727.8	2184471.4	5304.4	EM7	187727.8	2184471.6	5304.0	EM7	187727.8	2184471.6	5304.0	0.0	0.1	-0.4	0.0	0.0	0.0
EM8	187806.3	2184332.0	5298.2	EM8	187806.3	2184332.1	5297.8	EM8	187806.3	2184332.1	5297.8	0.0	0.1	-0.4	0.0	0.0	0.0

RECORD CONDITION SURVEY				Spring 2019 SURVEY				Fall 2019 SURVEY				RESULTS					
				Date of survey: 05/16/19				*Date of survey: 01/14/20*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM1	188086.9	2185027.4	5287.8	EM1	188086.9	2185027.5	5287.6	EM1	188087.0	2185027.5	5287.7	0.1	0.1	-0.1	0.0	0.0	0.1
EM2	187933.6	2184981.4	5297.1	EM2	187933.6	2184981.5	5296.8	EM2	187933.5	2184981.5	5296.8	0.0	0.1	-0.3	0.0	0.0	0.0
EM3	187817.7	2185028.3	5303.4	EM3	187817.7	2185028.4	5303.2	EM3	187817.7	2185028.4	5303.2	0.0	0.1	-0.2	0.0	0.0	0.0
EM4	187781.1	2185204.9	5303.6	EM4	187781.1	2185205.0	5303.4	EM4	187781.1	2185204.9	5303.4	0.0	0.1	-0.2	-0.1	0.0	0.0
EM5	187481.5	2184463.0	5302.4	EM5	187481.5	2184463.1	5302.0	EM5	187481.5	2184463.1	5302.0	0.0	0.1	-0.4	0.0	0.0	0.0
EM6	187611.7	2184518.3	5307.7	EM6	187611.6	2184518.5	5307.2	EM6	187611.6	2184518.4	5307.2	-0.1	0.1	-0.5	0.0	0.0	0.0
EM7	187727.8	2184471.4	5304.4	EM7	187727.8	2184471.6	5304.0	EM7	187727.8	2184471.6	5304.0	0.0	0.1	-0.4	0.0	0.0	0.0
EM8	187806.3	2184332.0	5298.2	EM8	187806.3	2184332.1	5297.8	EM8	187806.3	2184332.1	5297.8	0.0	0.1	-0.3	0.0	0.0	0.0

RECORD CONDITION SURVEY				Fall 2019 SURVEY				Spring 2020 SURVEY				RESULTS					
				Date of survey: 01/14/20				*Date of survey: 04/23/20*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM1	188086.9	2185027.4	5287.8	EM1	188087.0	2185027.5	5287.7	EM1	188086.9	2185027.5	5287.7	0.0	0.1	-0.1	0.0	0.0	0.0
EM2	187933.6	2184981.4	5297.1	EM2	187933.5	2184981.5	5296.8	EM2	187933.6	2184981.5	5296.9	0.0	0.1	-0.2	0.0	0.0	0.1
EM3	187817.7	2185028.3	5303.4	EM3	187817.7	2185028.4	5303.2	EM3	187817.7	2185028.4	5303.2	0.1	0.1	-0.2	0.0	0.0	0.1
EM4	187781.1	2185204.9	5303.6	EM4	187781.1	2185204.9	5303.4	EM4	187781.0	2185205.0	5303.5	0.0	0.1	-0.1	0.0	0.0	0.1
EM5	187481.5	2184463.0	5302.4	EM5	187481.5	2184463.1	5302.0	EM5	187481.5	2184463.2	5302.1	0.0	0.1	-0.3	0.0	0.0	0.1
EM6	187611.7	2184518.3	5307.7	EM6	187611.6	2184518.4	5307.2	EM6	187611.7	2184518.4	5307.3	0.0	0.1	-0.4	0.1	0.0	0.1
EM7	187727.8	2184471.4	5304.4	EM7	187727.8	2184471.6	5304.0	EM7	187727.8	2184471.6	5304.1	0.0	0.1	-0.4	0.0	0.0	0.0
EM8	187806.3	2184332.0	5298.2	EM8	187806.3	2184332.1	5297.8	EM8	187806.4	2184332.1	5297.9	0.1	0.1	-0.3	0.0	0.0	0.0

RECORD CONDITION SURVEY				Spring 2020 SURVEY				Fall 2020 SURVEY				RESULTS					
				Date of survey: 04/23/20				*Date of survey: 10/01/20*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM1	188086.9	2185027.4	5287.8	EM1	188086.9	2185027.5	5287.7	EM1	188086.9	2185027.5	5287.6	0.0	0.1	-0.2	0.0	0.0	0.0
EM2	187933.6	2184981.4	5297.1	EM2	187933.6	2184981.5	5296.9	EM2	187933.6	2184981.5	5296.8	0.0	0.1	-0.3	0.0	0.0	-0.1
EM3	187817.7	2185028.3	5303.4	EM3	187817.7	2185028.4	5303.2	EM3	187817.7	2185028.4	5303.2	0.0	0.1	-0.3	0.0	0.0	-0.1
EM4	187781.1	2185204.9	5303.6	EM4	187781.0	2185205.0	5303.5	EM4	187781.1	2185205.0	5303.4	0.0	0.1	-0.2	0.0	0.0	-0.1
EM5	187481.5	2184463.0	5302.4	EM5	187481.5	2184463.2	5302.1	EM5	187481.5	2184463.1	5302.0	-0.1	0.1	-0.4	0.0	0.0	-0.1
EM6	187611.7	2184518.3	5307.7	EM6	187611.7	2184518.4	5307.3	EM6	187611.6	2184518.4	5307.2	-0.1	0.1	-0.5	-0.1	0.0	-0.1
EM7	187727.8	2184471.4	5304.4	EM7	187727.8	2184471.6	5304.1	EM7	187727.8	2184471.5	5304.0	0.0	0.1	-0.4	0.0	0.0	-0.1
EM8	187806.3	2184332.0	5298.2	EM8	187806.4	2184332.1	5297.9	EM8	187806.3	2184332.1	5297.9	0.0	0.1	-0.3	0.0	0.0	0.0

CHANGE IN ELF EROSION/SETTLEMENT MONUMENT POSITION

RECORD CONDITION SURVEY				Fall 2020 SURVEY				Spring 2021 SURVEY				RESULTS					
				Date of survey: 10/01/20				*Date of survey: 05/25/21*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM1	188086.9	2185027.4	5287.8	EM1	188086.9	2185027.5	5287.6	EM1	188086.9	2185027.5	5287.7	0.0	0.1	-0.1	0.0	0.0	0.1
EM2	187933.6	2184981.4	5297.1	EM2	187933.6	2184981.5	5296.8	EM2	187933.5	2184981.5	5297.0	0.0	0.1	-0.1	0.0	0.0	0.1
EM3	187817.7	2185028.3	5303.4	EM3	187817.7	2185028.4	5303.2	EM3	187817.7	2185028.4	5303.2	0.1	0.1	-0.2	0.0	0.0	0.1
EM4	187781.1	2185204.9	5303.6	EM4	187781.1	2185205.0	5303.4	EM4	187781.1	2185205.0	5303.5	0.0	0.1	-0.1	0.0	0.0	0.1
EM5	187481.5	2184463.0	5302.4	EM5	187481.5	2184463.1	5302.0	EM5	187481.5	2184463.2	5302.0	-0.1	0.1	-0.3	0.0	0.0	0.0
EM6	187611.7	2184518.3	5307.7	EM6	187611.6	2184518.4	5307.2	EM6	187611.6	2184518.4	5307.2	-0.1	0.1	-0.5	0.0	0.0	0.0
EM7	187727.8	2184471.4	5304.4	EM7	187727.8	2184471.5	5304.0	EM7	187727.8	2184471.6	5304.0	0.0	0.1	-0.4	0.0	0.1	0.0
EM8	187806.3	2184332.0	5298.2	EM8	187806.3	2184332.1	5297.9	EM8	187806.4	2184332.1	5297.8	0.1	0.1	-0.4	0.0	0.0	0.0

RECORD CONDITION SURVEY				Spring 2021 SURVEY				Fall 2021 SURVEY				RESULTS					
				Date of survey: 05/25/21				*Date of survey: 12/02/21*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM1	188086.9	2185027.4	5287.8	EM1	188086.9	2185027.5	5287.7	EM1	188087.0	2185027.4	5287.5	0.1	0.0	-0.3	0.1	-0.1	-0.2
EM2	187933.6	2184981.4	5297.1	EM2	187933.5	2184981.5	5297.0	EM2	187933.5	2184981.6	5296.8	-0.1	0.1	-0.3	0.0	0.0	-0.2
EM3	187817.7	2185028.3	5303.4	EM3	187817.7	2185028.4	5303.2	EM3	187817.7	2185028.4	5303.2	0.1	0.1	-0.2	0.0	0.0	0.0
EM4	187781.1	2185204.9	5303.6	EM4	187781.1	2185205.0	5303.5	EM4	187781.2	2185205.0	5303.3	0.1	0.1	-0.2	0.1	0.0	-0.1
EM5	187481.5	2184463.0	5302.4	EM5	187481.5	2184463.2	5302.0	EM5	187481.5	2184463.1	5302.0	-0.1	0.1	-0.4	0.0	-0.1	-0.1
EM6	187611.7	2184518.3	5307.7	EM6	187611.6	2184518.4	5307.2	EM6	187611.6	2184518.5	5307.3	0.0	0.2	-0.4	0.0	0.1	0.0
EM7	187727.8	2184471.4	5304.4	EM7	187727.8	2184471.6	5304.0	EM7	187727.9	2184471.5	5304.0	0.0	0.1	-0.5	0.1	-0.1	-0.1
EM8	187806.3	2184332.0	5298.2	EM8	187806.4	2184332.1	5297.8	EM8	187806.3	2184332.1	5297.8	0.0	0.1	-0.4	-0.1	0.0	0.0

RECORD CONDITION SURVEY				Fall 2021 SURVEY				Spring 2022 SURVEY				RESULTS					
				Date of survey: 12/02/21				*Date of survey: 05/19/22*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM1	188086.9	2185027.4	5287.8	EM1	188087.0	2185027.4	5287.5	EM1	188087.0	2185027.4	5287.5	0.1	0.0	-0.3	0.0	0.0	0.1
EM2	187933.6	2184981.4	5297.1	EM2	187933.5	2184981.6	5296.8	EM2	187933.5	2184981.5	5296.8	0.0	0.1	-0.3	0.1	-0.1	0.0
EM3	187817.7	2185028.3	5303.4	EM3	187817.7	2185028.4	5303.2	EM3	187817.6	2185028.3	5303.1	-0.1	0.0	-0.3	-0.1	-0.1	-0.1
EM4	187781.1	2185204.9	5303.6	EM4	187781.2	2185205.0	5303.3	EM4	187781.1	2185204.9	5303.2	0.0	0.0	-0.4	-0.1	-0.1	-0.1
EM5	187481.5	2184463.0	5302.4	EM5	187481.5	2184463.1	5302.0	EM5	187481.4	2184463.1	5301.9	-0.1	0.1	-0.5	-0.1	0.0	-0.1
EM6	187611.7	2184518.3	5307.7	EM6	187611.6	2184518.5	5307.3	EM6	187611.5	2184518.3	5307.2	-0.1	0.0	-0.5	-0.1	-0.2	-0.1
EM7	187727.8	2184471.4	5304.4	EM7	187727.9	2184471.5	5304.0	EM7	187727.9	2184471.5	5303.8	0.1	0.0	-0.6	0.1	0.0	-0.1
EM8	187806.3	2184332.0	5298.2	EM8	187806.3	2184332.1	5297.8	EM8	187806.3	2184332.0	5297.9	-0.1	0.0	-0.3	0.0	-0.1	0.0

RECORD CONDITION SURVEY				Spring 2022 SURVEY				Fall 2022 SURVEY				RESULTS					
				Date of survey: 05/19/22				*Date of survey: 02/02/23*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM1	188086.9	2185027.4	5287.8	EM1	188087.0	2185027.4	5287.5	EM1	188086.8	2185027.3	5287.5	-0.1	-0.1	-0.3	-0.2	-0.1	0.0
EM2	187933.6	2184981.4	5297.1	EM2	187933.5	2184981.5	5296.8	EM2	187933.4	2184981.4	5296.7	-0.2	-0.1	-0.4	-0.2	-0.1	-0.1
EM3	187817.7	2185028.3	5303.4	EM3	187817.6	2185028.3	5303.1	EM3	187817.6	2185028.2	5303.0	-0.1	-0.2	-0.4	0.0	-0.2	-0.1
EM4	187781.1	2185204.9	5303.6	EM4	187781.1	2185204.9	5303.2	EM4	187780.7	2185204.9	5303.4	-0.4	0.0	-0.2	-0.4	0.0	0.2
EM5	187481.5	2184463.0	5302.4	EM5	187481.4	2184463.1	5301.9	EM5	187481.0	2184462.9	5302.0	-0.6	-0.1	-0.3	-0.4	-0.1	0.1
EM6	187611.7	2184518.3	5307.7	EM6	187611.5	2184518.3	5307.2	EM6	187611.0	2184518.3	5307.3	-0.7	0.0	-0.4	-0.5	0.0	0.1
EM7	187727.8	2184471.4	5304.4	EM7	187727.9	2184471.5	5303.8	EM7	187727.3	2184471.4	5304.2	-0.5	-0.1	-0.2	-0.6	-0.1	0.4
EM8	187806.3	2184332.0	5298.2	EM8	187806.3	2184332.0	5297.9	EM8	187805.9	2184332.0	5298.1	-0.5	-0.1	-0.1	-0.4	-0.1	0.2

RECORD CONDITION SURVEY				Fall 2022 SURVEY				Spring 2023 SURVEY				RESULTS					
				Date of survey: 02/02/23				*Date of survey: 05/14/23*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM1	188086.9	2185027.4	5287.8	EM1	188086.8	2185027.3	5287.5	EM1	188086.4	2185027.4	5287.7	-0.5	-0.1	-0.1	-0.4	0.0	0.2
EM2	187933.6	2184981.4	5297.1	EM2	187933.4	2184981.4	5296.7	EM2	187933.0	2184981.4	5296.9	-0.5	0.0	-0.2	-0.3	0.0	0.2
EM3	187817.7	2185028.3	5303.4	EM3	187817.6	2185028.2	5303.0	EM3	187817.3	2185028.4	5303.3	-0.4	0.0	-0.1	-0.3	0.2	0.3
EM4	187781.1	2185204.9	5303.6	EM4	187780.7	2185204.9	5303.4	EM4	187780.7	2185204.8	5303.4	-0.4	-0.1	-0.2	0.0	-0.1	-0.1
EM5	187481.5	2184463.0	5302.4	EM5	187481.0	2184462.9	5302.0	EM5	187480.9	2184463.0	5302.1	-0.6	0.0	-0.3	-0.1	0.1	0.0
EM6	187611.7	2184518.3	5307.7	EM6	187611.0	2184518.3	5307.3	EM6	187611.1	2184518.3	5307.4	-0.6	0.0	-0.3	0.1	0.0	0.1
EM7	187727.8	2184471.4	5304.4	EM7	187727.3	2184471.4	5304.2	EM7	187727.3	2184471.4	5304.1	-0.5	-0.1	-0.3	0.0	0.0	-0.1
EM8	187806.3	2184332.0	5298.2	EM8	187805.9	2184332.0	5298.1	EM8	187805.9	2184331.9	5297.9	-0.5	-0.1	-0.3	0.0	0.0	-0.2

CHANGE IN ELF EROSION/SETTLEMENT MONUMENT POSITION

RECORD CONDITION SURVEY				Spring 2023 SURVEY				Fall 2023 SURVEY				RESULTS					
				Date of survey: 05/14/23				*Date of survey: 01/03/24*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM1	188086.9	2185027.4	5287.8	EM1	188086.8	2185027.3	5287.5	EM1	188086.9	2185027.4	5287.6	0.0	0.0	-0.2	0.1	0.1	0.1
EM2	187933.6	2184981.4	5297.1	EM2	187933.4	2184981.4	5296.7	EM2	187933.5	2184981.4	5296.8	-0.1	0.0	-0.3	0.1	0.1	0.1
EM3	187817.7	2185028.3	5303.4	EM3	187817.6	2185028.2	5303.0	EM3	187817.7	2185028.3	5303.1	0.1	-0.1	-0.3	0.1	0.1	0.1
EM4	187781.1	2185204.9	5303.6	EM4	187780.7	2185204.9	5303.4	EM4	187781.2	2185204.9	5303.3	0.1	0.0	-0.3	0.5	0.0	-0.1
EM5	187481.5	2184463.0	5302.4	EM5	187481.0	2184462.9	5302.0	EM5	187481.4	2184463.0	5302.0	-0.1	0.0	-0.4	0.4	0.1	-0.1
EM6	187611.7	2184518.3	5307.7	EM6	187611.0	2184518.3	5307.3	EM6	187611.5	2184518.4	5307.1	-0.2	0.0	-0.6	0.4	0.1	-0.2
EM7	187727.8	2184471.4	5304.4	EM7	187727.3	2184471.4	5304.2	EM7	187727.7	2184471.5	5304.0	-0.1	0.0	-0.5	0.4	0.1	-0.2
EM8	187806.3	2184332.0	5298.2	EM8	187805.9	2184332.0	5298.1	EM8	187806.3	2184332.0	5297.8	0.0	-0.1	-0.4	0.5	0.0	-0.2

RECORD CONDITION SURVEY				Fall 2023 SURVEY				Spring 2024 SURVEY				RESULTS					
				Date of survey: 01/03/24				*Date of survey: 04/04/24*				CHANGE RELATIVE TO RECORD CONDITION			CHANGE RELATIVE TO PRIOR SURVEY		
Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	Point No.	Grid Northing	Grid Easting	Elevation	DELTA N	DELTA E	DELTA EL	DELTA N	DELTA E	DELTA EL
EM1	188086.9	2185027.4	5287.8	EM1	188086.9	2185027.4	5287.6	EM1	188086.9	2185027.4	5287.6	-0.05	-0.01	-0.19	-0.05	0.02	0.03
EM2	187933.6	2184981.4	5297.1	EM2	187933.5	2184981.4	5296.8	EM2	187933.5	2184981.5	5296.8	-0.09	0.05	-0.27	-0.02	0.05	0.04
EM3	187817.7	2185028.3	5303.4	EM3	187817.7	2185028.3	5303.1	EM3	187817.6	2185028.3	5303.2	-0.07	-0.01	-0.22	-0.14	0.04	0.07
EM4	187781.1	2185204.9	5303.6	EM4	187781.2	2185204.9	5303.3	EM4	187781.2	2185205.0	5303.4	0.14	0.10	-0.16	0.01	0.11	0.14
EM5	187481.5	2184463.0	5302.4	EM5	187481.4	2184463.0	5302.0	EM5	187481.4	2184463.1	5302.0	-0.13	0.09	-0.34	-0.01	0.10	0.07
EM6	187611.7	2184518.3	5307.7	EM6	187611.5	2184518.4	5307.1	EM6	187611.6	2184518.4	5307.2	-0.10	0.05	-0.47	0.11	0.02	0.13
EM7	187727.8	2184471.4	5304.4	EM7	187727.7	2184471.5	5304.0	EM7	187727.8	2184471.6	5304.0	-0.05	0.13	-0.38	0.09	0.09	0.08
EM8	187806.3	2184332.0	5298.2	EM8	187806.3	2184332.0	5297.8	EM8	187806.3	2184332.1	5297.9	-0.02	0.04	-0.30	-0.05	0.10	0.06

APPENDIX E

Monthly Flow Summaries

Monthly HWL LCS and LDS Sump Volume Readings

May 2023 through April 2024

Date	HWL LCS1		HWL LCS2		HWL LCS3		HWL LCS4	
	Totalizer Volume (gal.)	Increase in Volume (gal.)	Totalizer Volume (gal.)	Increase in Volume (gal.)	Totalizer Volume (gal.)	Increase in Volume (gal.)	Totalizer Volume (gal.)	Increase in Volume (gal.)
May-23	1580600.0	0.0	1296800.0	0.0	381000.0	0.0	1260000.0	0.0
June-23	1580600.0	0.0	1296800.0	0.0	381000.0	0.0	1260000.0	0.0
July-23	1581900.0	1300.0	1297000.0	200.0	381000.0	0.0	1267500.0	7500.0
August-23	1581900.0	0.0	1297000.0	0.0	381000.0	0.0	1267500.0	0.0
September-23	1581900.0	0.0	1297000.0	0.0	381000.0	0.0	1267500.0	0.0
October-23	1581900.0	0.0	1300500.0	3500.0	381000.0	0.0	1267500.0	0.0
November-23	1583200.0	1300.0	1300500.0	0.0	381000.0	0.0	1267500.0	0.0
December-23	1583200.0	0.0	1300500.0	0.0	381000.0	0.0	1267500.0	0.0
January-24	1583200.0	0.0	1300500.0	0.0	381000.0	0.0	1267500.0	0.0
February-24	1583200.0	0.0	1300500.0	0.0	381000.0	0.0	1267500.0	0.0
March-24	1583200.0	0.0	1303300.0	2800.0	381000.0	0.0	1267500.0	0.0
April-24	1584700.0	1500.0	1303300.0	0.0	381000.0	0.0	1267500.0	0.0

Date	HWL LDS1		HWL LDS2		HWL LDS3		HWL LDS4	
	Totalizer Volume (gal.)	Increase in Volume (gal.)	Totalizer Volume (gal.)	Increase in Volume (gal.)	Totalizer Volume (gal.)	Increase in Volume (gal.)	Totalizer Volume (gal.)	Increase in Volume (gal.)
May-23	29071.0	0.0	24088.0	0.0	23682.0	0.0	2374.0	0.0
June-23	29071.0	0.0	24088.0	0.0	23682.0	0.0	2374.0	0.0
July-23	29071.0	0.0	24088.0	0.0	23682.0	0.0	2374.0	0.0
August-23	29071.0	0.0	24088.0	0.0	23682.0	0.0	2374.0	0.0
September-23	29071.0	0.0	24088.0	0.0	23682.0	0.0	2374.0	0.0
October-23	29071.0	0.0	24088.0	0.0	23682.0	0.0	2374.0	0.0
November-23	29454.0	383.0	24088.0	0.0	23682.0	0.0	2374.0	0.0
December-23	29454.0	0.0	24088.0	0.0	23682.0	0.0	2374.0	0.0
January-24	29454.0	0.0	24088.0	0.0	23682.0	0.0	2374.0	0.0
February-24	29454.0	0.0	24088.0	0.0	23682.0	0.0	2374.0	0.0
March-24	29454.0	0.0	24742.0	654.0	23682.0	0.0	2819.0	445.0
April-24	29454.0	0.0	24742.0	0.0	23682.0	0.0	2819.0	0.0

Monthly ELF LCS and LDS Sump Volume Readings

May 2023 through April 2024

Date	ELF WPLCS		ELF LBLCS	
	Totalizer Volume (gal.)	Increase in Volume (gal.)	Totalizer Volume (gal.)	Increase in Volume (gal.)
May-23	15119.0	0.0	601924.0	0.0
June-23	15119.0	0.0	601924.0	0.0
July-23	15119.0	0.0	601924.0	0.0
August-23	15119.0	0.0	601924.0	0.0
September-23	15119.0	0.0	601924.0	0.0
October-23	15119.0	0.0	601924.0	0.0
November-23	15119.0	0.0	601924.0	0.0
December-23	15119.0	0.0	601924.0	0.0
January-24	15119.0	0.0	601924.0	0.0
February-24	15119.0	0.0	601924.0	0.0
March-24	15119.0	0.0	601924.0	0.0
April-24	15119.0	0.0	601924.0	0.0

Date	ELF WPLDS1		ELF WPLDS2		ELF LBLDS1		ELF LBLDS2	
	Totalizer Volume (gal.)	Increase in Volume (gal.)	Totalizer Volume (gal.)	Increase in Volume (gal.)	Totalizer Volume (gal.)	Increase in Volume (gal.)	Totalizer Volume (gal.)	Increase in Volume (gal.)
May-23	46584.0	0.0	135718.0	0.0	40237.0	0.0	35488.0	0.0
June-23	46584.0	0.0	135718.0	0.0	40237.0	0.0	35488.0	0.0
July-23	46584.0	0.0	135718.0	0.0	40237.0	0.0	35488.0	0.0
August-23	46584.0	0.0	135718.0	0.0	40237.0	0.0	35488.0	0.0
September-23	46584.0	0.0	135718.0	0.0	40237.0	0.0	35488.0	0.0
October-23	46584.0	0.0	135718.0	0.0	40237.0	0.0	35488.0	0.0
November-23	46584.0	0.0	135718.0	0.0	40237.0	0.0	35488.0	0.0
December-23	46584.0	0.0	135718.0	0.0	40237.0	0.0	35488.0	0.0
January-24	46584.0	0.0	135718.0	0.0	40237.0	0.0	35488.0	0.0
February-24	46584.0	0.0	135718.0	0.0	40237.0	0.0	35488.0	0.0
March-24	46584.0	0.0	135718.0	0.0	40237.0	0.0	35488.0	0.0
April-24	46584.0	0.0	135718.0	0.0	40237.0	0.0	35488.0	0.0

APPENDIX F-1

Hazardous Waste Landfill
Post-Closure Groundwater Monitoring Report
Calendar Year 2023

ROCKY MOUNTAIN ARSENAL

HAZARDOUS WASTE LANDFILL
POST-CLOSURE GROUNDWATER MONITORING REPORT

CALENDAR YEAR 2023

Revision 0
June 20, 2024

U.S. Department of the Army
Shell Oil Company

Prepared by:

Navarro Research and Engineering, Inc.

CONTENTS

Section **Page**

TABLES

FIGURES

SUPPORTING DOCUMENTATION

ACRONYMS

amsl	Above Mean Sea Level
ARDL	Applied Research and Development Laboratory
CAMU	Corrective Action Management Unit
CFS	Confined Flow System
CUSUM	Cumulative Sum
DQI	Data Quality Indicator
ELF	Enhanced Hazardous Waste Landfill
HWL	Hazardous Waste Landfill
IC	Indicator Compound
LCS	Leachate Collection System
LDS	Leak Detection System
MRL	Method Reporting Limit
µg/L	Microgram(s) per liter
NRAP	Non-Routine Action Plan
NWS	National Weather Service
OCN	Operational Change Notice
O&M	Operations and Maintenance
PCGMP	Post-Closure Groundwater Monitoring Plan
RMA	Rocky Mountain Arsenal
SOM	Supplemental Operational Monitoring
SQAPP	Sampling Quality Assurance Project Plan
UCL	Upper Confidence Limit
UFS	Unconfined Flow System

EXECUTIVE SUMMARY

The post-closure groundwater monitoring program for the Hazardous Waste Landfill (HWL) is designed to monitor groundwater flow directions, groundwater quality beneath and in the vicinity of the HWL and evaluate the potential for hazardous constituent releases into the groundwater sourced from the landfill.

This report covers the post-closure monitoring at the HWL for calendar year 2023 quarterly groundwater sampling events conducted in January, July, and October, and the annual sampling event in April. Groundwater flow directions beneath the HWL were consistent over the four quarters of 2023 post-closure monitoring and are consistent with previous groundwater monitoring events within the Corrective Action Management Unit area. As previously presented, a more pronounced groundwater high is present along the west side of the HWL consistent with recharge from the perimeter ditch located in the vicinity.

The wells sampled as part of the HWL 2023 post-closure groundwater monitoring include seven downgradient monitoring wells, four upgradient monitoring wells, and six Supplemental Operational Monitoring (SOM) wells. Downgradient wells 25086 and 25088 and SOM wells 25098 and 25100 were dry and not sampled in 2023. The groundwater samples were tested for a standard list of analytes including indicator compounds (ICs). The ICs selected for the monitoring program are presented in the *Hazardous Waste Landfill Post-Closure Groundwater Monitoring Plan* (HWL PCGMP) (Navarro 2019b).

Dieldrin was detected during all four quarters in downgradient well 25194 at concentrations ranging from 0.0159 micrograms per liter (µg/L) to 0.0703 µg/L. In July, the dieldrin concentration of 0.0703 µg/L exceeded the prediction limit of 0.05 µg/L. Per Table 3.0-2 of the *Hazardous Waste Landfill Post-Closure Plan* (HWL PCP) (Navarro 2019a) the regulatory agencies were notified of the exceedance via Non-Routine Action Plan (NRAP)-2023-003 on September 9, 2023 (Navarro 2023a).

The ICs detected in the SOM wells include 1,1,1-trichloroethane, 1,1-dichloroethene, 1,1-dichloroethane, 1,2-dichloroethane, carbon tetrachloride, chloroform, diisopropyl methylphosphonate (DIMP), dieldrin, and lead. The analytes detected in the SOM wells, with the exception of SOM well 25203, are associated with the North Plants-Bedrock Ridge contaminant plume. The analytical data from SOM wells are not used in the HWL statistical evaluations.

The ICs detected in the HWL leachate collection system (LCS) wastewater in 2023 include dichlorodifluoromethane, dicyclopentadiene, dieldrin, and DIMP, which are consistent with wastes placed in the landfills, and the chemical groups used to determine potential groundwater impacts.

No ICs were detected in the leak detection system (LDS) sumps in 2023. There were no LDS analytical results in 2023 that required regulatory agency notification per Table 3.0-2 of the HWL PCP (Navarro 2019a).

As a component of the data review process, the analytical data were evaluated against the Data Quality Indicators (DQIs) of precision, accuracy, representativeness, completeness, comparability and sensitivity. Based on the findings of the DQI evaluation, the sample results are considered valid and usable for their intended purpose. Data quality requirements were met for the analytical data, and the data are appropriate for use in evaluation of the water quality conditions present at the site.

Based on statistical evaluations and trend analysis, the groundwater quality around the HWL has not been affected by post-closure operations and maintenance of the landfill. The dieldrin concentrations in downgradient well 25194 are believed to be pre-existing contamination, which was investigated in accordance with NRAP-2016-004 (Navarro 2016b) and the *Hazardous Waste Landfill Groundwater Monitoring Wells 25194 and 25184 Subsurface Soil and Landfill Stormwater Runoff Sampling and Analysis Plan* (Navarro 2016a). Results of the investigation were documented in the *Hazardous Waste Landfill Groundwater Monitoring Wells 25194 and 25184 Subsurface Soil and Landfill Stormwater Runoff Data Summary Report* (Navarro 2019c). The Data Summary Report noted that the source of dieldrin detected in well 25194 during routine quarterly sampling was not definitively identified and recommended the continuation of routine sampling in accordance with the HWL PCGMP.

Based on the findings of previous investigations into the source of dieldrin in well 25194, and the abnormally high amount of precipitation that fell on the site in May and June of 2023, it is feasible that residual contamination was mobilized, resulting in an increased concentration of dieldrin that exceeded the prediction limit. As precipitation rates returned to previous levels, the dieldrin concentrations returned to a level below the prediction limit during the fourth quarter of 2023.

Based on the statistical evaluations and trend analysis, groundwater quality in the vicinity of the HWL has not been affected by operations, closure, or post-closure operations and maintenance of the landfill.

1.0 INTRODUCTION

The post-closure groundwater monitoring program for the Hazardous Waste Landfill (HWL) at the Rocky Mountain Arsenal (RMA) is designed to monitor groundwater flow directions, groundwater quality beneath and in the vicinity of the HWL and evaluate the potential for hazardous constituent releases into the groundwater sourced from the landfill. This report presents data generated by the HWL post-closure groundwater monitoring system in 2023 and an evaluation of the monitoring objectives.

Quarterly well sampling events were conducted in January, July, and October; and the annual sampling event was performed in April. The following information is presented in accordance with the *Hazardous Waste Landfill Post-Closure Groundwater Monitoring Plan* (HWL PCGMP) (Navarro 2019b).

- Groundwater level data collected from the HWL post-closure water level monitoring well network.
- Analytical results of groundwater samples collected from the HWL post-closure water quality monitoring well network.
- Analytical results of wastewater samples collected from the HWL Leachate Collection System (LCS) and Leak Detection System (LDS) sumps.
- Evaluation of data to determine compliance with post-closure groundwater monitoring criteria as presented in the HWL PCGMP.

Background information related to the HWL monitoring approach including site-specific characterization, applicable regulatory requirements, laboratory methods, statistical evaluation procedure, and monitoring program development are presented in the HWL PCGMP, the *Rocky Mountain Arsenal Sampling Quality Assurance Project Plan* (SQAPP) (Navarro 2019d), and previous annual groundwater reports.

2.0 GROUNDWATER MONITORING RESULTS

2.1 Field Activities

The field crew inspected the monitoring wells and well pads prior to each sampling event. As part of the annual sampling event, the casing height was measured prior to sampling the monitoring wells with dedicated pumps. The casing height and total depths were measured for monitoring wells without dedicated pumps. The inspection information, casing heights, and total depths are documented in the records.

Well 25122 has been noted as a dry well since monitoring began in 2002. An investigation in 2022 determined that the well was obstructed with sand approximately 4.4 feet above the top of the well screen. Based on this observation, well 25122 will not provide reliable data to support mapping of the potentiometric surface. The well was closed in September 2023 in accordance with recommendations presented in the *2022 HWL Post-Closure Groundwater Monitoring Report* (Navarro 2023c).

Operations and Maintenance Change Notice (OCN)-HWL-2023-001 (Navarro 2023b) was prepared in September of 2023 to address the closure of well 25122 and installation of replacement well 25222. The OCN also removed 25122 from the monitoring network listed in the HWL PCGMP and replaced it with new well 25222. Well 25222 was installed in October of 2023 and will be added to the monitoring network when OCN-HWL-2023-001 is approved by the regulatory agencies.

2.2 Groundwater Levels

The wells used in HWL post-closure groundwater level monitoring are presented in Table 3.1.2-1 of the HWL PCGMP and Figure 2.2-1 of this report. Water levels were measured quarterly in wells to evaluate the unconfined flow system (UFS) and confined flow system (CFS) flow conditions in the area of the Corrective Action Management Unit (CAMU) and to identify any significant changes in flow direction in the area of the CAMU.

Water level monitoring measurements are provided in Table 2.2-1. Figures 2.2-2 and 2.2-3 represent the April 2023 water table elevations for the UFS and the Denver Formation Lower Sandstone Unit within the UFS and CFS, respectively. The potentiometric surface of the UFS in the vicinity of the HWL shows that across the entire CAMU, groundwater flow is generally to the north and northwest. No significant variations in groundwater flow directions have been identified during post-closure monitoring.

Figure 2.2-2 shows a more pronounced groundwater high along the west side of the HWL similar to the observed water table over the past several years. This configuration of the water table is consistent with recharge from the grass-lined perimeter channel located along the west side of the HWL. This interpretation is further supported by the increasing trend in water elevations in other monitoring wells located on the west side of the HWL.

The potentiometric surface of the Denver Formation lower sandstone unit indicates flow from the CFS into the UFS downgradient of the HWL and illustrates the water table across the area and the interaction between the two flow systems. Groundwater flow in the lower sandstone unit of the CFS merges with the UFS on the north, west, and east sides of the HWL and the Enhanced Hazardous Waste Landfill (ELF). Currently, the zone where the UFS and CFS merge is illustrated by a dashed line for the approximate boundary indicating the lower sandstone unit in Figure 2.2-3. South of the line, the flow is confined to semi-confined, while north of the line the flow is unconfined where the confining unit is not present (TtFW 2004).

Water levels measured in well 25021, south and upgradient of the ELF, are not consistent with other monitoring wells within the CAMU area suggesting the screened zone is not hydraulically connected with the lower sandstone unit mapped in this report. Therefore, the water level measurement for well 25021 is not used in contouring the potentiometric surface for the lower sandstone unit.

2.3 Groundwater Quality

The HWL water quality network wells and Supplemental Operational Monitoring (SOM) wells are identified in Table 3.2-1 of the HWL PCGMP. Groundwater samples collected from the HWL water quality monitoring network were shipped to Applied Research and Development Laboratory (ARDL) in Mount Vernon, Illinois for analysis. Annual samples were analyzed for the complete analyte list as shown in Table 3.2-2 of the HWL PCGMP. Quarterly samples were analyzed for 16 indicator compounds (ICs) identified by bold text in Table 3.2-2 of the HWL PCGMP.

The ICs detected in the HWL network wells, SOM wells and sumps are shown in Figures 2.3-1 and 2.3-2, respectively.

2.3.1 Upgradient HWL Network Wells

The ICs detected in wells upgradient of the HWL are listed on Figure 2.3-1 with their respective concentrations and sample dates.

Detections of 1,1-dichloroethene, carbon tetrachloride, and chloroform in wells 25034 and 25121 are consistent with contaminants associated with the North Plants-Bedrock Ridge plumes. Concentrations of 1,1-dichloroethene in well 25034 have an increasing statistical trend, with the exception of a non-detection in 2015. Carbon tetrachloride was first detected in well 25034 in 2021. The concentrations of chloroform continue to show a decreasing statistical trend in well 25121, and carbon tetrachloride is stable. Detections of 1,1-dichloroethene and carbon tetrachloride in these upgradient HWL wells suggest the wells are in the flow path of the North Plants-Bedrock Ridge plume on the eastern edge of the HWL. An increase or change in the concentrations suggests variability within the plume.

Although lead was detected in upgradient wells 25034, 25101, and 25121, it was not detected in downgradient wells. The levels of lead in groundwater upgradient of the HWL appear consistent for all wells with detected concentrations just above the method reporting limit of 3 µg/L, which may be indicative of the natural water quality of the Denver Formation.

2.3.2 Downgradient HWL Network Wells

The ICs detected in wells downgradient of the HWL are listed on Figure 2.3-1 with their respective concentrations and sample dates. Arsenic was the only IC detected in the downgradient CFS wells (25195 only). Dieldrin was the only IC detected in the downgradient UFS wells (25087 and 25194). Refer to Section 3.1 for a description of potential sources of dieldrin in well 25194.

2.3.3 SOM Network Wells

SOM network wells 25091, 25099, 25189, and 25203 are sampled annually. SOM wells 25098 and 25100 were dry in 2023. The ICs detected in SOM wells are listed on Figure 2.3-1 with their respective concentrations and sample dates. The results of sampling SOM wells are consistent with groundwater quality associated with the North Plants plume. While ICs, including the volatile organic compounds, DIMP and dieldrin were detected in wells 25091, 25099, and 25189, these results are not consistent with analytical data for LCS2, LCS4, LDS2, and LDS4

located on the eastern side of the HWL. More than likely, the ICs detected in SOM wells along the eastern side of the HWL are attributed to the North Plants plume where these constituents were historically detected in groundwater where migration through the Denver Formation is much slower than in the alluvial sediments of the UFS.

2.4 LCS and LDS Wastewater Analytical Results

The HWL includes four LCS sumps and four LDS sumps. Wastewater samples collected from the HWL sumps were submitted to ARDL in Mount Vernon, Illinois for analysis. The first sample of the year collected from each sump was analyzed for the list of analytes shown on Table 3.2-2 of the HWL PCGMP. All subsequent samples were tested for an abbreviated list of analytes shown on Table 3.2.5-2 of the HWL PCGMP.

Per the HWL PCGMP sump sampling shall be performed prior to removal of wastewater from an HWL sump. The wastewater samples were collected to meet the post-closure monitoring requirements specified in the HWL PCGMP (Navarro 2019b) and were used to evaluate the chemistry of the wastewater to determine potential leakage from the HWL. The ICs detected in the HWL sumps are presented in Figure 2.3-2. Analytical results from the 2023 sampling events at the LCS and LDS sumps are included in the Supporting Documentation files.

2.4.1 LCS Wastewater

The ICs detected in the HWL LCS wastewater in 2023 include dichlorodifluoromethane, dicyclopentadiene, dieldrin, and DIMP, which are consistent with wastes placed in the landfills, and the chemical groups used to determine potential groundwater impacts.

2.4.2 LDS Wastewater

No ICs were detected in the wastewater of LDS1 in 2023. Water levels were not high enough in 2023 to initiate sampling in LDS2, LDS3 and LDS4. There were no LDS analytical results in 2023 that required regulatory agency notification per Table 3.0-2 of the *Hazardous Waste Landfill Post-Closure Plan* (HWL PCP) (Navarro 2019a).

2.5 Analytical Data Review

The objective of the analytical data review is to determine whether the analytical results are acceptable for use in making decisions for the project. As a component of the data review process, the analytical data are reviewed using the Data Quality Indicators (DQI) including precision, accuracy, representativeness, completeness, comparability, and sensitivity to interpret the degree of acceptability of data. These six parameters are identified in the SQAPP (Navarro 2019d). Failure to meet performance criteria did not necessarily result in rejection or qualification of the data. Professional judgment combined with the DQI evaluation were used to determine data usability.

The analytical data were collected in accordance with the HWL PCGMP and were reviewed consistent with the DQI process as presented in the SQAPP. Results of the DQI review are summarized below in Table 2.5-1, and data are presented in the Supporting Documentation accompanying this report.

Table 2.5-1. Data Quality Summary

Indicator	Summary
Precision	A total of 271 duplicate pair analyses of HWL target analytes were performed. Duplicate and investigative results are considered comparable in 269 cases and not comparable in 2 cases. *The data are considered acceptable for their intended use and no additional action in addition to the data qualification is considered necessary.*
Accuracy/Bias	The average recovery rate for the 1,205 matrix spike analyses was 90.9 percent. Recovery rates outside the lower or upper warning limits were observed in 40 analyses. Recovery rates outside the lower or upper control limits were observed in eight analyses. *No issues were identified requiring data qualification.* The average recovery rate for the 1,205 corresponding laboratory control spike analyses was 100.2 percent. Recovery rates outside the lower or upper warning limits were observed in 22 analyses. Recovery rates outside the lower or upper control limits were observed in two analyses. *No issues were identified requiring data qualification.*
Representativeness	Field blanks are collected and analyzed to evaluate possible cross contamination of the investigative samples. A total of 79 field blank analyses were performed. There were two field blank analyses above the Method Reporting Limit (MRL). Both analyses associated investigative values were reported at less than the MRL. *No qualification of the data is required.*
Completeness	Completeness was calculated at 100 percent. The completeness goal of 90 percent was achieved. *All results were determined to be acceptable by the laboratory.* Note – Missed cyanide analysis documented in NRAP-2023-001 (Navarro 2023d) did not impact the completeness calculation because the samples were not analyzed.
Comparability	Standard sampling and analysis techniques, based on certified analytical methods approved by Navarro or promulgated SW-846 methods, and standard procedures for sample collection were used throughout the groundwater monitoring programs at the HWL. Consistent procedures for the reporting and management of the data generated were also followed. *All data are considered comparable.*
Sensitivity	The laboratories prepared and analyzed method blanks as part of their analytical protocols. Method blanks measure potential contamination from laboratory sources such as glassware, reagents, and laboratory water. There were 1,354 method blank analyses in 2023 with 2 detections above the MRL. *Data qualification is not necessary as the associated investigative data is below the MRL*.

2.5.1 Data Quality Control Review

Data validation was conducted on a representative subset of the HWL groundwater analytical data. Validation checklists were completed, and laboratory case narratives were reviewed to determine potential problems identified by the analysts. The completeness result for all analytes achieves the minimum specification of 90 percent. No data were flagged as rejected in 2023.

Table 2.5.1-1 presents a summary of the quality control samples collected and analyzed to support HWL groundwater monitoring in 2023.

Table 2.5.1-1. Quality Control Samples

Sample Type/Site ID	Sample Date(s)
Field Duplicates	
25085	4/12/2023
25102	4/13/2023
Laboratory Duplicates	
LCS3	2/21/2023
25087	4/10/2023
25195	4/12/2023
25102	4/13/2023
25101	4/17/2023
25203	4/25/2023
LDS1	11/6/2023
Field Blanks	
25183	4/12/2023

2.5.2 Data Usability Evaluation

A data usability evaluation was conducted on 2,027 records. The evaluation identified two statistical outliers.

Based on the findings of the DQI review, the sample results are considered valid and usable for their intended purpose. Data quality requirements were sufficiently met for the analytical data, and data are appropriate for use in evaluation of the water quality conditions present at the site. The primary objectives of the sampling program were met.

3.0 STATISTICAL EVALUATIONS

The statistical evaluation of data includes comparing upgradient water quality to downgradient compliance wells utilizing prediction intervals that are calculated for each IC using upgradient water quality data. The prediction limits discussed in this section refer to the upper limit of each analyte-specific prediction interval. Comparison of downgradient water quality data to prediction limits should provide an indication whether groundwater has been impacted by the HWL.

The wells used to calculate prediction limits and statistical evaluations are presented in Table 3.0-1. A prediction interval was calculated for each IC, which included upgradient water quality data through the 2022 post-closure monitoring period. Sections 3.1 presents the results of the statistical evaluations for the HWL. The general approach for determining and evaluating prediction limits for the HWL is consistent with United States Environmental Protection Agency guidance document, *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance* (EPA 2009).

ChemStat statistical analysis software (StarPoint Software 2023) is utilized to calculate the prediction limit values, and statistical software output is available in the Supporting Documentation files. The prediction limit values for 2024 are included in Table 3.0-3. If a compound was not detected in any sample, the default non-parametric prediction limit for the analyte is the 99 percent upper confidence limit (UCL). In accordance with the PCGMP, the 99 percent UCL is defined as 1.3 times the MRL.

3.1 2023 Prediction Limits and the Current HWL Water Quality Data

Table 3.0-2 presents the 2023 prediction limits that were calculated using upgradient well data collected during the pre-operational, operational, closure, and post-closure groundwater monitoring periods (1996–2022).

The analytical results of samples collected from the downgradient HWL groundwater monitoring network in 2023 were compared to the prediction limits presented in Table 3.0-2 to determine whether groundwater quality was impacted by the HWL.

Dieldrin and arsenic were the only ICs detected in the downgradient wells. Arsenic was detected in CFS well 25195. Dieldrin was detected in UFS wells 25087 and 25194.

While dieldrin was detected in well 25087 at a concentration less than the prediction limit, in well 25194 concentrations ranged from 0.0159 to 0.0703 µg/L. The dieldrin concentration in the sample collected in July 2023 was 0.0703 µg/L, which exceeded the prediction limit of 0.05 µg/L. However, the concentration decreased to below the prediction limit in October 2023 (Figure 2.3-1).

Further evaluation of dieldrin in 25194 included an intrawell statistical comparison performed using a combined Shewhart-CUSUM control chart to determine whether the HWL contributed to the presence of dieldrin in groundwater at well 25194. The plotted data were collected quarterly from July 2011 through October 2023, with the initial eight dieldrin samples in well 25194 used as the baseline. The baseline data were determined to be from a normal distribution with no

outliers. These data were used to calculate the cumulative sum (CUSUM) and control limit. The EPA guidance, *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance* (EPA 2009), recommends using a control limit equal to five (h=5) standard deviations above the mean value for baseline data. The combined Shewhart-CUSUM control chart for dieldrin is included as Figure 3.1-1.

Figure 3.1-1 shows that the dieldrin concentrations began to increase in early 2016 while the CUSUM continued to increase until late 2017. Groundwater levels increased in well 25194, beginning in July 2015, which may have mobilized residual soil contamination that the Army believes existed prior to construction of the HWL. The control chart shows an apparent decreasing concentration trend since 2016, which is also reflected in the calculated CUSUM (Figure 3.1-1). Dieldrin concentrations did not exceed the control limit in 2023.

Control charts are useful in evaluating the potential for future impacts to groundwater based on comparisons to baseline data. It should be noted that no baseline data were collected for well 25194 or its predecessor before the HWL was constructed, and the dieldrin concentrations observed since the remedy may be within the historical range of the suspected pre-existing contamination. The intrawell comparison was included in the HWL PCGMP as another method to evaluate groundwater data in the HWL monitoring well networks in addition to the use of prediction limits.

The source of dieldrin in well 25194 was evaluated in accordance with Non-Routine Action Plan (NRAP)-2016-004 and the *Hazardous Waste Landfill Groundwater Monitoring Wells 25194 and 25184 Subsurface Soil and Landfill Stormwater Runoff Sampling and Analysis Plan* (Navarro 2016). The results of the evaluation were presented in the *Hazardous Waste Landfill Groundwater Monitoring Wells 25194 and 25184 Subsurface Soil and Landfill Stormwater Runoff Data Summary Report* (Navarro 2019c). The Data Summary Report noted that the source of dieldrin detected in well 25194 during routine quarterly sampling was not definitively identified and recommended the continuation of routine sampling in accordance with the HWL PCGMP.

Fluctuations in dieldrin concentrations may indicate seasonal variability related to the water level changes. Precipitation for the Denver, Colorado area in May of 2023 was 5.53 inches and June was 6.10 inches according to the National Weather Service (NWS). These values are nearly three times more than average. Precipitation recorded over these two months at RMA was slightly more than the NWS values in May and slightly less in June. The average precipitation for the first eight months of the year is 11.15 inches. As of August 30, 2023, the NWS recorded 17.45 inches of precipitation at Denver International Airport, while 18.31 inches of precipitation were recorded at RMA.

Based on the findings of previous investigations into the source of dieldrin in well 25194, and the abnormally high amount of precipitation that fell on the site in May and June of 2023, it is feasible that residual contamination was mobilized, resulting in an increased concentration of dieldrin that exceeded the prediction limit. As precipitation rates returned to normal levels, the

dieldrin concentrations returned to a level below the prediction limit during the fourth quarter of 2023.

Based on these statistical evaluations and trend analysis, it is concluded that groundwater quality in the vicinity of the HWL has not been affected by operations, closure, or post-closure operations and maintenance (O&M) of the landfill.

3.2 2024 Prediction Limits

Table 3.0-3 presents the upper prediction limits that will be applied to downgradient wells in 2024. The MRLs can change based on the method re-certification required every three years by the SQAPP. MRLs did not change for the ICs analyzed in upgradient wells in 2023, and therefore did not impact the prediction limits calculated for 2024 as presented in Table 3.0-3.

4.0 SUMMARY

The following summary is based on the groundwater and wastewater monitoring results for the 2023 post-closure monitoring at the HWL:

- The groundwater in the UFS and CFS flows to the north-northwest and is consistent with previous groundwater monitoring events for the HWL.
- Based on the findings of the DQI review, the analytical data collected are of acceptable quality for intended uses.
- Dieldrin exceeded its prediction limit in well 25194 in July of 2023. The regulatory agencies were notified of the exceedance via NRAP-2023-003. Concentrations returned to below the prediction limit in October of 2023. Fluctuations in the concentrations of dieldrin in groundwater may indicate seasonal variability related to the water level changes.
- The combined Shewhart-CUSUM control chart for dieldrin in well 25194 showed concentrations did not exceed the control limit, and the calculated CUSUM did not exceed the control limit, thus supporting the general downward trend in dieldrin concentrations in groundwater at this location.
- The LCS sample results indicate that the ICs used in the statistical evaluations for the HWL are representative of the waste placed in the HWL and are appropriate for the contaminants present in the HWL leachate.
- No ICs were detected in the HWL sump LDS1 in 2023. Sump levels were not high enough in 2023 to initiate sampling in LDS2, LDS3 and LDS4.
- Prediction limit values for all ICs were re-evaluated for 2024. No prediction limits were adjusted.

Based on the statistical evaluations and trend analysis, groundwater quality in the vicinity of the HWL has not been affected by operations, closure, or post-closure O&M of the landfill.

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TABLES

Table 2.2-1. 2023 Water Level Measurements

Well ID	Groundwater Elevations (ft amsl)			
	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Unconfined Flow System				
25003	5152.46	5152.36	5152.38	5152.54
25004	5217.52	5217.17	5217.27	5217.6
25015	5159.28	5159.09	5159.32	5159.62
25018	5164.02	5164.18	5164.82	5164.72
25022	5219.87	5219.61	5219.67	5219.85
25023	5218.56	5218.08	5218.41	5218.6
25027	5180.42	5180.3	5180.57	5180.61
25032	Dry	Dry	Dry	Dry
25041	5184.49	5184.75	5185.33	5185.17
25048	5171.42	5171.61	5172.23	5172.06
25054	5173.79	5173.95	5174.32	5174.38
25059	5178.38	5178.59	5179.12	5179.01
25086	Dry	Dry	Dry	Dry
25087	5166	5165.46	5165.94	5166.29
25088	Dry	Dry	Dry	Dry
25091	5169.55	5169.28	5169.69	5170.11
25092	5180.72	5180.42	5180.62	5180.7
25098	Dry	Dry	Dry	Dry
25099	5168.5	5168.31	5168.68	5169
25100	Dry	Dry	Dry	Dry
25102	5180.46	5180.19	5180.34	5180.35
25105	5217.45	5216.86	5217.45	5217.69
25106	5205.33	5204.89	5205.04	5205.03
25120	5188.55	5187.72	5188.35	5190.61
25121	5180.46	5179.96	5180.32	5180.32
25122 [1]	—	—	—	—
25189	5166.37	5166.45	5166.81	5167.15
25194	5180.83	5180.56	5181.69	5181.5
25203	5180.27	5180.19	5180.59	5180.57
25500	5217.36	5217.11	5217.34	5217.64
25502	5184.54	5184.69	5185.07	5185.19
26040	5147.44	5147.36	5147.42	5147.39
26051	5162.21	5162.06	5162.15	5162.08
26073	5177.7	5177.61	5177.7	5177.87
26097	5184.04	5183.88	5184.04	5184.4
26099	5182.04	5181.62	5182.03	5183.11
26158	5179.36	5179.23	5179.45	5179.86
26159	5202.41	5202.16	5202.39	5203.73
26164	5144.28	5144.19	5144.28	5144.15
26170	5139.71	5139.63	5139.61	5139.7
26175	5156.54	5156.44	5156.6	5157.13
26176	Dry	Dry	Dry	Dry
26177	5157.98	5157.82	Dry	Dry
26178	Dry	Dry	5182.29	Dry

Table 2.2-1. 2023 Water Level Measurements

Well ID	Groundwater Elevations (ft amsl)			
	Quarter 1	Quarter 2	Quarter 3	Quarter 4
26179	5167.96	5167.84	5168.03	5167.78
26180	5177.5	5177.44	5177.41	5177.55
26181	5166.87	5166.7	5166.8	5166.53
26182	5176.17	5176.08	5176.06	5176.11
26183	5165.28	5165.21	5165.19	5165.19
26184	Dry	Dry	Dry	Dry
26186	5163.99	5163.91	5163.83	5163.9
36186	5235.82	5235.59	5235.5	5238.25
Confined Flow System				
25016	5153.33	5153.18	5153.55	5153.29
25017 [2]	5154.48	5154.42	—	—
25019	5162.19	5162.16	5162.65	5162.46
25020	5148.35	5148.41	5149.12	5148.79
25021	5174.05	5173.96	5173.95	5174.01
25024	5202.23	5201.75	5202.22	5201.74
25034	5172.62	5172.07	5172.59	5172.9
25085	5164.31	5163.8	5164.23	5164.62
25093	5170.22	5170.62	5170.87	5171.01
25101	5173.45	5173.24	5173.63	5173.84
25123	5175.24	5175.19	5175.46	5175.64
25183	5163.67	5163.16	5163.63	5164.14
25195	5165.15	5164.86	5165.21	5165.78
26150	5171.02	5170.83	5170.91	5171.05
26185	5151.43	5151.34	5151.61	5151.61

Notes:

[1] Water not encountered at depth due to obstruction in well comprised of sand filter pack.

[2] Possible blockage suspected at depth in well; water not encountered.

amsl – above mean sea level

Table 3.0-1. HWL Groundwater Monitoring Well Usage

Well/ Designation	Data Used to Calculate Current (2023) Prediction Limits [1]			Prediction Limits Applied to Downgradient Wells Quarterly in 2023
	Data Used to Calculate Baseline (2009) Prediction Limits		Upgradient Data from Post-Closure Monitoring Period 5/21/2009 to 11/3/2022	
	Upgradient/Downgradient Data from Pre-operational Monitoring Period 10/1/1996 to 4/30/1999	Upgradient Data from Operational/Closure Monitoring Period 5/11/1999 to 5/20/2009		
Upgradient				
25034	X	X	X	
25101	X	X	X	
25102	X	X	X[2]	
25121		X	X	
Upgradient – Abandoned prior to post-closure monitoring				
25008	X			
25033	X			
25037	X	X		
25065	X			
25076B	X			
25081	X	X		
25082	X	X		
Downgradient				
25085	X			X
25087	X			X
25183	Refer to Well 25083 for pre-operational data			X
25194				X
25195				X
25086				Dry wells; no samples collected
25088				
Downgradient – Abandoned prior to post-closure monitoring				
25083	X			

Note:

[1] Analytical results from the pre-operational, operational, closure, and post-closure monitoring periods utilized to calculate the current HWL prediction limits are available in the Supporting Documentation files.

[2] 25102 is sampled quarterly because it is also part of the Enhanced Hazardous Waste Landfill downgradient water quality network.

Table 3.0-2. Prediction Limits for HWL 2023 Water Quality Monitoring

Indicator Compound	Current Method Reporting Limit (µg/L)	Proportion of Upgradient Non-detected Sample Values (2006-2022)	Statistical Method Used	Selected Prediction Limit (µg/L)
Volatile Organic Compounds				
1,1,1-Trichloroethane	0.2	97.6	Non-parametric	0.395
1,1-Dichloroethane[1]	0.2	100	Non-parametric	0.26
1,1-Dichloroethene	0.22	89.5	Non-parametric	7.79
1,2-Dichloroethane	0.2	94.3	Non-parametric	0.9
Benzene	0.2	99.5	Non-parametric	1.17
Bicycloheptadiene [1]	0.221	100	Non-parametric	0.29
Carbon tetrachloride	0.2	89	Non-parametric	11.8
Chloroform	0.2	81	Non-parametric	4.72
Dichlorodifluoromethane [1]	0.6	100	Non-parametric	0.78
Dicyclopentadiene [1]	0.21	100	Non-parametric	0.26
Organochlorine Pesticides				
Dieldrin	0.00252	98.6	Non-parametric	0.05
Organophosphorus Compounds				
DIMP [1]	0.602	100	Non-parametric	0.78
Metals				
Arsenic	1	99.1	Non-parametric	3.35
Chromium	10	95.3	Non-parametric	24.1
Lead	3	80.3	Non-parametric	15
Mercury [1]	0.2	100	Non-parametric	0.26

Notes:

[1] Because this compound was not detected in any sample, the non-parametric prediction limit value for this analyte is the 99 percent upper confidence limit (UCL). For the purpose of this report, the 99 percent UCL is defined as 1.3 times the MRL.

[2] The reporting limits have changed as a result of an MRL study required by the SQAPP for method recertification every three years.

µg/L – micrograms per liter

Table 3.0-3. Prediction Limits for HWL 2024 Water Quality Monitoring

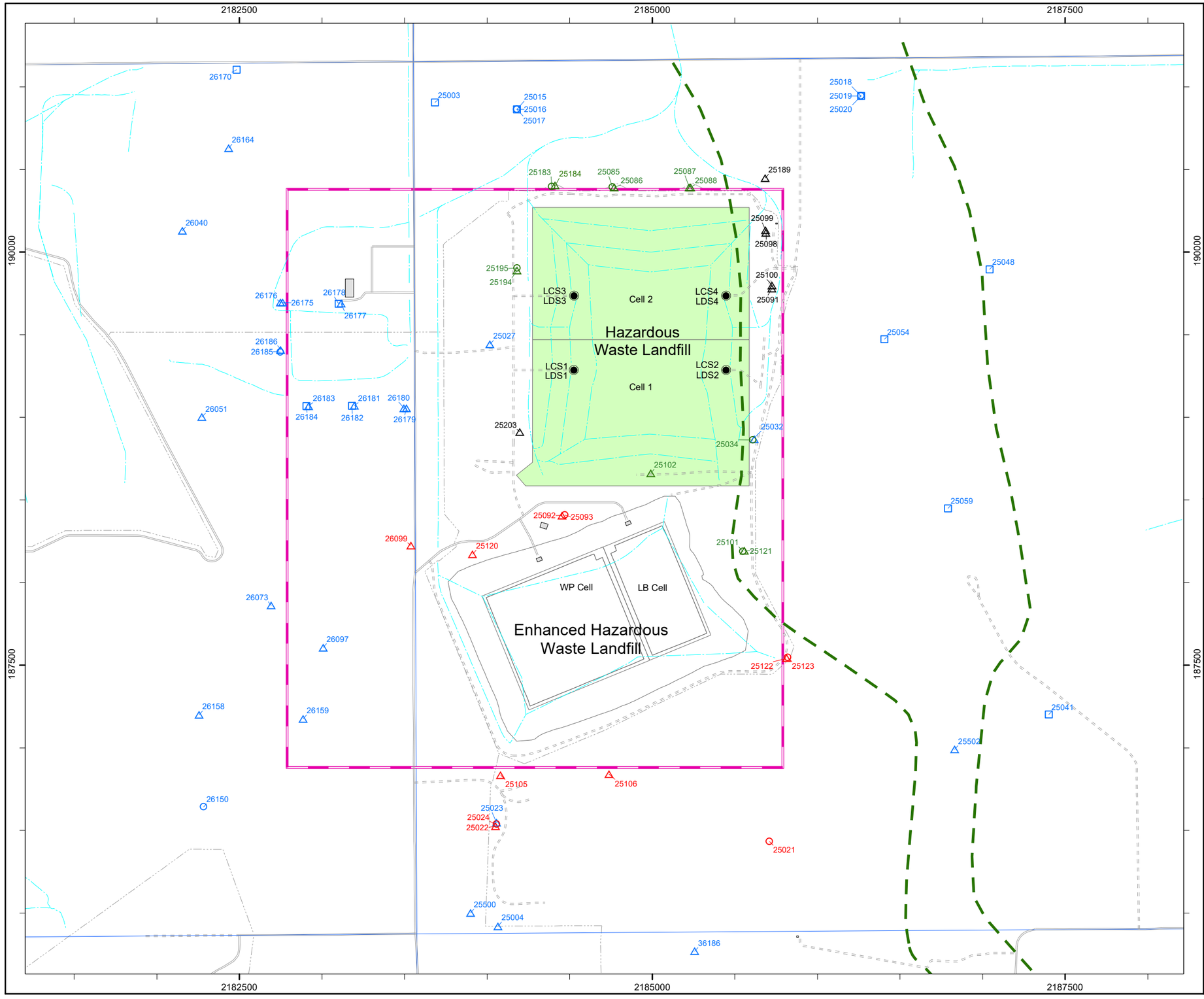
Indicator Compound	Current Method Reporting Limit (µg/L)	Proportion of Upgradient Non-detected Sample Values (2006-2023)	Statistical Method Used	Statistical Distribution	Selected Prediction Limit (µg/L)
Volatile Organic Compounds					
1,1,1-Trichloroethane	0.2	97.7	Non-parametric	Unknown	0.395
1,1-Dichloroethane[1]	0.2	100	Non-parametric	Unknown	0.26
1,1-Dichloroethene	0.2	89.4	Non-parametric	Unknown	7.79
1,2-Dichloroethane	0.2	94.5	Non-parametric	Unknown	0.9
Benzene	0.2	99.5	Non-parametric	Unknown	1.17
Bicycloheptadiene [1]	0.22	100	Non-parametric	Unknown	0.29
Carbon tetrachloride	0.2	88.5	Non-parametric	Unknown	11.8
Chloroform	0.2	80.6	Non-parametric	Unknown	4.72
Dichlorodifluoromethane [1]	0.6	100	Non-parametric	Unknown	0.78
Dicyclopentadiene [1]	0.2	100	Non-parametric	Unknown	0.26
Organochlorine Pesticides					
Dieldrin	0.00252	98.6	Non-parametric	Unknown	0.05
Organophosphorus Compounds					
DIMP [1]	0.602	100	Non-parametric	Unknown	0.78
Metals					
Arsenic	1	99.1	Non-parametric	Unknown	3.35
Chromium	10	95.5	Non-parametric	Unknown	24.1
Lead	3	79.5	Non-parametric	Unknown	15
Mercury [1]	0.2	100	Non-parametric	Unknown	0.26

Notes:

[1] Because this compound was not detected in any sample, the non-parametric prediction limit value for this analyte is the 99 percent upper confidence limit (UCL). For the purpose of this report, the 99 percent UCL is defined as 1.3 times the MRL.

µg/L – micrograms per liter

FIGURES



Legend

- Sumps
- 2014 North Plants/ Bedrock Ridge Plume Extent
- CAMU Boundary
- Buildings
- ELF Cells
- Section Lines
- Light Duty Roads
- Unpaved Roads
- Fences
- Ditches, Canals

Monitoring Well Network	Flow System/Aquifer		
	Unconfined Alluvial	Unconfined Denver	Confined Denver
Hazardous Waste Landfill (HWL)		△	○
HWL Supplemental Operations		△	
Enhanced Hazardous Waste Landfill (ELF)		△	○
Water Level Only	□	△	○

N

0 300 600 1,200

Feet

Sources: U.S. Army, RMA GIS, OMC, Shell/AECOM

NAD27-NGVD29 Datum, US Survey Feet, Colorado North Zone

Program Manager
Rocky Mountain Arsenal

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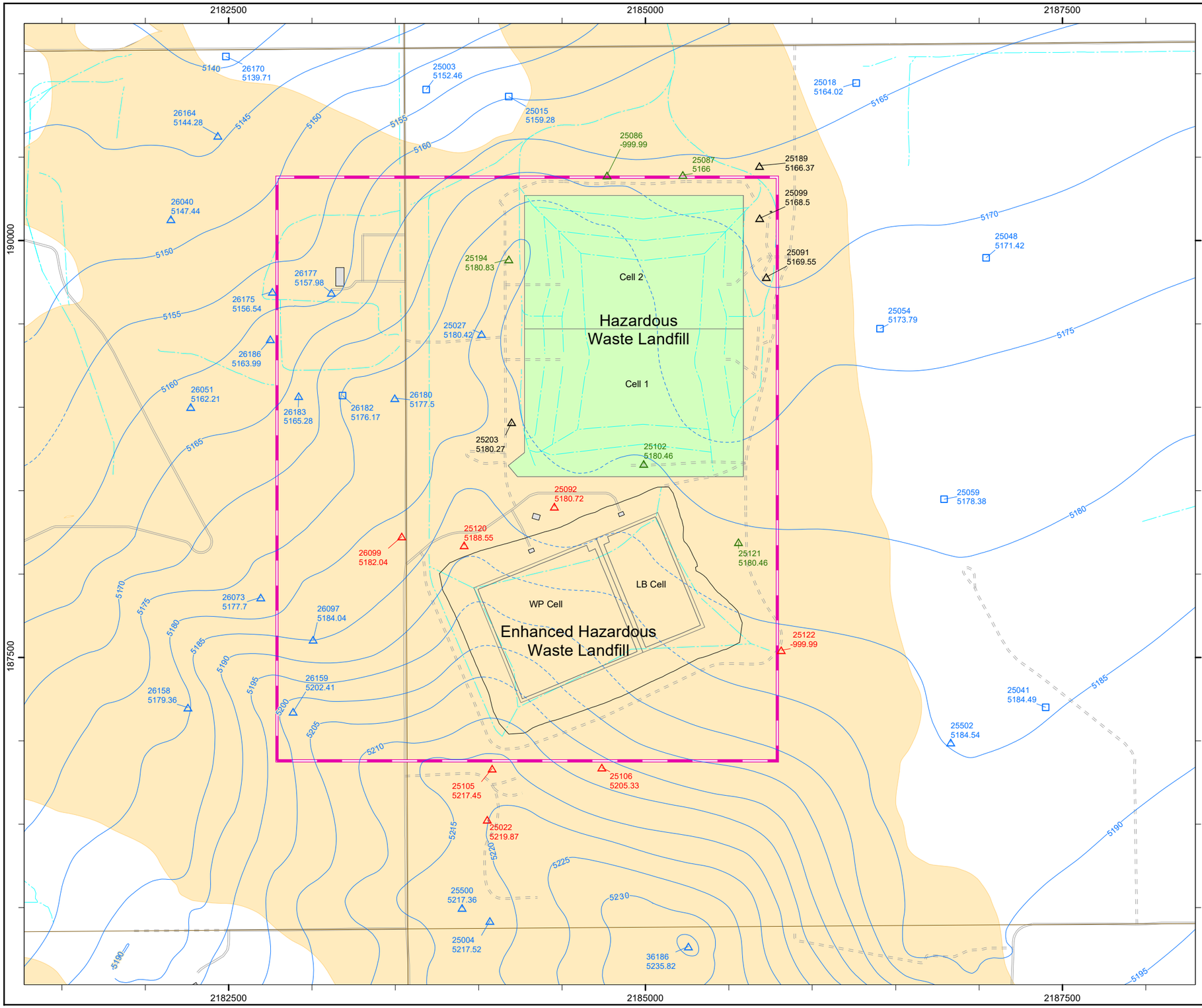
Figure 2.2-1

Well/Piezometer/Sump Location Map
2023 Groundwater Monitoring

M:\projects\hwl_post-closure\2023\mxds\hwl_well_piezometer_loc_2023.mxd
6/2/2024



Legend

- CAMU Boundary
- Section Lines
- Light Duty Roads
- Unpaved Roads
- Ditches, Canals
- Buildings
- Unsaturated Alluvium
- Water Elevation Contours - 5-foot intervals
- Inferred Water Elevation Contours

Monitoring Well Network	Flow System/Aquifer	
	Unconfined Alluvial	Unconfined Denver
Hazardous Waste Landfill (HWL)		△
HWL Supplemental Operations		△
Enhanced Hazardous Waste Landfill (ELF)		△
Water Level Only	□	△

N

0 300 600 1,200
Feet

NAD27-NGVD29 Datum, US Survey Feet, Colorado North Zone

Sources: U.S. Army, RMA GIS, OMC, Shell/AECOM

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Figure 2.2-2

Potentiometric Surface of the Unconfined Flow System, Hazardous Waste Landfill April 2023

M:\projects\hwl_post-closure\2023\mxds\hwl_ufs_fy23.mxd
5/31/2024

2182500 2185000 2187500

190000 187500

25016 5153.18
25019 5162.16
26164 5144.19
26040 5147.36
25183 5163.16
25085 5163.80
25087 5165.46
25189 5166.45
25099 5168.31
25195 5164.86
26177 5157.82
26175 5156.44
25091 5169.28
26186 5163.91
26179 5167.84
26183 5165.21
26051 5162.06
26181 5166.70
25034 5172.07
25093 5170.62
25101 5173.24
25123 5175.19
25105 5216.86
25106 5204.89
26150 5170.83
25024 5201.75

5145 5150 5155 5160 5165 5170 5175 5180 5185 5190 5195 5200 5205

Hazardous Waste Landfill

Enhanced Hazardous Waste Landfill

Legend

- Approximate Boundary of the Lower Sandstone Units
- 2014 North Plants/ Bedrock Ridge Plume Extent
- CAMU Boundary
- Light Duty Roads
- Unpaved Roads
- Ditches, Canals
- Section Lines
- Buildings
- Unsaturated Alluvium
- Water Elevation Contours - 5-foot Invervals
- Inferred Water Elevation Contours

Monitoring Well Network	Flow System/Aquifer	
	Confined Denver	Unconfined Denver
Hazardous Waste Landfill (HWL)	○	△
HWL Supplemental Operations		△
Enhanced Hazardous Waste Landfill (ELF)	○	△
Water Level Only	○	△

N

0 500 1,000
Feet

NAD27-NGVD29 Datum, US Survey Feet, Colorado North Zone

Sources: U.S. Army, RMA GIS, OMC, Shell/AECOM

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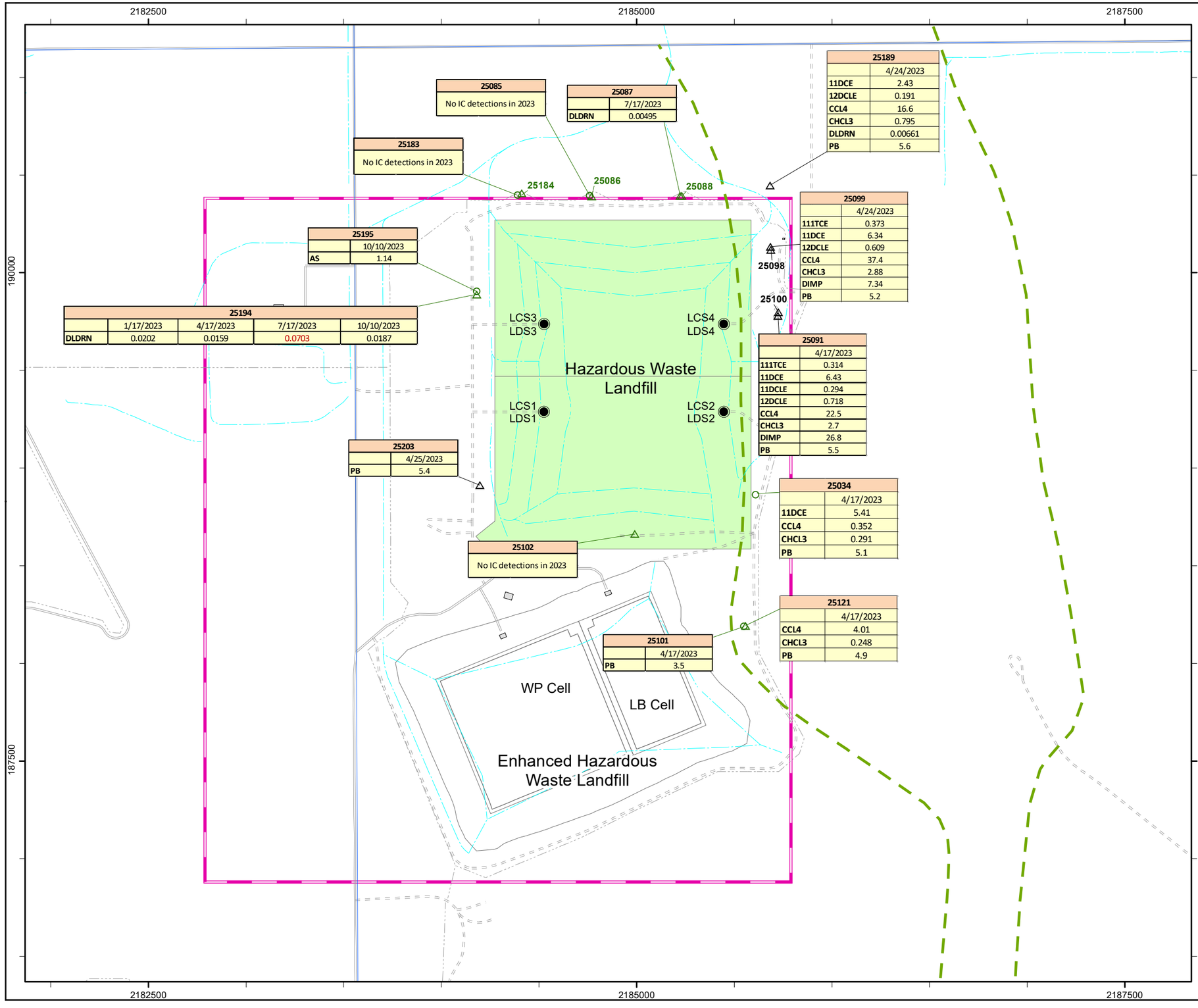
Figure 2.2-3

Potentiometric Surface for the Lower Sandstone Unit and Equivalent Units, April 2023

M:\projects\hwl_post-closure\2023\mxds\hwl_lwr_sandstoneWL_2023.mxd
6/2/2024



Legend

- Ditches, Canals
- 2014 North Plants/ Bedrock Ridge Plume Extent
- CAMU Boundary
- Section Lines
- Fences
- Light Duty Roads
- Unpaved Roads
- Buildings
- ELF Cells
- Sumps

Note: [1] Concentrations are in micrograms per liter
[2] Data shown from calendar year 2023
[3] Value in red exceeds the 2023 Prediction Limit

Monitoring Well Network	Flow System/Aquifer		
	Unconfined Alluvial	Unconfined Denver	Confined Denver
Hazardous Waste Landfill (HWL)		△	○
HWL Supplemental Operations		△	

N

0 250 500 1,000
Feet

NAD27-NGVD29 Datum, US Survey Feet, Colorado North Zone

Sources: U.S. Army, RMA GIS, OMC, Shell/AECOM

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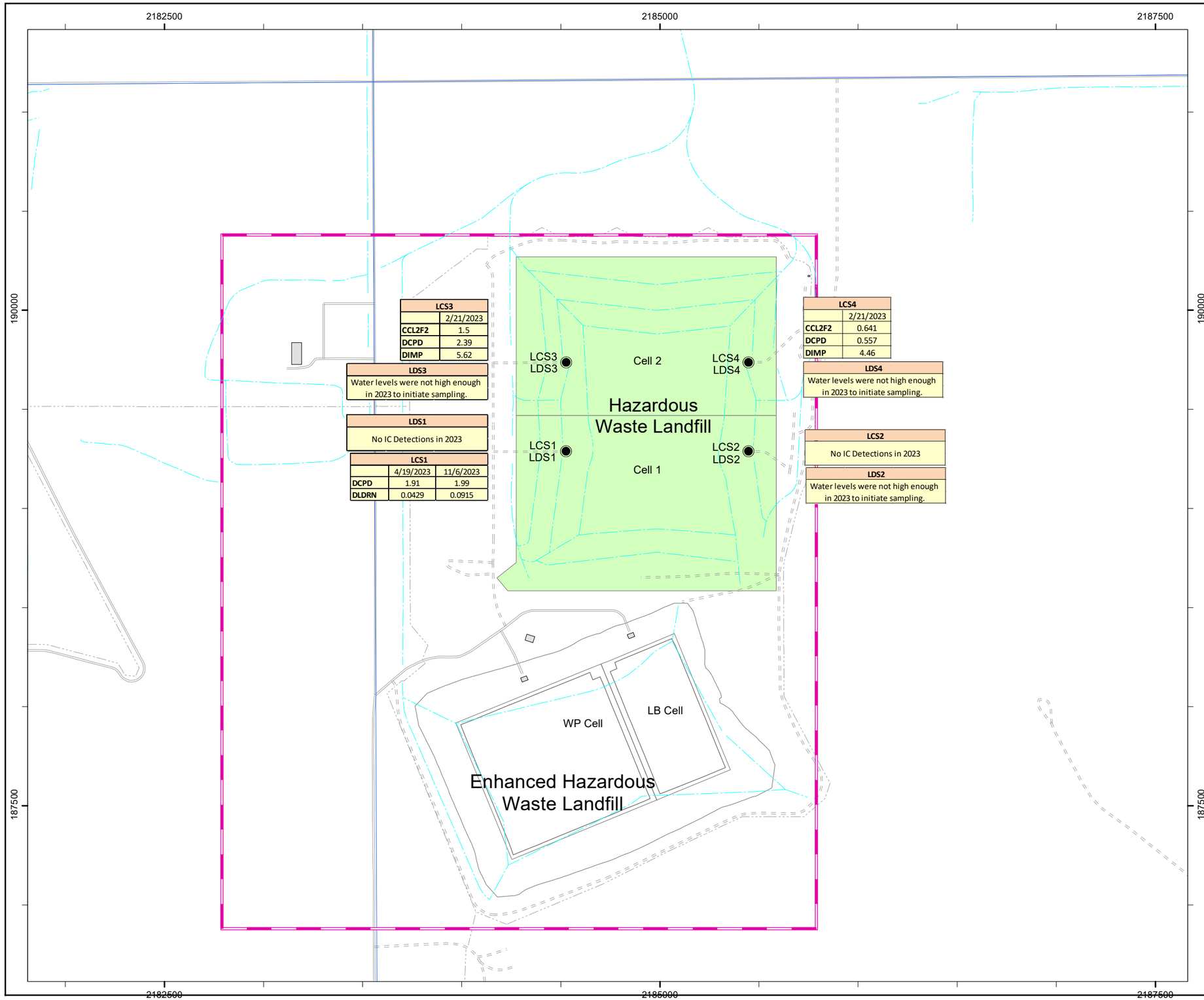
Figure 2.3-1

Indicator Compounds Detection Map
2023 Groundwater Monitoring

M:\projects\hwl_post-closure\2023\mxds\hwl_ind_cmpd_detection_2023.mxd
6/3/2024



LCS3	2/21/2023
CCL2F2	1.5
DCPD	2.39
DIMP	5.62

LDS3
Water levels were not high enough in 2023 to initiate sampling.

LDS1
No IC Detections in 2023

LCS1	4/19/2023	11/6/2023
DCPD	1.91	1.99
DLDRN	0.0429	0.0915

LCS4	2/21/2023
CCL2F2	0.641
DCPD	0.557
DIMP	4.46

LDS4
Water levels were not high enough in 2023 to initiate sampling.

LCS2
No IC Detections in 2023

LDS2
Water levels were not high enough in 2023 to initiate sampling.

Legend

- Leachate Collection/Leak Detection Systems
- 2014 North Plants/ Bedrock Ridge Plume Extent
- Ditches, Canals
- CAMU Boundary
- Section Lines
- Fences
- Light Duty Roads
- Unpaved Roads
- Buildings
- ELF Cells

Note: [1] Concentrations are in micrograms per liter
[2] LT - Less than the method detection limit
[3] Data shown from calendar year 2023

N

0 125 250 500 750
Feet

NAD27-NGVD29 Datum, US Survey Feet, Colorado North Zone

Sources: U.S. Army, RMA GIS, OMC, Shell/AECOM

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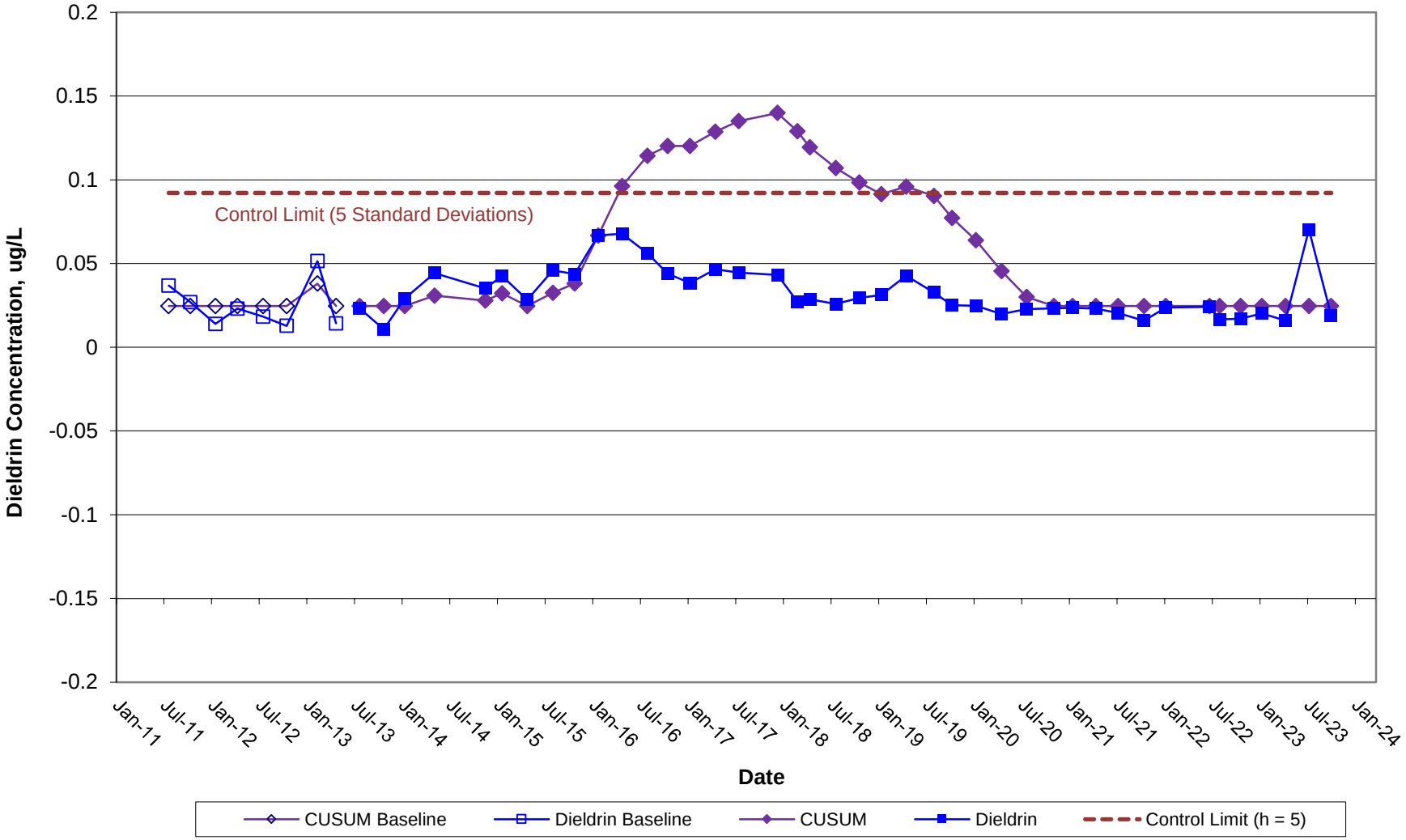
Figure 2.3-2

Indicator Compounds Detection Map
2023 HWL Leachate Collection and Leak Detection Systems

M:\projects\hwl_post-closure\2023\mxds\hwl_ind_detect_lcs_lds_2023.mxd
6/3/2024

Figure 3.1-1
Shewhart-CUSUM Control Chart
for Dieldrin Concentrations in HWL Well 25194



APPENDIX F-2

Enhanced Hazardous Waste Landfill
Post-Closure Groundwater Monitoring Report
Calendar Year 2023

ROCKY MOUNTAIN ARSENAL

ENHANCED HAZARDOUS WASTE LANDFILL
POST-CLOSURE GROUNDWATER MONITORING REPORT

CALENDAR YEAR 2023

Revision 0
June 20, 2024

U.S. Department of the Army
Shell Oil Company

Prepared by:

Navarro Research and Engineering, Inc.

CONTENTS

Section **Page**

TABLES

FIGURES

SUPPORTING DOCUMENTATION

ACRONYMS

amsl	Above Mean Sea Level
CAMU	Corrective Action Management Unit
CFS	Confined Flow System
DQI	Data Quality Indicator
ELF	Enhanced Hazardous Waste Landfill
HWL	Hazardous Waste Landfill
IC	Indicator Compound
LBLCS	LB Leachate Collection System
LBLDS	LB Leak Detection System
LCS	Leachate Collection System
LDS	Leak Detection System
MRL	Method Reporting Limit
NRAP	Non-Routine Action Plan
µg/L	Microgram(s) per liter
O&M	Operations and Maintenance
OCN	Operations and Maintenance Change Notice
PCGMP	Post-Closure Groundwater Monitoring Plan
RMA	Rocky Mountain Arsenal
SQAPP	Sampling Quality Assurance Project Plan
UCL	Upper Confidence Limit
UFS	Unconfined Flow System
WPLCS	WP Leachate Collection System
WPLDS	WP Leak Detection System

EXECUTIVE SUMMARY

The post-closure groundwater monitoring program for the Enhanced Hazardous Waste Landfill (ELF) is designed to monitor groundwater flow directions, groundwater quality beneath and in the vicinity of the ELF and evaluate the potential for hazardous constituent releases into groundwater sourced from the landfill.

This report covers the post-closure monitoring at the ELF for the 2023 calendar year quarterly sampling events conducted during January, July, and October, and the annual sampling event conducted in April. Groundwater flow directions beneath the ELF were consistent over the four quarters of 2023 post-closure monitoring and are consistent with the previous groundwater monitoring events within the Corrective Action Management Unit area.

The wells sampled as part of the ELF 2023 post-closure groundwater monitoring include five downgradient monitoring wells, six upgradient monitoring wells and one cross-gradient monitoring well. The groundwater samples were tested for a standard list of analytes including indicator compounds (ICs). The ICs selected for the monitoring program are presented in the *Enhanced Hazardous Waste Landfill Post-Closure Groundwater Monitoring Plan* (ELF PCGMP) (Navarro 2020).

No ICs were detected in four of the five downgradient wells. Lead was the only IC detected in downgradient UFS well 26009. The lead concentration was 5.3 micrograms per liter (μg/L) and is less than the prediction limit value of 26.3 μg/L. Historically, lead was detected in downgradient wells prior to waste being placed in the ELF in April 2006.

The ELF LB Leak Detection System (LBLDS) sumps and WP Leak Detection System (WPLDS) sumps were not sampled in 2023. They will be sampled prior to the next waste removal event per the ELF PCGMP (Navarro 2020).

As a component of the data review process, the analytical data were evaluated against the Data Quality Indicators (DQI) of precision, accuracy, representativeness, completeness, comparability, and sensitivity. Based on the findings of the DQI review, requirements were met and the data are appropriate for use in evaluation of the water quality conditions present at the site.

Based on statistical evaluations, the groundwater quality around the ELF has not been affected by post-closure operations and maintenance of the landfill.

1.0 INTRODUCTION

The post-closure groundwater monitoring program for the Enhanced Waste Landfill (ELF) at the Rocky Mountain Arsenal (RMA) is designed to monitor groundwater flow directions, groundwater quality beneath and in the vicinity of the ELF and evaluate the potential for hazardous constituent releases into the groundwater sourced from the landfill. This report presents data generated by the ELF post-closure groundwater monitoring system in 2023 and an evaluation of the monitoring objectives.

Quarterly well sampling events were conducted during January, July, and October, and the annual sampling event was performed in April. The following information is presented in accordance with the *Enhanced Waste Landfill Post-Closure Groundwater Monitoring Plan* (ELF PCGMP) (Navarro 2020).

- Groundwater level data collected from the ELF post-closure water level monitoring well network.
- Analytical results of groundwater samples collected from the ELF post-closure water quality monitoring well network.
- Analytical results of wastewater samples collected from the ELF Leachate Collection System (LCS) and LB Leak Detection System (LBLDS) sumps and the WP Leak Detection System (WPLDS) sumps.
- Evaluation of data to determine compliance with post-closure groundwater monitoring criteria as presented in the ELF PCGMP.

Background information related to the ELF monitoring approach including site-specific characterization, applicable regulatory requirements, laboratory methods, statistical evaluation procedures, and monitoring program development are presented in the ELF PCGMP, *Rocky Mountain Arsenal Sampling Quality Assurance Project Plan* (SQAPP) (Navarro 2019), and previous annual groundwater reports.

2.0 GROUNDWATER MONITORING RESULTS

2.1 Field Activities

The field crew inspected the monitoring wells and well pads prior to each sampling event. As part of the annual sampling event, the casing height was measured prior to sampling the monitoring wells with dedicated pumps. The casing heights and total depths were measured for monitoring wells without dedicated pumps. The casing heights and total depths are documented in the records.

Well 25122 has been noted as a dry well since monitoring began in 2002. An investigation in 2022 determined that the well was obstructed with sand approximately 4.4. feet above the top of the well screen. Based on this observation, well 25122 will not provide reliable data to support mapping of the potentiometric surface. The well was closed in September 2023 in accordance with the recommendation presented in the *2022 ELF Post-Closure Groundwater Monitoring Report* (Navarro 2023b).

Operations and Maintenance Change Notice (OCN)-ELF-2023-001 (Navarro 2023a) was prepared in September of 2023 to address the closure of well 25122 and installation of replacement well 25222. The OCN also removed 25122 from the monitoring network listed in the ELF PCGMP and replaced it with new well 25222. Well 25222 was installed in October of 2023 and will be added to the monitoring network when OCN-ELF-2023-001 is approved by the regulatory agencies.

2.2 Groundwater Monitoring

The wells used in the ELF post-closure groundwater level monitoring are presented in Table 3.2-1 of the ELF PCGMP and Figure 2.2-1 of this report. Water levels were measured quarterly in wells to evaluate the unconfined flow system (UFS) and confined flow system (CFS) flow conditions in the area of the Corrective Action Management Unit (CAMU) and to identify any significant changes in flow direction in the area of the CAMU.

Water level monitoring measurements are provided in Table 2.2-1. Figures 2.2-2 and 2.2-3 represent the April 2023 water table elevation for the UFS and the Denver Formation Lower Sandstone Unit within the UFS and CFS, respectively. The potentiometric surface of the UFS in the vicinity of the ELF shows that across the entire CAMU, groundwater flow is generally to the north and northwest. No significant variations in groundwater flow directions have been identified during post-closure monitoring.

The potentiometric surface of the Denver Formation lower sandstone unit indicates flow from the CFS into UFS downgradient of the Hazardous Waste Landfill (HWL) and illustrates the water table across the area and the interaction between the two flow systems. Groundwater flow in the lower sandstone unit of the CFS merges with the UFS on the north, west, and east sides of the HWL and ELF. Currently, the zone where the UFS and CFS merge is illustrated by a dashed line for the approximate boundary indicating the lower sandstone unit in Figure 2.2-3. South of the line, the flow is confined to semi-confined, while north of the line the flow is unconfined where the confining unit is not present (TtFW 2004).

Water levels measured in well 25021, south and upgradient of the ELF, are not consistent with other monitoring wells near the ELF suggesting the screened zone is not hydraulically connected with the lower sandstone unit mapped in this report. Therefore, the water level data from well 25021 are not used in contouring the potentiometric surface for the lower sandstone unit. The well, however, will continue to be monitored as part of the upgradient ELF water-quality well network.

2.3 Groundwater Quality

The ELF water quality network wells are identified in Table 3.2-2 of the ELF PCGMP and Figure 2.2-1 of this report. Groundwater samples collected from the ELF water quality monitoring network were shipped to Applied Research and Development Laboratory, Mount Vernon, Illinois for analysis. Annual samples were analyzed for the complete analyte lists as presented in Table 3.2-3 of the ELF PCGMP. Quarterly samples were analyzed for 13 indicator compounds (IC) identified by bold text in Table 3.2-3 of the ELF PCGMP.

The ICs detected in the ELF network wells are shown in Figures 2.3-1.

2.3.1 Upgradient and Cross-gradient ELF Network Wells

The ICs detected in wells upgradient and cross-gradient of the ELF are listed on Figure 2.3-1 with their respective concentrations and sample dates.

Detections of chloroform and carbon tetrachloride in cross-gradient well 25121 are consistent with contaminants associated with the North Plants/Bedrock Ridge plume. Concentrations of carbon tetrachloride and chloroform have remained stable or have decreased since 2010.

2.3.2 Downgradient ELF Network Wells

ICs detected in wells downgradient of the ELF are listed on Figure 2.3-1 with their respective concentrations and sample dates. Lead was the only IC detected in one of four downgradient UFS wells. Lead was detected in well 26099 once during the second quarter 2023.

2.4 LCS and LDS Wastewater Analytical Results

The ELF includes two LCS sumps and four LDS sumps. Water levels in sumps LB Leachate Collection System (LBLCS) and WP Leachate Collection System (WPLCS) were not high enough to initiate sampling in accordance with the ELF PCGMP in 2023.

Water levels in sumps LB Leak Detection System (LBLDS)1, LBLDS2, WP Leak Detection System (WPLDS)1 and WPLDS2 were not high enough to initiate sampling in accordance with the PCGMP in 2023. Since there were no LDS analytical results in 2023, none required regulatory agency notification per Table 3.0-2 of the *Enhanced Hazardous Waste Landfill Post-Closure Plan* (Navarro 2020).

2.5 Analytical Data Review

The objective of the analytical data review is to determine whether the analytical results are acceptable for use in making decisions for the project. As a component of the data review process, the analytical data are evaluated against the Data Quality Indicators (DQI) including precision, accuracy, representativeness, completeness, comparability, and sensitivity to interpret the degree of acceptability of the data. These six parameters are identified in the SQAPP (Navarro 2019). Failure to meet performance criteria did not necessarily result in rejection or qualification of the data. Professional judgment combined with the DQI evaluation were used to determine data usability.

The analytical data were collected in accordance with the ELF PCGMP and were reviewed consistent with the DQI process as presented in the SQAPP. Results of the DQI review are summarized below in Table 2.5-1, and data are presented in the Supporting Documentation accompanying this report.

Table 2.5-1. Data Quality Summary

Indicator	Summary
Precision	A total of 222 duplicate pair analyses of ELF target analytes were performed. Duplicate and investigative results are considered comparable in 219 cases and not comparable in 3 cases. *The data are considered acceptable for their intended use and no additional action in addition to the data qualification is considered necessary*.
Accuracy/Bias	The average recovery rate for the 779 matrix spike analyses was 90.7 percent. Recovery rates outside the lower or upper warning limits were observed in 17 analyses. Recovery rates outside the lower or upper control limits were observed in zero analyses. *No issues were identified requiring data qualification.* The average recovery rate for the 779 corresponding laboratory control spike analyses was 100.7 percent. Recovery rates outside the lower or upper warning limits were observed in 35 analyses. Recovery rates outside the lower or upper control limits were observed in one analysis. *No issues were identified requiring data qualification.*
Representativeness	Field blanks are collected and analyzed to evaluate possible cross contamination of the investigative samples. A total of 149 field blank analyses were performed. There were five field blank analyses above the Method Reporting Limit (MRL). Of the five associated investigative samples only one zinc analysis requires qualification as it was less than the field blank value. The associated lot ALPZ noted dilution to the entire lot due to historically high levels of sodium. No technical problems were noted. The associated investigative value will be qualified with an “E” flag indicating the field blank contains target analytes above the reporting limit. *The data is considered acceptable for their intended use and no additional action is considered necessary.*
Completeness	Completeness was calculated at 100 percent. The completeness goal of 90 percent was achieved. *All results were determined to be acceptable by the laboratory.* Note – Missed cyanide analysis documented in NRAP-2023-001 (Navarro 2023c) did not impact the completeness calculation because the samples were not analyzed.
Comparability	Standard sampling and analysis techniques, based on certified analytical methods approved by Navarro or promulgated SW-846 methods, and standard procedures for sample collection were used throughout the groundwater monitoring programs at the ELF. Consistent procedures for the reporting and management of the data generated were also followed. *All data are considered comparable.*
Sensitivity	The laboratories prepared and analyzed method blanks as part of their analytical protocols. Method blanks measure potential contamination from laboratory sources such as glassware, reagents, and laboratory water. There were 853 method blank analyses in 2023 with zero detections above the MRL. *All data is considered acceptable for their intended use and no additional action is considered necessary.*

2.5.1 Data Quality Control Review

Data validation was conducted on a representative subset of the ELF groundwater analytical data. Validation checklists were completed, and laboratory case narratives were reviewed to determine potential problems identified by the analysts. The completeness result for all analytes achieves the minimum specification of 90 percent. No data were flagged as rejected in 2023.

Table 2.5.1-1 presents a summary of the quality control samples collected and analyzed to support ELF groundwater monitoring in 2023.

Table 2.5.1-1 Quality Control Samples

Sample Type/Site ID	Sample Date(s)
Field Duplicates	
25102	04/13/2023
25102	07/18/2023
25105	04/18/2023
Laboratory Duplicates	
25022	04/18/2023
25102	04/13/2023
25123	04/24/2023
26099	04/19/2023
Field Blanks	
25123	04/24/2023
25183	04/12/2023
27500	10/12/2023

2.5.2 Data Usability Evaluation

A data usability evaluation was conducted on 1,302 records. The evaluation identified no statistical outliers.

Based on the findings of the DQI review, the sample results are considered valid and usable for their intended purpose. Data quality requirements were sufficiently met for the analytical data, and data are appropriate for use in evaluation of the water quality conditions present at the site. The primary objectives of the sampling program were met.

3.0 STATISTICAL EVALUATIONS

The statistical evaluation of data includes comparing upgradient water quality to downgradient compliance wells utilizing prediction intervals that are calculated for each IC using upgradient water quality data. The prediction limits discussed in this section refer to the upper limit of each analyte-specific prediction interval. Comparison of downgradient water quality data to prediction limits should provide an indication whether groundwater has been impacted by the ELF.

The wells used to calculate prediction limits and statistical evaluations are presented in Table 3.0-1. A prediction interval was calculated for each IC, which included upgradient water quality data through the 2022 post-closure monitoring period. The general approach for determining and evaluating prediction limits for the ELF is consistent with United States Environmental Protection Agency guidance document (EPA 2009).

ChemStat statistical analysis software (StarPoint Software 2023) was utilized to determine the prediction limit values and documentation is available in the Supporting Documentation files. The prediction limit values for 2024 are included in Table 3.0-3. If a compound was not detected in any sample, the default non-parametric predication limit for the analyte is the 99 percent upper confidence limit (UCL). In accordance with the PCGMP, the 99 percent UCL is defined as 1.3 times the MRL.

3.1 2023 Prediction Limits and the Current ELF Water Quality Data

Table 3.0-2 presents the 2023 prediction limits that were calculated using upgradient well data collected during the pre-operational, operational, closure, and post-closure groundwater monitoring periods (2003–2022).

The analytical results of samples collected from the downgradient ELF groundwater monitoring network in 2023 were compared with the prediction limit values presented in Table 3.0-2 to determine whether groundwater quality was impacted by the ELF.

Lead was the only IC detected in the downgradient wells. Lead was detected in UFS well 26092 at a concentration of 5.3 µg/L. The value is below the prediction limit value of 26.3 µg/L. Historically, lead was detected in downgradient wells prior to waste being placed in the ELF in April 2006.

Based on the statistical evaluation, it is concluded that the groundwater quality in the vicinity of the ELF has not been affected by operations, closure, or post-closure operations and maintenance (O&M) of the landfill.

3.2 2024 Prediction Limits

Table 3.0-3 presents the prediction limit values that will be applied to downgradient wells in 2024. The MRLs can change based on the analytical method re-certification required every three years by the SQAPP (Navarro 2019). MRLs did not change for the ICs analyzed in upgradient wells in 2023, and therefore did not impact the prediction limits calculated for 2024 as presented in Table 3.0-3.

4.0 SUMMARY

The following conclusions are based on the groundwater and wastewater monitoring results for the 2023 post-closure groundwater monitoring at the ELF:

- The groundwater in the UFS and CFS flows to the north-northwest and is consistent with the previously monitored groundwater elevations and flow directions for the ELF.
- Based on the findings of the DQI evaluation, the analytical data collected are of acceptable quality for intended uses.

- No ICs exceeded the 2023 prediction limits.
- Carbon tetrachloride, chloroform and lead were detected in cross-gradient UFS well 25121. Detections of chloroform and carbon tetrachloride in well 25121 are consistent with contaminants associated with the North Plants/Bedrock Ridge plume.
- Due to an insufficient amount of sample material, the ELF LCS and LDS sumps were not sampled in 2023. They will be sampled prior to the next waste removal event per the ELF PCGMP.
- Prediction limit values for all ICs were re-evaluated for 2024. No prediction limits were adjusted.

Based on the statistical evaluation, it is concluded that the groundwater quality in the vicinity of the ELF has not been affected by operations, closure, or post-closure O&M of the landfill.

5.0 REFERENCES

EPA (U.S. Environmental Protection Agency)

2009 *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities* Unified Guidance, EPA 530/R-09-007. March.

Navarro (Navarro Research and Engineering, Inc.)

2023a *O&M Change Notice OCN-ELF-2023-001*. September 22, 2023.

2023b *Enhanced Waste Landfill Post-Closure Groundwater Monitoring Report, Calendar Year 2022.* Revision 0. June 21, 2023.

2023c *Non-Routine Action Plan NRAP-2023-001*. May 10, 2023.

2020 *Enhanced Hazardous Waste Landfill Post-Closure Groundwater Monitoring Plan*. Revision 1. April 2, 2020.

2019 *Rocky Mountain Arsenal Sampling Quality Assurance Project Plan.* Revision 2. January 30, 2019.

StarPoint Software, Inc. (StarPoint Software)

2023 ChemStat Statistical Analysis Software for Environmental Data. Version 6.5, January 2023.

TtFW (Tetra Tech FW, Inc.)

2004 *Hazardous Waste Landfill and Landfill Wastewater Treatment System Annual Groundwater Monitoring Report for July 2002–June 2003.* Revision 0.

TABLES

Table 2.2-1. 2023 Water Level Measurements

Well ID	Groundwater Elevations (ft amsl)			
	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Unconfined Flow System				
25003	5152.46	5152.36	5152.38	5152.54
25004	5217.52	5217.17	5217.27	5217.6
25015	5159.28	5159.09	5159.32	5159.62
25018	5164.02	5164.18	5164.82	5164.72
25022	5219.87	5219.61	5219.67	5219.85
25023	5218.56	5218.08	5218.41	5218.6
25027	5180.42	5180.3	5180.57	5180.61
25032	Dry	Dry	Dry	Dry
25041	5184.49	5184.75	5185.33	5185.17
25048	5171.42	5171.61	5172.23	5172.06
25054	5173.79	5173.95	5174.32	5174.38
25059	5178.38	5178.59	5179.12	5179.01
25086	Dry	Dry	Dry	Dry
25087	5166	5165.46	5165.94	5166.29
25088	Dry	Dry	Dry	Dry
25091	5169.55	5169.28	5169.69	5170.11
25092	5180.72	5180.42	5180.62	5180.7
25098	Dry	Dry	Dry	Dry
25099	5168.5	5168.31	5168.68	5169
25100	Dry	Dry	Dry	Dry
25102	5180.46	5180.19	5180.34	5180.35
25105	5217.45	5216.86	5217.45	5217.69
25106	5205.33	5204.89	5205.04	5205.03
25120	5188.55	5187.72	5188.35	5190.61
25121	5180.46	5179.96	5180.32	5180.32
25122 [1]	—	—	—	—
25189	5166.37	5166.45	5166.81	5167.15
25194	5180.83	5180.56	5181.69	5181.5
25203	5180.27	5180.19	5180.59	5180.57
25500	5217.36	5217.11	5217.34	5217.64
25502	5184.54	5184.69	5185.07	5185.19
26040	5147.44	5147.36	5147.42	5147.39
26051	5162.21	5162.06	5162.15	5162.08
26073	5177.7	5177.61	5177.7	5177.87
26097	5184.04	5183.88	5184.04	5184.4
26099	5182.04	5181.62	5182.03	5183.11
26158	5179.36	5179.23	5179.45	5179.86
26159	5202.41	5202.16	5202.39	5203.73

Table 2.2-1. 2023 Water Level Measurements

Well ID	Groundwater Elevations (ft amsl)			
	Quarter 1	Quarter 2	Quarter 3	Quarter 4
26164	5144.28	5144.19	5144.28	5144.15
26170	5139.71	5139.63	5139.61	5139.7
26175	5156.54	5156.44	5156.6	5157.13
26176	Dry	Dry	Dry	Dry
26177	5157.98	5157.82	Dry	Dry
26178	Dry	Dry	5182.29	Dry
26179	5167.96	5167.84	5168.03	5167.78
26180	5177.5	5177.44	5177.41	5177.55
26181	5166.87	5166.7	5166.8	5166.53
26182	5176.17	5176.08	5176.06	5176.11
26183	5165.28	5165.21	5165.19	5165.19
26184	Dry	Dry	Dry	Dry
26186	5163.99	5163.91	5163.83	5163.9
36186	5235.82	5235.59	5235.5	5238.25
Confined Flow System				
25016	5153.33	5153.18	5153.55	5153.29
25017 [2]	5154.48	5154.42	—	—
25019	5162.19	5162.16	5162.65	5162.46
25020	5148.35	5148.41	5149.12	5148.79
25021	5174.05	5173.96	5173.95	5174.01
25024	5202.23	5201.75	5202.22	5201.74
25034	5172.62	5172.07	5172.59	5172.9
25085	5164.31	5163.8	5164.23	5164.62
25093	5170.22	5170.62	5170.87	5171.01
25101	5173.45	5173.24	5173.63	5173.84
25123	5175.24	5175.19	5175.46	5175.64
25183	5163.67	5163.16	5163.63	5164.14
25195	5165.15	5164.86	5165.21	5165.78
26150	5171.02	5170.83	5170.91	5171.05
26185	5151.43	5151.34	5151.61	5151.61

Notes:

[1] Water not encountered at depth due to obstruction in well comprised of sand filter pack.

[2] Possible blockage suspected at depth in well; water not encountered.

amsl – above mean sea level

Table 3.0-1. ELF Groundwater Monitoring Well Usage

Well/ Designation	Data Used to Calculate Current (2023) Prediction Limits [1]			Prediction Limits Applied to Downgradient Wells Quarterly in 2023
	Data Used to Calculate Baseline (2010) Prediction Limits		Upgradient Data from Post-Closure Monitoring Period 5/27/2010 to 6/7/2022	
	Upgradient Data from Preoperational Monitoring Period 10/1/2003 to 3/31/2006	Upgradient Data from Operational/Closure Monitoring Period 4/1/2006 to 5/26/2010		
Upgradient				
25021	X	X	X	
25022	X	X	X	
25024	X	X	X	
25105	X	X	X	
25106	X	X	X	
25123	X	X	X	
Downgradient				
25092				X
25093				X
25102				X
25120				X
26099				X

Notes:

Well 25121 has been removed from this table. Detections of carbon tetrachloride and chloroform in cross-gradient well 25121 suggests the well is in a flow path with the North Plants/Bedrock Ridge Plume. In accordance with the ELF PCGMP (Navarro 2020) well 25121 is used to evaluate any cross-gradient potential impacts to the UFS and CFS from the North Plants/Bedrock Ridge plume contaminants. It is not used to calculate the prediction limits for ELF.

[1] Analytical results from the pre-operational, operational, closure, and post-closure monitoring periods utilized to calculate the current HWL prediction limits are available in the Supporting Documentation files.

Table 3.0-2. Prediction Limits for ELF 2023 Water Quality Monitoring

Indicator Compound	Current Method Reporting Limit (µg/L)	Proportion of Upgradient Non-detected Sample Values (2006-2022)	Statistical Method Used	Selected Prediction Limit (µg/L)
Volatile Organic Compounds				
1,1,1-Trichloroethane [1]	0.2	100	Non-parametric	0.26
1,1-Dichloroethane [1]	0.2	100	Non-parametric	0.26
1,1-Dichloroethene [1]	0.2	100	Non-parametric	0.26
1,2-Dichloroethane [1]	0.2	100	Non-parametric	0.26
Benzene	0.2	99.2	Non-parametric	0.93
Carbon tetrachloride [1]	0.2	100	Non-parametric	0.26
Chloroform [1]	0.2	100	Non-parametric	0.26
Organochlorine Pesticides				
Dieldrin	0.00252	81.2	Non-parametric	0.107
Organophosphorus Compounds				
DIMP [2]	0.602	98.3	Non-parametric	1.21
Metals				
Arsenic	1	78.2	Non-parametric	11.5
Chromium	10	99.6	Non-parametric	10.4
Lead	3	70.1	Non-parametric	26.3
Mercury [1]	0.2	100	Non-parametric	0.26

Notes:

[1] Because this compound was not detected in any sample, the non-parametric prediction limit value for this analyte is the 99 percent upper confidence limit (UCL). For the purpose of this report, the 99 percent UCL is defined as 1.3 times the MRL.

[2] The reporting limits have changed as a result of an MRL study required by the SQAPP for method recertification every three years.

µg/L – micrograms per liter

Table 3.0-3. Prediction Limits for ELF 2024 Water Quality Monitoring

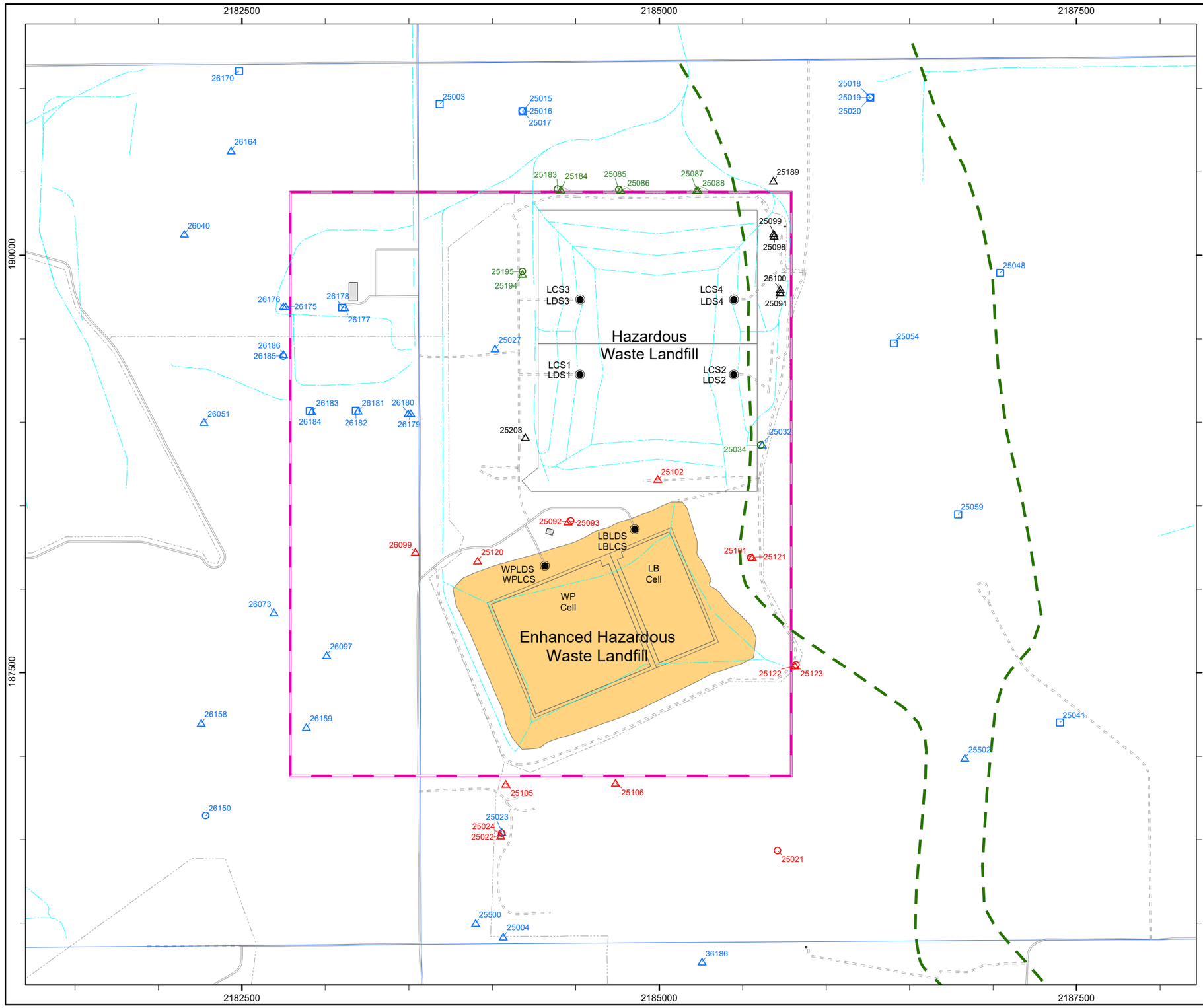
Indicator Compound	Current Method Reporting Limit (µg/L)	Proportion of Upgradient Non-detected Sample Values (2003-2023)	Statistical Method Used	Selected Prediction Limit (µg/L)
Volatile Organic Compounds				
1,1,1-Trichloroethane[1]	0.2	100	Non-parametric	0.26
1,1-Dichloroethane[1]	0.2	100	Non-parametric	0.26
1,1-Dichloroethene[1]	0.2	100	Non-parametric	0.26
1,2-Dichloroethane[1]	0.2	100	Non-parametric	0.26
Benzene	0.2	99.2	Non-parametric	0.93
Carbon tetrachloride[1]	0.2	100	Non-parametric	0.26
Chloroform[1]	0.2	100	Non-parametric	0.26
Organochlorine Pesticides				
Dieldrin	0.00252	80.9	Non-parametric	0.107
Organophosphorus Compounds				
DIMP	0.602	98.4	Non-parametric	1.21
Metals				
Arsenic	1	78.3	Non-parametric	11.5
Chromium	10	99.6	Non-parametric	10.4
Lead	3	68.8	Non-parametric	26.3
Mercury[1]	0.2	100	Non-parametric	0.26

Notes:

[1] Because this compound was not detected in any sample, the non-parametric prediction limit value for this analyte is the 99 percent upper confidence limit (UCL). For purposes of this report, the 99 percent UCL is defined as 1.3 times the MRL.

µg/L – micrograms per liter

FIGURES



Legend

- CAMU Boundary
- Buildings
- Sumps
- 2014 North Plants/ Bedrock Ridge Plume Extent
- Section Lines
- Light Duty Roads
- Unpaved Roads
- Fences
- Ditches, Canals

Monitoring Well Network	Flow System/Aquifer		
	Unconfined Alluvial	Unconfined Denver	Confined Denver
Hazardous Waste Landfill (HWL)		△	○
HWL Supplemental Operations		△	
Enhanced Hazardous Waste Landfill (ELF)		△	○
Water Level Only	□	△	○

N

0 300 600 1,200
Feet

Sources: U.S. Army, RMA GIS, OMC, Shell/AECOM

NAD27-NGVD29 Datum, US Survey Feet, Colorado North Zone

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Rocky Mountain Arsenal
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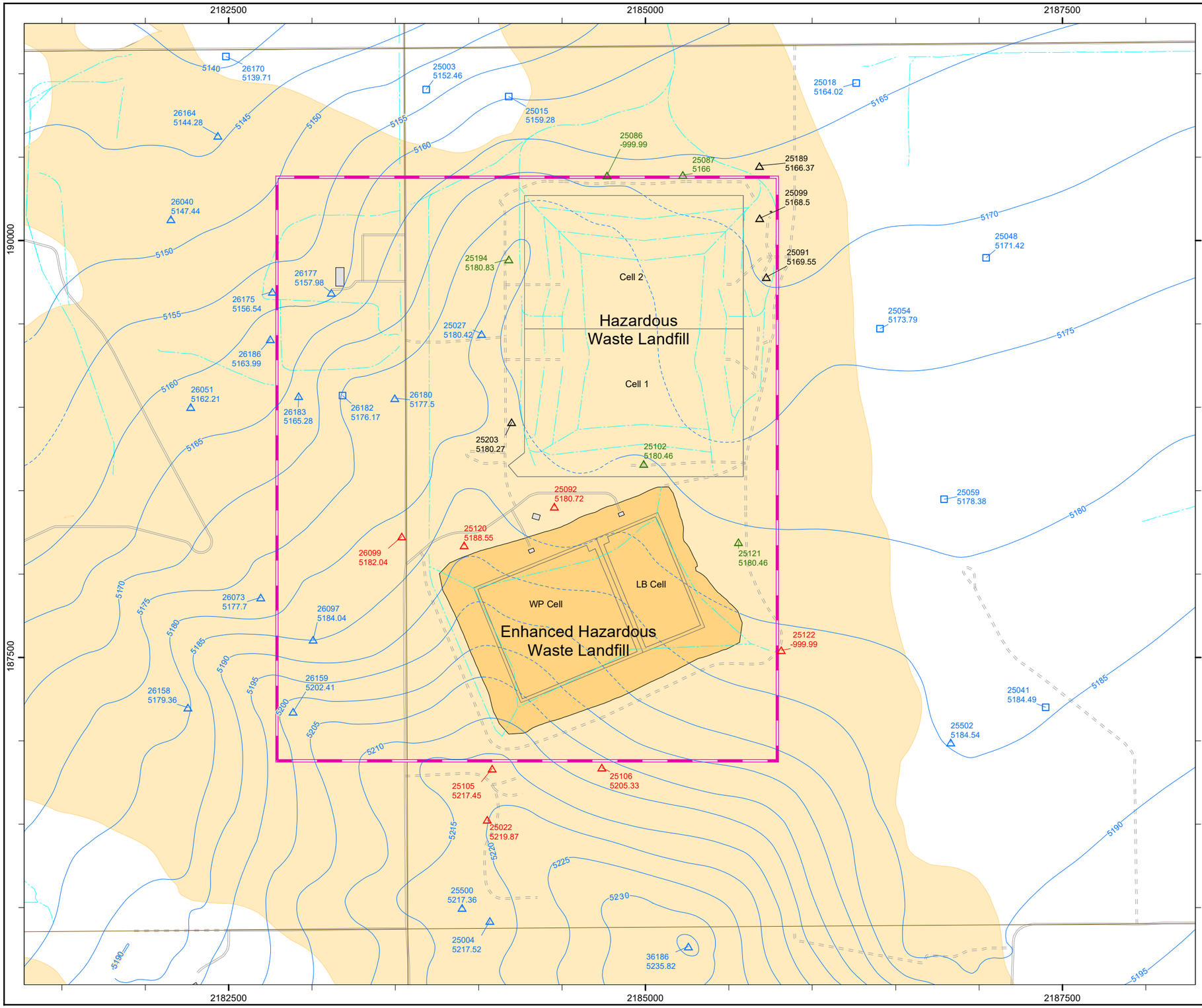
Figure 2.2-1

Well/Piezometer/Sump Location Map
2023 Groundwater Monitoring

M:\projects\elf_post-closure\2023\mxds\elf_well_piezometer_loc_2023.mxd
6/2/2024



Legend

- CAMU Boundary
- Section Lines
- Light Duty Roads
- Unpaved Roads
- Ditches, Canals
- Buildings
- Unsaturated Alluvium
- Water Elevation Contours - 5-foot intervals
- Inferred Water Elevation Contours

Monitoring Well Network	Flow System/Aquifer	
	Unconfined Alluvial	Unconfined Denver
Hazardous Waste Landfill (HWL)		△
HWL Supplemental Operations		△
Enhanced Hazardous Waste Landfill (ELF)		△
Water Level Only	□	△

N

0 300 600 1,200
Feet

NAD27-NGVD29 Datum, US Survey Feet,
Colorado North Zone

Sources: U.S. Army, RMA GIS, OMC, Shell/AECOM

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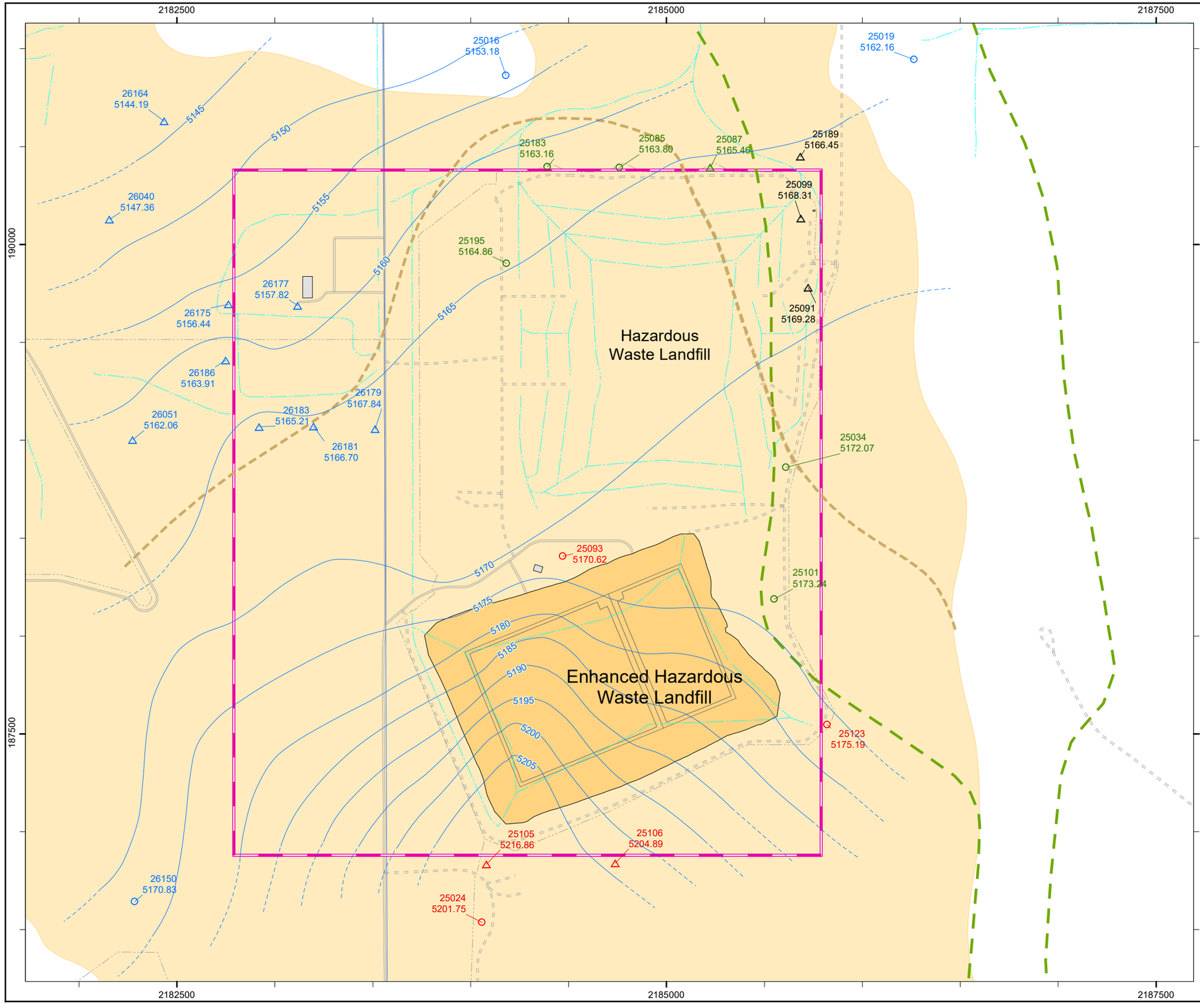
Figure 2.2-2

Potentiometric Surface of the
Unconfined Flow System,
Enhanced Hazardous Waste Landfill
April 2023

M:\projects\elf_post-closure\2023\mxds\elf_ufs_fy23.mxd
5/31/2024



Legend

- Approximate Boundary of the Lower Sandstone Units
- 2014 North Plants/ Bedrock Ridge Plume Extent
- CAMU Boundary
- Light Duty Roads
- Unpaved Roads
- Ditches, Canals
- Section Lines
- Buildings
- Unsaturated Alluvium
- Water ElevationContours - 5-foot Intervals
- Inferred Water Elevation Contours

Monitoring Well Network	Flow System/Aquifer	
	Confined Denver	Unconfined Denver
Hazardous Waste Landfill (HWL)	○	△
HWL Supplemental Operations		△
Enhanced Hazardous Waste Landfill (ELF)	○	△
Water Level Only	○	△

N

0 500 1,000
Feet

NAD27-NGVD29 Datum, US Survey Feet,
Colorado North Zone

Sources: U.S. Army, RMA GIS, OMC, Shell/AECOM

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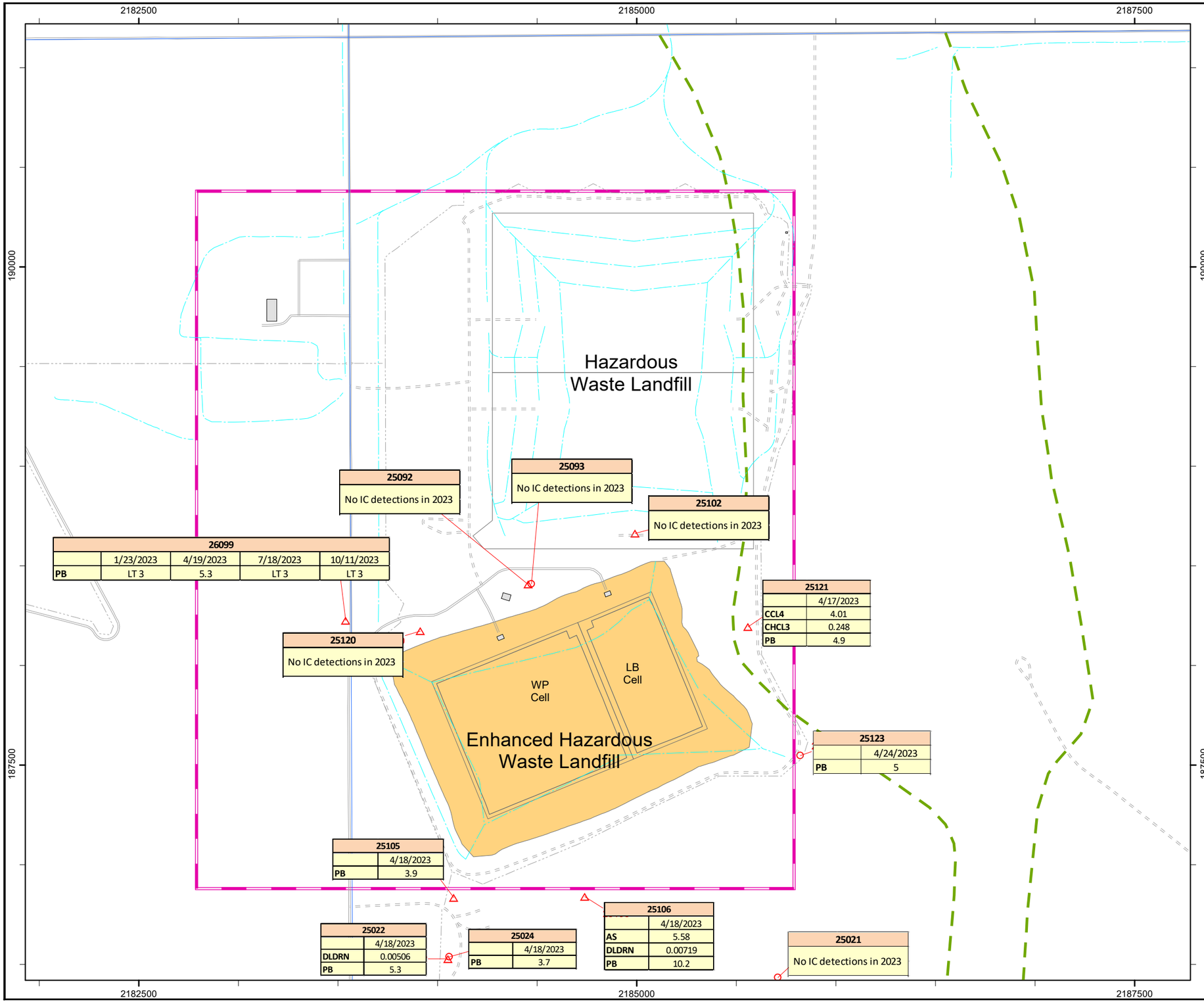
Figure 2.2-3

Potentiometric Surface for the
Lower Sandstone Unit and Equivalent Units,
April 2023

M:\projects\elf_post-closure\2023\mxds\elf_lwr_sandstoneWL_2023.mxd
6/2/2024



Legend

- 2014 North Plants/ Bedrock Ridge Plume Extent
- Ditches, Canals
- Section Lines
- Fences
- Light Duty Roads
- Unpaved Roads
- CAMU Boundary
- Buildings

Note: [1]Concentrations are in micrograms per liter
[2]Data shown from calendar year 2023
[3]LT - Less than the method detection limit

Monitoring Well Network	Flow System/Aquifer		
	Unconfined Alluvial	Unconfined Denver	Confined Denver
Enhanced Hazardous Waste Landfill (ELF)		△	○

N

0 250 500 1,000
Feet

NAD27-NGVD29 Datum, US Survey Feet,
Colorado North Zone

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Figure 2.3-1

Indicator Compounds Detection Map
2023 Groundwater Monitoring

M:\projects\elf_post-closure\2023\mxds\elf_ind_cmpd_detection_2023.mxd
5/30/2024

APPENDIX G

Non-Routine Action Plans

NRAP Number	**NRAP-2023-001**
Applicable Design(s)	☒ Hazardous Waste Landfill – Record Documents ☒ Enhanced Hazardous Waste Landfill – Record Documents
Applicable Design Document(s)	☐ Drawing Number/Title/Revision: ☐ Spec. Number /Title/Revision: ☒ Plan Title/Revision: *HWL Post-Closure Plan*, Revision 4 *ELF Post-Closure Plan*, Revision 1
Description of the Condition Requiring Action	The OMC sampling staff collected annual groundwater samples from the HWL and ELF well networks in April of 2023 in accordance with the *HWL Post-Closure Plan*, Revision 4 and *ELF Post-Closure Plan*, Revision 1. The samples were shipped to Applied Research and Development Laboratory (ARDL) in Mount Vernon, Illinois for analysis. On April 28, 2023 ARDL notified the OMC Sample Manager that the instrument used to analyze samples for cyanide was inoperable and the laboratory would not be able to analyze several groundwater samples from the HWL and ELF well networks before the sample hold times expired. The OMC and ARDL representatives considered shipping the samples to another laboratory but concluded that the samples would likely exceed their respective hold times before an analysis could be performed. The instrumentation issue impacted 13 groundwater samples, three duplicate samples, one field blank sample, and one leachate sample collected from HWL sump LCS1. Refer to Table 1 for a complete list of HWL and ELF groundwater quality network wells and 2023 samples affected by the instrumentation issue. The ARDL staff received replacement parts for the instrument on May 1 and anticipates the instrument to be back online by May 5. Table 3.0-2 of the *HWL Post-Closure Plan* and the *ELF Post-Closure Plan* lists the conditions that require completion of an NRAP. While this specific scenario is not listed on Table 3.0-2, the Army considers the loss of analytical data due to instrument failure worthy of regulatory agency notification and documentation. Therefore, this NRAP has been prepared in accordance with the requirements of Section 3.5 of the *HWL Post-Closure Plan* and *ELF Post-Closure Plan*.
Description of the Action	**Evaluation:** The OMC staff reviewed historical analytical results from the affected wells to determine the impact of missing cyanide data for 2023. The results of the data query are presented in Table 1. Between 1997 and 2022 cyanide was detected once in wells 25034, 52091, and 25101, and twice in well 25106. The most recent detections were recorded in 2017 at well 25034, 25091, and 25106. Two duplicate samples also had cyanide above the reporting limit of 10 micrograms per liter. Cyanide is not an Indicator Compound in either the HWL or ELF groundwater quality monitoring networks, therefore there is no prediction limit associated with the analyte. The Army determined that it is unlikely that cyanide is present above the reporting limit in the affected samples and that the missing cyanide data for 2023 does not adversely impact the ability to determine if the landfills are affecting groundwater quality. **Responses Considered:** The Army and OMC evaluated the following potential responses to the missing cyanide data.

	Option 1: Direct ARDL to ship the samples to another laboratory for analysis. The OMC and ARDL representatives considered sending samples to another laboratory, but the additional shipping and handling time made it unlikely that the samples would be analyzed before the hold times expired. There were also concerns regarding data reporting and analytical methods used by a lab that was not approved or audited by the OMC. This option was undesirable. Option 2: Re-sample the wells and ship them to ARDL after the instrumentation is repaired and operational. The OMC and Army considered re-sampling the affected wells. Based on the historical data and the fact that cyanide is not an Indicator Compound for either landfill, the Army determined that the data were not necessary to determine if the landfills were impacting groundwater quality. Considering the cost of re-sampling and shipping a second round of samples, and the negligible amount of information that would be gained, re-sampling the affected wells was undesirable. Option 3: Document the missing data in an NRAP and the 2023 Post-Closure Groundwater Monitoring Reports for both landfills. The Army and OMC considered documentation of the missing analytical data in an NRAP and the subsequent annual groundwater reports for both landfills. This administrative process was determined to be the most acceptable option. The Army sent an email notification to the regulatory agencies on May 2, 2023, summarizing the situation and recommending this documentation process as the best path forward. The regulatory agencies agreed with the recommendation on May 3. **Recommended Action:** Based on the evaluations performed by the Army and OMC described above, this NRAP serves as documentation of the missing cyanide analytical data for wells shown in Table 1. The well list documented by this NRAP is slightly different that the one included in the notification email dated May 2, 2023. This difference resulted from additional input from ARDL indicating that samples from wells 25083, 25183, and 25195, and one field blank, were successfully analyzed for cyanide and were thus removed from the list.
	Material Requirements: None
	Performance Criteria: None
	Does the action deviate from the requirements of the applicable design package(s)? ☐ Yes ☒ No If so, provide rationale for the deviation from the design package(s). **Rationale:**
Closeout Requirements	Is a multi-Agency post-action inspection required? ☐ Yes ☒ No Are modifications to monitoring or inspection frequencies required? ☐ Yes ☒ No Others:_____
Consultation Record	Consultation Date: May 2, 2023 (email) Consultation Method: E-mail Consulted Parties: EPA, CDPHE, ACHD
Attached Exhibits	☐ None ☐ Inspection Form(s) ☐ Map of Affected Area ☐ Correspondence ☐ Supplemental Work Plan(s) ☐ Rationale for Deviation From Design ☐ Modified Inspection Frequencies ☒ Others:

		Table 1 – *List of Wells and Historic Cyanide Detections*

Approvals

Signature indicates the Parties are in consensus and concur with the proposed action and closeout requirements.

Cover Manager, or Designee Signature & Date:	Army Project Manager, or Designee Signature & Date:
Michael W. Jones Digitally signed by: Michael W. Jones DN: CN = Michael W. Jones email = jonesm@navarro-inc.com C = US O = Navarro Research and Engineering, Inc. OU = Rocky Mountain Arsenal Date: 2023.05.10 11:42:20 -06'00'	MACKELVEY.DONALD.J.III.1165665992 Digitally signed by MACKELVEY.DONALD.J.III.1165665992 Date: 2023.05.10 17:02:46 -06'00'

EPA Signature & Date:	CDPHE Signature & Date:	ACHD Signature & Date:
Connolly, David Digitally signed by Connolly, David Date: 2023.05.15 11:19:56 -06'00'	Susan Newton Digitally signed by Susan Newton Date: 2023.05.15 15:29:51 -06'00'	Thomas J Butts Digitally signed by Thomas J Butts Date: 2023.05.15 15:45:24 -06'00'

Table 1: List of Wells and Historic Cyanide Detections

Well No.	2023 Well Sample Affected	HWL Network Location	ELF Network Location	Historic Cyanide Detections			
				Date	Value (UGL)	Reporting Limit (UGL)	Flag Code
25021			Upgradient	N/A			
25022	Yes		Upgradient	N/A			
25024	Yes		Upgradient	N/A			
25034	Yes	Upgradient		4/19/2017	13.5	10	
25085		Downgradient		N/A			
25086		Downgradient		N/A			
25087		Downgradient		N/A			
25088		Downgradient		N/A			
25091	Yes	NA		4/19/2017	19.2	10	
25092	Yes		Downgradient	N/A			
25093	Yes		Downgradient	N/A			
25098		NA		N/A			
25099		NA		N/A			
25100		NA		N/A			
25101	Yes	Upgradient		4/18/2011	11.1	10	
25102	Yes	Upgradient	Downgradient	N/A			
25105	Yes		Upgradient	N/A			
25106	Yes		Upgradient	4/20/2004	12	10	
				4/25/2017	14.4	10	
25120	Yes		Downgradient	N/A			
25121	Yes	Upgradient	Crossgradient	4/24/2017	11.5	10	D
25123			Upgradient	N/A			
25183		Downgradient		N/A			
25189		NA		N/A			
25194		Downgradient		N/A			
25195		Downgradient		N/A			
25203		NA		N/A			
26099	Yes		Downgradient	4/22/2004	11.8	10	D

D - Duplicate

UGL - Micrograms per liter

NRAP Number	**NRAP-2023-003**
Applicable Design(s)	☒ Hazardous Waste Landfill – Record Documents ☐ Enhanced Hazardous Waste Landfill – Record Documents
Applicable Design Document(s)	☐ Drawing Number/Title/Revision: ☐ Spec. Number /Title/Revision: ☒ Plan Title/Revision: *HWL Post-Closure Plan*, Revision 4
Description of the Condition Requiring Action	Groundwater was sampled from well 25194 on July 17, 2023, in accordance with the Hazardous Waste Landfill (HWL) Post-Closure Plan (PCP) and Post-Closure Groundwater Monitoring Plan (PCGMP). Analytical results from the sample included a dieldrin concentration of 0.0703 micrograms per liter (µg/L). This analytical result is above the 2023 Prediction Limit (PL) for dieldrin, which is 0.05 µg/L. The HWL PCGMP classifies well 25194 as a downgradient well within the HWL groundwater quality monitoring network. Well 25194 is screened in the Unconfined Flow System (UFS). Analyses of samples collected from well 25194 in accordance with the PCGMP have detected dieldrin above the Method Reporting Limit in every sample collected since sufficient groundwater became available in 2011. A series of samples collected in 2016 also had dieldrin detections above the PL. Refer to Table 1 for a history of dieldrin concentrations in well 25194 and the respective PLs. Dieldrin is listed in Table 6.1-1, *Upper Prediction Limits for the HWL as of 2019* in the HWL PCGMP (Appendix B of the HWL PCP) as an Indicator Compound with a corresponding PL. Likewise, dieldrin is listed in Table 3.0-3, *Prediction Limits for HWL 2023 Water Quality Monitoring* in the *Hazardous Waste Landfill Post-Closure Groundwater Monitoring Report, Calendar Year 2022*, which was issued in June of 2023 as an appendix to the *2023 RCRA Landfills and Groundwater Monitoring Report*. In both locations the PL for dieldrin is listed as 0.05 µg/L. Detection of analytes in Table 6.1-1 of the HWL PCGMP above the PL result in a non-routine action process described in Section 3.5 of the HWL PCP, and consultation between the Army and regulatory agencies.
Description of the Action	On August 30, 2023, the Army determined that the concentration of dieldrin in a sample collected from well 25194 on July 17, 2023, exceeded the 2023 PL. The Army notified the regulatory agencies of the July 2023 PL exceedance via email on August 31, 2023. Dieldrin has occasionally been detected above the PL in well 25194 since post-closure sampling began in 2011, and dieldrin concentrations are routinely discussed in the annual HWL Post-Closure Groundwater Monitoring Reports. A series of dieldrin PL exceedances in well 25194 occurred in 2016 and triggered the development of NRAP-2016-004 as well as the *HWL Groundwater Monitoring Wells 25194 and 25184 Subsurface Soil and Landfill Stormwater Runoff Sampling and Analysis Plan* (SAP), which was dated November 17, 2016. The purpose of the SAP was to determine the source of dieldrin detected in well 25194. The work included installation of a new well downgradient of the HWL (25184) with subsurface soil sampling, collection of subsurface soil samples near well 25194, and collection of a stormwater runoff sample from the adjacent drainage channel. The results of work performed in accordance with the SAP were summarized in the *Hazardous Waste Landfill Groundwater Monitoring Wells 25194 and 25184 Subsurface Soil and Landfill Stormwater Runoff Data Summary Report* (DSR) dated November 18, 2019. The DSR concluded that there is no evidence that the dieldrin contamination at well 25194 is connected with the waste contained within the HWL. While the source of the contamination was not conclusively identified, the most likely explanation for the dieldrin detections is remobilization

	of residual contamination that pre-dates the construction of the landfill. The remobilization of residual contamination may have been caused by the modification of the hydrogeology in this area when the landfill's grass-lined perimeter channel was constructed west of the HWL in 2008. This perimeter channel conveys stormwater runoff from the HWL and Enhanced Hazardous Waste Landfill (ELF) and allows for infiltration in the grass-lined portions, including the area east of well 25194. Figure 3.1-1 of the *HWL Post-Closure Groundwater Monitoring Report, Calendar Year 2022* is a Shewhart-Cumulative Sum (CUSUM) control chart for dieldrin concentrations in Well 25194. This figure shows that the dieldrin concentrations began to decrease after April 2016, although the CUSUM continued to increase. Groundwater levels appear higher in well 25194, beginning in July 2015, which may have mobilized residual contamination that the Army believes existed prior to construction of the HWL. In 2022, measured dieldrin concentrations did not exceed the control limit, and the CUSUM has generally been decreasing since December 2017. Fluctuations in dieldrin concentrations may indicate seasonal variability related to the water level changes and mobilization of residual contamination from precipitation. Precipitation for the Denver, Colorado area in May was 5.53" and June was 6.10" according to the National Weather Service (NWS). These values are nearly three times more than average. Precipitation recorded over these two months at RMA was slightly more than the NWS values in May and slightly less in June. The average precipitation for the first eight months of the year is 11.15". As of August 30, 2023, the NWS recorded 17.45" of precipitation at Denver International Airport (DIA), while 18.31" of precipitation were recorded at RMA. Based on the findings of previous investigations into the source of dieldrin in well 25194, and the abnormally high amount of precipitation that fell on the site in May and June of 2023, it is feasible that residual contamination was mobilized, resulting in an increased concentration of dieldrin that exceeded the PL. It is reasonable to expect the dieldrin concentrations to return to a lower level as precipitation rates return to normal. The recommended course of action includes the following steps. • Continue routine quarterly sampling of well 25194 in accordance with the HWL PCGMP. • Evaluate the dieldrin concentrations using an intrawell comparison (Shewhart-CUSUM control chart) in accordance with EPA guidance *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance*. • Evaluate the dieldrin concentrations using Mann-Kendall trend analysis. • Report conclusions in the annual HWL Post-Closure Groundwater Monitoring Reports.
	Material Requirements: None
	Performance Criteria: None
	Does the action deviate from the requirements of the applicable design package(s)? ☐ Yes ☒ No If so, provide rationale for the deviation from the design package(s). **Rationale:** N/A
Closeout Requirements	Is a multi-Agency post-action inspection required? ☐ Yes ☒ No Are modifications to monitoring or inspection frequencies required? ☐ Yes ☒ No Others:_____
Consultation Record	Consultation Date: August 31, 2023 Consultation Method: E-mail Consulted Parties: EPA, CDPHE, ACHD

Attached Exhibits	☐ None ☐ Inspection Form(s) ☐ Map of Affected Area ☐ Correspondence	☐ Supplemental Work Plan(s) ☐ Rationale for Deviation From Design ☐ Modified Inspection Frequencies ☒ Others: TABLE 1: Dieldrin Concentrations in Well 25194

Approvals

Signature indicates the Parties are in consensus and concur with the proposed action and closeout requirements.

Cover Manager, or Designee Signature:	Army Project Manager, or Designee Signature:
Michael W. Jones Digitally signed by: Michael W. Jones DN: CN = Michael W. Jones email = jonesm@navarro-inc.com C = US O = Navarro Research and Engineering, Inc. OU = Rocky Mountain Arsenal Date: 2023.09.25 12:48:25 -06'00'	MACKELVEY.DONALD.J.III.1165665992 Digitally signed by MACKELVEY.DONALD.J.III.1165665992 Date: 2023.09.25 12:58:47 -06'00'

EPA Signature:	CDPHE Signature:	ACHD Signature:
Connolly, David Digitally signed by Connolly, David Date: 2023.09.25 15:58:00 -06'00'	Susan Newton Digitally signed by Susan Newton Date: 2023.09.26 13:09:39 -06'00'	Joseph Chisholm Digitally signed by Joseph Chisholm Date: 2023.09.28 08:24:59 -06'00'

TABLE 1: Dieldrin Concentrations in Well 25194

Date	Prediction Limit (µg/L)	Concentration (µg/L)	NRAP Trigger? (Yes/No)
7/21/2011	0.03	0.0368	No
10/12/2011	0.03	0.0269	No
1/17/2012	0.03	0.0139	No
4/10/2012	0.03	0.0231	No
7/18/2012	0.03	0.0182	No
10/16/2012	0.03	0.0128	No
2/12/2013	0.03	0.0515	No
4/24/2013	0.03	0.0142	No
7/24/2013	0.03	0.023	No
10/24/2013	0.03	0.0107	No
1/13/2014	0.05	0.0291	No
4/21/2014	0.05	0.0364	No
5/7/2014	0.05	0.0443	No
7/23/14	0.05	0.0328	No
11/18/2014	0.05	0.0352	No
1/22/2015	0.05	0.0426	No
4/28/2015	0.05	0.0283	No
8/5/2015	0.05	0.046	No
10/27/2015	0.05	0.0437	No
1/26/2016	**0.05**	**0.0668**	**Yes**
4/26/2016	**0.05**	**0.0678**	**Yes**
8/2/2016	**0.05**	**0.0562**	**Yes**
10/18/2016	0.05	0.044	No
1/12/2017	0.05	0.0383	No
4/19/2017	0.05	0.0466	No
7/18/2017	0.05	0.0445	No
12/14/2017	0.05	0.0431	No
3/1/2018	0.05	0.0272	No
4/17/2018	0.05	0.0286	No
7/26/2018	0.05	0.0259	No
10/24/2018	0.05	0.0294	No
1/17/2019	0.05	0.0312	No
4/22/2019	0.05	0.0427	No
8/7/2019	0.05	0.0326	No
10/15/2019	0.05	0.0251	No
1/15/2020	0.05	0.0248	No
4/22/2020	0.05	0.0198	No
7/28/2020	0.05	0.0227	No
11/9/2020	0.05	0.0232	No
1/20/2021	0.05	0.0235	No
4/19/2021	0.05	0.023	No
7/14/2021	0.05	0.0204	No
10/21/2021	0.05	0.0158	No

TABLE 1: Dieldrin Concentrations in Well 25194

Date	Prediction Limit (µg/L)	Concentration (µg/L)	NRAP Trigger? (Yes/No)
1/13/2022	0.05	0.0237	No
6/30/2022	0.05	0.0242	No
8/8/2022	0.05	0.0165	No
10/27/2022	0.05	0.017	No
1/17/2023	0.05	0.0202	No
4/17/2023	0.05	0.0159	No
7/17/2023	**0.05**	**0.0703**	**Yes**

Note: Samples in **bold** exceeded the Prediction Limit for dieldrin.

APPENDIX H

Operations and Maintenance Change Notices

ROCKY MOUNTAIN ARSENAL
O&M CHANGE NOTICE

WBS Number: 4.01.01.23		OCN Number: **OCN-HWL-2023-001**
Affected Plan/Procedure	☒ HWL Post-Closure Plan	☐ Long-Term Monitoring Plan for GW & Surface Water
	☐ ELF Post-Closure Plan	☐ Land Use Controls Plan
	☐ Basin F Post-Closure Plan	☐ RVO SOP No. _____:
	☐ Long-Term Care Plan	☐ Other:

Recommended disposition: Class 1 Modification (required for HWL, ELF, and Basin F Post-Closure Plans)

Describe proposed change (Exact change in redlined/strike-through format preferred. Provide below or in attachment):	Reason for change:
This OCN includes technical specifications for the closure of well 25122 and installation of well 25222. Well 25222 is intended to replace well 25122, which is no longer functional. This OCN also includes updates to the Hazardous Waste Landfill (HWL) groundwater level monitoring network described in the HWL *Post-Closure Groundwater Monitoring Plan* (PCGMP). Changes to the HWL PCGMP include the replacement of well 25122 with well 25222 in Table 3.2-1 and Figure 3.2-1. All changes to the HWL PCGMP are shown in redline/strikeout format.	Well 25122 is included in the HWL groundwater level monitoring network defined in the HWL PCGPM. In June of 2022, the Army determined that the well is partially filled with sand. While the origin of the sand is unknown, the Army concluded that well 25122 will no longer provide reliable data to support mapping of the potentiometric surface, and recommended that the well be closed, removed from the monitoring network, and replaced by a new well. The observations and recommendations were documented in the *2023 RCRA Landfills and Groundwater Monitoring Report*, Revision 0, dated June 21, 2023. This OCN provides the technical specifications for the closure of well 25122 and the installation of replacement well 25222. The location and construction details of well 25222 have been designed to provide water level data that are analogous to the data that have historically been collected from well 25122. Well 25122 has been dry since 2002 and well 25222 is also expected to be dry.

Exhibits attached: ☐ None ☒ List:

- Technical Specification Section 02032 – Abandonment and Closure of Monitoring Wells
- Technical Specification Section 02673 – Installation of Groundwater Monitoring Wells
- *HWL Post-Closure Groundwater Monitoring Plan* in redline/strikeout format (affected pages only)

Originator: Michael W. Jones	Date: September 22, 2023

Final Approval:

OMC Project Manager Signature	Army Project Manager Signature
Michael W. Jones Digitally signed by: Michael W. Jones DN: CN = Michael W. Jones email = jonesm@navarro-inc.com C = US O = Navarro Research and Engineering, Inc. OU = Rocky Mountain Arsenal Date: 2023.09.22 14:41:35 -06'00'	MACKELVEY.DONALD.J.III.1165665992 Digitally signed by MACKELVEY.DONALD.J.III.1165665992 Date: 2023.09.25 09:23:26 -06'00'
OMC Project Engineer Signature (required for record drawing/design changes)	OMC Regulatory Compliance Manager Signature
	Scott Ache Digitally signed by: Scott Ache DN: CN = Scott Ache email = ache@navarro-inc.com C = US Date: 2023.09.22 17:35:04 -06'00'

Regulatory Approvals:

EPA Signature	CDPHE Signature	ACHD Signature

SPECIFICATION SECTION 02032
ABANDONMENT AND CLOSURE OF MONITORING WELLS

PART 1 GENERAL

This Specification includes:

A. The technical requirements for the permanent abandonment and closure of monitoring well 25122 associated with the Hazardous Waste landfill (HWL) and the Enhanced Hazardous Waste Landfill (ELF).

1.1 References

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ASTM INTERNATIONAL

ASTM C 150/C 150 M-21	Standard Specification for Portland Cement
ASTM D5299/D5299M-18	Standard Guide for Decommissioning of Ground Water Wells, Vadose Zone Monitoring Devices, Boreholes, and Other Devices for Environmental Activities

CODE OF COLORADO REGULATIONS (CCR)

2 CCR 402-2	Rules and Regulations for Water Well Construction, Pump Installation, Cistern Installation, and Monitoring and Observation Hole/Well Construction. Effective July 1, 2018.

1.2 Scope

A. Abandonment and closure of unconfined flow system groundwater monitoring well 25122 associated with the HWL and ELF. The well is obstructed at a depth of approximately 26 feet below the top of casing. The obstruction appears to be well filter pack sand as seen in downhole video recording.

B. Work described in this specification will be performed by Navarro Research and Engineering, Inc. (Navarro or Contractor).

1.3 Qualifications

A. Licensed Water Well Construction contractor or Authorized Individual in accordance with Rule 16 of 2 CCR 402-2 who is experienced in the abandonment and closure of wells, including experience in the Denver area, and maintaining a current valid Water Well Construction installation license, or Contractor-approved equivalent. Only a licensed Water Well Construction contractor is allowed to abandon wells penetrating a confining layer, such as those confined flow system wells screened in the Denver Formation.

B. Persons authorized to install pumping equipment may plug and seal wells which do not require the removal of casing from more than one aquifer or the ripping or perforating of casing opposite confining layers.

C. A Geologist or Hydrogeologist (having obtained applicable college degree) or a licensed Water Well Construction contractor with at least one year of experience in well abandonment will inspect well abandonment.

1.4 Quality Control

A. Provide and maintain a quality control program ensuring compliance with the requirements.

B. Field Logbook – Maintain log of daily activities that documents the abandonment procedure used for the well.

C. Well Abandonment and Closure Form – Prepare a Well Abandonment and Closure Form (see Attachment 02032-1) for the well.

1.5 Submittals

A. Contractor shall document and provide the following items to for review by the Contractor Project Engineer.

1. List of construction equipment, including backhoe and/or drilling rig (if used), model number, and rating.

2. Source of materials listed in Part 2, and relevant material certifications.

3. Proposed sealing mix design that meets regulatory requirements.

4. A copy of daily logbooks submitted weekly unless otherwise directed by Navarro.

B. If applicable, provide shipping receipts/packing slips to Navarro project personnel for review upon receipt of materials on site.

C. Prepare a Well Abandonment and Closure Form (see Attachment 02032-1) for the Navarro Geologist or Hydrogeologist to review.

PART 2 PRODUCTS

2.1 Materials

A. Well abandonment materials shall consist of the following, for use by the Contractor:

1. Type I Portland cement conforming to ASTM C150/C150M-21, unless otherwise specified.

2. Bentonite-based products specifically designed for permanent well abandonment. Acceptable products include Plug-Gel®, Shur-Gel®, Benseal®, or Contractor-approved equivalent.

3. Washed, clean silica sand, or Contractor-approved equivalent.

4. Potable or non-potable water from an RMA-supplied source.

5. Cement-bentonite grout consistent with State Rule 10, which recommends 6 gallons non-potable water to one 94-pound bag of Portland cement if grout is poured into the well casing. Add 2 to 4 percent bentonite (by dry weight) plus an additional ¾ gallon water for each 1 percent of bentonite used. Add more bentonite only if needed for easier pumping but add no more than 8 percent bentonite. The density of the grout is to be checked using a "mud balance."

B. Store well abandonment materials in a clean, uncontaminated condition throughout the course of the project in an area designated by the Contractor.

PART 3 EXECUTION

3.1 General Requirements

A. Abandon wells in accordance with 2 CCR 402-2, State Rule 16.

B. Maintain existing survey monuments and monitoring wells that are not slated for abandonment in the vicinity, and protect them from damage by equipment and vehicular traffic. Contractor will repair any items damaged during the work effort.

C. Notify the Contractor Project Engineer of any field discrepancies and request confirmation of well identification prior to well abandonment.

D. Complete proper Well Abandonment and Closure Forms to document well abandonment (see Attachment 02032-1).

E. Divert and control surface water to prevent entry into the well at each abandonment site until completion of abandonment.

3.2 Preparation

A. Measure depth to sand filling the well casing with a weighted tape measure or water level meter to the nearest 0.1 ft. Record these data, including the date of measurement, on the Well Abandonment and Closure Form (Attachment 02032-1) prior to proceeding with abandonment.

3.3 Well Abandonment

A. Abandon the well, which is screened in the Denver Formation, in accordance with the following.

1. Contractor will remove well pad, protective casing, bollards, control boxes, and other surface material (where present) from each well site.

2. Fill the well casing with clean, washed sand or Contractor-approved equivalent, to the higher of the static water level or 1 ft above the top of the well screen.

3. Fill casing with grout to 5 ft below existing grade and cut off the casing at the top of the grout. Ensure a minimum of 5 ft of grout is placed in the well. Refer to Subpart 3.3B for grout placement requirements.

4. Top off the well with gradefill as specified in Subpart 3.3C of this Specification Section.

B. Grout Placement:

1. Mix grout manually or by machine. Fully hydrate bentonite slurry prior to adding other materials to the mix.

2. Due to the depth of the well and sand in place, place grout by gravity feeding to 5 feet from the ground surface.

3. Check the completed grout level after 24 hours, and top off grout to the specified depth as necessary.

4. Report the number of bags and gallons of water for manual mixing and a mud balance for mechanical mixing. When multiple batches are mixed for one well, report all requisite information for each batch, as well as the total volume and number of batches, on the Well Abandonment Form.

C. Gradefill Placement:

1. After completion of grout placement in accordance with Subpart 3.3B, place clean fill from Contractor-approved location and compact by tamping with hand tools to prevent settling.

2. Continue filling and tamping until the soil level is consistent with surrounding grades.

3.4 Final Condition and Cleanup

A. After completion and before acceptance of the work, remove all equipment, surplus materials, and rubbish, leaving the site in a clean condition, acceptable to the Contractor Project Engineer.

3.5 Field Quality Control

A. Verify that the well is abandoned in accordance with all required specifications, plans and drawings. Verification will be performed by Contractor and documented in the Project Logbook.

END OF SECTION

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ATTACHMENT 02032-1

WELL ABANDONMENT AND CLOSURE FORM

Well ID:	**Aquifer:**	**Closure Date:**
State Permitted Well? **Yes ☐ No ☐ Unknown ☐**	**Permit Number:**	
RMAED Information	**Field Information***	**Sand Type:**
TOC Elevation (ft):	**Last Known Depth to Water (ft bgs):**	
Casing Diameter (in):	**Last Known Total depth (ft bgs):**	
Ground Elevation (ft):	**Sand Bottom (ft bgs):**	**Sand Amount Used:**
Casing Stick-up (ft):	**Sand Top (ft bgs):**	
Screen Length (ft):	**Grout Bottom (ft bgs):**	
Screen Top (ft bgs):	**Grout Top (ft bgs):**	**Grout Type:**
Casing Depth (ft bgs):	**Casing Cut at Least 2 feet below grade:** **Yes ☐ No ☐**	
Bedrock Depth (ft bgs):		
Easting	**Permanent Cap Installed: Yes ☐ No ☐**	**Grout Amount Used:**
Northing	**Site Backfilled: Yes ☐ No ☐**	
Comments:		
Preparer Name and Signature:		**Date:**
Reviewer Name and Signature:		**Date:**

*In the case of a damaged well, field information shall be complete to the extent possible.

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SPECIFICATION SECTION 02673
INSTALLATION OF GROUNDWATER MONITORING WELLS

PART 1 GENERAL

This Specification includes:

A. Requirements for installing groundwater monitoring wells

B. Requirements for performing lithologic logging

C. Requirements for well development

1.1 References

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ASTM INTERNATIONAL

ASTM A 1064	Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM C 150	Portland Cement
ASTM C 387	Standard Specification for Packaged, Dry, Combined Materials for Concrete and High Strength Mortar
ASTM D 1586	Penetration Test and Split-Barrel Sampling of Soils
ASTM D 1785	Polyvinyl chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2487	Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2488	Description and Identification of Soils (Visual-Manual Procedure)
ASTM D 5088	Decontamination of Field Equipment Used at Nonradioactive Waste Sites
ASTM D 5092	Design and Installation of Ground Water Monitoring Wells in Aquifers
ASTM F 480	Thermoplastic Well Casing Pipe and Couplings Made in Standard Dimension Ratios (SDR), SCH 40 and SCH 80

CODE OF COLORADO REGULATIONS (CCR)

2 CCR 402-2	Rules and Regulations for Water Well Construction, Pump Installation, Cistern Installation, and Monitoring and Observation Hole/Well Construction. Effective July 1, 2018.

CODE OF FEDERAL REGULATIONS (CFR)

49 CFR 172	Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements

ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 600/4-79/020	Methods for Chemical Analysis of Water & Wastes
EPA SOP 3.2	USEPA Region VIII Standard Operating Procedure for Well Development, Version 1, June 1994

GEOLOGICAL SOCIETY OF AMERICA (GEOSA)

GEOSA-RCC011	Geological Society of America Rock Color Chart

NSF INTERNATIONAL (NSF)

NSF Standard 14	Plastics Piping Components and Related Materials

U.S. ARMY CORPS OF ENGINEERS

EM 1110-1-4000	Monitoring Well Design, Installation, and Documentation at Hazardous and/or Toxic Waste Sites

1.2 Project Description

One monitoring well will be installed to replace existing unconfined flow system well 25122 using a hollow-stem auger with the capability to collect continuous core. The collection of core will be conducted with the objective to describe subsurface lithology—alluvium and bedrock—and identifying whether groundwater is present. The well will be installed to a depth approximating that of well 25122 as described in this specification.

1.3 Performance Requirements

Drill borehole and install the monitoring well in a manner to prevent aquifer contamination by the drilling operation and equipment, prevent intra- and inter-aquifer contamination, and prevent vertical seepage of surface water adjacent to the well into the subsurface, especially the monitoring well intake zone.

1.4 Submittals

A field borehole log, a well construction log, and well development log—included as attachments to this specification—will be completed for the monitoring well by Contractor.

Contractor shall maintain a field logbook documenting daily activities. The field borehole log will describe soil lithology and document subsurface geologic occurrences encountered during drilling and well construction, including pertinent depths, and drilling and post-drilling activities.

PART 2 PRODUCTS

2.1 Materials

A. Blank Well Casing – The well casing shall be new, flush-threaded 2-inch diameter, Schedule 40 polyvinyl chloride (PVC) environmental well casing with an expandable J-plug PVC locking well cap. Blank casing shall be certified clean from the manufacturer and received and stored in sealed bags.

B. Well Screen – New, flush-threaded 2-inch diameter, 10-slot (0.010-inch), Schedule 40 PVC environmental well screen with a flush-threaded PVC bottom cap shall be used in the well. The well screen shall be certified clean from the manufacturer and received and stored in sealed bags.

C. Filter Pack – The sand filter pack in the well shall consist of 10/20 washed silica sand. The sand shall be manufactured by Colorado Silica Sand or the equivalent approved by Contractor.

D. Bentonite Seal – Bentonite pellets or chips, "Pure Gold" or the equivalent approved by Contractor, shall be used for the bentonite seal. After placement, the bentonite seal shall be hydrated with clean water in accordance with manufacturer's recommendations.

E. Cement – Type II Portland cement shall be used for applications requiring cement (e.g., grout).

F. Cement-Bentonite Grout – Cement-bentonite grout shall consist of a slurry of Portland Type II cement, bentonite, and water. Cement grout shall be proportioned not to exceed 7 gallons of water per cubic foot of cement with a mixture of such consistency that the well can be properly grouted. Bentonite powder may be added to reduce shrinkage. Typical mixtures consist of approximately 20 parts cement to 1 part bentonite with 6–7 gallons of approved water per 94-pound bag of Type II Portland cement and 3% by weight sodium bentonite; installed to within 2 to 3 feet of the surface.

G. Protective Casing – The protective casing shall be a round steel casing and 8 inches (minimum) in diameter and 5 feet long (minimum) equipped with a locking cover. The outer casing shall be long enough to extend 2 to 3 feet below grade and provide for a stick-up height of 2–2.5 feet. The protective casing cover must be a Royer brand aluminum cover that will accommodate a padlock. Stick-up height shall be determined by Contractor at the time of installation and will be tall enough to accommodate the J-plug PVC cap.

H. Well Pad Construction – A square (2 feet by 2 feet), nominal 3.5-inch-thick reinforced concrete pad with a 2 percent slope away from the protective casing to the edges of the pad shall be constructed flush with the ground around each well. Quick-Crete or contractor approved equivalent mixed to manufacturer's instructions shall be used for the pad.

I. Drums – Dry soil cuttings will be spread thin on the ground surrounding the drilling location. Department of Transportation (DOT)-approved open-top steel drums will be used to containerize moist or wet soil cuttings and decontamination solids. Steel or polyethylene drums will be used to containerize well development water, which will be dispositioned at the Basin A Neck (BANS) treatment plant.

PART 3 EXECUTION

3.1 General Requirements

A. Construct groundwater monitoring wells to the dimensions shown in Table 1. The monitoring well will be drilled using 4¼-inch inside-diameter hollow-stem augers. The drill rig and other equipment will have the capabilities to successfully drill and complete the well of the type, and size described in this specification. Subcontractor shall provide all tools, equipment, and supplies necessary to drill, install, complete, and develop the well.

B. Split-spoon sample barrels will be used to collect soil core for the length of each borehole. The soil will be logged by Contractor in accordance with ASTM D 2487 and ASTM D 2488

C. Variations in site-specific geologic conditions may require changes to well construction plans. Changes to the well construction plans shall require approval of Contractor prior to proceeding with subsequent portions of construction.

3.2 Well Construction Requirements

A. Borehole – Boreholes shall be drilled to the approximate depth shown in the Table 1. Actual depth may be slightly different than shown based on the materials observed in the drill cuttings and core. Contractor will make the final determination on the well construction.

B. Well String – The well string consisting of blank casing with top cap, well screen, and bottom cap, shall be constructed to the dimensions shown in Table 1. The final well screen placement intervals will be subject to the approval of Contractor. The blank well casing shall extend no more than 2.5 feet above the ground surface.

C. Well Filter Pack – Sand, as the filter pack, shall be placed from total depth of the borehole to no less than 2 to 3 feet above the well screen. The sand pack shall be installed through the hollow stem augers by pouring the sand between the well casing and the inside of the augers in a manner typical for installation of shallow environmental monitoring wells. As the sand pack is placed, the augers shall be pulled out of the borehole. Care shall be taken to keep the sand inside the augers while pulling the augers to ensure that the sand does not bridge off inside the augers. The depth of the well pack shall be measured frequently to verify proper depth. The amount of sand pack placed in the well shall be measured and recorded.

D. Annular Seal – A bentonite pellet or chip seal shall be placed on top of the filter pack and shall extend 2 to 3 feet above the top of the filter pack. After placement, the bentonite seal will be hydrated. A cement-bentonite grout will be placed from the top bentonite seal to the ground surface. Additional grout shall be added as necessary to maintain grout at ground surface. Well construction operations shall be conducted continuously from placement of the well casing string to placement of the hydrated bentonite pellet or chip seal.

E. Protective Casing – The steel protective casing shall be installed after grouting the borehole. The casing does not require painting.

F. Drill/Soil Cuttings – Two types of soil cuttings will be generated as waste and be managed separately as follows:

- Dry Soil Cuttings – These cuttings are generated during drilling from ground surface to approximately 3 to 5 feet above the water table based on observations of soil cutting circulated during drilling and returned to the surface. This soil shall be spread on the ground in the vicinity of the borehole/well location.

– Moist and Saturated Soil Cuttings – These cuttings are generated from 3 to 5 feet above the water table to the total depth of the well based on observations of soil cutting circulated during drilling and returned to the surface. This soil must be containerized in 55-gallon DOT-approved drums and then moved to Building 887 by Subcontractor for storage. Contractor is responsible for disposition of drummed soil waste.

It is likely that no water will be encountered during drilling. In that event, all soil cuttings will be spread on the ground.

G. Surveying – Upon completion of the project, the ground surface elevation, the top of casing elevation, and the location coordinates of the monitoring well will be surveyed by the Contactor. For consistency, the top of casing elevations will be measured on the north side of the well casing.

3.3 Well Development

If water is encountered during drilling and installation, the well shall be developed following completion, but no sooner than 24 hours after cement grouting is completed. The well shall be developed by alternately surging, bailing, and pumping as described below:

- Surge all of the screened sections of the aquifer using a surge block that brushes the inside of the well screen. Surge and bail for a minimum of 30 minutes prior to pumping the well.
- Develop the well by pumping or bailing a minimum of five borehole volumes of water from the well.
- The pH, temperature, turbidity, and conductivity will be measured by Contractor before, during and after development of well. At the discretion of Contractor's field geologist, the need to achieve stabilized parameters (e.g., turbidity) may be amended based on historical information related to development of existing wells in the vicinity.
- The pH will be considered stabilized when three of the last five readings are within a pH of 0.2 units.
- Temperature and conductivity measurements will be allowed to stabilize to within 10 percent of the previous readings before the well is considered developed.
- Turbidity will be considered stable when the measurement is 5 nephelometric turbidity units (NTUs) or less. If 5 NTUs is not achievable, then three of the last five readings should be 20 percent of the previous readings.
- Measurements obtained in the field before, during, and after development will include static water levels, pumping rate, field parameters, and the total volume of water pumped from the well and will be documented on the attached Well Development Log after completion of development activities.
- Development water will be containerized, appropriately labeled, and dispositioned at the BANS treatment plant.

3.4 Quality Control

A. General – Subcontractor shall maintain records as required by Contractor to assure the well construction is being conducted within subcontract limits. The results of drilling construction and development activities shall be documented to assure they meet specifications. Subcontractor shall maintain records of observations (including observations of drill cuttings and drilling rates), measurements, and tests performed. These records shall be furnished to Contractor no later than 24 hours after the tests, measurements, and/or observations are completed.

B. Field Logbook – Subcontractor shall provide a daily log of well construction activities. The field borehole log shall be maintained by Contractor and shall identify subsurface geologic occurrences encountered during well construction. All pertinent depths and activities shall be noted.

3.5 Cleanup

Upon completion, all equipment, surplus materials, and trash will be removed from the site by Subcontractor. The site will be returned to the original condition acceptable to Contractor.

3.6 Documentation

Use attached forms to establish and maintain documentation for well construction and development to record the desired information and to assure compliance with contract requirements.

END OF SECTION

Table 1. Proposed Monitoring Well Construction Summary

Well ID	Coordinates[1]	Casing Stickup	Casing Depth	Well Depth	Bore Diameter	Casing Type	Top of Screen (feet bgs)	Screen Length and Type	Filter Pack	Surface Completion/ Concrete Pad
Enhanced Hazardous Waste Landfill										
25222	N 187543, E 2185810	2–2.5 feet	35–39 feet bgs	36–40 feet TOC	8 inches	2-inch Schedule 40 PVC	29 (maximum depth)	10-foot length, 0.010-inch slotted, Schedule 40 PVC	10/20 Colorado® Silica Sand (or equivalent)	8-inch steel casing with aluminum locking cap and J-plug; 2-foot x 2-foot concrete pad flush with the ground; no bollards

[1] Coordinates are provided in feet in North American Datum 1927, Colorado State Plane, North Zone.
bgs – below ground surface
TOC – top of casing

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SPECIFICATION SECTION 02673

ATTACHMENTS

FIELD BOREHOLE LOG

Site ID:

Page **1** of

Project Name: **ELF Well Installation**		Diameter of hole (in):
Completion depth:	Well Installation: **Yes** ☒ No ☐	Date completed:
Equipment and drilling method:		
Initial water level (ft):	Final water level (ft) _____	Date _____
Drilling company:	Driller:	No. Samples:
Bit type:	Sampler type:	Diameter (in):
Auger Inner/Outer Diameter (in):	Bit Diameter (in):	
Field Geologist (Name)/Date:	Checked by (Name):	
Signature:	Signature:	

Lithology Logged: ☒ Core (where noted) ☒ Cuttings from auger

Depth (ft)	Well Completion	Sample Interval	Recovery (ft/ft)	Blow Count	Soil/Rock Description	**Description** (USCS Abbreviations, Moisture, Consistency/Density, Munsell Color, Cementation, Texture, Structures, Sorting, Comments, etc.)
0						
2						
4						
6						
8						
10						

Site ID:

Project Name: **ELF Well Installation**

Page of

Depth (ft)	Well Completion	Sample Interval	Recovery (ft/ft)	Blow Count	Soil/Rock Description	**Description** (USCS Abbreviations, Moisture, Consistency/Density, Munsell Color, Cementation, Texture, Structures, Sorting, Comments, etc.)
10						
12						
14						
16						
18						
20						
22						
24						
26						
28						

Site ID:	
Project Name: **ELF Well Installation**	Page of

Depth (ft)	Well Completion	Sample Interval	Recovery (ft/ft)	Blow Count	Soil/Rock Description	**Description** (USCS Abbreviations, Moisture, Consistency/Density, Munsell Color, Cementation, Texture, Structures, Sorting, Comments, etc.)
28						
30						
32						
34						
36						
38						
40						
42						
44						Depth to water – ___ ft Weathered bedrock – ___ ft Competent bedrock – ___ ft TD – ___ ft
46						

WELL CONSTRUCTION LOG

Well No.:

Project Name: **ELF Well Installation**

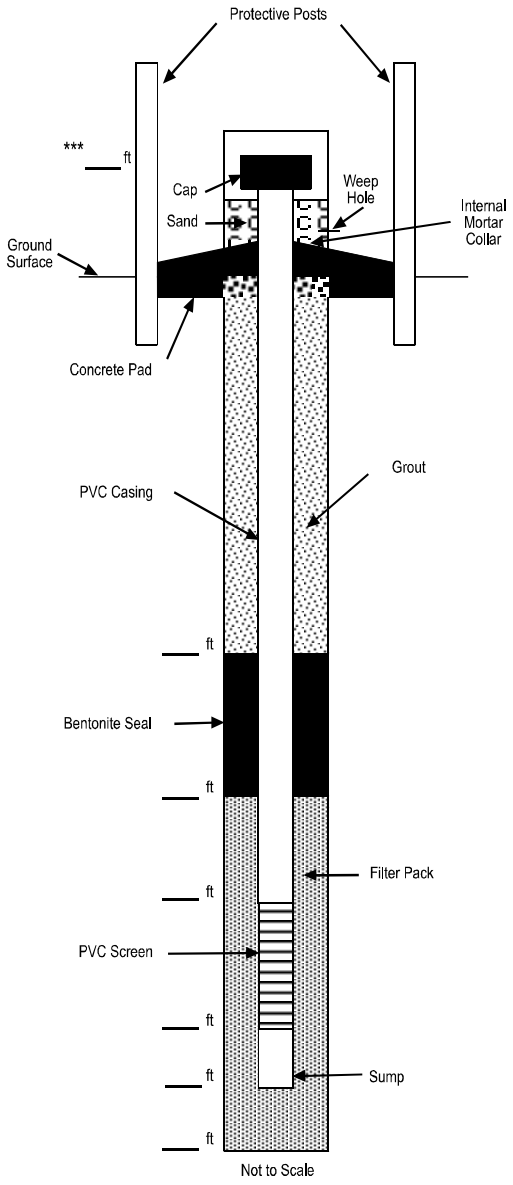
Date:

Field Geologist (Name):

QA Checked by (Name):

Signature:

Signature:



* Water added to aid drilling. Check field log book.

** Water added during well construction OTHER THAN for grout or bentonite.

*** Feet above ground surface.

Measuring point is from ground surface unless otherwise noted.

Drilling Summary

Total depth (ft):

Borehole diameter (in):

Drilling company:

Driller:

Rig type:

Drilling Method

☒ Hollow-stem auger
☐ Air rotary
☐ Air rotary/driven casing
☐ Mud rotary
☐ Other (describe):

Drilling water (if applicable)* (gal):

Well Construction Details

Grout Quantity (gal):	Type:	
Filter Pack (# bags):	Sand type:	
Bentonite:	Size:	Type:

Construction water** (gal):

Depths

Measured internal well depth (ft):

Stick-up (ft):

Screen and Casing

Screen Length (ft):	Casing Length (ft):
I.D. (in):	O.D. (in):

Slot size: **0.010**

Screen Type:

Casing Schedule:

Initial water level (ft):

Comments:

WELL DEVELOPMENT LOG

Well No.:

Project Name: **ELF Well Installation**

Date:

Method of Development:

Field Geologist:

Pump Type:

Reviewer:

Serial No.:

	Before	Reference Point	After
Depth to water (ft):			
Depth to sediment (ft):			

Initial/final thickness of sediment (ft): _____/_____

Initial water column height (ft) (*h*):

Depth of well (ft):

Radius of Boring (ft) (*R*):

Radius of casing (ft) (*r*):

Depth to water after 24 hrs (ft):

Drilling water added (gal):

Construction water added (gal):

Casing volume (gals)[(1)] = (πr^2) (h(ft)) (7.48 gal/ft^3) =

0.3 saturated annulus (gal)[(2)] = 0.3 {[(πR^2) (h(ft)) (7.48 gals/ft^3)] – casing volume (gal)} =

Well volume (WV) = Casing volume + 0.3 saturated annulus =

Total minimum volume necessary to be purged = (WV x 3) + drilling water + construction water = ___ (gal)

Disposition of development water:

Time	pH[(3)]	Turbidity NTU	Temp. (°C)[(4)]	Conductivity[(5)] (μmhos)	Pump Rate (gpm)	Vol. of Water Removed (gal)	Water Level (ft)	Physical Characteristics

Comments:

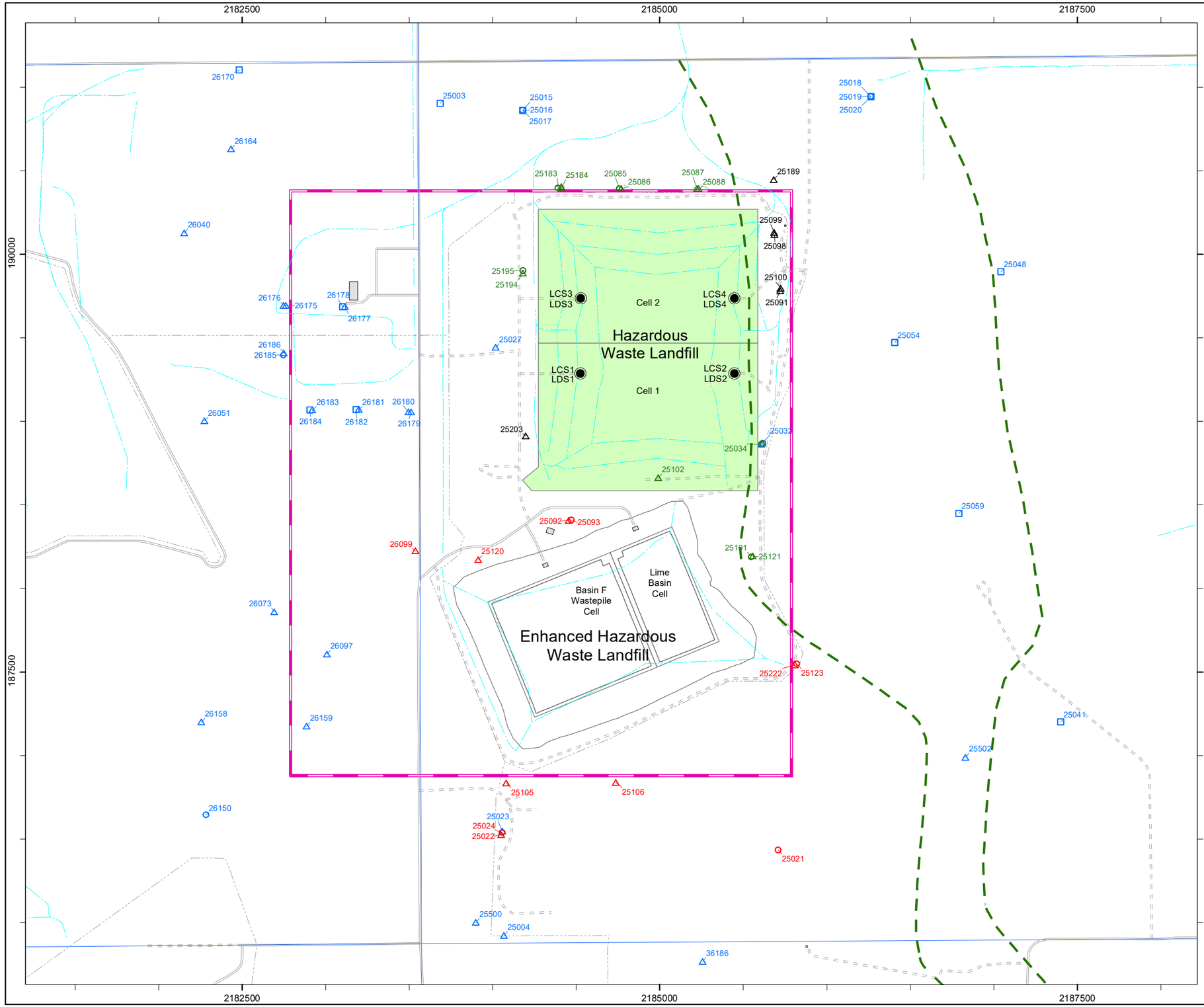
(1) *r* = radius of well casing
(2) *R* = radius of boring
(3) Three of last five consecutive measurements within 20% of each other.
(4) Three consecutive measurements within 1°C of each other.
(5) Three consecutive measurements within 10% of each other.

Table 3.1.2-1: Water Level Monitoring Network

Well Number	Aquifer	Groundwater Flow System
25003	Alluvium	UFS
25004	Denver Fm	UFS
25015	Alluvium/Denver Fm	UFS
25016	Denver Fm	CFS
25017	Denver Fm	CFS
25018	Alluvium/Denver Fm	UFS
25019	Denver Fm	CFS
25020	Denver Fm	CFS
25021	Denver Fm	CFS
25022	Denver Fm	UFS
25023	Denver Fm	UFS
25024	Denver Fm	CFS
25027	Denver Fm	UFS
25032	Denver Fm	UFS
25034	Denver Fm	CFS
25041	Alluvium	UFS
25048	Alluvium	UFS
25054	Alluvium	UFS
25059	Alluvium/Denver Fm	UFS
25183	Denver Fm	CFS
25085	Denver Fm	CFS
25086	Denver Fm	UFS
25087	Denver Fm	UFS
25088	Denver Fm	UFS
25189	Denver Fm	UFS
25091	Denver Fm	UFS
25092	Denver Fm	UFS
25093	Denver Fm	CFS
25194	Denver Fm	UFS
25195	Denver Fm	CFS
25098	Denver Fm	UFS
25099	Denver Fm	UFS
25100	Denver Fm	UFS
25101	Denver Fm	CFS
25102	Denver Fm	UFS
25203	Denver Fm	UFS
25105	Denver Fm	UFS
25106	Denver Fm	UFS
25120	Denver Fm	UFS
25121	Denver Fm	UFS
~~25122~~	~~Denver Fm~~	~~UFS~~
25123	Denver Fm	CFS
25222	Denver Fm	UFS

Commented [MWJ1]: OCN-HWL-2023-001

Commented [MWJ2]: OCN-HWL-2023-001



Legend

- Sumps
- Estimated North Plants/ Bedrock Ridge Plume Extent
- CAMU Boundary
- Buildings
- ELF Cells
- Section Lines
- Light Duty Roads
- Unpaved Roads
- Fences
- Ditches, Canals

Monitoring Well Network	Flow System/Aquifer		
	Unconfined Alluvial	Unconfined Denver	Confined Denver
Hazardous Waste Landfill (HWL)		△	○
HWL Supplemental Operations		△	
Enhanced Hazardous Waste Landfill (ELF)		△	○
Water Level Only	□	△	○

N

0 300 600 1,200
Feet

Sources: U.S. Army, RMA GIS, OMC, Shell/AECOM

NAD27-NGVD29 Datum, US Survey Feet, Colorado North Zone

Program Manager
Rocky Mountain Arsenal
U.S. Army
• COMMITTED TO PROTECTION OF THE ENVIRONMENT •

HWL Post-Closure Groundwater Monitoring Plan

Figure 3.2-1

Well Location Map

M:\projects\hwl_post-closure\mxds\hwl_well_piezometer_loc_091423.mxd
9/14/2023

ROCKY MOUNTAIN ARSENAL
O&M CHANGE NOTICE

WBS Number: 4.01.02.23		OCN Number: **OCN-ELF-2023-001**
Affected Plan/Procedure	☐ HWL Post-Closure Plan	☐ Long-Term Monitoring Plan for GW & Surface Water
	☒ ELF Post-Closure Plan	☐ Land Use Controls Plan
	☐ Basin F Post-Closure Plan	☐ RVO SOP No. _____:
	☐ Long-Term Care Plan	☐ Other:

Recommended disposition: Class 1 Modification (required for HWL, ELF, and Basin F Post-Closure Plans)

Describe proposed change (Exact change in redlined/strike-through format preferred. Provide below or in attachment):	Reason for change:
This OCN includes technical specifications for the closure of well 25122 and installation of well 25222. Well 25222 is intended to replace well 25122, which is no longer functional. This OCN also includes updates to the Enhanced Hazardous Waste Landfill (ELF) groundwater level monitoring network described in the ELF *Post-Closure Groundwater Monitoring Plan* (PCGMP). Changes to the ELF PCGMP include the replacement of well 25122 with well 25222 in Table 3.2-1 and Figure 3.2-1. All changes to the ELF PCGMP are shown in redline/strikeout format.	Well 25122 is included in the ELF groundwater level monitoring network defined in the ELF PCGPM. In June of 2022, the Army determined that the well is partially filled with sand. While the origin of the sand is unknown, the Army concluded that well 25122 will no longer provide reliable data to support mapping of the potentiometric surface, and recommended that the well be closed, removed from the monitoring network, and replaced by a new well. The observations and recommendations were documented in the *2023 RCRA Landfills and Groundwater Monitoring Report*, Revision 0, dated June 21, 2023. This OCN provides the technical specifications for the closure of well 25122 and the installation of replacement well 25222. The location and construction details of well 25222 have been designed to provide water level data that are analogous to the data that have historically been collected from well 25122. Well 25122 has been dry since 2002 and well 25222 is also expected to be dry.

Exhibits attached: ☐ None ☒ List:

- Technical Specification Section 02032 – Abandonment and Closure of Monitoring Wells
- Technical Specification Section 02673 – Installation of Groundwater Monitoring Wells
- *ELF Post-Closure Groundwater Monitoring Plan* in redline/strikeout format (affected pages only)

Originator: Michael W. Jones	Date: September 22, 2023

Final Approval:

OMC Project Manager Signature	Army Project Manager Signature
Michael W. Jones Digitally signed by: Michael W. Jones DN: CN = Michael W. Jones email = jonesm@navarro-inc.com C = US O = Navarro Research and Engineering, Inc. OU = Rocky Mountain Arsenal Date: 2023.09.22 14:25:00 -06'00'	MACKELVEY.DONALD.J.III.1165665992 Digitally signed by MACKELVEY.DONALD.J.III.1165665992 Date: 2023.09.25 09:22:25 -06'00'
OMC Project Engineer Signature (required for record drawing/design changes)	OMC Regulatory Compliance Manager
	Scott Ache Digitally signed by: Scott Ache DN: CN = Scott Ache email = ache@navarro-inc.com C = US Date: 2023.09.22 17:34:28 -06'00'

Regulatory Approvals:

EPA Signature	CDPHE Signature	ACHD Signature

SPECIFICATION SECTION 02032
ABANDONMENT AND CLOSURE OF MONITORING WELLS

PART 1 GENERAL

This Specification includes:

A. The technical requirements for the permanent abandonment and closure of monitoring well 25122 associated with the Hazardous Waste landfill (HWL) and the Enhanced Hazardous Waste Landfill (ELF).

1.1 References

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ASTM INTERNATIONAL

ASTM C 150/C 150 M-21	Standard Specification for Portland Cement
ASTM D5299/D5299M-18	Standard Guide for Decommissioning of Ground Water Wells, Vadose Zone Monitoring Devices, Boreholes, and Other Devices for Environmental Activities

CODE OF COLORADO REGULATIONS (CCR)

2 CCR 402-2	Rules and Regulations for Water Well Construction, Pump Installation, Cistern Installation, and Monitoring and Observation Hole/Well Construction. Effective July 1, 2018.

1.2 Scope

A. Abandonment and closure of unconfined flow system groundwater monitoring well 25122 associated with the HWL and ELF. The well is obstructed at a depth of approximately 26 feet below the top of casing. The obstruction appears to be well filter pack sand as seen in downhole video recording.

B. Work described in this specification will be performed by Navarro Research and Engineering, Inc. (Navarro or Contractor).

1.3 Qualifications

A. Licensed Water Well Construction contractor or Authorized Individual in accordance with Rule 16 of 2 CCR 402-2 who is experienced in the abandonment and closure of wells, including experience in the Denver area, and maintaining a current valid Water Well Construction installation license, or Contractor-approved equivalent. Only a licensed Water Well Construction contractor is allowed to abandon wells penetrating a confining layer, such as those confined flow system wells screened in the Denver Formation.

B. Persons authorized to install pumping equipment may plug and seal wells which do not require the removal of casing from more than one aquifer or the ripping or perforating of casing opposite confining layers.

C. A Geologist or Hydrogeologist (having obtained applicable college degree) or a licensed Water Well Construction contractor with at least one year of experience in well abandonment will inspect well abandonment.

1.4 Quality Control

A. Provide and maintain a quality control program ensuring compliance with the requirements.

B. Field Logbook – Maintain log of daily activities that documents the abandonment procedure used for the well.

C. Well Abandonment and Closure Form – Prepare a Well Abandonment and Closure Form (see Attachment 02032-1) for the well.

1.5 Submittals

A. Contractor shall document and provide the following items to for review by the Contractor Project Engineer.

1. List of construction equipment, including backhoe and/or drilling rig (if used), model number, and rating.

2. Source of materials listed in Part 2, and relevant material certifications.

3. Proposed sealing mix design that meets regulatory requirements.

4. A copy of daily logbooks submitted weekly unless otherwise directed by Navarro.

B. If applicable, provide shipping receipts/packing slips to Navarro project personnel for review upon receipt of materials on site.

C. Prepare a Well Abandonment and Closure Form (see Attachment 02032-1) for the Navarro Geologist or Hydrogeologist to review.

PART 2 PRODUCTS

2.1 Materials

A. Well abandonment materials shall consist of the following, for use by the Contractor:

1. Type I Portland cement conforming to ASTM C150/C150M-21, unless otherwise specified.

2. Bentonite-based products specifically designed for permanent well abandonment. Acceptable products include Plug-Gel®, Shur-Gel®, Benseal®, or Contractor-approved equivalent.

3. Washed, clean silica sand, or Contractor-approved equivalent.

4. Potable or non-potable water from an RMA-supplied source.

5. Cement-bentonite grout consistent with State Rule 10, which recommends 6 gallons non-potable water to one 94-pound bag of Portland cement if grout is poured into the well casing. Add 2 to 4 percent bentonite (by dry weight) plus an additional ¾ gallon water for each 1 percent of bentonite used. Add more bentonite only if needed for easier pumping but add no more than 8 percent bentonite. The density of the grout is to be checked using a "mud balance."

B. Store well abandonment materials in a clean, uncontaminated condition throughout the course of the project in an area designated by the Contractor.

PART 3 EXECUTION

3.1 General Requirements

A. Abandon wells in accordance with 2 CCR 402-2, State Rule 16.

B. Maintain existing survey monuments and monitoring wells that are not slated for abandonment in the vicinity, and protect them from damage by equipment and vehicular traffic. Contractor will repair any items damaged during the work effort.

C. Notify the Contractor Project Engineer of any field discrepancies and request confirmation of well identification prior to well abandonment.

D. Complete proper Well Abandonment and Closure Forms to document well abandonment (see Attachment 02032-1).

E. Divert and control surface water to prevent entry into the well at each abandonment site until completion of abandonment.

3.2 Preparation

A. Measure depth to sand filling the well casing with a weighted tape measure or water level meter to the nearest 0.1 ft. Record these data, including the date of measurement, on the Well Abandonment and Closure Form (Attachment 02032-1) prior to proceeding with abandonment.

3.3 Well Abandonment

A. Abandon the well, which is screened in the Denver Formation, in accordance with the following.

1. Contractor will remove well pad, protective casing, bollards, control boxes, and other surface material (where present) from each well site.

2. Fill the well casing with clean, washed sand or Contractor-approved equivalent, to the higher of the static water level or 1 ft above the top of the well screen.

3. Fill casing with grout to 5 ft below existing grade and cut off the casing at the top of the grout. Ensure a minimum of 5 ft of grout is placed in the well. Refer to Subpart 3.3B for grout placement requirements.

4. Top off the well with gradefill as specified in Subpart 3.3C of this Specification Section.

B. Grout Placement:

1. Mix grout manually or by machine. Fully hydrate bentonite slurry prior to adding other materials to the mix.

2. Due to the depth of the well and sand in place, place grout by gravity feeding to 5 feet from the ground surface.

3. Check the completed grout level after 24 hours, and top off grout to the specified depth as necessary.

4. Report the number of bags and gallons of water for manual mixing and a mud balance for mechanical mixing. When multiple batches are mixed for one well, report all requisite information for each batch, as well as the total volume and number of batches, on the Well Abandonment Form.

C. Gradefill Placement:

1. After completion of grout placement in accordance with Subpart 3.3B, place clean fill from Contractor-approved location and compact by tamping with hand tools to prevent settling.

2. Continue filling and tamping until the soil level is consistent with surrounding grades.

3.4 Final Condition and Cleanup

A. After completion and before acceptance of the work, remove all equipment, surplus materials, and rubbish, leaving the site in a clean condition, acceptable to the Contractor Project Engineer.

3.5 Field Quality Control

A. Verify that the well is abandoned in accordance with all required specifications, plans and drawings. Verification will be performed by Contractor and documented in the Project Logbook.

END OF SECTION

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ATTACHMENT 02032-1

WELL ABANDONMENT AND CLOSURE FORM

Well ID:	**Aquifer:**	**Closure Date:**
State Permitted Well? **Yes ☐ No ☐ Unknown ☐**	**Permit Number:**	
RMAED Information	**Field Information***	**Sand Type:**
TOC Elevation (ft):	**Last Known Depth to Water (ft bgs):**	
Casing Diameter (in):	**Last Known Total depth (ft bgs):**	
Ground Elevation (ft):	**Sand Bottom (ft bgs):**	**Sand Amount Used:**
Casing Stick-up (ft):	**Sand Top (ft bgs):**	
Screen Length (ft):	**Grout Bottom (ft bgs):**	
Screen Top (ft bgs):	**Grout Top (ft bgs):**	**Grout Type:**
Casing Depth (ft bgs):	**Casing Cut at Least 2 feet below grade:** **Yes ☐ No ☐**	
Bedrock Depth (ft bgs):		
Easting	**Permanent Cap Installed: Yes ☐ No ☐**	**Grout Amount Used:**
Northing	**Site Backfilled: Yes ☐ No ☐**	
Comments:		
Preparer Name and Signature:		**Date:**
Reviewer Name and Signature:		**Date:**

*In the case of a damaged well, field information shall be complete to the extent possible.

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SPECIFICATION SECTION 02673
INSTALLATION OF GROUNDWATER MONITORING WELLS

PART 1 GENERAL

This Specification includes:

A. Requirements for installing groundwater monitoring wells

B. Requirements for performing lithologic logging

C. Requirements for well development

1.1 References

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ASTM INTERNATIONAL

ASTM A 1064	Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM C 150	Portland Cement
ASTM C 387	Standard Specification for Packaged, Dry, Combined Materials for Concrete and High Strength Mortar
ASTM D 1586	Penetration Test and Split-Barrel Sampling of Soils
ASTM D 1785	Polyvinyl chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2487	Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2488	Description and Identification of Soils (Visual-Manual Procedure)
ASTM D 5088	Decontamination of Field Equipment Used at Nonradioactive Waste Sites
ASTM D 5092	Design and Installation of Ground Water Monitoring Wells in Aquifers
ASTM F 480	Thermoplastic Well Casing Pipe and Couplings Made in Standard Dimension Ratios (SDR), SCH 40 and SCH 80

CODE OF COLORADO REGULATIONS (CCR)

2 CCR 402-2	Rules and Regulations for Water Well Construction, Pump Installation, Cistern Installation, and Monitoring and Observation Hole/Well Construction. Effective July 1, 2018.

CODE OF FEDERAL REGULATIONS (CFR)

49 CFR 172	Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements

ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 600/4-79/020	Methods for Chemical Analysis of Water & Wastes
EPA SOP 3.2	USEPA Region VIII Standard Operating Procedure for Well Development, Version 1, June 1994

GEOLOGICAL SOCIETY OF AMERICA (GEOSA)

GEOSA-RCC011	Geological Society of America Rock Color Chart

NSF INTERNATIONAL (NSF)

NSF Standard 14	Plastics Piping Components and Related Materials

U.S. ARMY CORPS OF ENGINEERS

EM 1110-1-4000	Monitoring Well Design, Installation, and Documentation at Hazardous and/or Toxic Waste Sites

1.2 Project Description

One monitoring well will be installed to replace existing unconfined flow system well 25122 using a hollow-stem auger with the capability to collect continuous core. The collection of core will be conducted with the objective to describe subsurface lithology—alluvium and bedrock—and identifying whether groundwater is present. The well will be installed to a depth approximating that of well 25122 as described in this specification.

1.3 Performance Requirements

Drill borehole and install the monitoring well in a manner to prevent aquifer contamination by the drilling operation and equipment, prevent intra- and inter-aquifer contamination, and prevent vertical seepage of surface water adjacent to the well into the subsurface, especially the monitoring well intake zone.

1.4 Submittals

A field borehole log, a well construction log, and well development log—included as attachments to this specification—will be completed for the monitoring well by Contractor.

Contractor shall maintain a field logbook documenting daily activities. The field borehole log will describe soil lithology and document subsurface geologic occurrences encountered during drilling and well construction, including pertinent depths, and drilling and post-drilling activities.

PART 2 PRODUCTS

2.1 Materials

A. Blank Well Casing – The well casing shall be new, flush-threaded 2-inch diameter, Schedule 40 polyvinyl chloride (PVC) environmental well casing with an expandable J-plug PVC locking well cap. Blank casing shall be certified clean from the manufacturer and received and stored in sealed bags.

B. Well Screen – New, flush-threaded 2-inch diameter, 10-slot (0.010-inch), Schedule 40 PVC environmental well screen with a flush-threaded PVC bottom cap shall be used in the well. The well screen shall be certified clean from the manufacturer and received and stored in sealed bags.

C. Filter Pack – The sand filter pack in the well shall consist of 10/20 washed silica sand. The sand shall be manufactured by Colorado Silica Sand or the equivalent approved by Contractor.

D. Bentonite Seal – Bentonite pellets or chips, "Pure Gold" or the equivalent approved by Contractor, shall be used for the bentonite seal. After placement, the bentonite seal shall be hydrated with clean water in accordance with manufacturer's recommendations.

E. Cement – Type II Portland cement shall be used for applications requiring cement (e.g., grout).

F. Cement-Bentonite Grout – Cement-bentonite grout shall consist of a slurry of Portland Type II cement, bentonite, and water. Cement grout shall be proportioned not to exceed 7 gallons of water per cubic foot of cement with a mixture of such consistency that the well can be properly grouted. Bentonite powder may be added to reduce shrinkage. Typical mixtures consist of approximately 20 parts cement to 1 part bentonite with 6–7 gallons of approved water per 94-pound bag of Type II Portland cement and 3% by weight sodium bentonite; installed to within 2 to 3 feet of the surface.

G. Protective Casing – The protective casing shall be a round steel casing and 8 inches (minimum) in diameter and 5 feet long (minimum) equipped with a locking cover. The outer casing shall be long enough to extend 2 to 3 feet below grade and provide for a stick-up height of 2–2.5 feet. The protective casing cover must be a Royer brand aluminum cover that will accommodate a padlock. Stick-up height shall be determined by Contractor at the time of installation and will be tall enough to accommodate the J-plug PVC cap.

H. Well Pad Construction – A square (2 feet by 2 feet), nominal 3.5-inch-thick reinforced concrete pad with a 2 percent slope away from the protective casing to the edges of the pad shall be constructed flush with the ground around each well. Quick-Crete or contractor approved equivalent mixed to manufacturer's instructions shall be used for the pad.

I. Drums – Dry soil cuttings will be spread thin on the ground surrounding the drilling location. Department of Transportation (DOT)-approved open-top steel drums will be used to containerize moist or wet soil cuttings and decontamination solids. Steel or polyethylene drums will be used to containerize well development water, which will be dispositioned at the Basin A Neck (BANS) treatment plant.

PART 3 EXECUTION

3.1 General Requirements

A. Construct groundwater monitoring wells to the dimensions shown in Table 1. The monitoring well will be drilled using 4¼-inch inside-diameter hollow-stem augers. The drill rig and other equipment will have the capabilities to successfully drill and complete the well of the type, and size described in this specification. Subcontractor shall provide all tools, equipment, and supplies necessary to drill, install, complete, and develop the well.

B. Split-spoon sample barrels will be used to collect soil core for the length of each borehole. The soil will be logged by Contractor in accordance with ASTM D 2487 and ASTM D 2488

C. Variations in site-specific geologic conditions may require changes to well construction plans. Changes to the well construction plans shall require approval of Contractor prior to proceeding with subsequent portions of construction.

3.2 Well Construction Requirements

A. Borehole – Boreholes shall be drilled to the approximate depth shown in the Table 1. Actual depth may be slightly different than shown based on the materials observed in the drill cuttings and core. Contractor will make the final determination on the well construction.

B. Well String – The well string consisting of blank casing with top cap, well screen, and bottom cap, shall be constructed to the dimensions shown in Table 1. The final well screen placement intervals will be subject to the approval of Contractor. The blank well casing shall extend no more than 2.5 feet above the ground surface.

C. Well Filter Pack – Sand, as the filter pack, shall be placed from total depth of the borehole to no less than 2 to 3 feet above the well screen. The sand pack shall be installed through the hollow stem augers by pouring the sand between the well casing and the inside of the augers in a manner typical for installation of shallow environmental monitoring wells. As the sand pack is placed, the augers shall be pulled out of the borehole. Care shall be taken to keep the sand inside the augers while pulling the augers to ensure that the sand does not bridge off inside the augers. The depth of the well pack shall be measured frequently to verify proper depth. The amount of sand pack placed in the well shall be measured and recorded.

D. Annular Seal – A bentonite pellet or chip seal shall be placed on top of the filter pack and shall extend 2 to 3 feet above the top of the filter pack. After placement, the bentonite seal will be hydrated. A cement-bentonite grout will be placed from the top bentonite seal to the ground surface. Additional grout shall be added as necessary to maintain grout at ground surface. Well construction operations shall be conducted continuously from placement of the well casing string to placement of the hydrated bentonite pellet or chip seal.

E. Protective Casing – The steel protective casing shall be installed after grouting the borehole. The casing does not require painting.

F. Drill/Soil Cuttings – Two types of soil cuttings will be generated as waste and be managed separately as follows:

- Dry Soil Cuttings – These cuttings are generated during drilling from ground surface to approximately 3 to 5 feet above the water table based on observations of soil cutting circulated during drilling and returned to the surface. This soil shall be spread on the ground in the vicinity of the borehole/well location.

– Moist and Saturated Soil Cuttings – These cuttings are generated from 3 to 5 feet above the water table to the total depth of the well based on observations of soil cutting circulated during drilling and returned to the surface. This soil must be containerized in 55-gallon DOT-approved drums and then moved to Building 887 by Subcontractor for storage. Contractor is responsible for disposition of drummed soil waste.

It is likely that no water will be encountered during drilling. In that event, all soil cuttings will be spread on the ground.

G. Surveying – Upon completion of the project, the ground surface elevation, the top of casing elevation, and the location coordinates of the monitoring well will be surveyed by the Contactor. For consistency, the top of casing elevations will be measured on the north side of the well casing.

3.3 Well Development

If water is encountered during drilling and installation, the well shall be developed following completion, but no sooner than 24 hours after cement grouting is completed. The well shall be developed by alternately surging, bailing, and pumping as described below:

- Surge all of the screened sections of the aquifer using a surge block that brushes the inside of the well screen. Surge and bail for a minimum of 30 minutes prior to pumping the well.
- Develop the well by pumping or bailing a minimum of five borehole volumes of water from the well.
- The pH, temperature, turbidity, and conductivity will be measured by Contractor before, during and after development of well. At the discretion of Contractor's field geologist, the need to achieve stabilized parameters (e.g., turbidity) may be amended based on historical information related to development of existing wells in the vicinity.
- The pH will be considered stabilized when three of the last five readings are within a pH of 0.2 units.
- Temperature and conductivity measurements will be allowed to stabilize to within 10 percent of the previous readings before the well is considered developed.
- Turbidity will be considered stable when the measurement is 5 nephelometric turbidity units (NTUs) or less. If 5 NTUs is not achievable, then three of the last five readings should be 20 percent of the previous readings.
- Measurements obtained in the field before, during, and after development will include static water levels, pumping rate, field parameters, and the total volume of water pumped from the well and will be documented on the attached Well Development Log after completion of development activities.
- Development water will be containerized, appropriately labeled, and dispositioned at the BANS treatment plant.

3.4 Quality Control

A. General – Subcontractor shall maintain records as required by Contractor to assure the well construction is being conducted within subcontract limits. The results of drilling construction and development activities shall be documented to assure they meet specifications. Subcontractor shall maintain records of observations (including observations of drill cuttings and drilling rates), measurements, and tests performed. These records shall be furnished to Contractor no later than 24 hours after the tests, measurements, and/or observations are completed.

B. Field Logbook – Subcontractor shall provide a daily log of well construction activities. The field borehole log shall be maintained by Contractor and shall identify subsurface geologic occurrences encountered during well construction. All pertinent depths and activities shall be noted.

3.5 Cleanup

Upon completion, all equipment, surplus materials, and trash will be removed from the site by Subcontractor. The site will be returned to the original condition acceptable to Contractor.

3.6 Documentation

Use attached forms to establish and maintain documentation for well construction and development to record the desired information and to assure compliance with contract requirements.

END OF SECTION

Table 1. Proposed Monitoring Well Construction Summary

Well ID	Coordinates[1]	Casing Stickup	Casing Depth	Well Depth	Bore Diameter	Casing Type	Top of Screen (feet bgs)	Screen Length and Type	Filter Pack	Surface Completion/ Concrete Pad
Enhanced Hazardous Waste Landfill										
25222	N 187543, E 2185810	2–2.5 feet	35–39 feet bgs	36–40 feet TOC	8 inches	2-inch Schedule 40 PVC	29 (maximum depth)	10-foot length, 0.010-inch slotted, Schedule 40 PVC	10/20 Colorado® Silica Sand (or equivalent)	8-inch steel casing with aluminum locking cap and J-plug; 2-foot x 2-foot concrete pad flush with the ground; no bollards

[1] Coordinates are provided in feet in North American Datum 1927, Colorado State Plane, North Zone.
bgs – below ground surface
TOC – top of casing

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SPECIFICATION SECTION 02673

ATTACHMENTS

FIELD BOREHOLE LOG

Site ID:

Page **1** of

Project Name: **ELF Well Installation**		Diameter of hole (in):
Completion depth:	Well Installation: **Yes** ☒ No ☐	Date completed:
Equipment and drilling method:		
Initial water level (ft):	Final water level (ft) _____	Date _____
Drilling company:	Driller:	No. Samples:
Bit type:	Sampler type:	Diameter (in):
Auger Inner/Outer Diameter (in):	Bit Diameter (in):	
Field Geologist (Name)/Date:	Checked by (Name):	
Signature:	Signature:	

Lithology Logged: ☒ Core (where noted) ☒ Cuttings from auger

Depth (ft)	Well Completion	Sample Interval	Recovery (ft/ft)	Blow Count	Soil/Rock Description	**Description** (USCS Abbreviations, Moisture, Consistency/Density, Munsell Color, Cementation, Texture, Structures, Sorting, Comments, etc.)
0						
2						
4						
6						
8						
10						

Site ID:

Project Name: **ELF Well Installation**

Page of

Depth (ft)	Well Completion	Sample Interval	Recovery (ft/ft)	Blow Count	Soil/Rock Description	**Description** (USCS Abbreviations, Moisture, Consistency/Density, Munsell Color, Cementation, Texture, Structures, Sorting, Comments, etc.)
10						
12						
14						
16						
18						
20						
22						
24						
26						
28						

Site ID:	
Project Name: **ELF Well Installation**	Page of

Depth (ft)	Well Completion	Sample Interval	Recovery (ft/ft)	Blow Count	Soil/Rock Description	**Description** (USCS Abbreviations, Moisture, Consistency/Density, Munsell Color, Cementation, Texture, Structures, Sorting, Comments, etc.)
28						
30						
32						
34						
36						
38						
40						
42						
44						Depth to water – ___ ft Weathered bedrock – ___ ft Competent bedrock – ___ ft TD – ___ ft
46						

WELL CONSTRUCTION LOG

Well No.:

Project Name: **ELF Well Installation**

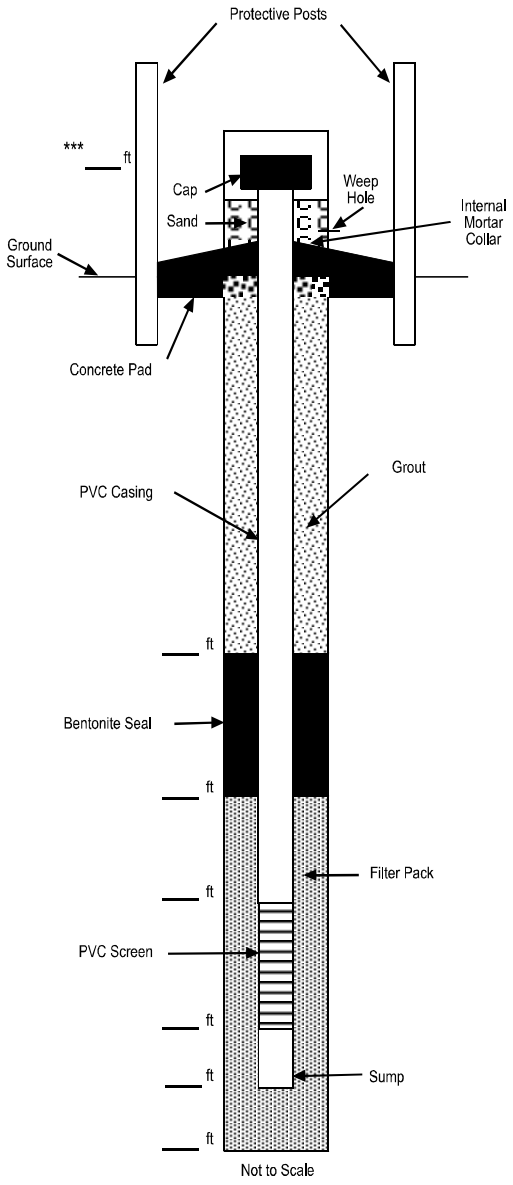
Date:

Field Geologist (Name):

QA Checked by (Name):

Signature:

Signature:



* Water added to aid drilling. Check field log book.

** Water added during well construction OTHER THAN for grout or bentonite.

*** Feet above ground surface.

Measuring point is from ground surface unless otherwise noted.

Drilling Summary

Total depth (ft):

Borehole diameter (in):

Drilling company:

Driller:

Rig type:

Drilling Method

☒ Hollow-stem auger
☐ Air rotary
☐ Air rotary/driven casing
☐ Mud rotary
☐ Other (describe):

Drilling water (if applicable)* (gal):

Well Construction Details

Grout Quantity (gal):	Type:	
Filter Pack (# bags):	Sand type:	
Bentonite:	Size:	Type:

Construction water** (gal):

Depths

Measured internal well depth (ft):

Stick-up (ft):

Screen and Casing

Screen Length (ft):	Casing Length (ft):
I.D. (in):	O.D. (in):

Slot size: **0.010**

Screen Type:

Casing Schedule:

Initial water level (ft):

Comments:

WELL DEVELOPMENT LOG

Well No.:

Project Name: **ELF Well Installation**

Date:

Method of Development:

Field Geologist:

Pump Type:

Reviewer:

Serial No.:

	Before	Reference Point	After
Depth to water (ft):			
Depth to sediment (ft):			

Initial/final thickness of sediment (ft): _____/_____

Initial water column height (ft) (*h*):

Depth of well (ft):

Radius of Boring (ft) (*R*):

Radius of casing (ft) (*r*):

Depth to water after 24 hrs (ft):

Drilling water added (gal):

Construction water added (gal):

Casing volume (gals)[(1)] = (πr^2) (h(ft)) (7.48 gal/ft^3) =

0.3 saturated annulus (gal)[(2)] = 0.3 {[(πR^2) (h(ft)) (7.48 gals/ft^3)] – casing volume (gal)} =

Well volume (WV) = Casing volume + 0.3 saturated annulus =

Total minimum volume necessary to be purged = (WV x 3) + drilling water + construction water = ___ (gal)

Disposition of development water:

Time	pH[(3)]	Turbidity NTU	Temp. (°C)[(4)]	Conductivity[(5)] (μmhos)	Pump Rate (gpm)	Vol. of Water Removed (gal)	Water Level (ft)	Physical Characteristics

Comments:

(1) *r* = radius of well casing
(2) *R* = radius of boring
(3) Three of last five consecutive measurements within 20% of each other.
(4) Three consecutive measurements within 1°C of each other.
(5) Three consecutive measurements within 10% of each other.

3.2.1 Monitoring Well Network

The wells included in the PCGMP were selected based on site-specific hydrogeological and chemical data and to meet regulatory requirements for the ELF. The water level monitoring well network and water quality monitoring well network for the PCGMP is provided in Tables 3.2-1 and 3.2-2, respectively. The water level measurement program for the ELF will be conducted within one week prior to each quarterly groundwater sampling event. The location of the ELF monitoring well network is shown on Figure 3.2-1.

The post-closure groundwater monitoring wells for the ELF are listed in Table 3.2-2 and shown on Figure 3.2-1. The ELF PCGMP includes 12 monitoring wells, designed to monitor water quality in both the UFS and CFS. The ELF groundwater monitoring well network includes four downgradient wells (25092, 25102, 25120, and 26099), three upgradient wells (25022, 25105, and 25106), and one crossgradient well (25121), which will be used to monitor water quality in the UFS. The remaining wells include one downgradient (25093) and three upgradient wells (25021, 25024, and 25123) that will provide water quality data for the CFS. ~~Well 25122 is not included in the water quality well network since it has either been dry or had insufficient water to sample.~~

Commented [MWJ1]: OCN-ELF-2023-001

Although there is low potential to detect North Plants/Bedrock Ridge plume contaminants in the monitoring well network, it is important to identify any potential impacts to the ELF. Water quality monitoring wells 25121 and 25123, located to the east of the ELF, will be used to evaluate any crossgradient potential impacts to the UFS and CFS from the North Plants/Bedrock Ridge plume contaminants. The estimated North Plants/Bedrock Ridge plume boundary is east of the ELF and is shown on Figures 3.1-1 and 3.1-2.

The well networks are designed to maximize monitoring coverage downgradient and upgradient for comparison of post-operational monitoring to preoperational, operational, and closure monitoring results.

3.2.2 Selection of Analytes

The waste placed in the ELF contains a wide range of RMA chemicals, associated byproducts, and degradation products. The rate by which a chemical will migrate in groundwater, in the unlikely event of a release from the landfill, depends on its solubility and mobility in water. Since it is unrealistic to conduct a monitoring program that includes all landfill chemicals, a target list of chemicals was selected that are considered the best indicators of potential releases from the ELF. Comparison of the selected indicator compounds (ICs) with background data will be performed to identify possible releases. The post-closure groundwater monitoring wells downgradient of the ELF will be monitored quarterly for ICs and annually for the complete analyte list. Upgradient well will be monitored annually for the complete analyte list. The complete analyte list, including ICs are found in Table 3.2-3.

The evaluation and selection of ICs for the PCGMP was based on a review of a comprehensive list of potential landfill chemicals presented in the Landfill Wastewater Treatment System ARARs Compliance and Discharge Control Mechanism Document (EPA 2006) and those ICs monitored for during the closure period of the ELF**.** The physical and chemical properties of these compounds and their potential presence in groundwater were evaluated along with current

Table 3.2-1: Water Level Monitoring Network

Well Number	Aquifer	Groundwater Flow System
25003	Alluvium	UFS
25004	Denver Formation	UFS
25015	Alluvium/Denver Formation	UFS
25016	Denver Formation	CFS
25017	Denver Formation	CFS
25018	Alluvium/Denver Formation	UFS
25019	Denver Formation	CFS
25020	Denver Formation	CFS
25021	Denver Formation	CFS
25022	Denver Formation	UFS
25023	Denver Formation	UFS
25024	Denver Formation	CFS
25027	Denver Formation	UFS
25032	Denver Formation	UFS
25034	Denver Formation	CFS
25041	Alluvium	UFS
25048	Alluvium	UFS
25054	Alluvium	UFS
25059	Alluvium/Denver Formation	UFS
25085	Denver Formation	CFS
25086	Denver Formation	UFS
25087	Denver Formation	UFS
25088	Denver Formation	UFS
25091	Denver Formation	UFS
25092	Denver Formation	UFS
25093	Denver Formation	CFS
25098	Denver Formation	UFS
25099	Denver Formation	UFS
25100	Denver Formation	UFS
25101	Denver Formation	CFS
25102	Denver Formation	UFS
25105	Denver Formation	UFS
25106	Denver Formation	UFS
25120	Denver Formation	UFS
25121	Denver Formation	UFS
~~25122~~	~~Denver Formation~~	~~UFS~~
25123	Denver Formation	CFS
25183	Denver Formation	CFS
25189	Alluvium/Denver Formation	UFS
25194	Alluvium/Denver Formation	UFS
25195	Denver Formation	CFS
25203	Alluvium/Denver Formation	UFS

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Table 3.2-1: Water Level Monitoring Network

Well Number	Aquifer	Groundwater Flow System
25222	Denver Formation	UFS
25500	Denver Formation	UFS
25502	Denver Formation	UFS
26040	Denver Formation	UFS
26051	Denver Formation	UFS
26073	Denver Formation	UFS
26097	Denver Formation	UFS
26099	Denver Formation	UFS
26150	Denver Formation	CFS
26158	Denver Formation	UFS
26159	Denver Formation	UFS
26164	Denver Formation	UFS
26170	Alluvium/Denver Formation	UFS
26175	Denver Formation	UFS
26176	Denver Formation	UFS
26177	Denver Formation	UFS
26178	Alluvium	UFS
26179	Denver Formation	UFS
26180	Denver Formation	UFS
26181	Denver Formation	UFS
26182	Alluvium	UFS
26183	Denver Formation	UFS
26184	Alluvium	UFS
26185	Denver Formation	CFS
26186	Denver Formation	UFS
36186	Denver Formation	UFS

CFS Confined Flow System
UFS Unconfined Flow System

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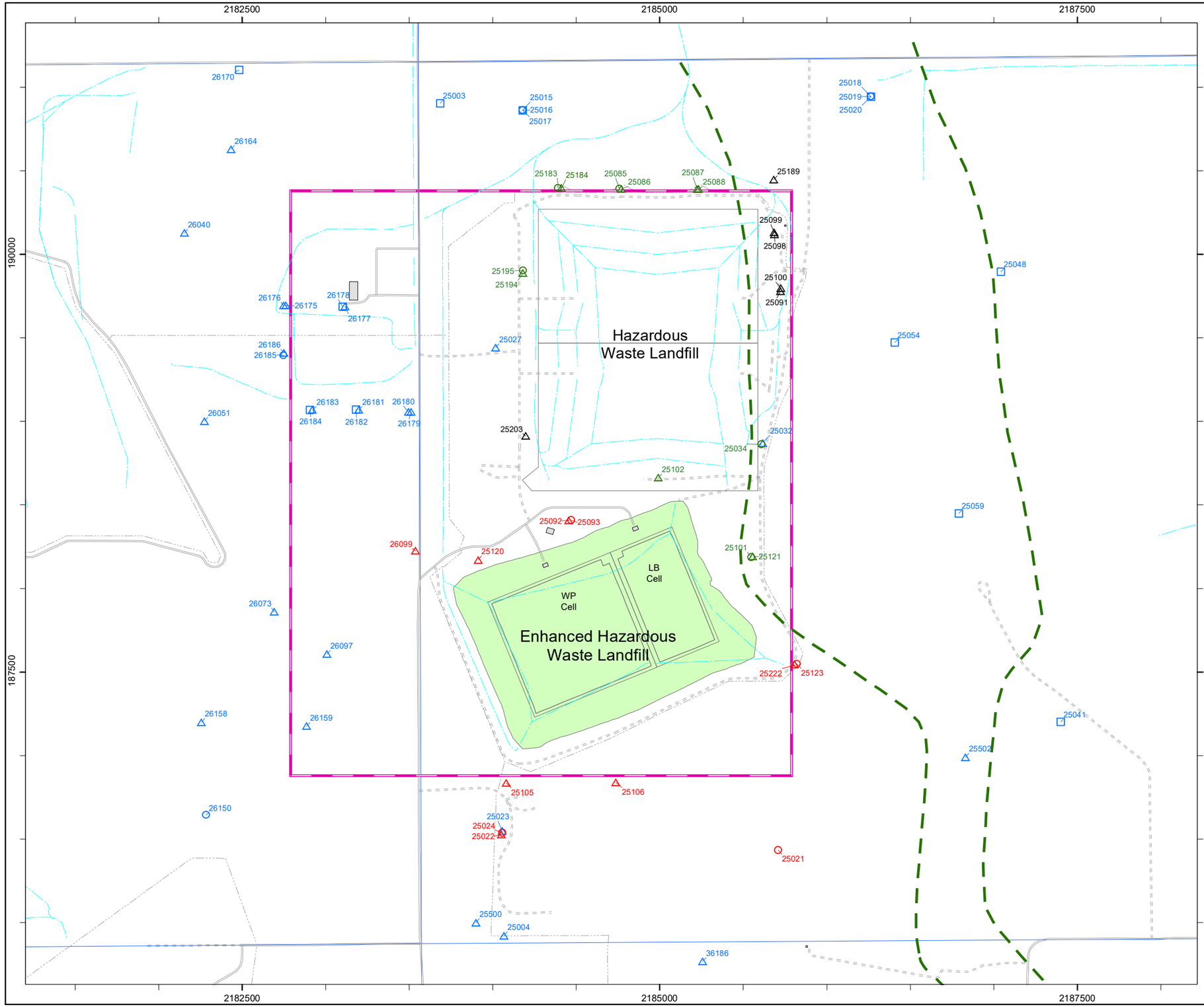

Legend

- CAMU Boundary
- Buildings
- Estimated North Plants/ Bedrock Ridge Plume Extent
- Section Lines
- Light Duty Roads
- Unpaved Roads
- Fences
- Ditches, Canals

Monitoring Well Network	Flow System/Aquifer		
	Unconfined Alluvial	Unconfined Denver	Confined Denver
Hazardous Waste Landfill (HWL)		△	O
HWL Supplemental Operations		△	
Enhanced Hazardous Waste Landfill (ELF)		△	O
Water Level Only	□	△	O

N

0 300 600 1,200
Feet

Sources: U.S. Army, RMA GIS, OMC, Shell/AECOM

NAD27-NGVD29 Datum, US Survey Feet, Colorado North Zone

Program Manager
Rocky Mountain Arsenal
U.S. Army
• COMMITTED TO PROTECTION OF THE ENVIRONMENT •

ELF Post-Closure Groundwater Monitoring Plan

Figure 3.2-1

Well Location Map

M:\projects\elf_post-closure\mxds\elf_well_piezometer_loc_091423.mxd
9/14/2023

ROCKY MOUNTAIN ARSENAL
O&M CHANGE NOTICE

WBS Number: 4.01.01.24		OCN Number: **OCN-HWL-2024-001**
Affected Plan/Procedure	☒ HWL Post-Closure Plan	☐ Long-Term Monitoring Plan for GW & Surface Water
	☐ ELF Post-Closure Plan	☐ Land Use Controls Plan
	☐ Basin F Post-Closure Plan	☐ RVO SOP No. _____:
	☐ Long-Term Care Plan	☐ Other:

Recommended disposition: Class 1 Modification (required for HWL, ELF, and Basin F Post-Closure Plans)

Refer to 6 CCR 1007-3 Part 100, Appendix I to § 100.63 – Classification of Permit Modification:
A. General Permit Provisions, 1. Administrative and informational changes
B. General Facility Standards, 3. Changes in procedures for maintaining the operating record.

Describe proposed change (Exact change in redlined/strike-through format preferred. Provide below or in attachment):	Reason for change:
This OCN updates the language used in the Hazardous Waste Landfill (HWL) Post-Closure Plan (PCP) for consistency with the U.S. Army's electronic records management system requirements. The various forms found in the HWL PCP have been converted into fillable PDF forms with minor format changes that are intended to facilitate form usage. Forms in other electronic formats may also be used as they become available. Other administrative changes to the PCP include the following. • The mailing address of the Army Project Manager was updated in Section 1.3. • References to Tri-County Health Department (TCHD) were replaced with Adams County Health Department (ACHD) throughout the document. Redline/strike-through text for the HWL PCP is attached, with fillable PDF forms.	In accordance with the Office of Management and Budget Memorandum M-19-21, the U.S. Army has transitioned to a paperless records management system. The language used in Revision 2 of the HWL PCP assumes that paper forms would be used to document O&M activities, that hardcopy reports would be produced annually, and that hardcopy project files would be maintained by the O&M contractor and transmitted to the Army annually. This OCN updates the HWL PCP to allow for electronic O&M recordkeeping.

Exhibits attached: ☐ None ☒ List:
- HWL PCP, Revision 4 with redline/strike-through text (affected pages only)
- Forms in fillable PDF format:
  - Form 3.5.4-1: Non-Routine Action Plan Template
  - Form SOP HWL 001-1: HWL Cap Type I Inspection Form
  - Form SOP HWL 001-2: HWL Cap Type II Inspection Form
  - Form 3.1.3-1: HWL LCS/LDS and Wastewater Conveyance System Quarterly Inspection Form

Originator: Michael W. Jones	Date: March 29, 2024

Final Approval:	
Navarro Project Manager Signature and Date Michael W. Jones Digitally signed by: Michael W. Jones DN: CN = Michael W. Jones email = jonesm@navarro-inc.com C = US OU = Navarro Research and Engineering, Inc. Date: 2024.03.29 12:41:03 -06'00'	Army Project Manager Signature and Date Cable, Kelly Digitally signed by Cable, Kelly Date: 2024.04.01 08:02:18 -06'00'
Navarro Project Engineer Signature and Date (required for record drawing/design changes)	Navarro Regulatory Compliance Manager Signature and Date Scott Ache Digitally signed by: Scott Ache DN: CN = Scott Ache email = sache@navarro-inc.com C = US Date: 2024.03.29 14:26:23 -06'00'

Regulatory Approvals:		
EPA Signature and Date DAVID CONNOLLY Digitally signed by DAVID CONNOLLY Date: 2024.04.04 16:38:31 -06'00'	CDPHE Signature and Date Susan Newton Digitally signed by Susan Newton Date: 2024.04.10 14:12:36 -06'00'	ACHD Signature and Date Joseph Chisholm Digitally signed by Joseph Chisholm Date: 2024.04.10 14:17:50 -06'00'

ACRONYMS

ACB	Articulated Concrete Blocks
ACHD	Adams County Health Department
AMA	Army-Maintained Area
APM	Army Project Manager
BBM	Biota Barrier Material
BMPs	Best Management Practices
CAMU	Corrective Action Management Unit
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CCR	Code of Colorado Regulations
CDD	CAMU Designation Document
CDPHE	Colorado Department of Public Health and Environment
~~DTC~~	~~Document Tracking Center~~
ELF	Enhanced Hazardous Waste Landfill
EPA	U.S. Environmental Protection Agency
FFA	Federal Facility Agreement
gpad	Gallons per Acre per Day
H	Horizontal
HWL	Hazardous Waste Landfill
LCS	Leachate Collection System
LDS	Leak Detection System
LS/LF	Leachate Storage and Loadout Facility
LTCP	*Long-Term Care Plan*
NRAP	*Non-Routine Action Plan*
O&M	Operations and Maintenance
PCGMP	*Post-Closure Groundwater Monitoring Plan*
PCWMP	*Post-Closure Wastewater Management Plan*
PCP	*Post-Closure Plan*
RCRA	Resource Conservation and Recovery Act
RMA	Rocky Mountain Arsenal
RMANWR	RMA National Wildlife Refuge
SOP	Standard Operating Procedure
~~TCHD~~	~~Tri-County Health Department~~
USFWS	U.S. Fish and Wildlife Service
V	Vertical

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1.0 INTRODUCTION

This *Post-Closure Plan* (PCP) describes the activities that will be undertaken during the post-closure period for the double-lined Hazardous Waste Landfill (HWL). The HWL is within the Corrective Action Management Unit (CAMU) at Rocky Mountain Arsenal (RMA), located in Adams County, Colorado. This CAMU was established under the requirements of the Resource Conservation and Recovery Act (RCRA) as described in the *CAMU Designation Document* (CDD) (HLA 1996).

The post-closure period as required by RCRA will begin following the physical completion of the HWL cap and continue for a minimum of 30 years after that date. The physical completion of the final cap is defined as completion of the final inspection by the Regulatory Agencies, which was held on May 20, 2009. The HWL was the first CAMU facility to enter the post-closure period at the RMA. Post-closure requirements for the Enhanced Hazardous Waste Landfill, another CAMU Facility, and for Basin F are detailed in separate post-closure plans. The CAMU facilities and other areas defined in the *RCRA-Equivalent, 2-, and 3-Foot Covers Long-Term Care Plan* (LTCP) (TtEC 2011) comprise the Army-Maintained Areas (AMAs) of the RMA and as such, will be retained by the Army and not become part of the RMA National Wildlife Refuge (RMANWR).

The Colorado Department of Public Health and Environment (CDPHE), the U.S. Environmental Protection Agency (EPA), and the ~~Tri-County Health Department (TCHD)~~Adams County Health Department (ACHD), are referred to in this PCP as the "Regulatory Agencies." The Regulatory Agencies and the Army make up the "parties."

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1.1 Purpose and Scope

Remediation wastes have been disposed of in the CAMU HWL facility. State regulations (6 Code of Colorado Regulations [CCR] 1007-3, Section 264.552) require that areas within the CAMU where remediation wastes remain in place after closure be managed and contained to control, minimize, or eliminate future releases to the extent necessary to protect human health and the environment. During the closure period a cap was constructed over the HWL as required by the *HWL Closure Plan* (TtEC 2006). The integrity of the HWL Cap will be maintained by the U.S. Army for the duration of the post-closure period.

This document describes the post-closure activities for the HWL facility, shown on Figure 1.1-1. This PCP was prepared in accordance with the CDD requirements, which incorporate requirements of the Colorado Hazardous Waste Regulations (6 CCR 1007-3, Section 264.552) and uses as guidance, 6 CCR 1007-3, Part 265, Subpart G.

1.2 Document Organization

Information is presented within this PCP as follows:

- Section 2 presents a general description of the HWL.
- Section 3 describes the requirements for implementing post-closure inspection, monitoring, maintenance, and reporting activities.
- Section 4 describes the anticipated schedule for the post-closure period.

- Section 5 provides a list of references used in this document.

~~Documents contained within the appendices of this plan are maintained and available at the Document Tracking Center (DTC), currently located in Building 129 at RMA.~~

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1.3 Document Maintenance

The point of contact for RMA regarding this PCP is the Army Project Manager (APM), U.S. Army, Rocky Mountain Arsenal, ~~6550 Gateway Road~~ 7270 Kingston Parkway, Commerce City, Colorado, 80022. The Army will be responsible for ensuring those activities described in this PCP are implemented, documented, and reported. The PCP documents, reports, monitoring data, and records will be maintained ~~by the Covers Manager in the project file or~~ electronically by the Army.~~(e.g., spreadsheets, databases) and transferred at least annually for permanent storage to the DTC.~~ The project reports generated by Army contractors will be transferred to the Army and stored in accordance with Army Records Management Standards. Certain monitoring data will be maintained in the RMA Environmental Database, as indicated in this PCP and appendices.

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When changes to any of the HWL PCP documents are proposed, the Army will submit the revised document to the Regulatory Agencies for review and approval prior to implementation. HWL PCP revisions may typically be considered following the preparation of an annual *RCRA Landfills and Groundwater Monitoring Report*, during a Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Five-Year Review, or as a result of performance standards not being achieved.

1.4 Amendments to the Post-Closure Plan

If necessary, this PCP will be modified in accordance with state regulations [6 CCR 1007-3 Section 265.118(d)]. When modifications to this PCP are proposed by the Army, a written request to CDPHE will be made 60 days prior to the proposed change or no later than 60 days after an unexpected event has occurred that has affected the PCP. The ~~TCHD~~ACHD and EPA will be notified of the Army's request for proposed change. Modifications are mandatory when changes identified in state regulations (6 CCR 1007-3, Section 100.63) are made.

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1.5 Roles and Responsibilities

The Army has established an integrated management team with the capabilities required to implement long-term care activities on the HWL. The organizational structure, functional responsibilities, minimum qualifications, lines of communication, and interfaces for operation and maintenance (O&M) of the HWL are identified in the following subsections.

The Army's HWL management team may include all, or some, of the staff positions described in the following subsections, but will include competent personnel who meet the minimum qualifications. Individuals may fill multiple roles if the minimum qualifications for those roles are met.

1.5.1 Army Project Manager

The Army representative, who is the APM, is responsible for overseeing this PCP, including overseeing personnel and communicating with and providing notifications to the Regulatory Agencies. The Covers Manager (described below) serves at the direction and discretion of the

of industrial water and wastewater systems. Personnel will be knowledgeable and trained in the O&M requirements and proper sampling, preserving, labeling, and shipping requirements.

1.5.9 Vegetation Expert

The Vegetation Expert is required to have knowledge in regional vegetation and at least five years of experience performing vegetation assessments; have a background in practical soil science, agronomy, or restoration ecology; and have a related degree or applicable experience. The Vegetation Expert may be an Army Contractor, a representative from a local university extension agency, a USFWS staff member, or other suitable government expert, but will have subject knowledge and experience. Responsibilities of the Vegetation Expert include the following:

- Advising/training Site Inspectors in regional vegetation and weed management
- Participating in Type II Inspections to identify weeds and other vegetation problems, and make recommendations for weed control, vegetation maintenance, or repair.
- Involvement in vegetation repair or maintenance planning.
- Providing recommendations for maintaining vegetative cover conditions, including weed control methods and timing.
- Providing input for the annual *RCRA Landfills and Groundwater Monitoring Report*, including recommendations for the upcoming year.

1.5.10 U.S. Fish and Wildlife Service

The USFWS is responsible for managing the RMANWR which surrounds the AMAs. The USFWS may also act as a consultant to the Army regarding wildlife, vegetation, and habitat issues in accordance with future organizational agreements. Any USFWS activities within the AMAs will require coordination through the Covers Manager and approval by the Army. In addition, any USFWS activities within the AMAs for non-routine actions require review and approval by the Regulatory Agencies through the consultative process, prior to implementation. The USFWS will also coordinate with the Covers Manager regarding RMANWR activities that may impact the AMAs.

1.6 Training

All above listed personnel will receive on-the-job training specific to the requirements in this PCP. Additional training will be provided in environmental, health, safety, and quality requirements, as appropriate. Training will be documented and records maintained ~~in the project file~~by the Army.

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collected for the post-closure monitoring program will be analyzed using approved analytical methods in accordance with the *RMA Sampling Quality Assurance Project Plan* (Navarro 2019) and any implementing plans. All sump data will be presented in the *HWL Post-Closure Groundwater Monitoring Report*, an appendix to the annual *RCRA Landfills and Groundwater Monitoring Report*.

The quantities of liquid removed from the LDS sumps are compared with the action levels identified in the *HWL Action Leakage Rate/Response Action Plan* presented in Appendix D. Should the action leakage rates be exceeded, actions and reporting requirements described within the plan will be implemented.

During the post-closure period, liquids will be measured, collected, and transported off-site for disposal until it can be demonstrated that removal is no longer necessary to maintain less than 1-foot of head on the primary liner**.** The Army will provide a written request to the CDPHE for any reduction in measurement frequencies for quantity or quality as currently outlined in the above-referenced plans. The EPA and ~~TCHD~~ACHD will be notified upon submission of such requests.

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The LCS/LDS monitoring data described above will be submitted as a separate, site-specific appendix in the *HWL Post-Closure Groundwater Monitoring Report* and contained within the annual *RCRA Landfills and Groundwater Monitoring Report* during the post-closure period. The *RCRA Landfills and Groundwater Monitoring Report* will also include a discussion on LCS/LDS inspections, maintenance and repairs.

3.2.6 Groundwater Monitoring

The *HWL Post-Closure Groundwater Monitoring Plan* (Appendix B) will be implemented during the post-closure period. Quarterly, groundwater monitoring wells will be inspected and sampled. Samples will be analyzed for chemical constituents in accordance with the aforementioned plan and reported in the *HWL Groundwater Monitoring Report* within the annual *RCRA Landfills and Groundwater Monitoring Report* as discussed above.

The *HWL Post-Closure Groundwater Monitoring Plan* is independent from the *Final Rocky Mountain Arsenal Long-Term Monitoring Plan for Groundwater and Surface Water* (RVO 2010). However, information gained from the HWL groundwater monitoring wells may be used in site-wide *Long-Term Monitoring Plan* evaluations where and if appropriate.

3.3 Management of Wildlife Activities Within the AMA

The Covers Manager will use BMPs for managing wildlife that threaten the integrity of the HWL cap. BMPs for wildlife management, with special application to the cap, will be developed in consultation with one or more of the following agencies or consultants, as appropriate:

- USFWS, Bureau of Land Management, Department of Agriculture
- Colorado Division of Wildlife or other appropriate state wildlife management organizations
- Wildlife experts from Universities or Colleges
- Wildlife experts in private practice

- Regrading portions of the cap surface, enhancing or replacing existing soil to correct surface water drainage problems
- Improving existing surface water drainage system, such as installing new controls or modifying existing ones to improve drainage
- Enhancing soil productivity through addition of soil amendments and/or reseeding to improve plant growth and its ability to control erosion
- Use of replacement soil to compensate for reduced cap thickness
- Increasing monitoring frequency to further assess the deficiency
- Repair to drainage channels (e.g., ACB, concrete, liner systems, etc.)
- Repair to engineering controls such as replacing a monument
- Repair, reinstallation, or closure of monitoring wells

3.5.4 Close-out of a Non-Routine Action

Following implementation of the non-routine action, a multi-agency inspection may be conducted, if appropriate, to determine if the repair objectives were met and the repair effective. Close-out requirements shall be documented on Form 3.5.4-1 with attachments as appropriate upon completion of the repair. Documentation shall describe any modifications to the original design that were necessary to implement an effective repair and any modifications to monitoring or inspection frequencies to avoid development of similar problems in the future.

3.6 PERFORMANCE STANDARDS AND CORRECTIVE MEASURES

The following conditions indicate that performance standards are not being met, resulting in the HWL being considered out of compliance and subject to enforcement by CDPHE:

- When the action leakage rate in the LDS sumps exceeds 132 gallons per acre per day (gpad) in Sump 1 and 131 gpad in Sumps 2, 3, and 4.
- Thickness of the soil cap is reduced by 1.0 foot or more as measured at one or more erosion monuments.
- Identification of a leak into groundwater by comparing groundwater sample results to the Prediction Limit Values established for indicator compounds in upgradient wells and the analytical data from the LDS and LCS wastewater samples.

Evaluation of the cap against these performance standards began on March 23, 2010 with the approval of the *Final Report – Construction Quality Assurance for the Hazardous Waste Landfill Final Cover Construction* by CDPHE, with concurrence from EPA and ~~TCHD~~ACHD, and will continue through the post-closure period.

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3.6.1 Process for Out-Of-Compliance Conditions

Out-of-compliance conditions require initiation of a formal process to determine the appropriate corrective measure. This process is in addition to notification and reporting requirements indicated in Appendices B and D, although efforts may be made to combine the processes while still meeting the requirements of each. Immediately upon identification of an out-of-compliance

4.0 SCHEDULE

4.1 Post-Closure Duration

The post-closure period began on May 20, 2009, after the Final Inspection of cap construction. The post-closure period will continue for a minimum of 30 years after that date.

4.2 Certification of Post-Closure Completion

When the Army proposes to end the post-closure period, a certification will be submitted to the Regulatory Agencies for CDPHE approval in accordance with 6 CCR 1007-3 265.120, and concurrence by EPA and ~~TCHD~~ACHD. Certification of completion of post-closure will be made by the Army 60 days after completion of the established post-closure period. This certification will state that post-closure was performed in accordance with the requirements of this PCP.

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ROCKY MOUNTAIN ARSENAL
HAZARDOUS WASTE LANDFILL (HWL)
STANDARD OPERATING PROCEDURE – CAP INSPECTION

SOP NO.	SOP HWL 001
TITLE	HWL Cap Inspection
DATE	December 2019
PURPOSE	To describe the procedures for inspecting, monitoring, and documenting cap conditions.
RELATED SOPs AND PLANS	*HWL Post-Closure Plan* *Prohibited Plants and Weed Watch List* *HWL Post-Closure Wastewater Management Plan* Operations and Maintenance Contractor's Health and Safety Plan
FREQUENCY	Type II Inspections will be performed in spring between April 1st and April 30th and in fall between September 15th and October 31st. Type I Inspections will be performed in April, July, once between September 15th and October 31st, and once during winter months between November and February. Type I Inspections will also be performed after significant storm events (>1 inch of precipitation per 24-hour period)
HEALTH & SAFETY	Implement health and safety requirements described in the Operations and Maintenance Contractor's Health and Safety Plan.
FIELD EQUIPMENT	All-terrain vehicle (ATV) Red and any other color flagging tape Permanent black marker 12-inch ruler Global Positioning System device (GPS) Digital camera Clipboard and appropriate forms (Optional) 100-foot measuring tape Binoculars (optional)

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Form 3.5.4-1
Non-Routine Action Plan Template

NRAP Number	**NRAP-**	
Applicable Design(s)	☐ Hazardous Waste Landfill – Record Documents ☐ Enhanced Hazardous Waste Landfill – Record Documents	
Applicable Design Document(s)	☐ Drawing Number/Title/Revision: ☐ Spec. Number /Title/Revision: ☐ Plan Title/Revision:	
Description of the Condition Requiring Action		
Description of the Action	Action:	
	Material Requirements:	
	Performance Criteria:	
	Does the action deviate from the requirements of the applicable design package(s)? ☐ Yes ☐ No If so, provide rationale for the deviation from the design package(s).	
Closeout Requirements	Is a multi-Agency post-action inspection required? ☐ Yes ☐ No Are modifications to monitoring or inspection frequencies required? ☐ Yes ☐ No Others: _____	
Consultation Record	Consultation Date: Consultation Method: Consulted Parties:	
Attached Exhibits	☐ None ☐ Inspection Form(s) ☐ Map of Affected Area ☐ Correspondence	☐ Supplemental Work Plan(s) ☐ Rationale for Deviation From Design ☐ Modified Inspection Frequencies ☐ Others:_____

Approvals
Signature indicates the Parties are in consensus and concur with the proposed action and closeout requirements.

Covers Manager, or Designee Signature & Date:	Army Project Manager, or Designee Signature & Date:	
EPA Signature & Date:	CDPHE Signature & Date:	ACHD Signature & Date:

Form SOP HWL 001-1
HWL Cap Type I Inspection Form

Inspector's Names:	**Inspection Date(s):**
Inspection Type: ☐ Type I ☐ Post-Storm	
Drive-around Post-Storm Inspection Date (taken from Logbook): *Note: Post-storm event inspection items are indicated with a * next to the Inspection Item number.*	**Date(s) of Significant Storm Event:** **Total Precipitation (in):**
Inspection Conditions: Previous 24-hour precipitation: Weather Conditions:	
Attachments: ☐ Photographs ☐ Figures ☐ Other	

Inspection Item	Condition Present			Repeat Or Chronic Condition			Inspection Note	Confirm Completed Action (Initial and Date)
	Y	N	N/A	Y	N	N/A		
1.0 Surface Conditions								
1.1* Erosion rills or gullies	◯	◯	◯	◯	◯	◯		
1.2* Sheet erosion or plant pedestalling	◯	◯	◯	◯	◯	◯		
1.3* Depressions, ponding areas, sedimentation, or other conditions that could interrupt cap drainage	◯	◯	◯	◯	◯	◯		
1.4 Surface salts, crusting, or evidence of compaction	◯	◯	◯	◯	◯	◯		
1.5 Excessive animal trails or tire tracks/ruts	◯	◯	◯	◯	◯	◯		
1.6 Burrowing animal holes (localized burrows greater than 3 inches in diameter, or widespread burrows of any size)	◯	◯	◯	◯	◯	◯		

Form SOP HWL 001-1
HWL Cap Type I Inspection Form

Inspection Item	Condition Present			Repeat or Chronic Condition			Inspection Note	Confirm Completed Action (Initial and Date)
	Y	N	N/A	Y	N	N/A		
1.7* Seepage, differential settlement, cracking, subsidence, sliding, creep, or other signs of slope instability	◯	◯	◯	◯	◯	◯		
1.8 Intrusive damage such as unplanned excavation, drilling, grading, damage to engineering or access controls, vandalism	◯	◯	◯	◯	◯	◯		
2.0 Vegetative Cover								
2.1 Bare area or areas of poor growth greater than 100 square feet	◯	◯	◯	◯	◯	◯		
2.2 Areas of poor vigor, disease, over grazing, stress, burned, or discoloration greater than 100 square feet	◯	◯	◯	◯	◯	◯		
3.0 Engineering and Access Controls								
3.1 The perimeter fence is damaged	◯	◯	◯	◯	◯	◯		
3.2 Debris has collected along the perimeter fence	◯	◯	◯	◯	◯	◯		
3.3 Warning signs are not legible from 25 feet	◯	◯	◯	◯	◯	◯		
3.4* Damage to the Access Road such as potholes, washouts or burrowing	◯	◯	◯	◯	◯	◯		

Form SOP HWL 001-1
HWL Cap Type I Inspection Form

Inspection Item	Condition Present			Repeat or Chronic Condition			Inspection Note	Confirm Completed Action (Initial and Date)
	Y	N	N/A	Y	N	N/A		
4.0 LCS/LDS and LS/LF Monitoring								
4.1* Erosion rills or gullies, or burrowing animal holes around the LCS/LDS manholes	○	○	○	○	○	○		
4.2 LS/LF Building secondary containment is damaged or not intact. Storage tanks are leaking.	○	○	○	○	○	○		
5.0 Groundwater Monitoring								
5.1 Damage to monitoring wells	○	○	○	○	○	○		
6.0 Surface Water Controls								
6.1* Impeded drainage or ponding in the channel	○	○	○	○	○	○		
6.2* Excessive siltation in the channel	○	○	○	○	○	○		
6.3* Debris present in the channel	○	○	○	○	○	○		
6.4* Erosion rills or gullies in the channel	○	○	○	○	○	○		
6.5 Areas of degraded Articulated Concrete Block (ACB) or extensively cracked grout around ACB	○	○	○	○	○	○		
6.6* Subsidence or undercutting of the downchutes or perimeter drainage channels	○	○	○	○	○	○		
6.7 Damaged box culverts	○	○	○	○	○	○		

Form SOP HWL 001-1
HWL Cap Type I Inspection Form

Inspection Notes:	For areas with deficiencies, provide identifying labels for deficient areas, descriptions of deficiencies, approximate dimensions of the areas, locations with GPS coordinates, and photographs as needed. Provide attachments as appropriate.
Inspector	
Name:	**Signature and Date:**
Covers Manager Review of Inspection Documentation	
Name:	**Signature and Date:**
Covers Manager Confirmation of Completed Actions	
Name:	**Signature and Date:**

Form SOP HWL 001-2
HWL Cap Type II Inspection Form

Inspector's Names:	**Inspection Date(s):**
Inspection Type: ☐ Type II ☐ Post-Storm	
Drive-around Post-Storm Inspection Date (taken from Logbook): *Note: Post-storm event inspection items are indicated with a * next to the Inspection Item number.*	**Date(s) of Significant Storm Event:** **Total Precipitation (in):**
Inspection Conditions: Previous 24-hour precipitation: Weather Conditions:	
Attachments: ☐ Photographs ☐ Figures ☐ Other	

Inspection Item	Condition Present			Repeat or Chronic Condition			Inspection Note	Confirm Completed Action (Initial and Date)
	Y	N	N/A	Y	N	N/A		
1.0 Surface Conditions								
1.1* Erosion rills or gullies	○	○	○	○	○	○		
1.2* Sheet erosion or plant pedestalling	○	○	○	○	○	○		
1.3* Depressions, ponding areas, sedimentation, or other conditions that could interrupt cap drainage	○	○	○	○	○	○		
1.4 Surface salts, crusting, or evidence of compaction	○	○	○	○	○	○		
1.5 Excessive animal trails or tire tracks/ruts	○	○	○	○	○	○		
1.6 Burrowing animal holes (localized burrows greater than 3 inches in diameter, or widespread burrows of any size)	○	○	○	○	○	○		

Form SOP HWL 001-2
HWL Cap Type II Inspection Form

Inspection Item	Condition Present			Repeat or Chronic Condition			Inspection Note	Confirm Completed Action (Initial and Date)
	Y	N	N/A	Y	N	N/A		
1.7* Seepage, differential settlement, cracking, subsidence, sliding, creep, or other signs of slope instability	◯	◯	◯	◯	◯	◯		
1.8 Intrusive damage such as unplanned excavation, drilling, grading, damage to engineering or access controls, vandalism	◯	◯	◯	◯	◯	◯		
2.0 Vegetative Cover								
2.1 Bare area or areas of poor growth greater than 100 square feet	◯	◯	◯	◯	◯	◯		
2.2 Areas of poor vigor, disease, over grazing, stress, burned, or discoloration greater than 100 square feet	◯	◯	◯	◯	◯	◯		
2.3 Deep rooted, noxious, or undesirable weeds	◯	◯	◯	◯	◯	◯		
3.0 Engineering and Access Controls								
3.1 The perimeter fence is damaged	◯	◯	◯	◯	◯	◯		
3.2 Debris has collected along the perimeter fence	◯	◯	◯	◯	◯	◯		
3.3 Warning signs are not legible from 25 feet	◯	◯	◯	◯	◯	◯		
3.4* Damage to the Access Road such as potholes, washouts or burrowing	◯	◯	◯	◯	◯	◯		

Form SOP HWL 001-2
HWL Cap Type II Inspection Form

Inspection Item	Condition Present			Repeat or Chronic Condition			Inspection Note	Confirm Completed Action (Initial and Date)
	Y	N	N/A	Y	N	N/A		
3.5 Cap perimeter survey monuments appear to be disturbed (Inspect every five years, in conjunction with the CERCLA Five Year Review for legibility and to confirm record locations)	◯	◯	◯	◯	◯	◯		
4.0 LCS/LDS and LS/LF Monitoring								
4.1* Erosion rills or gullies, or burrowing animal holes around the LCS/LDS manholes	◯	◯	◯	◯	◯	◯		
4.2 LS/LF Building secondary containment is damaged or not intact. Storage tanks are leaking.	◯	◯	◯	◯	◯	◯		
5.0 Groundwater Monitoring								
5.1 Damage to monitoring wells	◯	◯	◯	◯	◯	◯		
6.0 Surface Water Controls								
6.1* Impeded drainage or ponding in the channel or downchute	◯	◯	◯	◯	◯	◯		
6.2* Excessive siltation in the channel or downchute	◯	◯	◯	◯	◯	◯		
6.3* Debris present in the channel or downchute	◯	◯	◯	◯	◯	◯		
6.4* Erosion rills or gullies in the channel or downchute	◯	◯	◯	◯	◯	◯		

Form SOP HWL 001-2
HWL Cap Type II Inspection Form

Inspection Item	Condition Present			Repeat or Chronic Condition			Inspection Note	Confirm Completed Action (Initial and Date)
	Y	N	N/A	Y	N	N/A		
6.5 Areas of degraded Articulated Concrete Block (ACB) or extensively cracked grout around ACB	○	○	○	○	○	○		
6.6* Subsidence or undercutting of the downchutes or perimeter drainage channels	○	○	○	○	○	○		
6.7 Damaged box culverts	○	○	○	○	○	○		

Inspection Item	EM-HWL01	EM-HWL02	EM-HWL03	EM-HWL04	EM-HWL05	EM-HWL06	EM-HWL07	EM-HWL08	EM-HWL09
7.0 Erosion/Settlement Monuments: *Inspect monuments for damage and legibility, and record the soil thickness loss, if any.*									
7.1 Monument is damaged or illegible *Check all that apply.*	☐	☐	☐	☐	☐	☐	☐	☐	☐
7.2 Measured Soil Thickness Loss (inches)									

Form SOP HWL 001-2
HWL Cap Type II Inspection Form

Inspection Notes: For areas with deficiencies, provide identifying labels for deficient areas, descriptions of deficiencies, approximate dimensions of the areas, locations with GPS coordinates, and photographs as needed. Provide attachments as appropriate.	
Inspector	
Name:	**Signature and Date:**
Covers Manager Review of Inspection Documentation	
Name:	**Signature and Date:**
Covers Manager Confirmation of Completed Actions	
Name:	**Signature and Date:**

Form 3.1.3-1
HWL LCS/LDS and Wastewater Conveyance System
Quarterly Inspection Form

Inspector's Names:	**Inspection Date(s):**
Attachments: ☐ Photographs ☐ Figures ☐ Other	

Inspection Item	**Condition Present**			**Repeat or Chronic Condition**			**Inspection Note**	**Confirm Completed Action (Initial and Date)**
	Y	**N**	**N/A**	**Y**	**N**	**N/A**		
1 Warning signs are not legible (Confined Space, Buried Pipe/Conduit, etc.)	◯	◯	◯	◯	◯	◯		
2 Extreme temperature inside LCS/LDS manholes	◯	◯	◯	◯	◯	◯		
3 Excessive liquid in LCS/LDS manholes	◯	◯	◯	◯	◯	◯		
4 Improper operation/condition of LCS/LDS pumps or instrumentation	◯	◯	◯	◯	◯	◯		
5 Improper operation/condition of lift station pumps or instrumentation	◯	◯	◯	◯	◯	◯		
6 Excessive liquid in lift station secondary containment	◯	◯	◯	◯	◯	◯		
7 Blockage of leachate collection or leak detection discharge piping	◯	◯	◯	◯	◯	◯		
8 Collapse of leachate collection or leak detection sump riser pipe	◯	◯	◯	◯	◯	◯		
9 LS/LF tank levels are above high level set points.	◯	◯	◯	◯	◯	◯		
10 Indication of leaks in the indoor piping system in the LS/LF.	◯	◯	◯	◯	◯	◯		
11 Indication that the LS/LF secondary containment is damaged or inadequate.	◯	◯	◯	◯	◯	◯		
12 Heating system in the LS/LF is malfunctioning.	◯	◯	◯	◯	◯	◯		

Form 3.1.3-1
HWL LCS/LDS and Wastewater Conveyance System
Quarterly Inspection Form

Inspection Notes: For areas with deficiencies, provide identifying labels for deficient areas, descriptions of deficiencies, approximate dimensions of the areas, locations with GPS coordinates, and photographs as needed. Provide attachments as appropriate.	
Inspector	
Name:	**Signature and Date:**
Covers Manager Review of Inspection Documentation	
Name:	**Signature and Date:**
Covers Manager Confirmation of Completed Actions	
Name:	**Signature and Date:**

ROCKY MOUNTAIN ARSENAL
O&M CHANGE NOTICE

WBS Number: 4.01.02.24		OCN Number: **OCN-ELF-2024-001**
Affected Plan/Procedure	☐ HWL Post-Closure Plan	☐ Long-Term Monitoring Plan for GW & Surface Water
	☒ ELF Post-Closure Plan	☐ Land Use Controls Plan
	☐ Basin F Post-Closure Plan	☐ RVO SOP No. _____:
	☐ Long-Term Care Plan	☐ Other:

Recommended disposition: Class 1 Modification (required for HWL, ELF, and Basin F Post-Closure Plans)

Refer to 6 CCR 1007-3 Part 100, Appendix I to § 100.63 – Classification of Permit Modification:
A. General Permit Provisions, 1. Administrative and informational changes
B. General Facility Standards, 3. Changes in procedures for maintaining the operating record.

Describe proposed change (Exact change in redlined/strike-through format preferred. Provide below or in attachment):

This OCN updates the language used in the Enhanced Hazardous Waste Landfill (ELF) Post-Closure Plan (PCP) for consistency with the U.S. Army's electronic records management system requirements. The various forms found in the ELF PCP have been converted into fillable PDF forms with minor format changes that are intended to facilitate form usage. Forms in other electronic formats may also be used as they become available.

Other administrative changes to the PCP include the following.

- The mailing address of the Army Project Manager was updated in Section 1.3.
- References to Tri-County Health Department (TCHD) were replaced with Adams County Health Department (ACHD) throughout the document.
- The CDPHE approval of the *Final Construction Quality Assurance (CQA) for the Enhanced Hazardous Waste Landfill (ELF) Final Cover Construction* Rev. 0 was added to Sections 3.6. References were added to Section 5.0.

Redline/strike-through text for the ELF PCP is attached, with fillable PDF forms.

Reason for change:

In accordance with the Office of Management and Budget Memorandum M-19-21, the U.S. Army has transitioned to a paperless records management system. The language used in Revision 1 of the ELF PCP assumes that paper forms would be used to document O&M activities, that hardcopy reports would be produced annually, and that hardcopy project files would be maintained by the O&M contractor and transmitted to the Army annually. This OCN updates the ELF PCP to allow for electronic O&M recordkeeping.

Exhibits attached: ☐ None ☒ List:

- ELF PCP, Revision 1 with redline/strike-through text (affected pages only)
- Forms in fillable PDF format:
  - Form 3.5.4-1: Non-Routine Action Plant Template
  - Form SOP ELF 001-1: ELF Cap Type I Inspection Form
  - Form SOP ELF 001-2: ELF Cap Type II Inspection Form
  - Form 3.1.3-1: ELF LCS/LDS and Wastewater Conveyance System Quarterly Inspection Form

Originator: Michael W. Jones	Date: March 20, 2024

Final Approval:			
Navarro Project Manager Signature and Date		Army Project Manager Signature and Date	
Michael W. Jones Digitally signed by: Michael W. Jones DN: CN = Michael W. Jones email = jonesm@navarro-inc.com C = US O = Navarro Research and Engineering, Inc. OU = Rocky Mountain Arsenal Date: 2024.03.20 15:28:08 -06'00'		Cable, Kelly Digitally signed by Cable, Kelly Date: 2024.03.21 10:44:47 -06'00'	
Navarro Project Engineer Signature and Date (required for record drawing/design changes)		Navarro Regulatory Compliance Manager Signature and Date	
		Scott Ache Digitally signed by: Scott Ache DN: CN = Scott Ache email = sache@navarro-inc.com C = US Date: 2024.03.20 15:47:11 -06'00'	
Regulatory Approvals:			
EPA Signature and Date	CDPHE Signature and Date		ACHD Signature and Date
DAVID CONNOLLY Digitally signed by DAVID CONNOLLY Date: 2024.04.04 16:47:48 -06'00'	Susan Newton Digitally signed by Susan Newton Date: 2024.04.10 13:20:26 -06'00'		Joseph Chisholm Digitally signed by Joseph Chisholm Date: 2024.04.10 13:26:43 -06'00'

ACRONYMS

Ac	acre
ACB	Articulated Concrete Block
ACHD	Adams County Health Department
AMA	Army-Maintained Area
APM	Army Project Manager
BBM	Biota Barrier Material
BMP	Best Management Practice
CAMU	Corrective Action Management Unit
CCL	Compacted Clay Liner
CCR	Code of Colorado Regulations
CDD	CAMU Designation Document
CDPHE	Colorado Department of Public Health and Environment
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CQA	Construction Quality Assurance
~~DTC~~	~~Document Tracking Center~~
ELF	Enhanced Hazardous Waste Landfill
EPA	U.S. Environmental Protection Agency
ft	foot (feet)
gpad	gallons per acre per day
H:V	Horizontal to Vertical Ratio
HWL	Hazardous Waste Landfill
LCS	Leachate Collection System
LDS	Leak Detection System
LRCH	Leachate Riser Control House
LS/LF	Loadout/Storage Facility
LTCP	Long-Term Care Plan
NRAP	Non-Routine Action Plan
O&M	Operations and Maintenance
PCGMP	Post-Closure Groundwater Monitoring Plan
PCWMP	Post-Closure Wastewater Management Plan
PCP	Post-Closure Plan
RCRA	Resource Conservation and Recovery Act
RMA	Rocky Mountain Arsenal
RMANWR	RMA National Wildlife Refuge
SOP	Standard Operating Procedure
~~TCHD~~	~~Tri-County Health Department~~

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Commented [MJ2]: OCN-ELF-2024-001

Commented [MJ3]: OCN-ELF-2024-001

1.0 INTRODUCTION

This Post-Closure Plan (PCP) describes the activities that will be undertaken during the post-closure period for the triple-lined Enhanced Hazardous Waste Landfill (ELF). The ELF is within the Corrective Action Management Unit (CAMU) at Rocky Mountain Arsenal (RMA), located in Adams County, Colorado. This CAMU was established under the requirements of the Resource Conservation and Recovery Act (RCRA) as described in the *CAMU Designation Document* (CDD) (HLA 1996).

The post-closure period as required by RCRA will begin following the physical completion of the ELF cap and continue for a minimum of 30 years after that date. The physical completion of the final cap is defined as completion of the final inspection by the Regulatory Agencies. The ELF is one of the CAMU facilities to enter the post-closure period at the RMA. Post-closure requirements for the Hazardous Waste Landfill, another CAMU Facility, and for the Basin F RCRA-Equivalent Cover are detailed in separate post-closure plans. The CAMU facilities and other areas defined in the *RCRA-Equivalent, 2-, and 3-Foot Covers Long-Term Care Plan* (*LTCP*) (TtEC 2011) comprise the Army-Maintained Areas (AMAs) of the RMA and as such, will be retained by the Army and not become part of the RMA National Wildlife Refuge (RMANWR).

The Colorado Department of Public Health and Environment (CDPHE), the U.S. Environmental Protection Agency (EPA), and the ~~Tri-County~~Adams County Health Department (~~TCHD~~ACHD) are referred to in this PCP as the "Regulatory Agencies." The Regulatory Agencies and the Army make up the "parties".

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1.1 Purpose and Scope

Remediation wastes have been disposed of in the CAMU ELF facility. State regulations (6 Code of Colorado Regulations [CCR] 1007-3, Section 264.552) require that areas within the CAMU where remediation wastes remain in place after closure be managed and contained to control, minimize, or eliminate future releases to the extent necessary to protect human health and the environment. During the closure period a cap will be constructed over the ELF as required by the *ELF Closure Plan* (TtEC 2008b). The integrity of the ELF Cap will be maintained by the U.S. Army for the duration of the post-closure period.

This document describes the post-closure activities for the ELF facility, shown on Figure 1.1-1. This PCP was prepared in accordance with the CDD requirements, which incorporate requirements of the Colorado Hazardous Waste Regulations (6 CCR 1007-3, Section 264.552) and uses as guidance, 6 CCR 1007-3, Part 265, Subpart G.

1.2 Document Organization

Information is presented within this PCP as follows:

- Section 2 presents a general description of the ELF.
- Section 3 describes the requirements for implementing post-closure inspection, monitoring, maintenance, and reporting activities.
- Section 4 describes the anticipated schedule for the post-closure period.
- Section 5 provides a list of references used in this document.

~~Documents contained within the appendices of this plan are maintained and available at the Document Tracking Center (DTC), currently located in Building 129 at RMA.~~

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1.3 Document Maintenance

The point of contact for RMA regarding this PCP is the Army Project Manager (APM), U.S. Army, Rocky Mountain Arsenal, ~~6550 Gateway Road, Building 129, Commerce City, Colorado, 80022. The street address for Building 129 is~~ 7270 Kingston Parkway, Commerce City, Colorado, 80022. The Army will be responsible for ensuring those activities described in this PCP are implemented, documented, and reported. The PCP documents, reports, monitoring data, and records will be maintained ~~by the Covers Manager in the project file or~~ electronically by the Army~~(e.g., spreadsheets, databases) and transferred at least annually for permanent storage to the DTC~~. The project reports generated by Army contractors will be transferred to the Army and stored in accordance with Army Records Management Standards. Certain monitoring data will be maintained in the RMA Environmental Database, as indicated in the PCP and appendices.

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When changes to any of the ELF PCP documents are proposed, the Army will submit the revised document to the Regulatory Agencies for review and approval prior to implementation. ELF PCP revisions may typically be considered following the preparation of an annual *RCRA Landfills and Groundwater Monitoring Report*, during the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Five-Year Review, or as a result of performance standards not being achieved.

1.4 Amendments to the Post-Closure Plan

If necessary, following its initial approval, this PCP will be modified in accordance with state regulations [6 CCR 1007-3 Section 265.118(d)]. When modifications to this PCP are proposed by the Army, a written request to the CDPHE will be made 60 days prior to the proposed change or no later than 60 days after an unexpected event has occurred that has affected the PCP. The ~~TCHD~~ ACHD and EPA will be notified of the Army's request for proposed change. Modifications are mandatory when changes identified in state regulations (6 CCR 1007-3, Section 100.63) are made.

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1.5 Roles and Responsibilities

The Army has established an integrated management team with the capabilities required to implement long-term care activities on the ELF cap. The organizational structure, functional responsibilities, minimum qualifications, lines of communication, and interfaces for operations and maintenance (O&M) of the ELF are identified in the following subsections.

The Army's ELF management team may include all, or some, of the staff positions described in the following subsections, but will include competent personnel who meet the minimum qualifications. Individuals may fill multiple roles if the minimum qualifications for those roles are met.

Army Project Manager

The Army representative, who is the APM, is responsible for overseeing this PCP, including overseeing personnel and communicating with and providing notifications to the Regulatory Agencies. The Covers Manager (described below) serves at the direction and discretion of the

1.5.8 Vegetation Expert

The Vegetation Expert is required to have knowledge in regional vegetation and at least five years of experience performing vegetation assessments; have a background in practical soil science, agronomy, or restoration ecology; and have a related degree or applicable experience. The Vegetation Expert may be an Army Contractor, a representative from a local university extension agency, a USFWS staff member, or other suitable government expert, but will have subject knowledge and experience. Responsibilities of the Vegetation Expert include the following:

- Advising/training Site Inspectors in regional vegetation and weed management.
- Participating in Type II Inspections to identify weeds and other vegetation problems, and make recommendations for weed control, vegetation maintenance, or repair.
- Involvement in vegetation repair or maintenance planning.
- Providing recommendations for maintaining vegetative cover conditions, including weed control methods and timing.
- Providing input for the annual *RCRA Landfills and Groundwater Monitoring Report*, including recommendations for the upcoming year.

1.5.9 U.S. Fish and Wildlife Service

The USFWS is responsible for managing the RMANWR which surrounds the AMAs. The USFWS may also act as a consultant to the Army regarding wildlife, vegetation, and habitat issues in accordance with future organizational agreements. Any USFWS activities within the AMAs will require coordination through the Covers Manager and approval by the Army. In addition, any USFWS activities within the AMAs for non-routine actions require review and approval by the Regulatory Agencies through the consultative process, prior to implementation. The USFWS will also coordinate with the Covers Manager regarding RMANWR activities that may impact the AMAs.

1.6 Training

All above listed personnel will receive on-the-job training specific to the requirements in this PCP. Additional training will be provided in environmental, health, safety, and quality requirements, as appropriate. Training will be documented, and records maintained ~~in the project file~~by the Army.

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Sampling Quality Assurance Project Plan (Navarro 2019) and any implementing plans. All sump data will be presented in the *ELF Post-Closure Groundwater Monitoring Report*, an appendix to the annual *RCRA Landfills and Groundwater Monitoring Report.*

The quantities of liquid removed from the LDS sumps are compared with the action levels identified in the *ELF Action Leakage Rate/Response Action Plan* presented in Appendix D. Plan requirements for action and reporting should the action leakage rates be exceeded will be implemented.

During the post-closure period, liquids will be measured, collected, and transported off-site for disposal until it can be demonstrated that removal is no longer necessary to maintain less than one ft of head on the primary liner**.** The Army will provide a written request to the CDPHE for any reduction in measurement frequencies for quantity or quality as currently outlined in the above-referenced plans. The EPA and ~~TCHD~~ ACHD will be notified upon submission of such requests.

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The LCS/LDS monitoring data described above will be submitted as a separate, site-specific appendix in the *ELF Post-Closure Groundwater Monitoring Report* and contained within the annual *RCRA Landfills and Groundwater Monitoring Report* during the post-closure period. The *RCRA Landfills and Groundwater Monitoring Report* will also include a discussion on the LCS/LDS inspection, maintenance, and repair.

3.2.6 Groundwater Monitoring

The *ELF Post-Closure Groundwater Monitoring Plan* (Appendix B) will be implemented during the post-closure period. Quarterly, groundwater monitoring wells will be inspected and sampled. Samples will be analyzed for chemical constituents in accordance with the aforementioned plan and reported in the *ELF Groundwater Monitoring Report* within the annual *RCRA Landfills and Groundwater Monitoring Report* as discussed above.

The *ELF Post-Closure Groundwater Monitoring Plan* is independent from the *Final Rocky Mountain Arsenal Long-Term Monitoring Plan for Groundwater and Surface Water* (RVO 2010). However, information gained from the ELF groundwater monitoring wells may be used in site-wide *Long-Term Monitoring Plan* evaluations where and if appropriate.

3.3 Management of Wildlife Activities Within the AMA

The Covers Manager will use BMPs for managing wildlife that threaten the integrity of the ELF cap. BMPs for wildlife management, with special application to the cap, will be developed in consultation with one or more of the following agencies or consultants, as appropriate:

- USFWS, Bureau of Land Management, Department of Agriculture
- Colorado Division of Wildlife or other appropriate state wildlife management organizations
- Wildlife experts from Universities or Colleges
- Wildlife experts in private practice
- Other wildlife experts

- Improving existing surface water drainage system, such as installing new controls or modifying existing ones to improve drainage
- Enhancing soil productivity through addition of soil amendments and/or reseeding to improve plant growth and its ability to control erosion
- Use of replacement soil to compensate for reduced cap thickness
- Increasing monitoring frequency to further assess the deficiency
- Repair to drainage channels (e. g., ACB, concrete, liner systems, etc.)
- Repair to engineering controls such as replacing a monument
- Repair, reinstallation, or closure of monitoring wells

3.5.4 Close-out of a Non-Routine Action

Following implementation of the non-routine action, a multi-agency inspection shall be conducted, as appropriate, to determine if the repair objectives were met and the repair effective. Close-out requirements shall be documented on Form 3.5.4-1 with attachments as appropriate upon completion of the repair. Documentation shall describe any modifications to the original design that were necessary to implement an effective repair and any modifications to monitoring or inspection frequencies to avoid development of similar problems in the future.

3.6 Performance Standards and Corrective Measures

The following conditions indicate that performance standards are not being met, resulting in the ELF being considered out of compliance and subject to enforcement by CDPHE:

- When the action leakage rate in the Primary WP LDS Sump exceeds 130 gallons per acre per day (gpad), the Secondary WP LDS Sump exceeds 159 gpad, Primary LB LDS Sump exceeds 260 gpad, or the Secondary LB LDS Sump exceeds 318 gpad.
- Thickness of the soil cap is reduced by 1.0 ft or more as measured at one or more erosion monuments.
- Identification of a leak into groundwater by comparing groundwater sample results to the Prediction Limit Values established for indicator compounds in upgradient wells and the analytical data from the LDS and LCS.

Evaluation of the cap against these performance standards ~~will begin immediately upon approval of the *ELF Cap CQAE Closure Certification Report*~~ began on November 11, 2010 when the *Final Construction Quality Assurance for the Enhanced Hazardous Waste Landfill Final Cover Construction*, Revision 0 (Golder 2010) was approved by CDPHE (CDPHE 2010), with concurrence from EPA and ~~TCHD~~Tri-County Health Department~~, and~~ . Enforcement will continue for a minimum of 30 years after that date.

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3.6.1 Process for Out-Of-Compliance Conditions

Out-of-compliance conditions require initiation of a formal process to determine the appropriate corrective measure. This process is in addition to notification and reporting requirements indicated in Appendices B and D, although efforts may be made to combine the processes while still meeting the requirements of each. Immediately upon identification of an out-of-compliance

4.0 SCHEDULE

4.1 Post-Closure Duration

The post-closure period began on May 26, 2010 after the Final Inspection of cap construction. The post-closure period will continue for a minimum of 30 years after that date.

4.2 Certification of Post-Closure Completion

When the Army proposes to end the post-closure period, a certification will be submitted to the Regulatory Agencies for CDPHE approval in accordance with 6 CCR 1007-3 265.120, and concurrence by EPA and ~~TCHD~~ACHD. Certification of completion of post-closure will be made by the Army 60 days after completion of the established post-closure period. This certification will state that post-closure was performed in accordance with the requirements of this PCP.

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5.0 REFERENCES

Army (U.S. Army)

2017 (Oct.) *PM-A-102: RMA Emergency Management/Contingency Plan.* Revision 3.

CDPHE (Colorado Department of Public Health and the Environment)

2010 (Nov.) *Letter to Bruce Huenefeld, U.S. Army. Re: CDPHE Acceptance of Final Construction Quality Assurance (CQA) for the Enhanced Hazardous Waste Landfill (ELF) Final Cover Construction Rev. 0.*

EPA (U.S. Environmental Protection Agency)

1989 (Feb.) *Federal Facility Agreement for the Rocky Mountain Arsenal.*

Golder Associates, Inc. (Golder)

2005 (July) *Construction Quality Assurance Monitoring and Test Results for Enhanced Hazardous Waste Landfill Excavation and Ber/Part 1 Liner Construction, Rocky Mountain Arsenal, Commerce City, Colorado.* Revision 0.

2006 (Mar.) *Construction Quality Assurance for the Enhanced Hazardous Waste Landfill Excavation and Berm, Part 2 Liner, Contingent Contaminated Stormwater Control System and Infrastructure Construction, Rocky Mountain Arsenal, Commerce City, Colorado.* Revision 0.

2010 (Sept.) *Final Construction Quality Assurance for the Enhanced Hazardous Waste Landfill Final Cover Construction.* Revision 0.

HLA (Harding Lawson and Associates)

1996 (June) *CAMU Designation Document, Rocky Mountain Arsenal.*

MKE (Morrison Knudson Engineers)

1988 (Jan.) *Geology of Rocky Mountain Arsenal.*

1998 (Apr.) *Landfill Wastewater Treatment System Final Design Package.*

Navarro (Navarro Research and Engineering, Inc.)

2013 (Oct.) *Land Use Control Plan*. Revision 0.

2019 (Jan.) *Rocky Mountain Arsenal Sampling Quality Assurance Project Plan* Revision 2.

RVO (Remediation Venture Office)

2009 (Nov.) *Remediation and Off-Site Waste Management Plan.* Revision 0.

2010 (Mar.) *Final Rocky Mountain Arsenal Long-Term Monitoring Plan for Groundwater and Surface Water*.

TtEC (Tetra Tech EC, Inc.)

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Form 3.5.4-1
Non-Routine Action Plan Template

NRAP Number	**NRAP-**	
Applicable Design(s)	☐ Hazardous Waste Landfill – Record Documents ☐ Enhanced Hazardous Waste Landfill – Record Documents	
Applicable Design Document(s)	☐ Drawing Number/Title/Revision: ☐ Spec. Number /Title/Revision: ☐ Plan Title/Revision:	
Description of the Condition Requiring Action		
Description of the Action	Action:	
	Material Requirements:	
	Performance Criteria:	
	Does the action deviate from the requirements of the applicable design package(s)? ☐ Yes ☐ No If so, provide rationale for the deviation from the design package(s).	
Closeout Requirements	Is a multi-Agency post-action inspection required? ☐ Yes ☐ No Are modifications to monitoring or inspection frequencies required? ☐ Yes ☐ No Others: _____	
Consultation Record	Consultation Date: Consultation Method: Consulted Parties:	
Attached Exhibits	☐ None ☐ Inspection Form(s) ☐ Map of Affected Area ☐ Correspondence	☐ Supplemental Work Plan(s) ☐ Rationale for Deviation From Design ☐ Modified Inspection Frequencies ☐ Others:_____

Approvals
Signature indicates the Parties are in consensus and concur with the proposed action and closeout requirements.

Covers Manager, or Designee Signature & Date:	Army Project Manager, or Designee Signature & Date:	
EPA Signature & Date:	CDPHE Signature & Date:	ACHD Signature & Date:

Form SOP ELF 001-1
ELF Cap Type I Inspection Form

Inspector's Names:	**Inspection Date(s):**
Inspection Type: ☐ Type I ☐ Post-Storm	
Drive-around Post-Storm Inspection Date (taken from Logbook): *Note: Post-storm event inspection items are indicated with a * next to the Inspection Item number.*	**Date(s) of Significant Storm Event:** **Total Precipitation (in):**
Inspection Conditions: Previous 24-hour precipitation: Weather Conditions:	
Attachments: ☐ Photographs ☐ Figures ☐ Other	

Inspection Item	Condition Present			Repeat or Chronic Condition			Inspection Note	Confirm Completed Action (Initial and Date)
	Y	N	N/A	Y	N	N/A		
1.0 Surface Conditions								
1.1* Erosion rills or gullies	◯	◯	◯	◯	◯	◯		
1.2* Sheet erosion or plant pedestalling	◯	◯	◯	◯	◯	◯		
1.3* Depressions, ponding areas, sedimentation, or other conditions that could interrupt cap drainage	◯	◯	◯	◯	◯	◯		
1.4 Surface salts, crusting, or evidence of compaction	◯	◯	◯	◯	◯	◯		
1.5 Excessive animal trails or tire tracks/ruts	◯	◯	◯	◯	◯	◯		
1.6 Burrowing animal holes (localized burrows greater than 3 inches in diameter, or widespread burrows of any size)	◯	◯	◯	◯	◯	◯		

Form SOP ELF 001-1
ELF Cap Type I Inspection Form

Inspection Item	Condition Present			Repeat or Chronic Condition			Inspection Note	Confirm Completed Action (Initial and Date)
	Y	N	N/A	Y	N	N/A		
1.7* Seepage, differential settlement, cracking, subsidence, sliding, creep, or other signs of slope instability	○	○	○	○	○	○		
1.8 Intrusive damage such as unplanned excavation, drilling, grading, damage to engineering or access controls, vandalism	○	○	○	○	○	○		
1.9 Anchor Trench Drain outfalls exhibit flow, erosion, seepage, moisture or bare/ sparse vegetation.	○	○	○	○	○	○		
2.0 Vegetative Cover								
2.1 Bare area or areas of poor growth greater than 100 square feet	○	○	○	○	○	○		
2.2 Areas of poor vigor, disease, over grazing, stress, burned, or discoloration greater than 100 square feet	○	○	○	○	○	○		
3.0 Engineering and Access Controls								
3.1 The perimeter fence is damaged	○	○	○	○	○	○		
3.2 Debris has collected along the perimeter fence	○	○	○	○	○	○		
3.3 Warning signs are not legible from 25 feet	○	○	○	○	○	○		
3.4* Damage to the Access Road such as potholes, washouts or burrowing	○	○	○	○	○	○		

Form SOP ELF 001-1
ELF Cap Type I Inspection Form

Inspection Item	Condition Present			Repeat or Chronic Condition			Inspection Note	Confirm Completed Action (Initial and Date)
	Y	N	N/A	Y	N	N/A		
4.0 LRCH and LS/LF Monitoring								
4.1* Erosion rills or gullies, or burrowing animal holes around the LRCH Buildings	○	○	○	○	○	○		
4.2 LS/LF Building secondary containment is damaged or not intact. Storage tanks are leaking.	○	○	○	○	○	○		
5.0 Groundwater Monitoring								
5.1 Damage to monitoring wells	○	○	○	○	○	○		
6.0 Surface Water Controls								
6.1* Impeded drainage or ponding in the channel	○	○	○	○	○	○		
6.2* Excessive siltation in the channel	○	○	○	○	○	○		
6.3* Debris present in the channel	○	○	○	○	○	○		
6.4* Erosion rills or gullies in the channel	○	○	○	○	○	○		
6.5 Areas of degraded Articulated Concrete Block (ACB) or extensively cracked grout around ACB	○	○	○	○	○	○		
6.6* Subsidence or undercutting of the downchutes or perimeter drainage channels	○	○	○	○	○	○		
6.7 Damaged box culverts	○	○	○	○	○	○		

Form SOP ELF 001-1
ELF Cap Type I Inspection Form

Inspection Notes:	For areas with deficiencies, provide identifying labels for deficient areas, descriptions of deficiencies, approximate dimensions of the areas, locations with GPS coordinates, and photographs as needed. Provide attachments as appropriate.
Inspector	
Name:	**Signature and Date:**
Covers Manager Review of Inspection Documentation	
Name:	**Signature and Date:**
Covers Manager Confirmation of Completed Actions	
Name:	**Signature and Date:**

Form SOP ELF 001-2
ELF Cap Type II Inspection Form

Inspector's Names:	**Inspection Date(s):**
Inspection Type: ☐ Type II ☐ Post-Storm	
Drive-around Post-Storm Inspection Date (taken from Logbook): *Note: Post-storm event inspection items are indicated with a * next to the Inspection Item number.*	**Date(s) of Significant Storm Event:** **Total Precipitation (in):**
Inspection Conditions: Previous 24-hour precipitation: Weather Conditions:	
Attachments: ☐ Photographs ☐ Figures ☐ Other	

Inspection Item	Condition Present			Repeat or Chronic Condition			Inspection Note	Confirm Completed Action (Initial and Date)
	Y	N	N/A	Y	N	N/A		
1.0 Surface Conditions								
1.1* Erosion rills or gullies	○	○	○	○	○	○		
1.2* Sheet erosion or plant pedestalling	○	○	○	○	○	○		
1.3* Depressions, ponding areas, sedimentation, or other conditions that could interrupt cap drainage	○	○	○	○	○	○		
1.4 Surface salts, crusting, or evidence of compaction	○	○	○	○	○	○		
1.5 Excessive animal trails or tire tracks/ruts	○	○	○	○	○	○		
1.6 Burrowing animal holes (localized burrows greater than 3 inches in diameter, or widespread burrows of any size)	○	○	○	○	○	○		

Form SOP ELF 001-2
ELF Cap Type II Inspection Form

Inspection Item	Condition Present			Repeat or Chronic Condition			Inspection Note	Confirm Completed Action (Initial and Date)
	Y	N	N/A	Y	N	N/A		
1.7* Seepage, differential settlement, cracking, subsidence, sliding, creep, or other signs of slope instability	◯	◯	◯	◯	◯	◯		
1.8 Intrusive damage such as unplanned excavation, drilling, grading, damage to engineering or access controls, vandalism	◯	◯	◯	◯	◯	◯		
1.9 Anchor Trench Drain outfalls exhibit flow, erosion, seepage, moisture or bare/ sparse vegetation.	◯	◯	◯	◯	◯	◯		
2.0 Vegetative Cover								
2.1 Bare area or areas of poor growth greater than 100 square feet	◯	◯	◯	◯	◯	◯		
2.2 Areas of poor vigor, disease, over grazing, stress, burned, or discoloration greater than 100 square feet	◯	◯	◯	◯	◯	◯		
2.3 Deep rooted, noxious, or undesirable weeds	◯	◯	◯	◯	◯	◯		
3.0 Engineering and Access Controls								
3.1 The perimeter fence is damaged	◯	◯	◯	◯	◯	◯		
3.2 Debris has collected along the perimeter fence	◯	◯	◯	◯	◯	◯		
3.3 Warning signs are not legible from 25 feet	◯	◯	◯	◯	◯	◯		

Form SOP ELF 001-2
ELF Cap Type II Inspection Form

Inspection Item	Condition Present			Repeat or Chronic Condition			Inspection Note	Confirm Completed Action (Initial and Date)
	Y	N	N/A	Y	N	N/A		
3.4* Damage to the Access Road such as potholes, washouts or burrowing	◯	◯	◯	◯	◯	◯		
3.5 Cap perimeter survey monuments appear to be disturbed (Inspect every five years, in conjunction with the CERCLA Five Year Review for legibility and to confirm record locations)	◯	◯	◯	◯	◯	◯		
4.0 LRCH and LS/LF Monitoring								
4.1* Erosion rills or gullies, or burrowing animal holes around the LRCH Buildings	◯	◯	◯	◯	◯	◯		
4.2 LS/LF Building secondary containment is damaged or not intact. Storage tanks are leaking.	◯	◯	◯	◯	◯	◯		
5.0 Groundwater Monitoring								
5.1 Damage to monitoring wells	◯	◯	◯	◯	◯	◯		
6.0 Surface Water Controls								
6.1* Impeded drainage or ponding in the channel or downchute	◯	◯	◯	◯	◯	◯		
6.2* Excessive siltation in the channel or downchute	◯	◯	◯	◯	◯	◯		
6.3* Debris present in the channel or downchute	◯	◯	◯	◯	◯	◯		
6.4* Erosion rills or gullies in the channel or downchute	◯	◯	◯	◯	◯	◯		

Form SOP ELF 001-2
ELF Cap Type II Inspection Form

Inspection Item	Condition Present			Repeat or Chronic Condition			Inspection Note	Confirm Completed Action (Initial and Date)
	Y	N	N/A	Y	N	N/A		
6.5 Areas of degraded Articulated Concrete Block (ACB) or extensively cracked grout around ACB	○	○	○	○	○	○		
6.6* Subsidence or undercutting of the downchutes or perimeter drainage channels	○	○	○	○	○	○		
6.7 Damaged box culverts	○	○	○	○	○	○		

Inspection Item	EM-ELF01	EM-ELF02	EM-ELF03	EM-ELF04	EM-ELF05	EM-ELF06	EM-ELF07	EM-ELF08
7.0 Erosion/Settlement Monuments: *Inspect monuments for damage and legibility, and record the soil thickness loss, if any.*								
7.1 Monument is damaged or illegible *Check all that apply.*	☐	☐	☐	☐	☐	☐	☐	☐
7.2 Measured Soil Thickness Loss (inches)								

Form SOP ELF 001-2
ELF Cap Type II Inspection Form

Inspection Notes: For areas with deficiencies, provide identifying labels for deficient areas, descriptions of deficiencies, approximate dimensions of the areas, locations with GPS coordinates, and photographs as needed. Provide attachments as appropriate.	
Inspector	
Name:	**Signature and Date:**
Covers Manager Review of Inspection Documentation	
Name:	**Signature and Date:**
Covers Manager Confirmation of Completed Actions	
Name:	**Signature and Date:**

Form 3.1.3-1
ELF LCS/LDS and Wastewater Conveyance System
Quarterly Inspection Form

Inspector's Names:	**Inspection Date(s):**
Attachments: ☐ Photographs ☐ Figures ☐ Other	

Inspection Item	**Condition Present**			**Repeat or Chronic Condition**			**Inspection Note**	**Confirm Completed Action (Initial and Date)**
	Y	**N**	**N/A**	**Y**	**N**	**N/A**		
1 Improper operation/condition of instrumentation and valves	◯	◯	◯	◯	◯	◯		
2 Improper operation of leachate collection and leak detection pumps	◯	◯	◯	◯	◯	◯		
3 Excessive liquid in LRCHs or LS/LF	◯	◯	◯	◯	◯	◯		
4 Blockage of leachate collection leak detection discharge piping	◯	◯	◯	◯	◯	◯		
5 Collapse of leachate collection or leak detection sump riser pipe	◯	◯	◯	◯	◯	◯		
6 Flow meters or level indicators are malfunctioning	◯	◯	◯	◯	◯	◯		
7 LS/LF tank levels are above high-level set points	◯	◯	◯	◯	◯	◯		
8 Indication of leaks in the indoor piping system in the LRCHs or LS/LF	◯	◯	◯	◯	◯	◯		
9 Indication that the LS/LF secondary containment is damaged or inadequate	◯	◯	◯	◯	◯	◯		
10 Heating system in the LRCHs or LS/LF is malfunctioning	◯	◯	◯	◯	◯	◯		

Form 3.1.3-1
ELF LCS/LDS and Wastewater Conveyance System
Quarterly Inspection Form

Inspection Notes: For areas with deficiencies, provide identifying labels for deficient areas, descriptions of deficiencies, approximate dimensions of the areas, locations with GPS coordinates, and photographs as needed. Provide attachments as appropriate.	
Inspector	
Name:	**Signature and Date:**
Covers Manager Review of Inspection Documentation	
Name:	**Signature and Date:**
Covers Manager Confirmation of Completed Actions	
Name:	**Signature and Date:**

APPENDIX I

Responses to Regulatory Agency Comments

Department of the Army's Responses to
U.S. Environmental Protection Agency (EPA)
July 31, 2023 Technical Comments on
2023 RCRA Landfills and Groundwater Monitoring Report, Revision 0

Comment 1. **Section 6.2.3, Well 25122, pdf pg 25:** EPA concurs this well needs to be replaced. If this well has been in a dry, damaged condition since 2002, or for the past 21 years, this well replacement corrective measure is long overdue.

Response: Well 25122 has been replaced. Please note that the well was dry when it was initially installed and when monitoring began in 2002, but the damage likely occurred in early 2022.

Comment 2. The acronym LB and WP are not clearly defined in this document. They are not included in the acronym list, and first appear in section 6.3.1 ELF LCS/LDS Inspections and Maintenance. They're both referenced many times after this point in the document, but are not defined in the text. The only context provided is the use of these acronyms to label the landfill cells in the figures. Please clearly define the acronym LB and WP in this document.

Response: 'LB' and 'WP' are remnants of the landfill design and construction. The ELF design documents refer to two cells within the landfill. The western cell was designated to contain waste from the Basin F Waste Pile and the eastern cell was designated to contain Lime Basins waste, hence the terms WP and LB. However, a ROD amendment changed the remedy for the Lime Basins, and the eastern cell was filled with Principal Threat soil from the Basin F site. Rather than creating confusion between the Lime Basins and Basin F PT waste, the site convention has been to refer to the east cell as PT and west cell as WP, consistent with the design and construction documentation.

Comment 3. **Section 8.0, Recommendations and Corrective Measures, pdf pg 31:** The following recommendation presented in section 8.0 comes as a surprise at the end of the report because there is not a discussion or presentation of supporting information within the text of the report leading to this conclusion and recommendation. "The Army will continue investigating alternative disposal methods for the landfill leachate due to analytical data demonstrating the leachate is suitable for land disposal." Recommend the report include a discussion in an earlier section to include the evaluation of the leachate data that demonstrates support for this recommendation.

Response: The 2024 RCRA Landfills and Groundwater Monitoring Report includes a statement regarding alternative leachate disposal methods.

Comment 4. **Appendix F-1, HWL Post-Closure GW Monitoring Report CY22, Section 2.3.3.2 LDS Sumps, pdf pg 185:** The document reads "Typically, the detections are attributed to contaminants in the LCS clay liner material and consolidation water, rather than indications of leaks in the liner system." However, the report does not make clear how contaminant detections in LDS sump samples are distinguished as being sourced from leaks in the liner system versus being mobilized from the LCS clay liner.

Response: Leaks in the LCS liner system may be identified by increases in analyte concentrations in LDS sump samples and by increases in LDS sump fill rates. Neither of these instances were true for LDS1 or LDS3 in 2022. Since no Indicator Compounds were detected in the wastewater of LDS1 in 2023 and water levels were not high enough in 2023 to initiate sampling in LDS2, LDS3 and LDS4, Section 2.4.2 of the 2023 report does not discuss detections in the LDS sumps.

Comment 5. **Appendix F-1, HWL Post-Closure GW Monitoring Report CY22, Section 3.1, 2022 Prediction Limits and the Current HWL Water Quality Data, pdf pg192:** The document describes the analytical data as "…historical range of the suspected pre-existing contamination." The phrase pre-existing condition could be interpreted as the site conditions prior to Army occupation of the site in 1940s, but it presumably means "prior to the construction of the HWL" as mentioned earlier in the page. For clarity, recommend using the more temporally specific "prior to the construction of the HWL" instead of "pre-existing condition" when describing this situation.

Response: The suggested change does not provide additional temporal specificity because “prior to the construction of the HWL” could also refer to the time before RMA was established. Please note that the referenced section of the report used the term “pre-existing contamination” not “pre-existing condition” as stated in the comment.