ROCKY MOUNTAIN ARSENAL

2023 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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LIST OF ACRONYMS

ALR	Action Leakage Rate
AMA	Army Maintained Area
CAMU	Corrective Action Management Unit
CFS	Confined Flow System
CUSUM	Cumulative Sum
DIMP	Diisopropylmethyl Phosphonate
ELF	Enhanced Hazardous Waste Landfill
gpad	gallons per acre per day
HWL	Hazardous Waste Landfill
ICs	Indicator Compounds
LCS	Leachate Collection System
LDS	Leak Detection System
LRCH	Leachate Riser Control House
LS/LF	Leachate Storage and Loadout Facility
Navarro	Navarro Research and Engineering, Inc.
O&M	Operations and Maintenance
OMC	Operations and Maintenance Contractor
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 *2023 RCRA Landfills and Groundwater Monitoring Report* for the Rocky Mountain Arsenal 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 2023 reporting period of May 1, 2022, through April 30, 2023, and to provide recommendations for the post-closure care during the 2024 reporting period of May 1, 2023, through April 30, 2024. The activities presented in this report include the following items applicable to both the HWL and ELF:

- Army Maintained Area inspection results and maintenance activities, both routine and non-routine
- Leachate Collection System (LCS) and Leak Detection System (LDS) operation and maintenance (O&M)
- Action Leakage Rate analysis
- LCS/LDS wastewater management quantities
- LCS/LDS wastewater quality assessment
- Groundwater monitoring and assessment

Section 1.0 of the HWL PCP and ELF PCP state that post-closure, as required by the Resource Conservation and Recovery Act (RCRA), will begin following the physical completion of the respective caps and will continue for a minimum of 30 years after those dates. The Army and regulatory agencies participated in the final inspection meeting and site-walk of the HWL on May 20, 2009, and a final inspection meeting and site-walk of the ELF on May 26, 2010. Thus, the HWL post-closure period began May 21, 2009, and the ELF post-closure period began on May 27, 2010.

The Army's Operations and Maintenance Contractor (OMC), Navarro Research and Engineering, Inc. (Navarro), inspected, repaired, and maintained the HWL facility in accordance with the HWL PCP and the associated appendices. Similarly, the OMC staff inspected, repaired, and maintained the ELF facility in accordance with the ELF PCP and the associated appendices. The OMC Covers Manager evaluated the observations noted during the inspections and initiated routine maintenance and non-routine actions as appropriate.

The condition of the HWL soil cap and vegetation were good for the reporting period. Vegetation establishment continued to do well and provide substantial cover. The Army will continue to monitor the HWL for the development of perennial grass species and control of annual weeds will remain a priority. The persistence of tumbleweeds was greatly reduced during this reporting period but continued to be a slight nuisance and will require additional management. The OMC Inspectors did not observe erosion in high stormwater flow areas or on channel side slopes during the reporting period. The lack of erosion was an indication of improved soil stability.

The condition of the ELF cap was good for the reporting period. Establishment of desirable grass species is improving. The Army will continue to monitor the ELF for the development of

perennial grass species, especially in the reseeded areas. The persistence of tumbleweeds was greatly reduced during this reporting period but continued to be a slight nuisance and will require additional management. The OMC Inspectors did not observe erosion in high stormwater flow areas or on channel side slopes during the reporting period. The lack of erosion was an indication of improved soil stability.

The OMC Sample Technicians performed quarterly groundwater monitoring of the HWL and ELF. Sump wastewater was sampled prior to being removed from the sumps. Results of the groundwater monitoring and LCS/LDS sampling are reported on a calendar year basis. This report includes the methods, results, and conclusions for the HWL and ELF groundwater and LCS/LDS sampling performed in the calendar year of 2022. During this reporting period, the Army began investigating alternative disposal methods for the landfill leachate due to analytical data demonstrating that the leachate is suitable for land disposal.

The groundwater in the Unconfined Flow System and Confined Flow System flows to the north-northwest and is consistent with previous groundwater monitoring events for the HWL and ELF. No significant variations in groundwater flow directions have been identified across the Corrective Action Management Unit during post-closure monitoring.

Dieldrin and lead were the only indicator compounds (ICs) detected in the downgradient HWL wells. Statistical evaluations indicated that neither dieldrin, nor lead, exceeded their respective prediction limits. Therefore, the groundwater quality around the HWL has not been affected by waste placement operations, closure, and post-closure O&M of the landfill.

Lead was the only IC detected in the downgradient ELF wells, and the lead concentrations were below the calculated prediction limit. Therefore, the groundwater quality around the ELF has not been affected by waste placement operations, closure, and post-closure O&M of the landfill.

The ELF sumps were not sampled in 2022, therefore there were no detections during the reporting period that required regulatory agency notification.

The costs for operating, inspecting, and maintaining the HWL and ELF over the reporting period, including groundwater sampling, LCS/LDS sampling, LCS/LDS O&M, and wastewater disposal, totaled $445,987. Complete budgets for post-closure care of the HWL and ELF for May 2023 through April 2024 have not been approved as of the issuance of this report due to the timing of the annual funding cycle, which typically occurs near the end of the calendar year. However, the combined budgets for the period of December 2022 to November 2023 total $555,140.

In summary, and based on the information presented in this report, the HWL and ELF were in compliance with all performance standards and no corrective measures were required for this reporting period. Plans to maintain the integrity of the caps include continued diligence with weed control and tumbleweed maintenance, overseeding where necessary, inspection for erosion and burrowing animal holes, investigating leachate disposal options, closure of well 25122, and monitoring the groundwater and LCS/LDS wastewater quality.

1.0 INTRODUCTION

This *2023 RCRA Landfills and Groundwater Monitoring Report* 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 2023 reporting period of May 1, 2022, through April 30, 2023, and to provide recommendations for the post-closure care during the 2024 reporting period of May 1, 2023, through April 30, 2024. The activities presented in this report include the following items applicable to both the HWL and ELF:

- Army Maintained Area (AMA) inspection results and maintenance activities, both routine and non-routine
- Leachate Collection System (LCS) and Leak Detection System (LDS) operation and maintenance (O&M)
- Action Leakage Rate (ALR) analysis
- LCS/LDS wastewater management quantities
- LCS/LDS wastewater quality assessment
- Groundwater monitoring and assessment

Remediation waste was disposed in the Corrective Action Management Unit (CAMU) HWL and ELF facilities. State regulations (6 Code of Colorado Regulations 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 HWL closure period, a cap was constructed over the HWL as required by the *HWL Closure Plan* (TtEC 2006). Likewise, a cap was constructed over the ELF during the ELF closure phase, as required by the *ELF Closure Plan* (TtEC 2008). The HWL and ELF facilities also include stormwater drainage channels, wastewater conveyance systems, and groundwater monitoring wells. The Army will maintain the integrity of both landfills and their supporting systems for the duration of their respective post-closure periods.

The Army contracted Navarro Research and Engineering, Inc. (Navarro), to perform the work of the Operations and Maintenance Contractor (OMC). The OMC is responsible for inspecting, repairing, and maintaining the HWL facility in accordance with the HWL PCP and the associated appendices. Similarly, the OMC is responsible for inspecting, repairing, and maintaining the ELF facility in accordance with the ELF PCP and the associated appendices. The OMC Covers Manager evaluated the observations noted during the inspections and initiated routine maintenance and non-routine actions as appropriate.

As required by Section 3.9 of the HWL PCP and ELF PCP, this report for 2023 documents maintenance related activities performed between May 1, 2022, and April 30, 2023, as well as groundwater and LCS/LDS analytical data for samples collected between January 1, 2022, and December 31, 2022.

Section 1.0 of the HWL PCP and ELF PCP states that post-closure, as required by the Resource Conservation and Recovery Act (RCRA), will begin following the physical completion of the respective caps and will continue for a minimum of 30 years after those dates. The Army and regulatory agencies participated in the final inspection meeting and site-walk of the HWL on May 20, 2009, and a final inspection meeting and site-walk of the ELF on May 26, 2010. Thus, the HWL post-closure period began May 21, 2009, and the ELF post-closure period began on May 27, 2010.

The HWL and ELF facilities are located adjacent to each other within the northwest quadrant of Section 25, within the boundaries of the Rocky Mountain Arsenal National Wildlife Refuge perimeter fence. The U.S. Fish and Wildlife Service manages the Rocky Mountain Arsenal National Wildlife Refuge. The two facilities are surrounded by a common fence, which defines the AMA for the HWL and ELF. This AMA includes both landfills and surrounding support facilities and occupies roughly 130 acres. The ground surface elevation of the facilities generally ranges between 5,200 and 5,300 feet above mean sea level. No 100-year floodplains have been identified in this area.

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.

2.0 METHODOLOGY

The OMC inspected, repaired, and maintained the HWL facility in accordance with the HWL PCP and the associated appendices. Similarly, the OMC inspected, repaired, and maintained the ELF facility in accordance with the ELF PCP and the associated appendices. The OMC Covers Manager evaluated the observations noted during the inspections and initiated routine maintenance and non-routine actions as appropriate.

2.1 Type I, Type II, and Post-Storm Inspections

2.1.1 HWL Inspections

Standard Operating Procedure (SOP) HWL-001, presented in Appendix A of the HWL PCP, details the procedures for inspecting the HWL soil cap and infrastructure features. The SOP provides procedures for Type I and Type II inspections, as well as a procedure for measuring the loss of cap soil thickness. The OMC Inspectors conducted Type I inspections quarterly, and Type II inspections semiannually.

Post-storm inspections are required after rain events in which the RMA receives more than one inch of precipitation in a 24-hour period. There were two significant storm events during this reporting period. On June 1, 2022, and July 26, 2022, the RMA received 1.47 inches of rain and 1.07 inches of rain, respectively in a 24-hour period. Post-storm drive around inspections were performed on June 1, 2022, and July 27, 2022, and these inspections were documented in the project logbook. Cover post-storm inspections were performed on June 8, 2022, and August 3, 2022, and were documented on Form SOP 001-1 which are included in Appendix B-1 of this report.

Results of the HWL inspections are discussed in Section 4.1.

2.1.2 ELF Inspections

SOP ELF-001, presented in Appendix A of the ELF PCP, details the procedures for inspecting the ELF soil cap and infrastructure features. The SOP includes procedures for Type I and Type II inspections, as well as a procedure for measuring the loss of cap soil thickness. The OMC Inspectors conducted Type I inspections quarterly, and Type II inspections semiannually.

Post-storm inspections are required after rain events in which the RMA receives more than one inch of precipitation in a 24-hour period. There were two significant storm events during this reporting period. On June 1, 2022, and July 26, 2022, the RMA received 1.47 inches of rain and 1.07 inches of rain, respectively in a 24-hour period. Post-storm drive around inspections were performed on June 1, 2022, and July 27, 2022, and these inspections were documented in the project logbook. Cover post-storm inspections were performed on June 8, 2022, and August 3, 2022, and documented on Form SOP 001-1 which are included in Appendix B-2 of this report.

Results of the ELF inspections are discussed in Section 5.1.

2.2 Maintenance and Repair Activities

Table 3.0-1 of the HWL PCP lists examples of routine maintenance and repair activities for the HWL, and Table 3.0-2 of the HWL PCP lists conditions requiring Non-Routine Actions. Likewise, Table 3.0-1 of the ELF PCP lists examples of routine maintenance and repair activities for the ELF, and Table 3.0-2 of the ELF PCP lists conditions requiring Non-Routine Actions. Routine and non-routine maintenance and repair activities are discussed in Sections 4.2 and 5.2 of this report.

2.3 LCS/LDS Sump Inspection, Sampling and Analysis

2.3.1 HWL LCS/LDS Sumps

The OMC Wastewater Operator performed quarterly inspections of the HWL LCS and LDS Wastewater Conveyance System in accordance with the *HWL Post-Closure Wastewater Management Plan* (PCWMP), presented in Appendix C of the HWL PCP Revision 4 (Navarro 2019). The OMC Samplers sampled the HWL LCS and LDS liquids and shipped them to Applied Research and Development Laboratory in Mount Vernon, Illinois for analysis in accordance with the *HWL Post-Closure Groundwater Monitoring Plan* (PCGMP), presented in Appendix B of the HWL PCP Revision 4 (Navarro 2019).

Sample events at the LCS and LDS sumps are initiated when the wastewater levels reach the respective High-Level setting as defined in Section 3.1.1 of the HWL PCWMP. Once a sample is collected from the sump, the wastewater is pumped to the HWL lift station. Pumping stops when the wastewater level reaches the sump's Low-Level setting as defined in Section 3.1.1 of the HWL PCWMP. Each sump is sampled independently based on the wastewater level. If the wastewater needs to be removed from a sump for other operational reasons, samples will be collected from a sump before wastewater is pumped out, regardless of the sump level. There were no additional samples collected for operational reasons during this reporting period.

Analytical results and data evaluation for HWL post-closure LCS and LDS wastewater sampling performed from January through December of 2022 are presented in the *Hazardous Waste*

Landfill Post-Closure Groundwater Monitoring Report Calendar Year 2022 (HWL PCGMR), provided in Appendix F-1 of this report.

2.3.2 ELF LCS/LDS Sumps

The OMC Wastewater Operator performed quarterly inspections of the ELF LCS and LDS Wastewater Conveyance System in accordance with the ELF PCWMP (Navarro 2020), presented in Appendix C of the ELF PCP. The OMC is responsible for sampling the ELF LCS and LDS liquids in accordance with the ELF PCGMP (Navarro 2020), presented in Appendix B of the ELF PCP. However, there were no samples collected from the ELF LCS or LDS sumps during this reporting period because the sump levels did not reach their respective High-Levels.

2.4 ALR Evaluation

The ALR is the liquid flow rate that, when withdrawn from the LDS sumps, warrants follow-up actions. The ALR represents the capacity of the LDS to transmit flow and is independent of the sources of the liquids flowing into the system.

The monthly flow rate data were converted to an average daily flow rate for each of the HWL and ELF LDS sumps. The average daily flow rates for the HWL LDS sumps were compared with the ALRs identified in the *HWL Post-Closure Action Leakage Rate/Response Action Plan* presented in Appendix D of the HWL PCP, and the Non-Routine Action Trigger Levels presented in Table 3.0-2 of the HWL PCP Revision 4 (Navarro 2019). Likewise, the average daily flow rates for the ELF LDS sumps were compared with the ALRs identified in the *ELF Post-Closure Action Leakage Rate/Response Action Plan* (Navarro 2020) presented in Appendix D of the ELF PCP, and the Non-Routine Action Trigger Levels presented in Table 3.0-2 of the ELF PCP. Results of the HWL ALR comparison and ELF ALR comparison are presented in Section 6.1.2 and 6.3.2, respectively.

2.5 Groundwater Sampling

2.5.1 HWL Groundwater Sampling

The OMC implemented the HWL PCGMP, presented in Appendix B of the HWL PCP, quarterly with inspection and sampling of groundwater monitoring wells in the HWL groundwater monitoring well network. The network of groundwater monitoring wells, both upgradient and downgradient of the HWL is intended to monitor for existing hazardous constituents in the groundwater, and to monitor for potential releases of hazardous constituents from the HWL. Analytical results and data evaluation for post-closure groundwater sampling performed from the 2022 calendar year are presented in the HWL PCGMR provided in Appendix F-1 of this report.

2.5.2 ELF Groundwater Sampling

The OMC implemented the ELF PCGMP, presented in Appendix B of the ELF PCP, quarterly with inspection and sampling of groundwater monitoring wells in the ELF groundwater monitoring well network. The network of groundwater monitoring wells, both upgradient and downgradient of the ELF is intended to monitor for existing hazardous constituents in the groundwater, and to monitor for potential releases of hazardous constituents from the ELF. Analytical results and data evaluation for post-closure groundwater sampling performed from January through December of 2022 are presented in the *Enhanced Hazardous Waste Landfill*

Post-Closure Groundwater Monitoring Report Calendar Year 2022 (ELF PCGMR) provided in Appendix F-2 of this report.

3.0 PRECIPITATION DATA

The OMC collected precipitation data 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. The data are presented in Appendix A of this report. Total precipitation measured at the rain gauge between May 1, 2022, and April 30, 2023, was 11.04 inches. The HWL PCP and ELF PCP define a significant storm event as an event in which more than 1.0 inch of precipitation falls in a 24-hour period. On June 1, 2022, and July 26, 2022, the RMA received 1.47 inches of rain and 1.07 inches of rain, respectively in a 24-hour period.

4.0 HWL CAP ASSESSMENT, MAINTENANCE AND REPAIR ACTIONS

The HWL soil cap and vegetation were in good condition for the reporting period. Vegetation establishment continued to do well and provide adequate cover. The HWL will continue to be monitored for the development of perennial grass species. Erosion was not observed in high stormwater flow areas or on channel side slopes during the reporting period which is an indication of improved soil stability.

4.1 HWL Cap Inspections

The OMC Inspectors inspected the HWL cap quarterly and semiannually during this reporting period. Two post-storm inspections were also performed. Table 4.1-1 presents the dates and types of inspections performed.

Table 4.1-1: HWL Inspections

DATE	INSPECTION TYPE	NOTE
June 8, 2022	Post-Storm	Inspection after receiving > 1” of rain in 24-hr period
July 13, 2022	Type I	Regularly scheduled quarterly inspection.
August 3, 2022	Post-Storm	Inspection after receiving > 1” of rain in 24-hr period
October 11, 2022	Type II	Regularly scheduled semiannual inspection.
January 17, 2023	Type I	Regularly scheduled quarterly inspection.
April 10, 2023	Type II	Regularly scheduled semiannual inspection.

The OMC Inspectors evaluated the condition of the soil cap surface for evidence of erosion, cracking, subsidence, ponding of rainwater, and the presence of burrowing animals. The OMC Inspectors also inspected other features such as the vegetative cover, engineering and access controls, surface water controls, and erosion/settlement monuments. Specific inspection items are listed on forms SOP HWL 001-1 and SOP HWL 001-2, contained in Appendix A of the HWL PCP. Copies of the completed inspection forms are provided in Appendix B-1 of this report.

4.2 HWL Inspection Observations and Associated Repairs

The OMC Inspectors assessed each inspection item listed on form SOP HWL 001-1 during each Type I inspection, and form SOP HWL 001-2 during each Type II inspection. The OMC Inspectors identified the specific issues from those forms listed below. For all inspection categories not listed, no observations were noted, and maintenance was not required during this reporting period. The maintenance and repair activities are discussed following each observation.

The OMC staff also recognized weedy species during routine vegetation inspections often performed independently of the Type I and Type II inspections. These observations triggered weed control efforts that are also described below. Documentation of HWL maintenance activities is provided in Appendix C-1 of this report. The locations of maintenance actions are illustrated on Figure 4.2-1.

- Debris has collected along the perimeter fence (Inspection Form Item 3.2) and Debris present in the channel (Inspection Form Item 6.3): Excessive buildup of tumbleweeds was observed in the articulated concrete block channels, in the perimeter channels, and along the perimeter fence. In July and August, a subcontractor used a mower mounted to a skid steer and cleared out tumbleweeds from the channels and along the perimeter fence. One articulated concrete block in the northeast downchute was struck and damaged by the subcontractor during mowing operations. This block was repaired in August of 2022 by pouring concrete around the broken area.
- Debris present in the channel (Inspection Form Item 6.3): Tumbleweeds were observed in some of the articulated concrete block and perimeter channels during the 2023 spring Type II inspection performed on April 10, 2023. This maintenance issue was not addressed before the end of this reporting period. The channels will be maintained during the 2024 reporting period and will therefore be reported in the 2024 LGMR.
- Burrowing animal holes (Inspection Form Item 1.6): An animal hole was identified during the 2023 spring Type II inspection on top of the landfill. This hole was repaired during the inspection with existing soil next to the hole by using a shovel and tamping the soil into place.

The OMC Inspectors identified the maintenance items listed below as improvements that were necessary to facilitate effective O&M of the HWL. These maintenance items were not the result of inspection observations.

- In November 2022, ground clear herbicide was applied by the OMC herbicide subcontractor on the perimeter roads, the sump manhole access roads, around bollards, and in working areas so that personnel can work safely in these areas.
- In July and August 2022, herbicide was spot sprayed by the OMC herbicide subcontractor for thistles, bindweed, and kochia.
- Annual weedy species were identified primarily on top of the landfill. An OMC subcontractor mowed the annual weedy species in August of 2022 to further control the weed population, remove standing litter, and to encourage the growth of desirable perennial grasses.

4.3 HWL Erosion/Settlement Monuments

During the Type II inspections performed in October 2022 and April 2023, the OMC Inspectors measured erosion/settlement monuments to quantify soil thickness loss. The measured soil thickness loss for all nine monuments ranged from 0.0 to 2.0 inches, which is below the Non-Routine Action trigger level of 0.4 feet (or 4.8 inches) and the compliance level of 1.0 foot. The OMC Inspectors also surveyed the position of each monument as part of the semiannual inspections. Survey data are included in Appendix D of this report, together with data collected during prior surveys for reference.

4.4 HWL Vegetation

Established areas of seeded vegetation on the HWL cap 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. Established perennial grass species have been able to spread having been released from the competition of weedy species. On the other aspects and on top of the HWL, cool season grass species, especially Western Wheatgrass (*Pascopyrum smithii*) continue to dominate the plant community. However, there is diversity of seeded native grasses established. Blue grama (*Chondrosum gracil*) and buffalo grass (*Buchloe dactyloides)* are common warm season grass species. Broadleaf weedy species, especially Kochia (*Bassia scoparia*), and prickly lettuce (*Lactuca seriola*) 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 and appears to have been controlled effectively by herbicide treatment. Monitoring of cheatgrass will continue, as will investigation of control methods.

Vegetative litter continues to persist on the HWL thus also providing soil erosion protection. This year, standing dead vegetation was more prevalent on the HWL when compared to previous years and was mowed to remove the buildup.

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 fourteen growing seasons. Methods to promote stability and continued development of the plant community, such as control of annual weeds, reseeding, fertilization, and introduction of biological controls for perennial weeds will continue to be explored and considered.

5.0 ELF CAP ASSESSMENT, MAINTENANCE AND REPAIR ACTIONS

The ELF cap was in good condition for the reporting period. Establishment of desirable grass species is improving, and the ELF will continue to be monitored for development of perennial grass species. The OMC Inspectors did not observe erosion in high stormwater flow areas or on channel side slopes during the reporting period. The lack of erosion was an indication of improved soil stability, especially when compared to early post-closure years as the vegetation was still becoming established.

5.1 ELF Cap Inspections

The OMC Inspectors inspected the ELF cap quarterly and semiannually during this reporting period. Two post-storm inspections were also performed. Table 5.1-1 presents the dates and types of inspections performed during this reporting period.

Table 5.1-1: ELF Inspections

DATE	INSPECTION TYPE	NOTE
June 8, 2022	Post-Storm	Inspection after receiving > 1" of rain in 24-hr period
July 13, 2022	Type I	Regularly scheduled quarterly inspection.
August 3, 2022	Post-Storm	Inspection after receiving > 1" of rain in 24-hr period
October 11, 2022	Type II	Regularly scheduled semiannual inspection.
January 17, 2023	Type I	Regularly scheduled quarterly inspection.
April 10, 2023	Type II	Regularly scheduled semiannual inspection.

The OMC Inspectors evaluated the condition of the soil cap surface for evidence of erosion, cracking, subsidence, ponding of rainwater, and the presence of burrowing animals. The OMC also inspected other features such as the vegetative cover, trench drain outlets, engineering and access controls, surface water controls, erosion/settlement monuments, and the Leachate Storage and Loadout Facility (LS/LF) building. Specific inspection items are listed on forms SOP ELF 001-1 and SOP ELF 001-2, contained in Appendix A of the ELF PCP. Copies of the completed inspection forms are provided in Appendix B-2 of this report.

5.2 ELF Inspection Observations and Associated Repairs

The OMC Inspectors assessed each inspection item listed on form SOP ELF 001-1 during each Type I inspection, and form SOP ELF 001-2 during each Type II inspection. The OMC Inspectors identified the specific issues from those forms listed below. For all inspection categories not listed, no observations were noted, and maintenance was not required during this reporting period. The maintenance and repair activities are discussed following each observation.

The OMC Inspectors also recognized weedy species during routine vegetation inspections often performed independently of the Type I and Type II inspections. Documentation of ELF maintenance activities are provided in Appendix C-2 of this report. The locations of maintenance actions are illustrated on Figure 5.2-1.

- Debris has collected along the perimeter fence (Inspection Form Item 3.2) and Debris present in the channel (Inspection Form Item 6.3): Excessive buildup of tumbleweeds was observed in the articulated concrete block channels, in the perimeter channels, and along the perimeter fence. In July and August, a subcontractor used a mower mounted to a skid steer and cleared out the tumbleweeds from the channels and along the perimeter fence.
- Debris present in the channel (Inspection Form Item 6.3): Tumbleweeds were observed in some of the articulated concrete block and perimeter channels during the 2023 spring

Type II inspection performed on April 10, 2023. This maintenance issue was not addressed before the end of this reporting period. The channels will be maintained during the 2024 reporting period and will therefore be reported in the 2024 LGMR.

- Impeded drainage or ponding in a channel or downchute (Inspection Form Item 6.1): A hole was identified in the east perimeter channel during the 2023 Type II inspection. The hole was backfilled during the inspection using existing soil next to the hole and tamping the soil down.

The OMC Inspectors identified the maintenance items listed below as improvements that were necessary to facilitate effective O&M of the ELF. These maintenance items were not the result of inspection observations.

- In November 2022, ground clear herbicide was applied by the OMC herbicide subcontractor on the perimeter roads, the sump manhole access roads, around bollards, and in working areas so that personnel can work safely in these areas.
- In July and August 2022, herbicide was spot sprayed by the OMC herbicide subcontractor for thistles, bindweed, and kochia.
- Annual weedy species were identified in some areas, primarily on top of the landfill and along the east support area. An OMC subcontractor mowed the annual weedy species in August of 2022 to further control the weed population, remove standing litter, and to encourage the growth of desirable perennial grasses.
- The label plate for erosion/settlement monument EM-ELF04 was unattached to the monument post during the semiannual survey of the monuments. In March of 2023, OMC used epoxy to affix the label plate back to the post.
- Three holes were noticed on top of the landfill on the northeast corner that were created by predators. These holes were backfilled using existing soil in March of 2023.

5.3 ELF Erosion/Settlement Monuments

During the Type II Inspections performed in October 2022 and April 2023, the OMC Inspectors measured erosion/settlement monuments to quantify soil thickness loss. The measured soil thickness loss for all eight monuments ranged from 1.0 to 3.5 inches, which is below the Non-Routine Action trigger level of 0.4 feet (4.8 inches) and the compliance level of 1.0 foot. The OMC Inspectors also surveyed the position of each monument as part of the semiannual inspections. Survey data are included in Appendix D of this report, together with data collected during prior surveys for reference.

5.4 ELF Anchor Trench Drains

The OMC Inspectors inspected the ELF anchor trench drain outfalls in accordance with the SOP for evidence of flow, erosion, seepage, moisture, or bare/sparse vegetation. The inspections were documented on Type I and Type II inspection forms provided in Appendix B-2 of this report. All outfalls were free of flow and indications of moisture during the inspections performed during this reporting period.

5.5 ELF Vegetation

Seeded vegetation on the ELF cap continues to improve and provide greater cover. Plants of established seeded species are developing and reproducing. Sideoats grama (*Bouteloua curtipendula*), blue gramma (*Chondrosum gracile*) and buffalo grass (*Buchloe dactyloides*) are common warm season seeded species. Cool season grass species, especially western wheatgrass (*Pascopyrum smithii*) continue to provide abundant cover on the ELF cap. Perennial grass species continued to increase on the portion of the south face between the perimeter channel and the mid-slope drainage channel that has been sparsely covered by perennial seeded species. This increase may be due to control of the cheatgrass (*Bromus tectorum*) in this area with herbicide treatments. This year, standing dead vegetation was more prevalent on the top aspects and along the east support areas of the ELF and these areas were improved by mowing during this reporting period.

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 thirteen growing seasons. Most of the area has developed a stable and sustainable plant community.

The area near the gas vent layer's perimeter continues to have sparse vegetation cover by both annual and perennial vegetation. This condition is unlikely to improve because the soil thickness in this zone above the gas vent layer's filter fabric is too thin to support plant growth, especially in hot, dry weather.

The Army will continue to monitor the ELF for the development of perennial grass species. Maintenance activities will be conducted at regular and necessary intervals. The OMC staff seeded bare areas of the site in the fall of 2017, 2018, and 2021. The areas continue to be monitored for grass establishment and will be evaluated for additional seeding activities and herbicide applications during 2023. Cheatgrass areas will continue to be mapped and herbicide treatment will remain a priority for any areas identified.

6.0 LCS/LDS AND GROUNDWATER MONITORING

6.1 HWL LCS/LDS Operations

The OMC Wastewater Operator used flowmeter data to calculate monthly flow rates. Flow meters recorded the actual volume removed from the sumps and these data were downloaded daily into the RMA Environmental Database. The monthly flow summaries are provided in Appendix E of this report. On a quarterly basis, the Wastewater Operator also inspected the manholes for damage accumulation of excessive liquid buildup.

6.1.1 HWL LCS/LDS Inspections and Maintenance

The OMC Wastewater Operator inspected and maintained the HWL LCS/LDS in accordance with Sections 3.1.3 and 3.1.4 of the HWL PCWMP contained in Appendix C of the HWL PCP. The OMC Wastewater Operator and maintenance staff performed the following routine maintenance and repair activities on the HWL LCS/LDS.

- Performed monthly inspections on the HWL emergency lights and fire extinguishers.

- Performed quarterly inspections on the lift station liner leak detection and conveyance pipelines leak detection.
- Performed quarterly inspections on the HWL LCS/LDS Wastewater Conveyance System.
- Performed quarterly inspections for grounding and tool safety inspections and first aid kits.
- 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.
- The leak detection panel at the Lift Station was in fault for a few days. A bad zone splitter in Zone 2 was identified after trouble shooting. The zone splitter for the HWL was repaired.
- Reset the GFI buttons on the sump panels, as necessary.
- On October 4, 2022, a transformer on the RMA failed and the landfills lost power. A visual inspection of the tanks and LS/LF building was performed daily. Measurements of the two storage tanks were also performed daily until power was restored on October 21, 2022.
- The battery in the Program Logic Controller for the Lift Station was replaced.
- The water level probe in the Lift Station failed and was reporting an incorrect water level. The OMC electrician installed a new Endress and Hauser water pilot FMX21 probe and tested the accuracy. The new probe functions correctly.

The OMC Wastewater Operator documented system inspections on inspection forms included in the HWL PCWMP. There were no observations noted during the HWL LCS/LDS Wastewater Conveyance System quarterly inspections for this reporting period. Copies of the completed quarterly inspection forms are provided in Appendix B-1 of this report. Also, a system maintenance database was used to document inspections and maintenance activities. The Wastewater O&M Reports, provided in Appendix C-1 of this report, were generated by the database, and include log entries for inspections and maintenance activities.

6.1.2 HWL ALR Comparison

Each month the OMC Wastewater Operator calculated the wastewater collection rate in each LDS sump and compared that rate to the ALR for the respective sump as described in the *HWL Post-Closure Action Leakage Rate/Response Action Plan*, provided in Appendix D of the HWL PCP. The average daily flow rate was calculated as the volume of liquid pumped from the sump during the month, divided by the acreage of surface area served by the sump; divided by the number of days in the month. This average value is defined as the average daily flow rate and is expressed as gallons per acre per day (gpad). This average daily flow rate was then compared to the ALR and 85 percent of the ALR for the HWL to determine whether any response action is necessary. Table 6.1.2-1 presents the comparisons and conclusions for HWL LDS sumps 1 through 4. In all cases, the average daily flow rates 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 leak detection liquids were not exceeded. Appendix E of this report provides the monthly flow summaries used to calculate the average daily flow rates for each of the sumps.

Table 6.1.2-1: HWL Average Daily LDS Flow Rate and ALR Comparison

SUMP NO.	MONTH	AVERAGE DAILY FLOW RATE (gpad)	85% ALR (gpad)	> 85% ALR?	ALR (gpad)	> ALR?
HWL LDS1	May 2022	0.00	112	No	132	No
	June 2022	0.00	112	No	132	No
	July 2022	0.00	112	No	132	No
	Aug. 2022	0.00	112	No	132	No
	Sept. 2022	0.00	112	No	132	No
	Oct. 2022	0.00	112	No	132	No
	Nov. 2022	0.00	112	No	132	No
	Dec. 2022	0.00	112	No	132	No
	Jan. 2023	0.00	112	No	132	No
	Feb. 2023	0.00	112	No	132	No
	March 2023	0.00	112	No	132	No
	April 2023	0.00	112	No	132	No
HWL LDS2	May 2022	0.00	111	No	131	No
	June 2022	0.00	111	No	131	No
	July 2022	0.00	111	No	131	No
	Aug. 2022	0.00	111	No	131	No
	Sept. 2022	0.00	111	No	131	No
	Oct. 2022	0.00	111	No	131	No
	Nov. 2022	0.00	111	No	131	No
	Dec. 2022	0.00	111	No	131	No
	Jan. 2023	0.00	111	No	131	No
	Feb. 2023	0.00	111	No	131	No
	March 2023	0.00	111	No	131	No
	April 2023	0.00	111	No	131	No
HWL LDS3	May 2022	0.00	111	No	131	No
	June 2022	0.00	111	No	131	No

SUMP NO.	MONTH	AVERAGE DAILY FLOW RATE (gpad)	85% ALR (gpad)	> 85% ALR?	ALR (gpad)	> ALR?
	July 2022	0.00	111	No	131	No
	Aug. 2022	0.00	111	No	131	No
	Sept. 2022	0.00	111	No	131	No
	Oct. 2022	0.00	111	No	131	No
	Nov. 2022	0.00	111	No	131	No
	Dec. 2022	0.00	111	No	131	No
	Jan. 2023	0.00	111	No	131	No
	Feb. 2023	0.00	111	No	131	No
	March 2023	0.00	111	No	131	No
	April 2023	0.00	111	No	131	No
HWL LDS4	May 2022	0.00	111	No	131	No
	June 2022	0.00	111	No	131	No
	July 2022	0.00	111	No	131	No
	Aug. 2022	0.00	111	No	131	No
	Sept. 2022	0.00	111	No	131	No
	Oct. 2022	0.00	111	No	131	No
	Nov. 2022	0.00	111	No	131	No
	Dec. 2022	0.00	111	No	131	No
	Jan. 2023	0.00	111	No	131	No
	Feb. 2023	0.00	111	No	131	No
	March 2023	0.00	111	No	131	No
	April 2023	0.00	111	No	131	No

6.1.3 HWL Wastewater Management Quantities

When wastewater in the HWL LCS and LDS sumps reached the High-Level switch settings of 30 inches and 20 inches of head, respectively, the OMC Wastewater Operator transferred the wastewater from the affected sump to the lift station, and then to the two storage tanks located in the LS/LF building. Wastewater was stored in these tanks until a tanker truck arrived to transport the material off site for disposal.

The OMC hazardous waste disposal subcontractor transported approximately 19,493 gallons of HWL wastewater off-site for disposal between May 2022 and April 2023. That equates to a 15.7 percent decrease in wastewater compared to the previous period of May 2021 to April 2021

when 23,114 gallons of wastewater were shipped off site. However, the wastewater quantity for the 2023 reporting year is artificially small because the Army's waste disposal subcontractor was unable to incinerate leachate for the last three months of this reporting period. Thus, the wastewater quantity for the 2024 reporting period will most likely reflect a slight increase. However, the Army expects the overall trend in the HWL wastewater production to decrease in the following years. Refer to Table 6.1.3-1 for historical HWL wastewater volumes.

During this reporting period, the Army began investigating alternative disposal methods for the landfill leachate due to analytical data demonstrating that the leachate is suitable for land disposal.

Table 6.1.3-1: HWL Wastewater Production

REPORTING YEAR	REPORTING PERIOD	WASTEWATER QUANTITY (gallons)
2010	May 2009 to April 2010	88,543
2011	May 2010 to April 2011	57,628
2012	May 2011 to April 2012	56,417
2013	May 2012 to April 2013	48,104
2014	May 2013 to April 2014	45,161
2015	May 2014 to April 2015	28,037
2016	May 2015 to April 2016	30,736
2017	May 2016 to April 2017	28,077
2018	May 2017 to April 2018	21,490
2019	May 2018 to April 2019	26,116
2020	May 2019 to April 2020	21,661
2021	May 2020 to April 2021	21,968
2022	May 2021 to April 2022	23,114
2023	May 2022 to April 2023	19,493

6.1.4 HWL LCS/LDS Wastewater Quality

Analytical data from the HWL LCS/LDS wastewater sampling is provided in this report in accordance with Section 3.9 of the HWL PCP. The HWL PCP requires the reporting of wastewater analytical data for the 12-month period from January 1 to December 31 that precedes the submittal of this report. For this report, the reporting period for HWL LCS/LDS wastewater quality is January 1, 2022, to December 31, 2022. The purpose of the samples collected from the LCS/LDS sumps is to meet the requirements of the HWL PCP, to evaluate the chemistry of the wastewater to determine potential leakage from the HWL, and to characterize the leachate for disposal.

Refer to Table 6.1.4-1 for sample dates and triggers for the reporting period of January 2022 through December 2022.

Table 6.1.4-1: HWL LCS and LDS Sump Sample Events (January 2022 through December 2022)

DATE	LCS1	LDS1	LCS2	LDS2	LCS3	LDS3	LCS4	LDS4
February 2022	High Level						High Level	
April 2022		High Level	High Level			High Level		
July 2022	High Level		High Level					
November 2022	High Level		High Level					

A summary of analytical results from post-closure LCS/LDS wastewater monitoring at the HWL is provided in the following subsections. Refer to the 2022 HWL PCGMR, provided in Appendix F-1 of this report, for additional details regarding the methods, results and conclusions of post-closure LCS/LDS wastewater sampling performed between January and December of 2022.

6.1.4.1 *HWL LCS Analytical Results*

The results from the LCS samples are consistent with wastes placed in the landfills, and the chemical groups used to determine the potential impacts on the groundwater.

The indicator compounds (ICs) detected in the HWL LCS sumps in 2022 include benzene, dichlorodifluoromethane, dicyclopentadiene, dieldrin, diisopropylmethyl phosphonate (DIMP), and lead. Analytical results from the LCS sump samples are included in Appendix F-1 of this report.

6.1.4.2 *HWL LDS Analytical Results*

It is common for analytes to be detected in HWL LDS sump samples. 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. The soil used to construct the compacted clay liners of the HWL contained low levels of RMA contaminants that only became detectable after they were mobilized in water and analyzed using methods with much lower method reporting limits than what can be achieved in soil sample analyses.

Analytes detected in the LDS sumps are presented in Appendix F-1 of this report. The ICs detected in the HWL LDS sumps include dieldrin and dichlorodifluoromethane. There were no LDS analytical results in 2022 that required regulatory agency notification per the HWL PCP.

6.2 HWL Groundwater Monitoring and Assessment

Like the reporting requirements for HWL LCS/LDS wastewater sampling, Section 3.9 of the HWL PCP requires analytical data from the post-closure groundwater sampling to be reported in this report for the 12-month period from January 1 to December 31 that precedes the submittal of this report. For this report, the reporting period for post-closure groundwater monitoring is January 1, 2022, through December 31, 2022. The purpose of the post-closure groundwater sampling is to meet the requirements of the HWL PCP, to monitor groundwater flow directions

and groundwater quality beneath and around the HWL, and to monitor for potential releases of hazardous constituents from the HWL.

The OMC Sample Technicians sampled the HWL groundwater quarterly. The 2022 HWL PCGMR provided in Appendix F-1 of this report presents the methods, results, and conclusions of post-closure groundwater monitoring performed over four quarterly sampling events in the calendar year of 2022.

6.2.1 CAMU Groundwater Flow Direction

The OMC Sample Technicians measured water levels quarterly at 68 wells to evaluate the groundwater flow directions in the unconfined flow system (UFS) and confined flow system (CFS) in the area of the CAMU. The OMC Hydrogeologist used this information to evaluate groundwater flow for significant changes in flow direction over time. The water level data are presented in tabular and graphical form in Appendix F-1 of this report.

The groundwater in the UFS and CFS flows to the north-northwest and is consistent with previous groundwater monitoring events for the HWL. No significant variations in groundwater flow directions have been identified during post-closure monitoring.

6.2.2 HWL Impacts on Groundwater Quality

The OMC staff compared the results from the water quality sampling completed during 2022 post-closure groundwater monitoring period to the prediction limits calculated from the 2021 sampling results to determine if groundwater quality was impacted by the HWL in 2022. Lead and dieldrin were the only ICs detected in the downgradient wells.

Lead was detected in UFS wells 25087 and 25194 at concentrations of 4.7 and 4.8 µg/L, respectively. Lead was also detected in CFS wells 25183 (8.1 µg/L) and 25195 (3.1 µg/L). The lead detections did not exceed the 2022 prediction limit of 15 µg/L.

Dieldrin was detected at concentrations ranging from 0.0165 to 0.0242 µg/L in downgradient well 25194. Dieldrin concentrations in well 25194 did not exceed the 2022 prediction limit of 0.05 µg/L.

Further evaluation of dieldrin included an intrawell comparison performed using a combined Shewhart-Cumulative Sum (CUSUM) control chart to determine whether the HWL impacted the presence of dieldrin in groundwater at well 25194. The control chart, and a corresponding evaluation of the chart, is included in the HWL PCGMR in Appendix F-1 of this report.

The HWL PCP also provides for the use of trend analysis to evaluate groundwater quality. Further evaluation of dieldrin concentrations using Mann-Kendall trend analysis shows that for data collected from 2013 through 2022, dieldrin concentrations have exhibited a decreasing trend. Supporting documentation related to the Mann-Kendall trend analysis is provided in the 2021 HWL PCGMR in Appendix F-1 of this report.

Based on the statistical evaluations and trend analysis presented in the 2022 HWL PCGMR, the groundwater quality in the vicinity of the HWL has not been affected by operations, closure, or post-closure O&M of the landfill.

6.2.3 Well 25122

Well 25122 has been noted as a dry well since monitoring began in 2002. In June 2022, a down-well video was recorded and sand within the well casing was noted at a depth of approximately 26.8 feet from top of casing. This obstruction appears to be graded silica filter pack sand that is located 4.4 feet above the top of the well screen, and its origins are unknown. Based on this observation, well 25122 will not provide reliable data to support mapping of the potentiometric surface, and it is recommended that the well be closed, removed from the monitoring network, and replaced by a new well.

6.3 ELF LCS/LDS Operations

The OMC Wastewater Operator used flowmeter data to calculate monthly flow rates. The ELF flowmeters indicated that there was minimal flow from the ELF sumps during this reporting period. In October 2022, power was lost to the landfills due to a damaged transformer onsite. Once the power was restored, the sump totalizers had advanced by three to four gallons in all the LCS and LDS sumps. The monthly flow summaries are provided in Appendix E of this report. On a quarterly basis, the Wastewater Operator also inspected the sump level in the Leachate Riser Control House (LRCH) buildings and inspected the piping for damage.

6.3.1 ELF LCS/LDS Inspections and Maintenance

The OMC Wastewater Operator inspected and maintained the ELF LCS/LDS and associated buildings in accordance with Sections 3.1.3 and 3.1.4 of the *ELF Post-Closure Wastewater Management Plan*, contained in Appendix C of the ELF PCP. The OMC Wastewater Operator and maintenance staff performed the following routine maintenance and repair activities on the ELF LCS/LDS.

- Performed quarterly inspections on the LB LRCH building, the WP LRCH building, and the LS/LF building.
- Performed quarterly inspections on the ELF LCS/LDS Wastewater Conveyance System.
- Recorded monthly sump and tank levels for the ELF LCS/LDS and LS/LF building.
- Performed weekly LS/LF tank inspections.
- Performed monthly inspections on emergency/exit lights in the LS/LF building and both LRCH buildings.
- Performed quarterly inspections for grounding and tool safety inspections and first aid kits.
- On October 4, 2022, a transformer on the RMA failed and the landfills lost power. A visual inspection of the tanks and LS/LF building was performed daily. Measurements of the two storage tanks were also performed daily until power was restored on October 21, 2022.
- On October 25, during a quarterly Wastewater Conveyance System inspection the WP LCS provided a “motor overload tripped” error when the pump was engaged. The OMC electrician investigated the error and determined that the pump was inoperable. The WP LCS sump had less than one inch of water at the time and had not accumulated leachate for several years. The OMC suggested tagging the sump out of service and replacing the

pump in the future, if necessary. The Army notified the regulatory agencies of the situation on November 3, 2022. The regulatory agencies concurred with the course of action.

- The faulty transductors (surge suppression) were replaced in the Program Logic Controller panels for the WP and LB LRCH buildings.
- The contactor in the heater above the south door in the LS/LF building was replaced.
- The batteries were replaced in the Program Logic Controllers for the LB LRCH, WP LRCH, and LS/LF.
- The hard disk drive was replaced in the LS/LF Factory Talk computer.

The OMC Wastewater Operator documented system inspections on inspection forms included in the *ELF Post-Closure Wastewater Management Plan*. One inspection item was observed during the ELF LCS/LDS Wastewater Conveyance System quarterly inspections for this reporting period and is documented above in the bulletized list. Copies of the completed quarterly inspection forms are provided in Appendix B-2 of this report. Also, a system maintenance database was used to document inspections and maintenance activities. The Wastewater O&M Reports, provided in Appendix C-2 of this report, were generated by the database, and include log entries for inspections and maintenance activities.

6.3.2 ELF ALR Comparison

Each month the OMC Wastewater Operator calculated the wastewater collection rate in each LDS sump and compared that rate to the ALR for the respective sump as described in the *ELF Post-Closure Action Leakage Rate/Response Action Plan*, provided in Appendix D of the ELF PCP. The average daily flow rate was calculated as the volume of liquid pumped from the sump during the month, divided by the acreage of surface area served by the sump; divided by the number of days in the month. This average value is defined as the average daily flow rate and is expressed as gpad. This average daily flow rate was compared to the ALR, and 85 percent and 50 percent of the ALR to determine whether any response action is necessary. Table 6.3.2-1 presents the comparisons and conclusions for the four sumps. In all cases the average daily flow rates 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 leak detection liquids were not exceeded. Appendix E of this report provides the monthly flow summaries used to calculate the average daily flow rates for each of the sumps.

Table 6.3.2-1: ELF Average Daily LDS Flow Rate and ALR Comparison

SUMP NO.	MONTH	AVERAGE DAILY FLOW RATE (gpad)	50% ALR (gpad)	> 50% ALR?	85% ALR (gpad)	> 85% ALR?	ALR (gpad)	> ALR?
ELF WP LDS1	May 2022	0.00	65	No	110.5	No	130	No
	June 2022	0.00	65	No	110.5	No	130	No
	July 2022	0.00	65	No	110.5	No	130	No

SUMP NO.	MONTH	AVERAGE DAILY FLOW RATE (gpad)	50% ALR (gpad)	> 50% ALR?	85% ALR (gpad)	> 85% ALR?	ALR (gpad)	> ALR?
	Aug. 2022	0.00	65	No	110.5	No	130	No
	Sept. 2022	0.00	65	No	110.5	No	130	No
	Oct. 2022	0.01	65	No	110.5	No	130	No
	Nov. 2022	0.00	65	No	110.5	No	130	No
	Dec. 2022	0.00	65	No	110.5	No	130	No
	Jan. 2023	0.00	65	No	110.5	No	130	No
	Feb. 2023	0.00	65	No	110.5	No	130	No
	March 2023	0.00	65	No	110.5	No	130	No
	April 2023	0.00	65	No	110.5	No	130	No
ELF WP LDS2	May 2022	0.00	79.5	No	135.2	No	159	No
	June 2022	0.00	79.5	No	135.2	No	159	No
	July 2022	0.00	79.5	No	135.2	No	159	No
	Aug. 2022	0.00	79.5	No	135.2	No	159	No
	Sept. 2022	0.00	79.5	No	135.2	No	159	No
	Oct. 2022	0.01	79.5	No	135.2	No	159	No
	Nov. 2022	0.00	79.5	No	135.2	No	159	No
	Dec. 2022	0.00	79.5	No	135.2	No	159	No
	Jan. 2023	0.00	79.5	No	135.2	No	159	No
	Feb. 2023	0.00	79.5	No	135.2	No	159	No
	March 2023	0.00	79.5	No	135.2	No	159	No
	April 2023	0.00	79.5	No	135.2	No	159	No
ELF LB LDS1	May 2022	0.00	130	No	221	No	260	No
	June 2022	0.00	130	No	221	No	260	No
	July 2022	0.00	130	No	221	No	260	No
	Aug. 2022	0.00	130	No	221	No	260	No
	Sept. 2022	0.00	130	No	221	No	260	No
	Oct. 2022	0.02	130	No	221	No	260	No
	Nov. 2022	0.00	130	No	221	No	260	No
	Dec. 2022	0.00	130	No	221	No	260	No
	Jan. 2023	0.00	130	No	221	No	260	No

SUMP NO.	MONTH	AVERAGE DAILY FLOW RATE (gpad)	50% ALR (gpad)	> 50% ALR?	85% ALR (gpad)	> 85% ALR?	ALR (gpad)	> ALR?
	Feb. 2023	0.00	130	No	221	No	260	No
	March 2023	0.00	130	No	221	No	260	No
	April 2023	0.00	130	No	221	No	260	No
ELF LB LDS2	May 2022	0.00	159	No	270.3	No	318	No
	June 2022	0.00	159	No	270.3	No	318	No
	July 2022	0.00	159	No	270.3	No	318	No
	Aug. 2022	0.00	159	No	270.3	No	318	No
	Sept. 2022	0.00	159	No	270.3	No	318	No
	Oct. 2022	0.02	159	No	270.3	No	318	No
	Nov. 2022	0.00	159	No	270.3	No	318	No
	Dec. 2022	0.00	159	No	270.3	No	318	No
	Jan. 2023	0.00	159	No	270.3	No	318	No
	Feb. 2023	0.00	159	No	270.3	No	318	No
	March 2023	0.00	159	No	270.3	No	318	No
	April 2023	0.00	159	No	270.3	No	318	No

6.3.3 ELF Wastewater Management Quantities

When wastewater in the ELF LCS and LDS sumps reaches the High-Level switch settings of 24 inches of head, the OMC Wastewater Operator will transfer the wastewater to two storage tanks located in the LS/LF building. However, the wastewater levels in the ELF LCS or LDS sumps did not reach their respective High Levels during this reporting period. Therefore, no ELF wastewater was transported off-site for disposal between May 2022 and April 2023. This is the third year in a row that the ELF has produced zero gallons of wastewater. Refer to Table 6.3.3-1 for historical ELF wastewater volumes.

Table 6.3.3-1: ELF Wastewater Production

REPORTING YEAR	REPORTING PERIOD	WASTEWATER QUANTITY (gallons)
2011	May 2010 to April 2011	9,841
2012	May 2011 to April 2012	7,516
2013	May 2012 to April 2013	9,349
2014	May 2013 to April 2014	3,904
2015	May 2014 to April 2015	3,279

2016	May 2015 to April 2016	3,973
2017	May 2016 to April 2017	2,714
2018	May 2017 to April 2018	1,256
2019	May 2018 to April 2019	2,421
2020	May 2019 to April 2020	6,483
2021	May 2020 to April 2021	0
2022	May 2021 to April 2022	0
2023	May 2022 to April 2023	0

6.3.4 ELF LCS/LDS Wastewater Quality

There are no analytical data from the ELF LCS/LDS wastewater sampling to provide in this report in accordance with Section 3.9 of the ELF PCP. The ELF PCP requires the reporting of wastewater analytical data for the 12-month period from January 1 to December 31 that precedes the submittal of this report. For this report, the reporting period for ELF LCS/LDS wastewater quality is January 1, 2022, to December 31, 2022. During this reporting period, there were no samples collected from either the ELF LCS or LDS sumps because these sumps never reached their respective High-Level settings.

6.4 ELF Groundwater Monitoring and Assessment

Like the reporting requirements for ELF LCS/LDS wastewater sampling, Section 3.9 of the ELF PCP requires analytical data from the post-closure groundwater sampling to be reported in this report for the 12-month period from January 1 to December 31 that precedes the submittal of this report. For this report, the reporting period for post-closure groundwater monitoring is January 1, 2022, to December 31, 2022. The purpose of the post-closure groundwater sampling is to meet the requirements of the ELF PCP, to monitor groundwater flow directions and groundwater quality beneath and around the ELF, and to monitor for potential releases of hazardous constituents from the ELF.

The OMC Sample Technicians sampled the ELF groundwater quarterly. The 2022 ELF PCGMR, provided in Appendix F-2 of this report, presents the methods, results, and conclusions of post-closure groundwater monitoring performed over four quarterly sampling events in the calendar year of 2022.

6.4.1 CAMU Groundwater Flow Direction

Refer to Section 6.2.1 of this report for a description of groundwater flow in the CAMU area, including the ELF. Water level data are presented in tabular and graphical form in Appendix F-2 of this report.

6.4.2 ELF Impacts on Groundwater Quality

The OMC staff compared the results from the water quality sampling completed during 2022 post-closure groundwater monitoring period to the prediction limits calculated from the 2021 sampling results to determine if groundwater quality was impacted by the ELF in 2022. Lead was the only IC detected in the downgradient wells.

Lead was detected in wells 25092, 25093, 25102, and 25120 at concentrations ranging from 3.4 µg/L to 4.6 µg/L. The range of values 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 of 2006.

No ICs exceeded the calculated 2022 prediction limits. Based on the statistical evaluation, groundwater quality in the vicinity of the ELF has not been affected by operations, closure, or post-closure O&M of the landfill.

7.0 ROUTINE AND NON-ROUTINE ACTIONS

7.1 Routine Actions

The OMC staff and their subcontractors performed routine maintenance and repairs on the HWL and ELF caps and wastewater conveyance systems. These O&M activities ensured that the systems continue to function as designed. The OMC staff identified routine maintenance and repair actions during inspections, which are discussed in Sections 4.2, 5.2, 6.1.1 and 6.3.1 of this report. Figure 4.2-1 illustrates the locations of routine activities performed on the HWL cap and surrounding areas, while Figure 5.2-1 shows the locations of routine maintenance and repair activities performed on the ELF cap and surrounding areas. Wastewater conveyance system O&M activities were performed as necessary at the HWL sump manholes and lift station, and the ELF LRCH buildings and LS/LF building.

7.2 Non-Routine Actions

The implementation of non-routine actions is described in the HWL PCP and ELF PCP. Both PCPs provide criteria for non-routine actions and a mechanism for consultation between the parties and documentation of the consultative outcome. This process is described in Section 3.5 of both PCPs. There were no Non-Routine Action Plans applicable to the HWL nor the ELF for this reporting period.

7.3 O&M Change Notices

The Army occasionally identifies enhancements to the post-closure O&M of the landfills which require changes to portions of the PCPs. These changes are typically the result of new conditions or improvements that have come from operational experience. In these cases, the Army institutes the *RVO SOP ENGR.004.RA O&M Change Notice Procedure*, Revision 0 (RVO 2012). There were no O&M Change Notices for either the HWL or ELF that were applicable to this reporting period.

8.0 RECOMMENDATIONS AND CORRECTIVE MEASURES

The only recommendation for 2024 is the closure and replacement of well 25122, as described in Section 6.2.3 of this report. Inspection and maintenance activities will continue as required by the PCPs. Grass establishment and weed control are improving within the HWL and ELF AMA, but the Army will continue to be diligent with activities that may promote the establishment of desirable species. Inspection and maintenance of the stormwater drainage structures will continue to be a priority, as well as removing the tumbleweed accumulation in the channels and along the fence line. Observations for burrowing animal holes will also remain important. The Army will continue investigating alternative disposal methods for the landfill leachate due to analytical data demonstrating that the leachate is suitable for land disposal.

The HWL and ELF met all compliance standards; therefore, no corrective measures were necessary, and none are planned for the reporting period of 2024.

9.0 COSTS AND BUDGETS

Table 9.0-1 shows the costs incurred between May 2022 and April 2023, as well as the current budgets established for O&M of the HWL and ELF.

The costs for operating, inspecting, and maintaining the HWL and ELF over the reporting period, including groundwater sampling, LCS/LDS sampling, LCS/LDS O&M, and wastewater disposal, totaled $445,987. Complete budgets for post-closure care of the HWL and ELF for May 2023 through April 2024 have not been approved as of the issuance of this report due to the timing of the annual funding cycle, which typically occurs near the end of the calendar year. However, the combined budgets for the period of December 2022 to November 2023 total $555,140.

Table 9.0-1: Costs and Budgets

TASK	COSTS		BUDGETS	
	INCURRED	PERIOD	VALUE	PERIOD
HWL (Inspection, Maintenance, LCS/LDS and Groundwater Sampling, and Off-Site Wastewater Disposal)	$286,463	May 2022 – Apr 2023	$332,382	Dec 2022 – Nov 2023
ELF (Inspection, Maintenance, LCS/LDS and Groundwater Sampling, and Off-Site Wastewater Disposal)	$159,524	May 2022 – Apr 2023	$222,758	Dec 2022 – Nov 2023
TOTAL	$445,987		$555,140	

10.0 CONCLUSIONS

In summary, and based on the information presented in this report, the HWL and ELF were in compliance with all performance standards and no corrective measures were required. Keys to maintaining the integrity of the landfills include continued diligence with weed control and tumbleweed maintenance, overseeding where necessary, inspection for erosion and burrowing animal holes, investigating alternative leachate disposal methods, closure and replacement of well 25122, and monitoring the groundwater and LCS/LDS wastewater quality.

11.0 REFERENCES

Navarro (Navarro Research and Engineering, Inc.)

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

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

RVO (Remediation Venture Office)

2012 (Jan) *RVO SOP ENGR.004.RA O&M Change Notice Procedure*. Revision 0.

TtEC (TetraTech EC, Inc.)

2008 (July) *Enhanced Hazardous Waste Landfill Closure Plan*. Revision 0.

2006 (Aug) *Hazardous Waste Landfill Closure Plan*. Revision 0.

FIGURES

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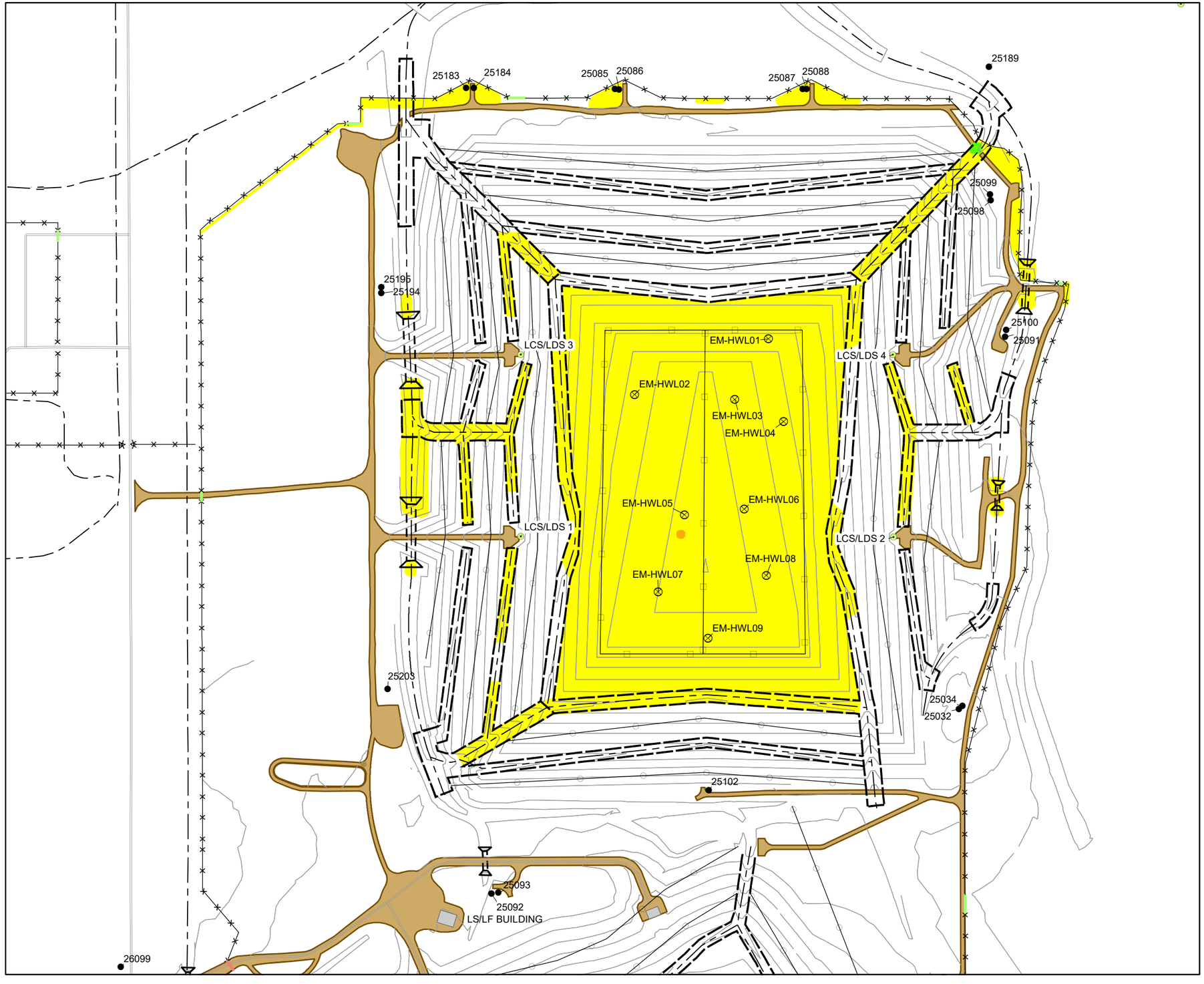

Legend

- Lower Vantage Paths
- Upper Vantage Paths
- Erosion/Settlement Monument
- Wells
- LCS/LDS Manholes
- Channel Flow Lines
- Fence
- Gate
- Cattle Guard
- Box Culvert
- Roads
- Existing Contours
- Articulated Concrete Block
- Channels and Downchutes
- Mowed
- Ground Clear Herbicide
- Reparied Animal Burrow
- Repaired Articulated Concrete Block

N

0 95 190 380 Feet

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

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

Figure 4.2-1

2023 Hazardous Waste Landfill
Routine Maintenance Activities

6/26/2023

M:\projects\HWLandELF_RoutineAndNonRoutineMaintenanceActivities\2023\mxds\HWL_RoutineMaintenanceActivities_May2023.mxd

Legend

- Lower Vantage Paths
- Upper Vantage Paths
- Erosion/Settlement Monument
- Wells
- Trench Drain Outfall
- Channel Flow Line
- Fence
- Gate
- Cattle Guard
- Gas Vent Layer
- Perimeter Channel Articulated Concrete Block
- Box Culvert
- Roads
- Existing Contours
- Articulated Concrete Block Channels and Downchutes
- Mowed
- Ground Clear Herbicide
- Reparied Animal Burrow
- Repaired Erosion Monument

N

0 95 190 380

Feet

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

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

Program Manager
Rocky Mountain Arsenal

U.S. Army • COMMITTED TO PROTECTION OF THE ENVIRONMENT •

Figure 5.2-1

2023 Enhanced Hazardous Waste Landfill Routine Maintenance Activities

6/26/2023

M:\projects\HWLandELF_RoutineAndNonRoutineMaintenanceActivities\2023\mxds\ELF_RoutineMaintenanceActivities_May2023.mxd

APPENDICES

A	Precipitation Data (May 01, 2022 through April 30, 2023)
B-1	HWL Inspection Documentation
B-2	ELF Inspection Documentation
C-1	HWL Maintenance Documentation
C-2	ELF Maintenance Documentation
D	HWL and ELF Erosion/Settlement Monument Survey Data
E	Monthly Flow Summaries
F-1	Hazardous Waste Landfill Post-Closure Groundwater Monitoring Report Calendar Year 2022
F-2	Enhanced Hazardous Waste Landfill Post-Closure Groundwater Monitoring Report Calendar Year 2022

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APPENDIX A

Precipitation Data

(May 01, 2022, through April 30, 2023)

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Appendix A - Precipitation Data (May 1, 2022 through April 30, 2023)

Note 1: The reporting period for this table is May 1, 2022 through April 30, 2023.

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 1, 2022	0.04
May 2, 2022	0.45
May 3, 2022	0.15
May 4, 2022	0.10
May 5, 2022	0.11
May 20, 2022	0.70
May 21, 2022	0.20
May 29, 2022	0.21
May 31, 2022	0.93
June 1, 2022	0.54
June 29, 2022	0.10
June 30, 2022	0.01
July 1, 2022	0.01
July 7, 2022	0.17
July 19, 2022	0.04
July 20, 2022	0.02
July 23, 2022	0.12
July 24, 2022	0.12
July 26, 2022	1.07
July 27, 2022	0.07
July 28, 2022	0.10
August 6, 2022	0.88
August 7, 2022	0.46
August 15, 2022	0.13
August 16, 2022	0.42
August 22, 2022	0.04
August 28, 2022	0.02
September 2, 2022	0.05
September 9, 2022	0.02
September 10, 2022	0.22
September 21, 2022	0.14
September 22, 2022	0.04
September 30, 2022	0.30
October 1, 2022	0.03
October 27, 2022	0.25
November 3, 2022	0.02
November 4, 2022	0.05
November 15, 2022	0.09

Date	Daily Precipitation (in)
November 17, 2022	0.01
November 18, 2022	0.05
November 19, 2022	0.01
November 29, 2022	0.04
December 21, 2022	0.03
December 22, 2022	0.01
December 24, 2022	0.25
December 28, 2022	0.19
December 29, 2022	0.22
December 30, 2022	0.06
December 31, 2022	0.14
January 2, 2023	0.09
January 3, 2023	0.04
January 18, 2023	0.18
January 19, 2023	0.03
January 20, 2023	0.02
January 21, 2023	0.01
January 22, 2023	0.04
January 23, 2023	0.04
January 24, 2023	0.04
January 26, 2023	0.01
February 15, 2023	0.01
February 16, 2023	0.06
February 17, 2023	0.07
February 22, 2023	0.02
March 15, 2023	0.12
March 16, 2023	0.07
April 15, 2023	0.12
April 16, 2023	0.01
April 20, 2023	0.02
April 22, 2023	0.06
April 23, 2023	0.09
April 26, 2023	0.19
April 27, 2023	0.05
April 28, 2023	0.21
April 29, 2023	0.01
Total:	**11.04**

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APPENDIX B-1

HWL Inspection Documentation

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

Inspector Name(s): M. Jones, K. Hoffman, V. Stewart | **Inspection Date(s):** 6-8-22

Field Conditions:
Previous 24-Hour Precipitation: 0 | Weather Conditions: sunny, calm, 50's - 60'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): 6-1-22

Date(s) of Significant Storm Event: 6-1-22

Total Precipitation (in): 1.47"

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

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	✓				✓	✓ 8-22	tumble weeds have collected in most of the channels	Addressed in August 2022. MJ 8/2/22
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.

Inspector		
Name: Kim Hoffman	**Signature:** Kim Hoffman	**Date:** 6-8-22
Cover Manager Review of Inspection Documentation		
Name: Michael W. Jones	**Signature:** Michael W. Jones	**Date:** 6/29/22
Cover Manager Confirmation of Completed Actions		
Name: Michael W. Jones	**Signature:** Michael W. Jones	**Date:** 8/2/22

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

Inspector Name(s): M. Jones, K. Hoffman, V. Stewart | **Inspection Date(s):** 7-13-22

Field Conditions:
Previous 24-Hour Precipitation: 0 | 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

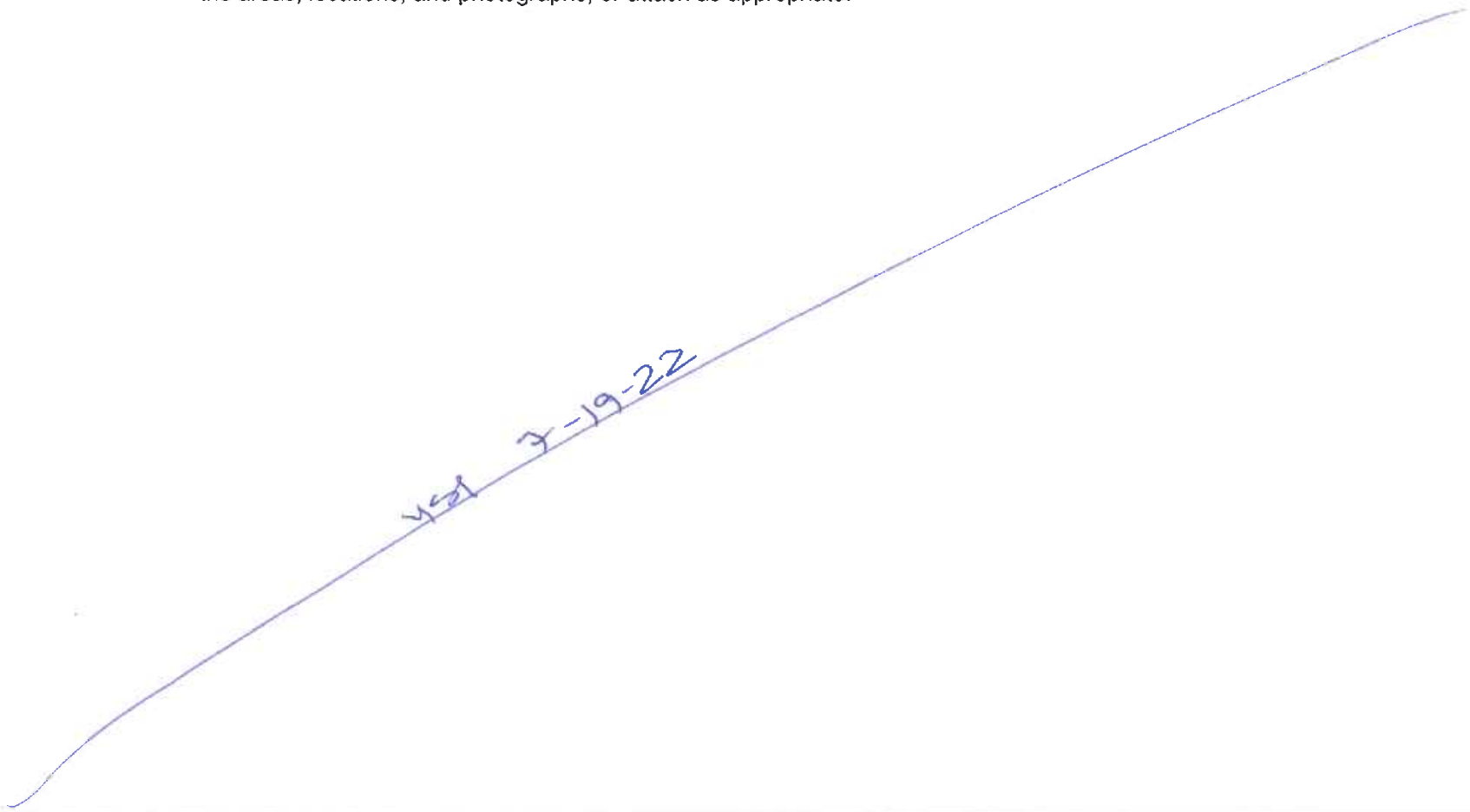
	INSPECTION ITEM	CONDITION IS PRESENT			REPEAT OR CHRONIC CONDITION			OBSERVATION Indicate recommended action, if required.	CONFIRMATION THAT ACTION IS COMPLETE (Initial and Date)
		Y	N	N/A	Y	N	N/A		
1.7*	Seepage, differential settlement, cracking, subsidence, sliding, creep, or other signs of slope instability		✓				✓	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	✓				✓		tumble weeds have collected along fence	Addressed in August 2022. MJ 8/2/22
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	✓				✓		tumble weeds have collected in most channels	Addressed in August 2022. MJ 8/2/22
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:**	**Date:** 7-19-22
Cover Manager Review of Inspection Documentation		
Name: Michael W. Jones	**Signature:**	**Date:** 7/21/22
Cover Manager Confirmation of Completed Actions		
Name: Michael W. Jones	**Signature:**	**Date:** 8/2/22

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

Inspector Name(s): M. Jones, K. Hoffman, V. Stewart | **Inspection Date(s):** 8-3-22

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): 7-27-22

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

Date(s) of Significant Storm Event: 7-26-22

Total Precipitation (in): 1.07"

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

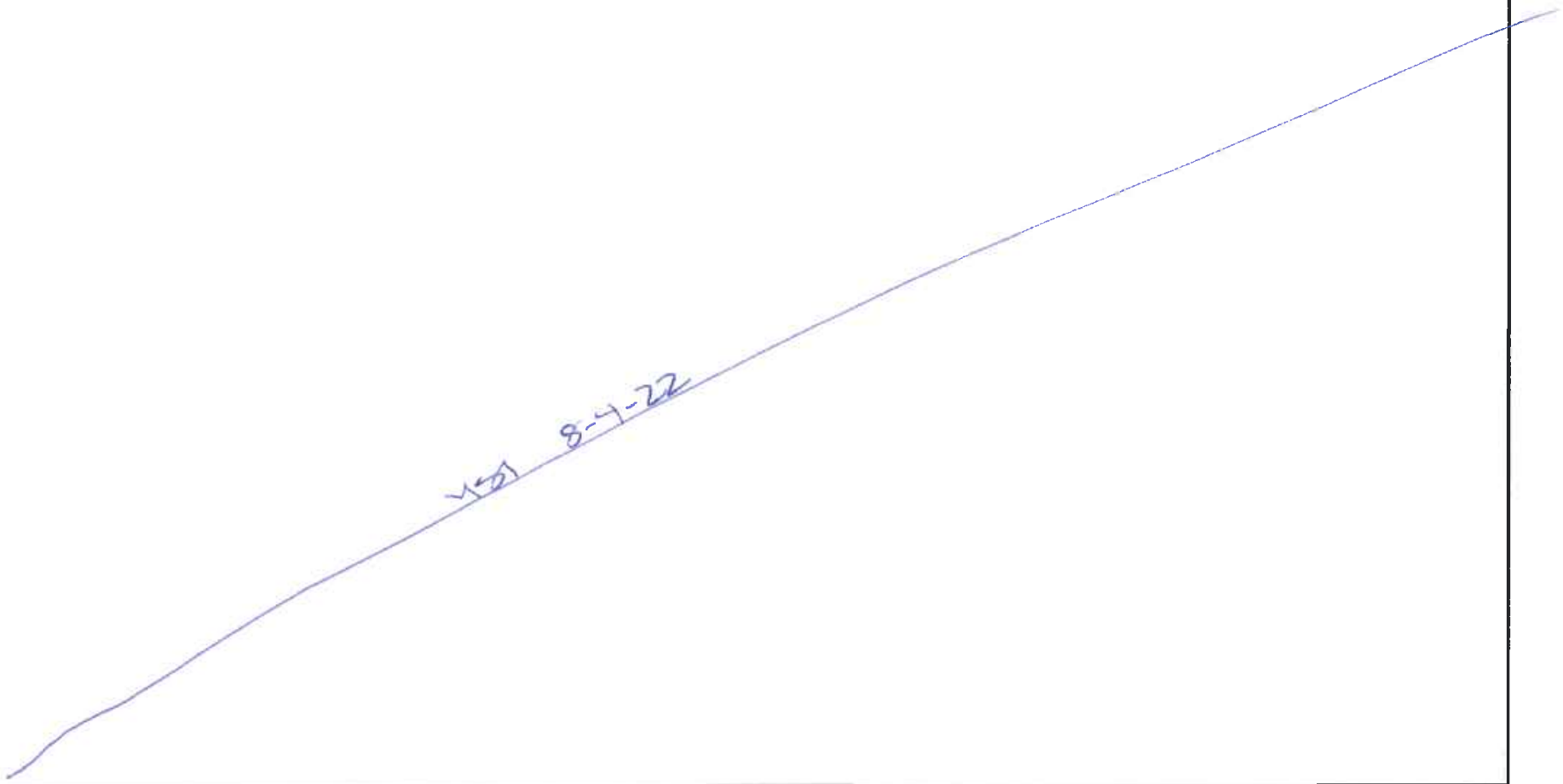
INSPECTION ITEM		CONDITION IS PRESENT			REPEAT OR CHRONIC CONDITION			OBSERVATION Indicate recommended action, if required.	CONFIRMATION THAT ACTION IS COMPLETE (Initial and Date)
		Y	N	N/A	Y	N	N/A		
1.7*	Seepage, differential settlement, cracking, subsidence, sliding, creep, or other signs of slope 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.



Inspector		
Name: Kim Hoffman	**Signature:** Kim Hoffman	**Date:** 8-4-22
Cover Manager Review of Inspection Documentation		
Name: Michael W. Jones	**Signature:**	**Date:** 10/3/22
Cover 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 Hoffmann, V. Stewart

Inspection Date(s): 10-11-22

Field Conditions:
Previous 24-Hour Precipitation: 0 Weather Conditions: calm winds, sunny 70'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

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 001-2
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)	0.25	1.5	2	0.75	0.5	1	0.75	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.

10-13-22

Inspector		
Name: Kim Hoffman	**Signature:** Kim Hoffman	**Date:** 10-13-22
Covers Manager Review of Inspection Documentation		
Name: Michael W. Jones	**Signature:** Michael W. Jones	**Date:** 11/4/22
Covers 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, V. Stewart | **Inspection Date(s):** 1-17-23

Field Conditions:
Previous 24-Hour Precipitation: Ø | Weather Conditions: mostly 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

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

Total Precipitation (in): N/A

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

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.

Inspection was postponed from 1-11-23 to 1-17-23 due to snow.

Inspector		
Name: Kim Hoffman	Signature: Kim Hoffman	Date: 1-18-23
Cover Manager Review of Inspection Documentation		
Name: Michael W. Jones	Signature: Michael W. Jones	Date: 1/23/23
Cover 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. Stewart | **Inspection Date(s):** 4-10-23

Field Conditions:
Previous 24-Hour Precipitation: ∅ | Weather Conditions: sunny, calm winds, 60'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

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)	✓				✓		Hole at N39 51.046 W104 50.514 backfilled with existing soil during inspection	Repaired in April 2023. MJ 4/24/23

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	✓				✓		Note 1.	
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)	0.75	1.25	1.5	0.5	Ø	0.25	1	Ø	1.5

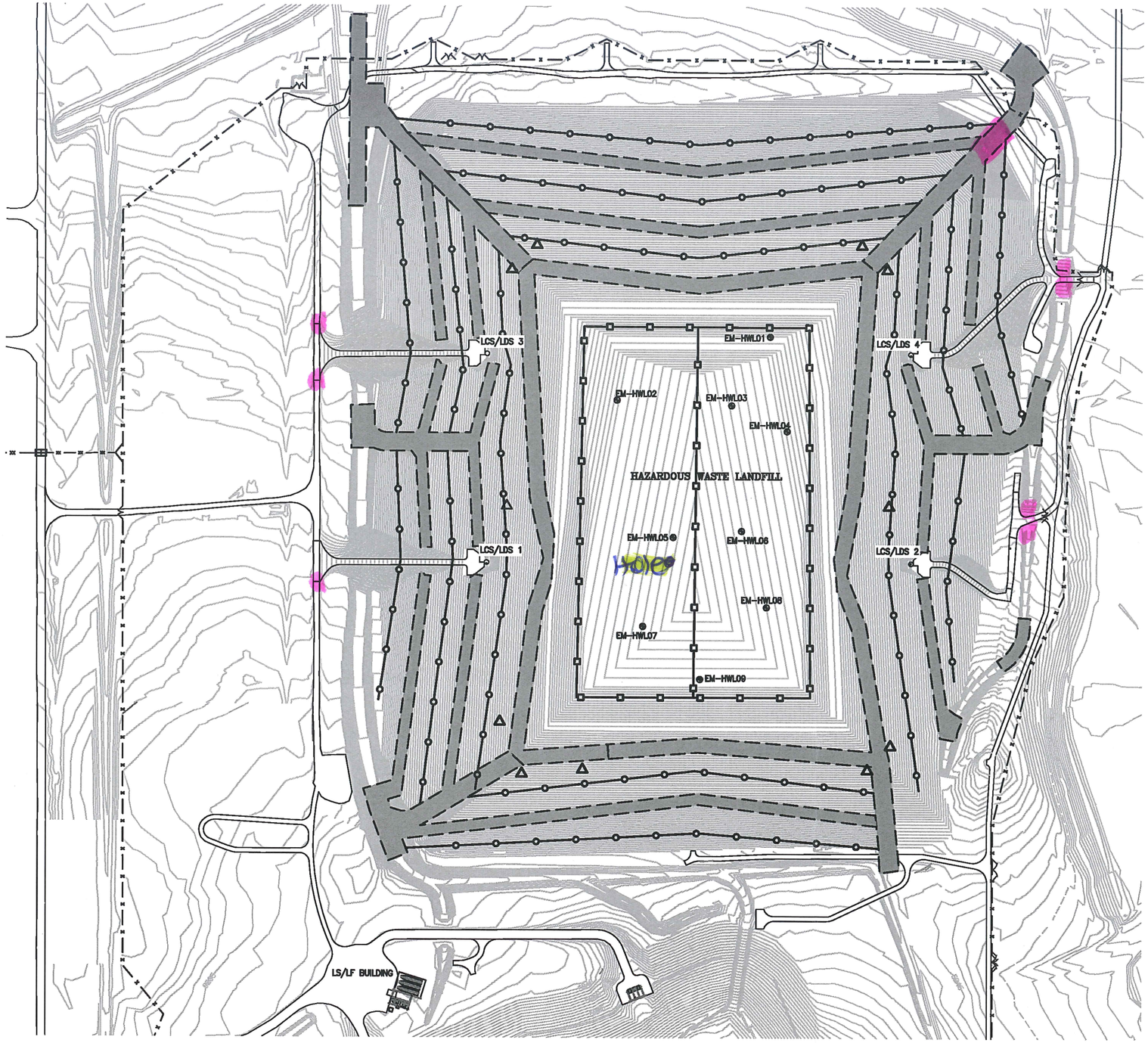
FORM SOP HWL 001-2
HWL CAP TYPE II INSPECTION FORM

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.

Note 1: Tumble weeds were observed in some of the channels. See attached figure for location information.

Inspector		
Name: Kim Hoffman	**Signature:** Kim Hoffman	**Date:** 4-10-23
Covers Manager Review of Inspection Documentation		
Name: Michael W. Jones	**Signature:** Michael W. Jones	**Date:** 4/24/23
Covers Manager Confirmation of Completed Actions		
Name:	**Signature:**	**Date:**

Hole observed on the HWL and backfilled using existing soil.



LEGEND:

- UPPER VANTAGE PATHS FOR MONTHLY AND SEMIANNUAL INSPECTIONS
- LOWER VANTAGE PATH FOR SEMIANNUAL INSPECTIONS
- PERIMETER FENCE/ARMY MAINTAINED AREA BOUNDARY
- ROAD
- CHANNELS AND DOWNCHUTES
- EM-HWL08 EROSION/SETTLEMENT MONUMENT
- SURVEY MONUMENTS

tumble weed accumulation

Backfilled hole

COLORADO STATE PLANE

0 120 240

Scale In Feet

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

ROCKY MOUNTAIN ARSENAL
COMMERCE CITY, COLORADO

NAVARRO Research and Engineering, Inc.

PROJECT NAME
HWL POST-CLOSURE PLAN

TITLE
LOCATION OF CAP FEATURES

CAD FILE:	DATE	FIGURE NUMBER
FugSOP-HWL001-1.dwg	07.29.19	SPO HWL 001-1

S:\G PROJECTS\ANNUAL COVERS REPORT 2019\FigureSOP-HWL001-1.dwg

HWL LCS/LDS AND WASTEWATER CONVEYANCE SYSTEM
QUARTERLY INSPECTION FORM

Inspector Name(s): K. Hoffmann

Inspection Date(s): 7-12-22

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.		✓				✓		

HWL LCS/LDS AND WASTEWATER CONVEYANCE SYSTEM
QUARTERLY INSPECTION FORM

12	Indication that the LS/LF secondary containment is damaged or inadequate.		✓				✓	KH 7-12-22	
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.

KH 7-12-22

Inspector		
Name: Kirin Hoffman	**Signature:** Kirin Hoffman	**Date:** 7-12-22
Treatment Operations Manager Review of Inspection Documentation		
Name: Michael W. Jones	**Signature:**	**Date:** 7/21/22
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): Kim Hoffman | **Inspection Date(s):** 10-25-22

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 10-25-22

HWL LCS/LDS AND WASTEWATER CONVEYANCE SYSTEM
QUARTERLY INSPECTION FORM

12	Indication that the LS/LF secondary containment is damaged or inadequate.		✓				✓	KH 10-25-22	
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.

KH 10-25-22

Inspector		
Name: Kim Hoffman	Signature: Kim Hoffman	Date: 10-25-22
Treatment Operations Manager Review of Inspection Documentation		
Name: Michael W. Jones	Signature:	Date: 11/4/22
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):** 1-4-23

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.		✓				✓		

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.		✓				✓	YSI 1-4-23

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.

YSI 1-4-23

Inspector		
Name: Kim Hoffman	**Signature:** Kim Hoffman	**Date:** 1-4-23
Treatment Operations Manager Review of Inspection Documentation		
Name: Michael W. Jones	**Signature:**	**Date:** 1/23/23
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. Hoffmann	Inspection Date(s): 4-5-23

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.)		✓				✓	none	
2	Extreme temperature inside LCS/LDS manholes		✓				✓	none	
3	Excessive liquid in LCS/LDS manholes		✓				✓	none	
4	Improper operation/condition of LCS/LDS pumps or instrumentation		✓				✓	none	
5	Improper operation/condition of lift station pumps or instrumentation		✓				✓	none	
6	Excessive liquid in lift station secondary containment		✓				✓	none	
7	Blockage of leachate collection or leak detection discharge piping		✓				✓	none	
8	Collapse of leachate collection or leak detection sump riser pipe		✓				✓	none	
9	LS/LF tank levels are above high level set points.		✓				✓	none	
10	LS/LF tanks are damaged or leaking.		✓				✓	none	
11	Indication of leaks in the indoor piping system in the LS/LF.		✓				✓	none	

HWL LCS/LDS AND WASTEWATER CONVEYANCE SYSTEM
QUARTERLY INSPECTION FORM

12	Indication that the LS/LF secondary containment is damaged or inadequate.		✓				✓	none	
13	Heating system in the LS/LF is malfunctioning.		✓				✓	none	

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.

KH 4-5-23

Inspector		
Name: Kym Hoffman	**Signature:** Kym Hoffman	**Date:** 4-5-23
Treatment Operations Manager Review of Inspection Documentation		
Name: Michael W. Jones	**Signature:**	**Date:** 4/24/23
Treatment Operations Manager Review of Inspection Documentation		
Name: N/A	**Signature:** N/A	**Date:** N/A

APPENDIX B-2

ELF Inspection Documentation

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

Inspector Name(s): M. Jones, K. Hoffman, V. Stewart | **Inspection Date(s):** 6-5-22

Field Conditions:
Previous 24-Hour Precipitation: Ø | Weather Conditions: sunny, calm, 50's-60'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): 6-1-22

Date(s) of Significant Storm Event: 6-1-22

Total Precipitation (in): 1.47"

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

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

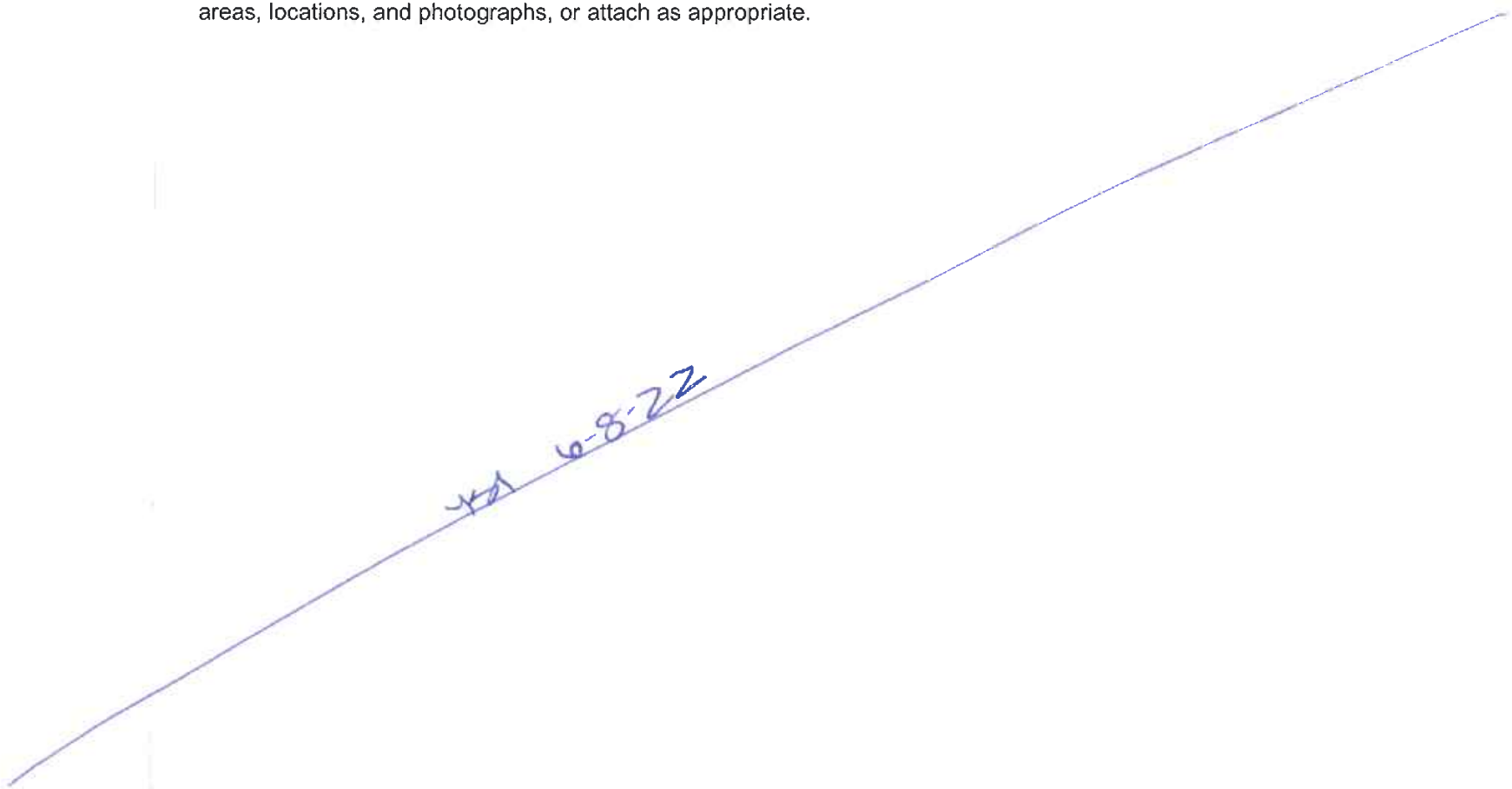
INSPECTION ITEM		CONDITION IS PRESENT			REPEAT OR CHRONIC CONDITION			OBSERVATION Indicate recommended action, if required.	CONFIRMATION THAT ACTION IS COMPLETE (Initial and Date)
		Y	N	N/A	Y	N	N/A		
1.7*	Seepage, differential settlement, cracking, subsidence, sliding, creep, or other signs of slope 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	✓				✓	~~✓~~ 6/5/22 ✓	tumble weeds are present in most of the channels	Addressed in August 2022. MJ 8/2/22
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 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: King Hoffman	Signature:	Date: 6-8-22
Covers Manager Review of Inspection Documentation		
Name: Michael W. Jones	Signature:	Date: 6/29/22
Covers Manager Confirmation of Completed Actions		
Name: Michael W. Jones	Signature:	Date: 8/2/22

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

Inspector Name(s): M. Jones, K. Hoffman, V. Stewart | **Inspection Date(s):** 7-13-22

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

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

Total Precipitation (in): N/A

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

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	✓				✓		tumble weeds have collected along fence	Addressed in August 2022. MJ 8/2/22
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	✓				✓		tumble weeds are present in most of the channels	Addressed in August 2022. MJ 8/2/22
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.

KH 7-19-22

Inspector		
Name: Kim Hoffman	**Signature:** Kim Hoffman	**Date:** 7-19-22
Covers Manager Review of Inspection Documentation		
Name: Michael W. Jones	**Signature:** Michael W. Jones	**Date:** 7/21/22
Covers Manager Confirmation of Completed Actions		
Name: Michael W. Jones	**Signature:** Michael W. Jones	**Date:** 8/2/22

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

Inspector Name(s): M. Jones, K. Hoffman, V. Stewart | **Inspection Date(s):** 8-3-22

Field Conditions:
Previous 24-Hour Precipitation: 0 | 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): 7-27-22
*Note: Post-storm event inspection items are indicated with a * next to the Inspection Item number.*

Date(s) of Significant Storm Event: 7-26-22

Total Precipitation (in): 1.07"

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

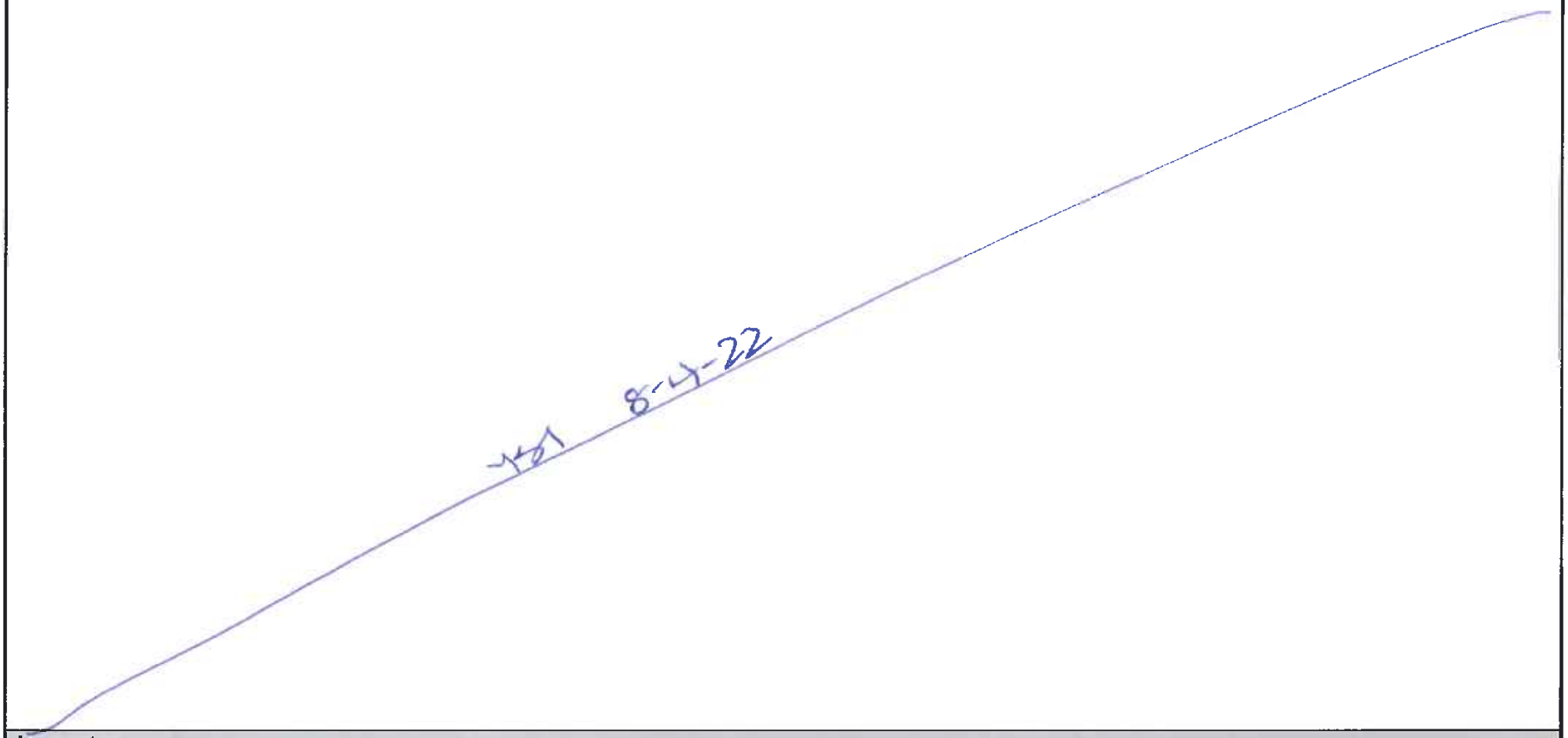
	INSPECTION ITEM	CONDITION IS PRESENT			REPEAT OR CHRONIC CONDITION			OBSERVATION Indicate recommended action, if required.	CONFIRMATION THAT ACTION IS COMPLETE (Initial and Date)
		Y	N	N/A	Y	N	N/A		
1.7*	Seepage, differential settlement, cracking, subsidence, sliding, creep, or other signs of slope instability		✓				✓	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			✓			✓	N/A	

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:** 8-4-22
Covers Manager Review of Inspection Documentation		
Name: Michael W. Jones	**Signature:**	**Date:** 10/3/22
Covers 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):** 10-11-22

Field Conditions:
Previous 24-Hour Precipitation: Ø Weather Conditions: sunny, calm winds, 70'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

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	

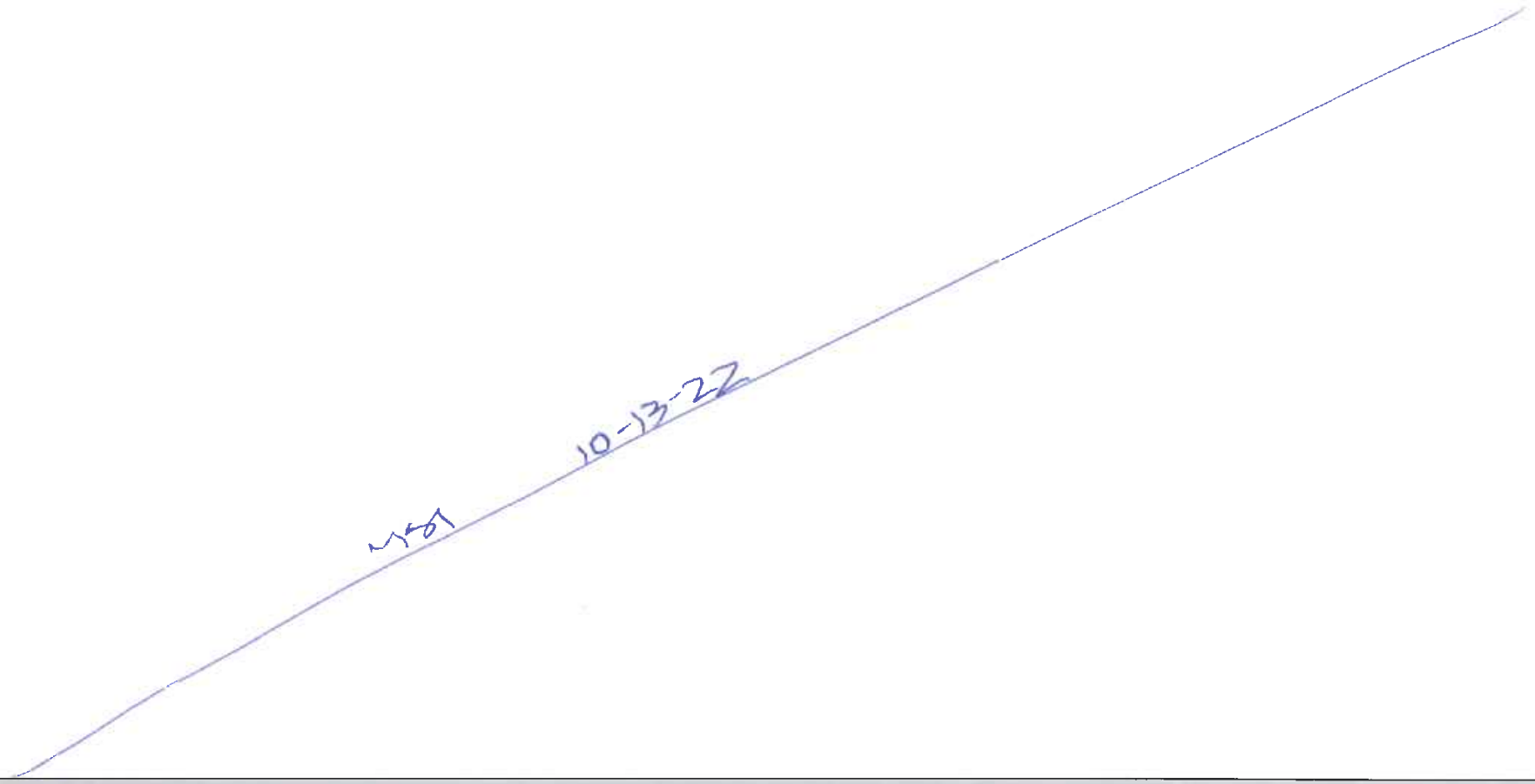
FORM SOP ELF 001-2
ELF CAP TYPE II INSPECTION FORM

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)	3	3	3.5	2.75	1	2	1.25	1

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:** 10-13-22
Cover Manager Review of Inspection Documentation		
Name: Michael W. Jones	**Signature:**	**Date:** 11/4/22
Cover 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, V. Stewart | **Inspection Date(s):** 1-17-23

Field Conditions:
Previous 24-Hour Precipitation: 0 | Weather Conditions: mostly 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.

Inspection was postponed from 1-11-23 to 1-17-23 due to snow.

Inspector		
Name: Kim Hoffman	**Signature:** Kim Hoffman DD	**Date:** 1-18-23
Covers Manager Review of Inspection Documentation		
Name: Michael W. Jones	**Signature:**	**Date:** 1/23/23
Covers 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): 4-10-23

Field Conditions:
Previous 24-Hour Precipitation: 0 Weather Conditions: Sunny, calm winds, 60'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

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 during this inspection or 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	✓				✓		Hole at N39 50.930 W104 50.405 was backfilled using existing soil	Repaired in April 2023. MJ 4/24/23
6.2 Excessive siltation in a channel or downchute		✓				✓	none	
6.3 Debris present in a channel or downchute	✓				✓		Note 1.	

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)	2.75	3	3.5	3	1	2	1	1

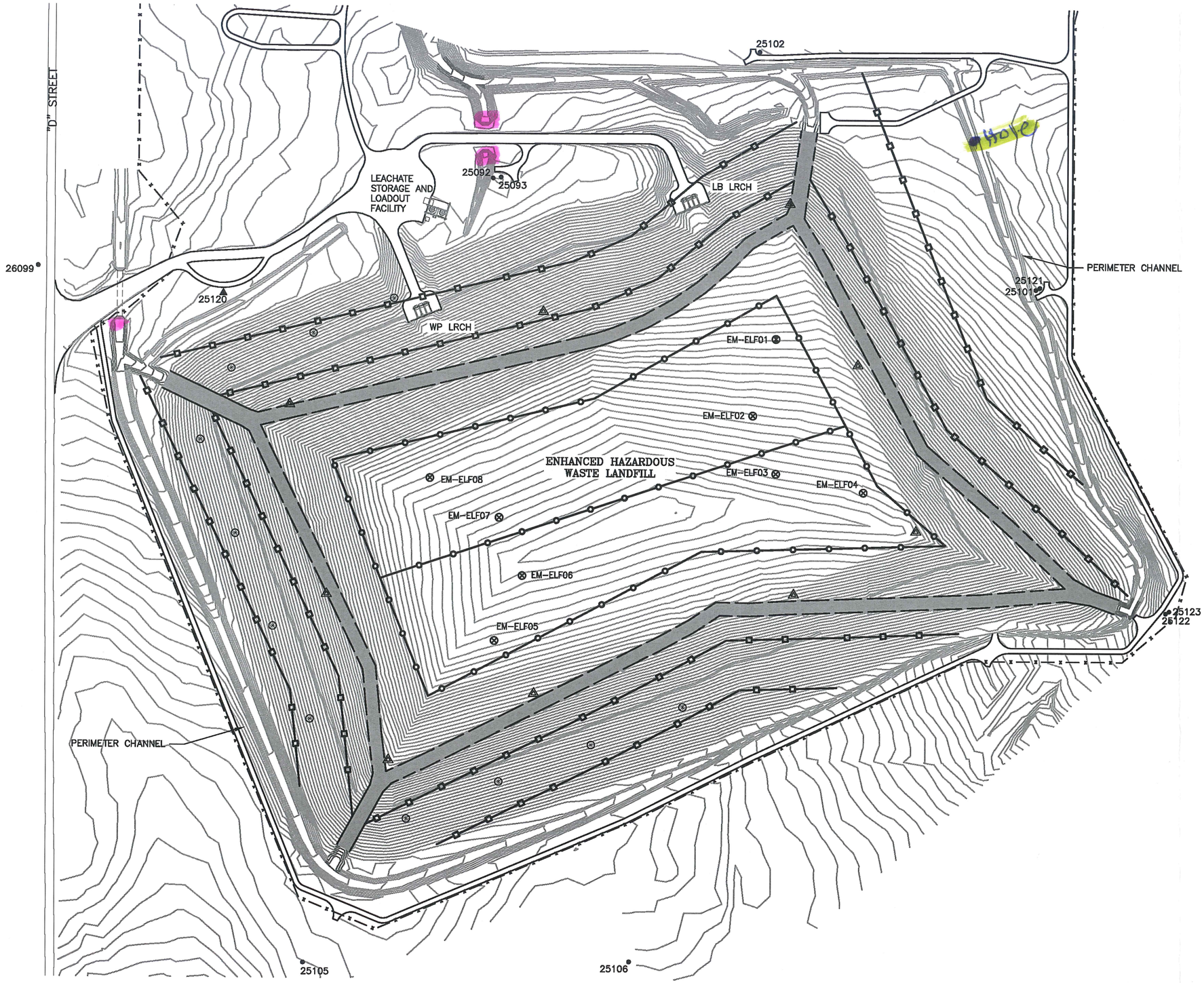
FORM SOP ELF 001-2
ELF CAP TYPE II INSPECTION FORM

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.

Note 1: Tumble weeds have accumulated in some channels. See attached figure for location information.

Inspector		
Name: Kim Hoffman	Signature:	Date: 4-10-23
Cover Manager Review of Inspection Documentation		
Name: Michael W. Jones	Signature:	Date: 4/24/23
Cover Manager Confirmation of Completed Actions		
Name:	Signature:	Date:

Hole observed along the perimeter channel at the ELF and backfilled using existing soil.



LEGEND:

- UPPER VANTAGE PATHS FOR TYPE I AND TYPE II INSPECTIONS
- LOWER VANTAGE PATH FOR TYPE II INSPECTIONS
- PERIMETER FENCE/ARMY MAINTAINED AREA BOUNDARY
- ROAD
- CHANNELS AND DOWNCHUTES
- EM-ELF01 EROSION/SETTLEMENT MONUMENT
- SURVEY MONUMENTS
- TRENCH DRAIN OUTFALL

backfilled hole

tumble weed accumulation

COLORADO STATE PLANE

0 100 200

Scale In Feet

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

ROCKY MOUNTAIN ARSENAL
COMMERCE CITY, COLORADO

NAVARRO Research and Engineering, Inc.

PROJECT NAME
ELF POST-CLOSURE PLAN

TITLE
LOCATION OF CAP FEATURES

CAD FILE:	DATE	FIGURE NUMBER
FIG-SOP ELF 001-1.DWG	10.07.19	SOP ELF 001-1

ELF LCS/LDS AND WASTEWATER CONVEYANCE SYSTEM
QUARTERLY INSPECTION FORM

Inspector Name(s): K. Hoffman

Inspection Date(s): 7-12-22

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:** 7-12-22
Operations Engineer Review of Inspection Documentation		
Name: Michael W. Jones	**Signature:**	**Date:** 7/21/22
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): King Hoffmann **Inspection Date(s):** 10-25-22

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		✓				✓	none	
2	Improper operation of leachate collection and leak detection pumps	✓				✓		LCS-1 WP goes to motor overload, tripped - notified electricians	Addressed in Nov. 2022. MJ 11/4/22
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.

10-25-22

Inspector		
Name: Kim Hoffman	Signature: Kim Hoffman	Date: 10-25-22
Operations Engineer Review of Inspection Documentation		
Name: Michael W. Jones	Signature: Michael W. Jones	Date: 11/4/22
Operations Manager Review of Implementation		
Name: Michael W. Jones	Signature: Michael W. Jones	Date: 11/4/22

ELF LCS/LDS AND WASTEWATER CONVEYANCE SYSTEM
QUARTERLY INSPECTION FORM

Inspector Name(s): K. Hoffman | **Inspection Date(s):** 1-4-23

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.		✓				✓		

1-4-23

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:** 1-4-23
Operations Engineer Review of Inspection Documentation		
Name: Michael W. Jones	**Signature:**	**Date:** 1/23/23
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):** 4-5-23

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.		✓				✓		

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:** 4-5-23
Operations Engineer Review of Inspection Documentation		
Name: Michael W. Jones	**Signature:**	**Date:** 4/24/23
Operations Manager Review of Implementation		
Name: N/A	**Signature:** N/A	**Date:** N/A

APPENDIX C-1

HWL Maintenance Documentation

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CONTRACTOR DAILY QUALITY CONTROL REPORT

Project Information	
Subcontractor: N/A	Project: HWL O&M
Task: maintenance	Date: 6/1/22
Weather AM: acceptable field conditions	Weather PM: acceptable field conditions

Activities Inspected and Observed:

OMC personnel performed a drive around inspection due to the RMA receiving 1.47" of rain in a 24-hour period. The rain stopped in the am of 6/1/22 and the inspection was performed in the afternoon. No new 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: 7-20-22
Reviewer Name: Mike Jones	Title/company: Caps and Covers Manager/Navarro
Signature:	Date: 7/29/22

CONTRACTOR DAILY QUALITY CONTROL REPORT

Project Information	
Subcontractor: Weed Wranglers	Project: HWL O&M
Task: maintenance	Date: 7/12/22
Weather AM: acceptable field conditions	Weather PM: acceptable field conditions
Activities Inspected and Observed:	
Weed Wranglers sprayed areas of Russian thistle and kochia using 2,4-D and Vista XRT. Approximately 1.2 acres were sprayed along the northeast and east perimeter.	
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: 7-20-22
Reviewer Name: Mike Jones	Title/company: Caps and Covers Manager/Navarro
Signature:	Date: 7/29/22

CONTRACTOR DAILY QUALITY CONTROL REPORT

Project Information	
Subcontractor: H2 Enterprises	Project: HWL O&M
Task: maintenance	Date: 7/25/22
Weather AM: acceptable field conditions	Weather PM: acceptable field conditions

Activities Inspected and Observed:

H2 Enterprises began removing the tumbleweeds from the perimeter fence, ACB lined channels, and grass lined channels. H2 began on the west perimeter channel of the HWL. H2 is using a mower attachment mounted to a track skidsteer.

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: 11-30-22
Reviewer Name: Mike Jones	Title/company: Caps and Covers Manager/Navarro
Signature: [signature]	Date: 12/14/22

CONTRACTOR DAILY QUALITY CONTROL REPORT

Project Information	
Subcontractor: H2 Enterprises	Project: HWL O&M
Task: maintenance	Date: 7/26/22
Weather AM: acceptable field conditions	Weather PM: acceptable field conditions

Activities Inspected and Observed:

H2 Enterprises continued removing the tumbleweeds from the perimeter fence, ACB lined channels, and grass lined channels. H2 is using a mower attachment mounted to a track skidsteer. H2 also used a John Deere tractor and batwing mower to mow weedy areas on and around the landfills.

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: 11-30-22
Reviewer Name: Mike Jones	Title/company: Caps and Covers Manager/Navarro
Signature:	Date: 12/14/22

CONTRACTOR DAILY QUALITY CONTROL REPORT

Project Information	
Subcontractor: N/A	Project: HWL O&M
Task: maintenance	Date: 7/27/22
Weather AM: acceptable field conditions	Weather PM: acceptable field conditions
Activities Inspected and Observed:	
The RMA received 1.07" of rain in a 24-hour period. A drive around post-storm inspection was performed. 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: 11-30-22
Reviewer Name: Mike Jones	Title/company: Caps and Covers Manager/Navarro
Signature: [signature]	Date: 12/14/22

CONTRACTOR DAILY QUALITY CONTROL REPORT

Project Information	
Subcontractor: H2 Enterprises	Project: HWL O&M
Task: maintenance	Date: 8/1/22
Weather AM: acceptable field conditions	Weather PM: acceptable field conditions

Activities Inspected and Observed:

H2 Enterprises continued removing the tumbleweeds from the perimeter fence, ACB lined channels, and grass lined channels. H2 is using a mower attachment mounted to a track skidsteer. H2 also used a John Deere tractor and batwing mower to mow weedy areas on and around the landfills. H2 completed the skidsteer work on the HWL today and moved to the ELF.

H2 struck a single ACB block in the northeast downchute with a truck hitch. The block was broken. The large portions of block will be saved and the voids will be backfilled with concrete.

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: 11-30-22
Reviewer Name: Mike Jones	Title/company: Caps and Covers Manager/Navarro

CONTRACTOR DAILY QUALITY CONTROL REPORT

Signature:	Date: 12/14/22

CONTRACTOR DAILY QUALITY CONTROL REPORT

Project Information	
Subcontractor: H2 Enterprises	Project: HWL O&M
Task: maintenance	Date: 8/2/22
Weather AM: acceptable field conditions	Weather PM: acceptable field conditions

Activities Inspected and Observed:

H2 Enterprises used a John Deere tractor and batwing mower to mow weedy areas on and around the landfills. H2 completed the east side of the support area of the HWL and the top of the HWL

H2 struck a single ACB block in the northeast downchute with a truck hitch on 8/1/22. The large portions of block were saved and placed back in the channel, and the voids were backfilled with concrete.

OMC replaced the steel well casing on well 25195.

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: 11-30-22
Reviewer Name: Mike Jones	Title/company: Caps and Covers Manager/Navarro

CONTRACTOR DAILY QUALITY CONTROL REPORT

Signature:	Date: 12/14/22

CONTRACTOR DAILY QUALITY CONTROL REPORT

Project Information	
Subcontractor: Weed Wranglers	Project: HWL O&M
Task: maintenance	Date: 8/9/22
Weather AM: acceptable field conditions	Weather PM: acceptable field conditions
Activities Inspected and Observed:	
Weed Wranglers spot sprayed noxious weeds using Escort XP® and Transline®.	
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: 11-30-22
Reviewer Name: Mike Jones	Title/company: Caps and Covers Manager/Navarro
Signature:	Date: 12/14/22

CONTRACTOR DAILY QUALITY CONTROL REPORT

Project Information	
Subcontractor: Weed Wranglers	Project: HWL O&M
Task: maintenance	Date: 11/9/22
Weather AM: acceptable field conditions	Weather PM: acceptable field conditions
Activities Inspected and Observed:	
Weed Wranglers sprayed ground clear herbicide on the roadways, around wells, and other hard working surfaces. Weed Wranglers used the herbicide 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: [signature]	Date: 11-30-22
Reviewer Name: Mike Jones	Title/company: Caps and Covers Manager/Navarro
Signature: [signature]	Date: 12/14/22

Operations and Maintenance Report
Beginning Date 05/01/2022 Ending Date 04/30/2023

Date	Start of Down Time	Plant Down Time (Hrs)	Summary of Significant Events
07/12/2022		0.00	Pumped HWL LCS1 and LCS2 to low level after high level sump sampling event. LCS1 started at 27.9 in and ended at 13.0 in. LCS2 started at 27.0 in and ended at 8.8 in. Lift Station started at 4.3 ft and ended at 4.5 ft. LT401 started at 84.2 in and ended at 103.1 in and LT402 started at 10.1 in and ended at 33.1 in. init:kh
07/25/2022		0.00	Clean Harbors was onsite to remove leachate from LT401. LT 401 started at 102.7 in and ended at 11.3 in. Approximately 4,652 gallons of leachate were removed for offsite disposal. init:kh
08/24/2022		0.00	The leak detection panel had been in fault for a few days. After troubleshooting, a bad zone splitter in Zone 2 was identified. The zone splitter for the HWL was repaired. init:kh init:kh
10/04/2022		0.00	Performed a visual inspection of the LSLF building because the remote monitoring system is down due to power failure. Inspections will be performed daily until the power is restored. There was no indication of tank leakage. A small quantity of stormwater (<1 gallon) was identified in the floor sump of the building. No other issues were identified. LT401 measured 12 in and LT402 measured 31.5 in. init:kh
10/05/2022		0.00	Performed a daily inspection of the LSLF building. Used a mop to remove the stormwater from the floor sump. LT401 measured 12 in and LT402 measured 31.5 in. No issues were identified for the tank inspection. init:kh
10/06/2022		0.00	Performed daily tank inspection of LSLF and no issues were observed. LT401 measured 12 in and LT402 measured 31.5 in. init:kh
10/07/2022		0.00	Performed daily tank inspection at the LSLF. No issues were observed. LT401 measured 12 in and LT402 measured 31.5 in. init:kh
10/08/2022		0.00	Performed daily tank inspection at the LSLF. No issues were observed. LT401 measured 12 in and LT402 measured 31.5 in. init:kh
10/09/2022		0.00	Performed daily tank inspection at the LSLF. No issues were observed. LT401 measured 12 in and LT402 measured 31.5 in. init:kh
10/10/2022		0.00	Performed daily tank inspection at the LSLF. No issues were observed. LT401 measured 12 in and LT402 measured 31.5 in. init:kh
10/11/2022		0.00	Performed daily tank inspection at the LSLF. No issues were observed. LT401 measured 12 in and LT402 measured 31.5 in. init:kh
10/12/2022		0.00	Performed daily tank inspection at the LSLF. No issues were observed. LT401 measured 12 in and LT402 measured 31.5 in. init:kh
10/13/2022		0.00	Performed daily tank inspection at the LSLF. No issues were observed. LT401 measured 12 in and LT402 measured 31.5 in. init:kh

Operations and Maintenance Report
Beginning Date 05/01/2022 Ending Date 04/30/2023

Date	Start of Down Time	Plant Down Time (Hrs)	Summary of Significant Events
10/14/2022		0.00	Performed daily tank inspection at the LSLF. No issues were observed. LT401 measured 12 in and LT402 measured 31.5 in. init:kh
10/15/2022		0.00	Performed daily tank inspection at the LSLF. No issues were observed. LT401 measured 12 in and LT402 measured 31.5 in. init:kh
10/16/2022		0.00	Performed daily tank inspection at the LSLF. No issues were observed. LT401 measured 12 in and LT402 measured 31.5 in. init:kh
10/17/2022		0.00	Performed daily tank inspection at the LSLF. No issues were observed. LT401 measured 12 in and LT402 measured 31.5 in. init:kh
10/18/2022		0.00	Performed daily tank inspection at the LSLF. No issues were observed. LT401 measured 12 in and LT402 measured 31.5 in. init:kh
10/19/2022		0.00	Performed daily tank inspection at the LSLF. No issues were observed. LT401 measured 12 in and LT402 measured 31.5 in. init:kh
10/20/2022		0.00	Performed daily tank inspection at the LSLF. No issues were observed. LT401 measured 12 in and LT402 measured 31.5 in. init:kh
10/21/2022		0.00	Performed daily tank inspection at the LSLF. No issues were observed. LT401 measured 12 in and LT402 measured 31.5 in. Power was restored to the landfills. All systems appear to be operational. init:kh
10/25/2022		0.00	All sump levels appear to be similar to before the power outage. ELF WP LCS defers to "motor overload tripped" when engaging pump. The OMC electrician looked at WP LCS and determined the best course of action is to tag this sump out. The sump has no water and replacing the motor at this time is not necessary. init:kh
10/31/2022		0.00	The OMC electrician replaced faulty transductors (surge suppression) in PLC panels for the WP and LB LRCH building. init:kh
11/14/2022		0.00	The OMC electrician replaced the contactor in the heater above the south door in the LSLF building. init:kh
11/28/2022		0.00	The batteries were replaced in the PLCs for the Lift Station, LB LRCH, WP LRCH, and LSLF. init:kh
11/30/2022		0.00	Pumped HWL LCS1 and LCS2 to low level after high level sump sampling event. LCS1 started at 26.5 in and ended at 13.1 in. LCS2 started at 28.6 in and ended at 8.6 in. Lift Station started at 5.7 ft and ended at 5.1 ft. LT402 started at 33.3 in and ended at 105.3 in. init:kh
01/20/2023		0.00	OMC maintenance replaced the hard disk drive in the Factory Talk computer. init:kh
01/24/2023		0.00	Clean Harbors was onsite to remove the leachate in T402. The starting measurement of the tank was 104.9 inches and the ending measurement was 10.6 inches. Clean Harbors removed approximately 4,743 gallons of leachate for offsite disposal. init:kh

Operations and Maintenance Report
Beginning Date 05/01/2022 Ending Date 04/30/2023

Date	Start of Down Time	Plant Down Time (Hrs)	Summary of Significant Events
02/23/2023		0.00	Pumped HWL LCS2 and LCS3 to low level after high level sampling event. The starting levels were: Lift Station 7.9 feet; T401 10.7 inches; LCS2 20.8 inches; LCS3 26.4 inches; and T402 10.6 inches. The ending levels were: Lift Station 8.5 feet; T401 105.1 inches; LCS2 8.9 inches; LCS3 11.7 inches; and T402 43.2 inches. init:kh
02/28/2023		0.00	Pumped the Lift Station of T402. The starting levels were Lift Station 8.6 feet and T402 43.0 inches. The ending levels were Lift Station 5.6 feet and T402 104.6 inches. init:kh
04/27/2023		0.00	Installed new Endress and Hauser water pilot FMX21 probe in the Lift Station. Span=0-30 PSI (69.3 ft) 4 MA= 1.5 ft 20MA=70.8 ft init:kh init:kh init:kh

Total Down Time Hours: 0.00

APPENDIX C-2

ELF Maintenance Documentation

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CONTRACTOR DAILY QUALITY CONTROL REPORT

Project Information	
Subcontractor: N/A	Project: ELF O&M
Task: maintenance	Date: 060122
Weather AM: acceptable field conditions	Weather PM: acceptable field conditions
Activities Inspected and Observed:	
OMC personnel performed a drive around inspection due to the RMA receiving 1.47" of rain in a 24-hour period. The rain stopped in the am of 6/1/22 and the inspection was performed in the afternoon. No new 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: 7-20-22
Reviewer Name: Mike Jones	Title/company: Caps and Covers Manager/Navarro
Signature:	Date: 7/29/22

CONTRACTOR DAILY QUALITY CONTROL REPORT

Project Information	
Subcontractor: Weed Wranglers	Project: ELF O&M
Task: maintenance	Date: 071222
Weather AM: acceptable field conditions	Weather PM: acceptable field conditions

Activities Inspected and Observed:

Weed Wranglers sprayed areas of Russian thistle and kochia using 2,4-D and Vista XRT. Approximately 1.2 acres were sprayed along the east and south perimeters.

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: 7-20-22
Reviewer Name: Mike Jones	Title/company: Caps and Covers Manager/Navarro
Signature:	Date: 7/21/22

CONTRACTOR DAILY QUALITY CONTROL REPORT

Project Information	
Subcontractor: N/A	Project: ELF O&M
Task: maintenance	Date: 072722
Weather AM: acceptable field conditions	Weather PM: acceptable field conditions
Activities Inspected and Observed:	
The RMA received 1.07" of rain in a 24-hour period. A drive around post-storm inspection was performed. 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: 11-30-22
Reviewer Name: Mike Jones	Title/company: Caps and Covers Manager/Navarro
Signature:	Date: 12/14/22

CONTRACTOR DAILY QUALITY CONTROL REPORT

Project Information	
Subcontractor: H2 Enterprises	Project: ELF O&M
Task: maintenance	Date: 8/1/22
Weather AM: acceptable field conditions	Weather PM: acceptable field conditions
Activities Inspected and Observed:	
H2 Enterprises began removing the tumbleweeds from the perimeter fence, ACB lined channels, and grass lined channels. H2 began on the east side of the ELF. H2 is using a mower attachment mounted to a track skidsteer.	
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: 11-30-22
Reviewer Name: Mike Jones	Title/company: Caps and Covers Manager/Navarro
Signature:	Date: 12/14/22

CONTRACTOR DAILY QUALITY CONTROL REPORT

Project Information	
Subcontractor: H2 Enterprises	Project: ELF O&M
Task: maintenance	Date: 8/2/22
Weather AM: acceptable field conditions	Weather PM: acceptable field conditions

Activities Inspected and Observed:

H2 Enterprises continued removing the tumbleweeds from the perimeter fence, ACB lined channels, and grass lined channels. H2 is using a mower attachment mounted to a track skidsteer. H2 completed the skidsteer work on the ELF.

H2 used a John Deere tractor and batwing mower to mow weedy areas on and around the landfills. The top of the ELF was started, but not completed 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: 11-30-22
Reviewer Name: Mike Jones	Title/company: Caps and Covers Manager/Navarro
Signature:	Date: 12/14/22

CONTRACTOR DAILY QUALITY CONTROL REPORT

Project Information	
Subcontractor: H2 Enterprises	Project: ELF O&M
Task: maintenance	Date: 8/3/22
Weather AM: acceptable field conditions	Weather PM: acceptable field conditions

Activities Inspected and Observed:

H2 Enterprises used a John Deere tractor and batwing mower to mow weedy areas on and around the landfills. The top of the ELF was completed today.

All equipment was demobilized from the site.

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: 11-30-22
Reviewer Name: Mike Jones	Title/company: Caps and Covers Manager/Navarro
Signature: [signature]	Date: 12/14/22

CONTRACTOR DAILY QUALITY CONTROL REPORT

Project information	
Subcontractor: Weed Wranglers	Project: ELF O&M
Task: maintenance	Date: 8/9/22
Weather AM: acceptable field conditions	Weather PM: acceptable field conditions
Activities Inspected and Observed:	
Weed Wranglers spot sprayed noxious weeds using Escort XP® and Transline®.	
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: 11-30-22
Reviewer Name: Mike Jones	Title/company: Caps and Covers Manager/Navarro
Signature: Mike Jones	Date: 12/14/22

CONTRACTOR DAILY QUALITY CONTROL REPORT

Project Information	
Subcontractor: N/A	Project: ELF O&M
Task: maintenance	Date: 10/4/22
Weather AM: acceptable field conditions	Weather PM: acceptable field conditions

Activities Inspected and Observed:

The landfills are experiencing a power outage due to a transformer being damaged during a storm on 10/3/22. The RMA received 0.55" of rain and it was during this storm, the transformer near the NWBCS was damaged. The LSLF building is being inspected daily until the power is restored. See the LSLF logbook for daily inspections and the Daily Tank Inspection Form in the landfills file system.

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

N/A

Comments:

The power was restored on October 21, 2022.

Additional Documentation Submitted:

N/A

Sign Off:	
Inspector Name: Kim Hoffman	Title/company: Caps and Covers Lead/Navarro
Signature: Kim Hoffman	Date: 11-30-22
Reviewer Name: Mike Jones	Title/company: Caps and Covers Manager/Navarro
Signature: Mike Jones	Date: 12/14/22

CONTRACTOR DAILY QUALITY CONTROL REPORT

Project Information	
Subcontractor: Weed Wranglers	Project: ELF O&M
Task: maintenance	Date: 11/9/22
Weather AM: acceptable field conditions	Weather PM: acceptable field conditions
Activities Inspected and Observed:	
Weed Wranglers sprayed ground clear herbicide on the roadways, around wells, and other hard working surfaces. Weed Wranglers used the herbicide Plainview SC®.	
Summary Meetings and Discussions Held or Attended, including Job Safety:	
N/A	
Comments:	
The power was restored on October 21, 2022.	
Additional Documentation Submitted:	
N/A	
Sign Off:	
Inspector Name: Kim Hoffman	Title/company: Caps and Covers Lead/Navarro
Signature: Kim Hoffman	Date: 11-30-22
Reviewer Name: Mike Jones	Title/company: Caps and Covers Manager/Navarro
Signature:	Date: 12/14/22

CONTRACTOR DAILY QUALITY CONTROL REPORT

Project Information	
Subcontractor: N/A	Project: ELF O&M
Task: maintenance	Date: 3/15/23
Weather AM: acceptable	Weather PM: acceptable

Activities Inspected and Observed:

OMC personnel repaired ELF ER-4. The label plate needed affixed back onto the post. OMC used a wire brush to clean the area and then applied an epoxy product to repair the monument.

OMC also backfilled three holes that were identified today on the northeast corner of the ELF. The holes appeared to be created by a predator.

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: Navarro
Signature: Kim Hoffman	Date: 3-29-23
Reviewer Name: Michael W. Jones	Title/company: Navarro
Signature: Michael W. Jones	Date: 4/24/23

Operations and Maintenance Report
Beginning Date 05/01/2022 Ending Date 04/30/2023

Date	Start of Down Time	Plant Down Time (Hrs)	Summary of Significant Events
07/12/2022		0.00	Pumped HWL LCS1 and LCS2 to low level after high level sump sampling event. LCS1 started at 27.9 in and ended at 13.0 in. LCS2 started at 27.0 in and ended at 8.8 in. Lift Station started at 4.3 ft and ended at 4.5 ft. LT401 started at 84.2 in and ended at 103.1 in and LT402 started at 10.1 in and ended at 33.1 in. init:kh
07/25/2022		0.00	Clean Harbors was onsite to remove leachate from LT401. LT 401 started at 102.7 in and ended at 11.3 in. Approximately 4,652 gallons of leachate were removed for offsite disposal. init:kh
08/24/2022		0.00	The leak detection panel had been in fault for a few days. After troubleshooting, a bad zone splitter in Zone 2 was identified. The zone splitter for the HWL was repaired. init:kh init:kh
10/04/2022		0.00	Performed a visual inspection of the LSLF building because the remote monitoring system is down due to power failure. Inspections will be performed daily until the power is restored. There was no indication of tank leakage. A small quantity of stormwater (<1 gallon) was identified in the floor sump of the building. No other issues were identified. LT401 measured 12 in and LT402 measured 31.5 in. init:kh
10/05/2022		0.00	Performed a daily inspection of the LSLF building. Used a mop to remove the stormwater from the floor sump. LT401 measured 12 in and LT402 measured 31.5 in. No issues were identified for the tank inspection. init:kh
10/06/2022		0.00	Performed daily tank inspection of LSLF and no issues were observed. LT401 measured 12 in and LT402 measured 31.5 in. init:kh
10/07/2022		0.00	Performed daily tank inspection at the LSLF. No issues were observed. LT401 measured 12 in and LT402 measured 31.5 in. init:kh
10/08/2022		0.00	Performed daily tank inspection at the LSLF. No issues were observed. LT401 measured 12 in and LT402 measured 31.5 in. init:kh
10/09/2022		0.00	Performed daily tank inspection at the LSLF. No issues were observed. LT401 measured 12 in and LT402 measured 31.5 in. init:kh
10/10/2022		0.00	Performed daily tank inspection at the LSLF. No issues were observed. LT401 measured 12 in and LT402 measured 31.5 in. init:kh
10/11/2022		0.00	Performed daily tank inspection at the LSLF. No issues were observed. LT401 measured 12 in and LT402 measured 31.5 in. init:kh
10/12/2022		0.00	Performed daily tank inspection at the LSLF. No issues were observed. LT401 measured 12 in and LT402 measured 31.5 in. init:kh
10/13/2022		0.00	Performed daily tank inspection at the LSLF. No issues were observed. LT401 measured 12 in and LT402 measured 31.5 in. init:kh

Operations and Maintenance Report
Beginning Date 05/01/2022 Ending Date 04/30/2023

Date	Start of Down Time	Plant Down Time (Hrs)	Summary of Significant Events
10/14/2022		0.00	Performed daily tank inspection at the LSLF. No issues were observed. LT401 measured 12 in and LT402 measured 31.5 in. init:kh
10/15/2022		0.00	Performed daily tank inspection at the LSLF. No issues were observed. LT401 measured 12 in and LT402 measured 31.5 in. init:kh
10/16/2022		0.00	Performed daily tank inspection at the LSLF. No issues were observed. LT401 measured 12 in and LT402 measured 31.5 in. init:kh
10/17/2022		0.00	Performed daily tank inspection at the LSLF. No issues were observed. LT401 measured 12 in and LT402 measured 31.5 in. init:kh
10/18/2022		0.00	Performed daily tank inspection at the LSLF. No issues were observed. LT401 measured 12 in and LT402 measured 31.5 in. init:kh
10/19/2022		0.00	Performed daily tank inspection at the LSLF. No issues were observed. LT401 measured 12 in and LT402 measured 31.5 in. init:kh
10/20/2022		0.00	Performed daily tank inspection at the LSLF. No issues were observed. LT401 measured 12 in and LT402 measured 31.5 in. init:kh
10/21/2022		0.00	Performed daily tank inspection at the LSLF. No issues were observed. LT401 measured 12 in and LT402 measured 31.5 in. Power was restored to the landfills. All systems appear to be operational. init:kh
10/25/2022		0.00	All sump levels appear to be similar to before the power outage. ELF WP LCS defers to "motor overload tripped" when engaging pump. The OMC electrician looked at WP LCS and determined the best course of action is to tag this sump out. The sump has no water and replacing the motor at this time is not necessary. init:kh
10/31/2022		0.00	The OMC electrician replaced faulty transductors (surge suppression) in PLC panels for the WP and LB LRCH building. init:kh
11/14/2022		0.00	The OMC electrician replaced the contactor in the heater above the south door in the LSLF building. init:kh
11/28/2022		0.00	The batteries were replaced in the PLCs for the Lift Station, LB LRCH, WP LRCH, and LSLF. init:kh
11/30/2022		0.00	Pumped HWL LCS1 and LCS2 to low level after high level sump sampling event. LCS1 started at 26.5 in and ended at 13.1 in. LCS2 started at 28.6 in and ended at 8.6 in. Lift Station started at 5.7 ft and ended at 5.1 ft. LT402 started at 33.3 in and ended at 105.3 in. init:kh
01/20/2023		0.00	OMC maintenance replaced the hard disk drive in the Factory Talk computer. init:kh
01/24/2023		0.00	Clean Harbors was onsite to remove the leachate in T402. The starting measurement of the tank was 104.9 inches and the ending measurement was 10.6 inches. Clean Harbors removed approximately 4,743 gallons of leachate for offsite disposal. init:kh

Operations and Maintenance Report
Beginning Date 05/01/2022 Ending Date 04/30/2023

Date	Start of Down Time	Plant Down Time (Hrs)	Summary of Significant Events
02/23/2023		0.00	Pumped HWL LCS2 and LCS3 to low level after high level sampling event. The starting levels were: Lift Station 7.9 feet; T401 10.7 inches; LCS2 20.8 inches; LCS3 26.4 inches; and T402 10.6 inches. The ending levels were: Lift Station 8.5 feet; T401 105.1 inches; LCS2 8.9 inches; LCS3 11.7 inches; and T402 43.2 inches. init:kh
02/28/2023		0.00	Pumped the Lift Station of T402. The starting levels were Lift Station 8.6 feet and T402 43.0 inches. The ending levels were Lift Station 5.6 feet and T402 104.6 inches. init:kh
04/27/2023		0.00	Installed new Endress and Hauser water pilot FMX21 probe in the Lift Station. Span=0-30 PSI (69.3 ft) 4 MA= 1.5 ft 20MA=70.8 ft init:kh init:kh init:kh

Total Down Time Hours: 0.00

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APPENDIX D

HWL and ELF Erosion/Settlement Monument Survey Data

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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	5307.8	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	189355.9	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	189150.7	2184866.6	5309.7	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	189637.2	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	189356.0	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	5306.6	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	2184866.5	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	5307.6	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	5308.8	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	2184866.5	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	2185133.8	5307.6	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

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		
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
ELF-EM1	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
ELF-EM2	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
ELF-EM3	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
ELF-EM4	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
ELF-EM5	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
ELF-EM6	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
ELF-EM7	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
ELF-EM8	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		
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
ELF-EM1	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
ELF-EM2	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
ELF-EM3	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
ELF-EM4	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
ELF-EM5	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
ELF-EM6	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
ELF-EM7	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
ELF-EM8	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		
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
ELF-EM1	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
ELF-EM2	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
ELF-EM3	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
ELF-EM4	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
ELF-EM5	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
ELF-EM6	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
ELF-EM7	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
ELF-EM8	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		
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
ELF-EM1	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
ELF-EM2	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
ELF-EM3	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
ELF-EM4	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
ELF-EM5	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
ELF-EM6	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
ELF-EM7	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
ELF-EM8	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		
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
ELF-EM1	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
ELF-EM2	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
ELF-EM3	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
ELF-EM4	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
ELF-EM5	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
ELF-EM6	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
ELF-EM7	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
ELF-EM8	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		
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
ELF-EM1	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
ELF-EM2	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
ELF-EM3	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
ELF-EM4	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
ELF-EM5	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
ELF-EM6	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
ELF-EM7	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
ELF-EM8	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		
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
ELF-EM1	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
ELF-EM2	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
ELF-EM3	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
ELF-EM4	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
ELF-EM5	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
ELF-EM6	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
ELF-EM7	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
ELF-EM8	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		
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
ELF-EM1	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
ELF-EM2	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
ELF-EM3	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
ELF-EM4	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
ELF-EM5	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
ELF-EM6	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
ELF-EM7	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
ELF-EM8	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		
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
ELF-EM1	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
ELF-EM2	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
ELF-EM3	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
ELF-EM4	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
ELF-EM5	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
ELF-EM6	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
ELF-EM7	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
ELF-EM8	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		
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
ELF-EM1	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
ELF-EM2	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
ELF-EM3	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
ELF-EM4	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
ELF-EM5	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
ELF-EM6	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
ELF-EM7	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
ELF-EM8	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		
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
ELF-EM1	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
ELF-EM2	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
ELF-EM3	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
ELF-EM4	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
ELF-EM5	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
ELF-EM6	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
ELF-EM7	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
ELF-EM8	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		
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
ELF-EM1	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
ELF-EM2	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
ELF-EM3	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
ELF-EM4	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
ELF-EM5	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
ELF-EM6	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
ELF-EM7	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
ELF-EM8	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		
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
ELF-EM1	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
ELF-EM2	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
ELF-EM3	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
ELF-EM4	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
ELF-EM5	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
ELF-EM6	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
ELF-EM7	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
ELF-EM8	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		
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
ELF-EM1	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
ELF-EM2	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
ELF-EM3	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
ELF-EM4	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
ELF-EM5	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
ELF-EM6	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
ELF-EM7	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
ELF-EM8	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		
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
ELF-EM1	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
ELF-EM2	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
ELF-EM3	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
ELF-EM4	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	0.0
ELF-EM5	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
ELF-EM6	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
ELF-EM7	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
ELF-EM8	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		
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
ELF-EM1	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
ELF-EM2	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
ELF-EM3	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
ELF-EM4	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
ELF-EM5	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
ELF-EM6	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
ELF-EM7	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
ELF-EM8	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		
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
ELF-EM1	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
ELF-EM2	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
ELF-EM3	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
ELF-EM4	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
ELF-EM5	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
ELF-EM6	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
ELF-EM7	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
ELF-EM8	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		
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
ELF-EM1	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
ELF-EM2	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
ELF-EM3	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
ELF-EM4	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
ELF-EM5	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
ELF-EM6	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
ELF-EM7	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
ELF-EM8	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		
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
ELF-EM1	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
ELF-EM2	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
ELF-EM3	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
ELF-EM4	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
ELF-EM5	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
ELF-EM6	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
ELF-EM7	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
ELF-EM8	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		
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
ELF-EM1	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
ELF-EM2	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
ELF-EM3	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
ELF-EM4	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
ELF-EM5	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
ELF-EM6	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
ELF-EM7	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
ELF-EM8	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		
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
ELF-EM1	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
ELF-EM2	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
ELF-EM3	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
ELF-EM4	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
ELF-EM5	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
ELF-EM6	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
ELF-EM7	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
ELF-EM8	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		
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
ELF-EM1	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
ELF-EM2	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
ELF-EM3	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
ELF-EM4	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
ELF-EM5	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
ELF-EM6	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
ELF-EM7	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
ELF-EM8	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		
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
ELF-EM1	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
ELF-EM2	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
ELF-EM3	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
ELF-EM4	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
ELF-EM5	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
ELF-EM6	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
ELF-EM7	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
ELF-EM8	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		
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
ELF-EM1	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
ELF-EM2	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
ELF-EM3	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
ELF-EM4	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
ELF-EM5	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
ELF-EM6	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
ELF-EM7	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
ELF-EM8	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		
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
ELF-EM1	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
ELF-EM2	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
ELF-EM3	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
ELF-EM4	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
ELF-EM5	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
ELF-EM6	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
ELF-EM7	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
ELF-EM8	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

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APPENDIX E

Monthly Flow Summaries

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Monthly HWL LCS and LDS Sump Volume Readings

May 2022 through April 2023

	HWL LCS1		HWL LCS2		HWL LCS3		HWL LCS4		HWL LDS1		HWL LDS2		HWL LDS3		HWL LDS4	
Date	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.)	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-22	1577100.0	0.0	1290800.0	1200.0	374000.0	0.0	1259000.0	0.0	29071.0	333.0	24088.0	0.0	23682.0	460.0	2374.0	0.0
June-22	1577100.0	0.0	1290800.0	0.0	374000.0	0.0	1259000.0	0.0	29071.0	0.0	24088.0	0.0	23682.0	0.0	2374.0	0.0
July-22	1578500.0	1400.0	1292700.0	1900.0	374000.0	0.0	1259000.0	0.0	29071.0	0.0	24088.0	0.0	23682.0	0.0	2374.0	0.0
August-22	1578500.0	0.0	1292700.0	0.0	374000.0	0.0	1259000.0	0.0	29071.0	0.0	24088.0	0.0	23682.0	0.0	2374.0	0.0
September-22	1578500.0	0.0	1292700.0	0.0	374000.0	0.0	1259000.0	0.0	29071.0	0.0	24088.0	0.0	23682.0	0.0	2374.0	0.0
October-22	1578500.0	0.0	1292700.0	0.0	374000.0	0.0	1259000.0	0.0	29071.0	0.0	24088.0	0.0	23682.0	0.0	2374.0	0.0
November-22	1579900.0	1400.0	1295100.0	2400.0	374000.0	0.0	1259000.0	0.0	29071.0	0.0	24088.0	0.0	23682.0	0.0	2374.0	0.0
December-22	1579900.0	0.0	1295100.0	0.0	374000.0	0.0	1259000.0	0.0	29071.0	0.0	24088.0	0.0	23682.0	0.0	2374.0	0.0
January-23	1579900.0	0.0	1295100.0	0.0	374000.0	0.0	1259000.0	0.0	29071.0	0.0	24088.0	0.0	23682.0	0.0	2374.0	0.0
February-23	1579900.0	0.0	1296800.0	1700.0	381000.0	7000.0	1260000.0	1000.0	29071.0	0.0	24088.0	0.0	23682.0	0.0	2374.0	0.0
March-23	1579900.0	0.0	1296800.0	0.0	381000.0	0.0	1260000.0	0.0	29071.0	0.0	24088.0	0.0	23682.0	0.0	2374.0	0.0
April-23	1580600.0	700.0	1296800.0	0.0	381000.0	0.0	1260000.0	0.0	29071.0	0.0	24088.0	0.0	23682.0	0.0	2374.0	0.0

Monthly ELF LCS and LDS Sump Volume Readings

May 2022 through April 2023

	ELF WPLCS		ELF LBLCS		ELF WPLDS1		ELF WPLDS2		ELF LBLDS1		ELF LBLDS2	
Date	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.)	Totalizer Volume (gal.)	Increase in Volume (gal.)	Totalizer Volume (gal.)	Increase in Volume (gal.)
May-22	15116.0	0.0	601920.0	0.0	46581.0	0.0	135715.0	0.0	40233.0	0.0	35484.0	0.0
June-22	15116.0	0.0	601920.0	0.0	46581.0	0.0	135715.0	0.0	40233.0	0.0	35484.0	0.0
July-22	15116.0	0.0	601920.0	0.0	46581.0	0.0	135715.0	0.0	40233.0	0.0	35484.0	0.0
August-22	15116.0	0.0	601920.0	0.0	46581.0	0.0	135715.0	0.0	40233.0	0.0	35484.0	0.0
September-22	15116.0	0.0	601920.0	0.0	46581.0	0.0	135715.0	0.0	40233.0	0.0	35484.0	0.0
October-22	15119.0	3.0	601924.0	4.0	46584.0	3.0	135718.0	3.0	40237.0	4.0	35488.0	4.0
November-22	15119.0	0.0	601924.0	0.0	46584.0	0.0	135718.0	0.0	40237.0	0.0	35488.0	0.0
December-22	15119.0	0.0	601924.0	0.0	46584.0	0.0	135718.0	0.0	40237.0	0.0	35488.0	0.0
January-23	15119.0	0.0	601924.0	0.0	46584.0	0.0	135718.0	0.0	40237.0	0.0	35488.0	0.0
February-23	15119.0	0.0	601924.0	0.0	46584.0	0.0	135718.0	0.0	40237.0	0.0	35488.0	0.0
March-23	15119.0	0.0	601924.0	0.0	46584.0	0.0	135718.0	0.0	40237.0	0.0	35488.0	0.0
April-23	15119.0	0.0	601924.0	0.0	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 2022

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ROCKY MOUNTAIN ARSENAL

HAZARDOUS WASTE LANDFILL
POST-CLOSURE GROUNDWATER MONITORING REPORT

CALENDAR YEAR 2022

Revision 0
June 21, 2023

U.S. Department of the Army
Shell Oil Company

Prepared by:

Navarro Research and Engineering, Inc.

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CONTENTS

Section **Page**

TABLES

FIGURES

SUPPORTING DOCUMENTATION
(available on Data CD)

ACRONYMS

amsl	Above Mean Sea Level
ARDL	Applied Research and Development Laboratory
CAMU	Corrective Action Management Unit
CFS	Confined Flow System
CUSUM	Cumulative Sum
ELF	Enhanced Hazardous Waste Landfill
HWL	Hazardous Waste Landfill
IC	Indicator Compound
IQR	Interquartile Range
LCS	Leachate Collection System
LDS	Leak Detection System
MRL	Method Reporting Limit
MS	Matrix Spike
µg/L	Microgram(s) per liter
NRAP	Non-Routine Action Plan
OCN	Operational Change Notice
O&M	Operations and Maintenance
OMC	Operations and Maintenance Contractor
PARCC	Precision, Accuracy, Representativeness, Completeness, and Comparability
PCGMP	Post-Closure Groundwater Monitoring Plan
QC	Quality Control
RMA	Rocky Mountain Arsenal
RMAED	Rocky Mountain Arsenal Environmental Database
RPD	Relative Percent Difference
SOM	Supplemental Operational Monitoring
SQAPP	Sampling Quality Assurance Project Plan
UCL	Upper Confidence Limit
UFS	Unconfined Flow System

(Note: All chemical codes are listed in Table 2.3-2)

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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 2022 quarterly groundwater sampling events conducted in January, August, and from late October through early November, and the annual sampling event from late April through June. Groundwater flow directions beneath the HWL were consistent over the four quarters of 2022 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 2022 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 2022. The groundwater samples were tested for a standard list of analytes including indicator compounds (ICs). The ICs selected for the monitoring program include 1,1,1-trichloroethane, 1,1-dichloroethane, 1,1-dichloroethene, 1,2-dichloroethane, arsenic, benzene, bicycloheptadiene, carbon tetrachloride, chromium, chloroform, dichlorodifluoromethane, dicyclopentadiene, dieldrin, diisopropylmethyl phosphonate (DIMP), mercury, and lead.

The ICs detected in the upgradient wells include 1,1-dichloroethene, carbon tetrachloride, chloroform and lead, while ICs detected downgradient of the HWL include dieldrin and lead. Dieldrin was detected during all four quarters in downgradient well 25194 at concentrations ranging from 0.0165 micrograms per liter (µg/L) to 0.0242 µg/L. Lead was detected downgradient in two unconfined flow system wells at concentrations ranging from 4.7 to 4.8 µg/L. Lead was detected in two of the three CFS wells at concentrations ranging from 3.1 to 8.1 µg/L. The levels of dieldrin and lead in the downgradient wells were below their prediction limit values of 0.05 µg/L and 15 µg/L, respectively.

The ICs detected in the SOM wells include 1,1,1-trichloroethane, 1,1-dichloroethene, 1,1-dichloroethane, 1,2-dichloroethane, carbon tetrachloride, chloroform, 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. Well 25203, located on the southwest side of the HWL, monitors the shallow flow system. Lead was detected in well 25203 in 2022. The analytical data from SOM wells are not used in the HWL statistical evaluations.

The ICs detected in the leachate collection system (LCS) sumps include, benzene, dichlorodifluoromethane, dicyclopentadiene, dieldrin, DIMP and lead. The results from the LCS samples are consistent with wastes placed in the landfills, and the chemical groups used to determine the potential impacts on the groundwater.

The ICs detected in the leak detection system (LDS) sumps include dieldrin and dichlorodifluoromethane.

There were no LDS analytical results in 2022 that required regulatory agency notification per Table 3.0-2 of the *Hazardous Waste Landfill Post-Closure Plan* (Navarro 2019a).

As a component of the data review process, the analytical data were evaluated against the data quality indicators of precision, accuracy, representativeness, completeness, and comparability (PARCC). Based on the findings of the PARCC 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 by the Army, which was investigated in accordance with 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). 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). At present, no corrective actions were identified as a result of the investigation.

1.0 INTRODUCTION

The Post-Closure Groundwater Monitoring Report for the 2022 quarterly groundwater sampling events conducted in January, August, and from late October through early November; and annual groundwater sampling event from late April through June documents the analytical results and data evaluation of the Hazardous Waste Landfill (HWL) post-closure groundwater monitoring performed at the Rocky Mountain Arsenal (RMA). 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 *Hazardous Waste Landfill Post-Closure Groundwater Monitoring Plan* (HWL PCGMP) (Navarro 2019b), the *Rocky Mountain Arsenal Sampling Quality Assurance Project Plan* (SQAPP) (Navarro 2019d), and previous annual groundwater reports.

The groundwater monitoring program defined in this document is specifically designed to monitor groundwater flow directions and groundwater quality beneath and around the HWL, and to monitor for potential releases of hazardous constituents from the HWL. Groundwater monitoring for the HWL was completed as required by the HWL PCGMP (Navarro 2019b).

2.0 GROUNDWATER MONITORING RESULTS

A summary of water level monitoring, and analytical results for the 2022 post-closure groundwater monitoring at the HWL are presented in the following sections. Also included is an evaluation of the Leachate Collection System (LCS) and Leak Detection System (LDS) wastewater analytical data.

2.1 Monitoring Well Activities

The RMA Operations and Maintenance Contractor (OMC) 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 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 OMC records.

Water quality monitoring well 25195 was repaired in June 2022. The well casing was damaged approximately 2.5 feet below the top of casing. The new top of casing was surveyed and water levels were recorded.

2.2 Water Level Monitoring

Water levels were measured in 68 wells quarterly 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. The wells used in HWL post-closure groundwater monitoring are presented in Table 2.2-1 and Figure 2.2-1.

Water level monitoring measurements are provided in Table 2.2-2. Figures 2.2-2 and 2.2-3 represent the April 2022 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 (Figure 2.2-2). 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 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 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.

Well 25122 has been noted as a dry well since monitoring began in 2002. In June 2022, a down-well video was recorded and sand within the well casing was noted at a depth of approximately 26.8 feet (top of casing). This obstruction appears to be graded silica filter pack sand that is located 4.4 feet above the top of the well screen, and its origins are unknown. Based on this observation, well 25122 will not provide reliable data to support mapping of the potentiometric surface, and it is recommended that the well be closed, removed from the monitoring network and replaced by a new well.

2.3 Analytical Results

The HWL water quality network wells and Supplemental Operational Monitoring (SOM) wells are identified in Table 2.3-1. Wells 25086 and 25088 were installed dry as noted in the HWL PCGMP (Navarro 2019b). The wells are only sampled if groundwater levels are within the well screen and adequate groundwater is available. Wells 25086 and 25088 were dry during all 2022 sampling events. The groundwater and leachate samples collected at the HWL were submitted to Applied Research and Development Laboratory (ARDL) in Mount Vernon, Illinois for analysis of the analytes listed in Table 2.3-2. Included in this table are the 16 indicator compounds (ICs) evaluated during quarterly sampling events, and the full suite of analytes evaluated during the annual sampling event.

The groundwater samples were tested for the ICs listed in Table 2.3-2. The ICs are highlighted in bold text in Table 2.3-2.

The ICs selected as part of the monitoring program include the following:

- Arsenic
- Benzene (C6H6)
- Bicycloheptadiene (BCHPD)
- Carbon tetrachloride (CCL4)
- Chloroform
- Chromium
- 1,1-dichloroethane (11DCLE)
- 1,2- dichloroethane (12DCLE)
- Dichlorodifluoromethane (CCL2F2)
- 1,1-dichloroethene (11DCE)
- Dicyclopentadiene (DCPD)
- Diisopropylmethyl phosphonate (DIMP)
- Dieldrin
- Lead
- Mercury
- 1,1,1-trichloroethane (111TCE)

The ICs detected in the HWL network wells, SOM wells and sumps are shown in Figures 2.3-1 and 2.3-2, respectively. Table 2.3-3 lists the quality control (QC) samples including field blanks and duplicates that were collected and analyzed as part of the quarterly and annual groundwater monitoring events in accordance with the SQAPP (Navarro 2019d).

The full suite of analytes detected in the HWL network wells, SOM wells, and sumps during the pre-operational, operational, closure, and post-closure monitoring periods are summarized in the Supporting Documentation folder.

2.3.1 HWL Network Wells Analytical Results

The wells sampled during the 2022 quarterly events and the annual post-closure groundwater monitoring event at the HWL include the following upgradient and downgradient wells screened in the UFS and CFS.

Upgradient		**Downgradient**	
UFS	**CFS**	**UFS**	**CFS**
25102	25034	25086	25083
25121	25101	25087	25183
		25088	25195
		25194	

Well 25194 was bailed, rather than pumped, due to slow recharge and low water volume all four quarters. During each of the four quarters, three casing volumes were removed from the well prior to sampling. During the first and fourth quarters, sampling took place over a 2-day period. During the second and third quarters, sample collection took place over a 3-day period. Wells 25086 and 25088 were dry during all sampling events in 2022. Well 25086 has been dry since monitoring began in 1996, while well 25088 has been dry most of the time, with the exception of two quarters during 2015 and 2016.

2.3.1.1 Upgradient HWL Network Wells

Upgradient monitoring well 25102 was sampled quarterly and as part of the annual sampling in May. Upgradient monitoring wells 25034, 25101, and 25121 were sampled annually in June. The following ICs were detected in the upgradient wells:

UFS

Well 25102

- Lead – 4.6 µg/L (January)
- Lead – 3.8 µg/L (May)

Well 25121

- Carbon tetrachloride – 2.1 µg/L (June)
- Chloroform – 0.179 µg/L (June)

CFS

Well 25034

- 1,1-Dichloroethene – 5.54 µg/L (June)
- Carbon tetrachloride – 0.257 µg/L (June)
- Chloroform – 0.291 µg/L (June)

Well 25101 – No detections

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 nondetection 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 (refer to Mann-Kendall analyses in the Supporting Documentation Statistical Evaluation subfolder). 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.

Additional compounds detected in upgradient wells in 2022 include the following:

- Ammonia
- Barium
- Boron
- Calcium
- Chloride
- Copper
- Fluoride
- Iron
- Kjeldahl nitrogen
- Magnesium
- Manganese
- Nitrate
- n-Nitrosodimethylamine
- Potassium
- Selenium
- Sodium
- Sulfate
- Toluene
- Zinc

2.3.1.2 Downgradient HWL Network Wells

Downgradient HWL network wells 25085, 25087, 25183, 25194, and 25195 are sampled as part of the monitoring network. Monitoring wells 25086 and 25088 continued to be dry in 2022 and were not sampled. Dieldrin and lead were the only ICs detected in the downgradient wells:

UFS

Well 25087

- Lead
  - 4.7 µg/L (April)

Well 25194

- Dieldrin
  - 0.0237 µg/L (January)
  - 0.0242 µg/L (June)
  - 0.0165µg/L (August)
  - 0.017 µg/L (October)
- Lead
  - 4.8 µg/L (April)

CFS

Well 25085

- No detections

Well 25183

- Lead
  - 8.1 µg/L (May)

Well 25195

- Lead
  - 3.1 µg/L (June)

Additional compounds detected in downgradient wells in 2022 include the following:

- alpha-Endosulfan
- Aluminum
- Ammonia
- Barium
- Boron
- Calcium
- Chloride
- Copper
- Endrin
- Fluoride
- Iron
- Isodrin
- Kjeldahl nitrogen
- Magnesium
- Manganese
- Nitrate
- Potassium
- Selenium
- Sodium
- Sulfate
- Toluene
- Vanadium
- Zinc

Of the additional compounds detected in the downgradient wells, boron, barium, calcium, chloride, copper, endrin, fluoride, iron, magnesium, nitrate, potassium, selenium, sodium, sulfate, and zinc were detected in well 25194. As discussed in Section 3.1, potential sources of dieldrin in well 25194 were investigated further in 2017 in accordance with a 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). 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).

2.3.2 Supplemental Operational Monitoring Wells Analytical Results

SOM network wells 25091, 25099, 25189, and 25203 are sampled annually. SOM wells 25098 and 25100 were dry in 2022.

The original group of SOM wells was initially installed to identify changes in water quality that may be attributable to Cell 1 and Cell 2 liner construction as part of the LCS/LDS sump systems and provide additional water quality data in the vicinity of the HWL. Due to network changes approved in DCN-GWMON-009, all the designated SOM wells with the exception of 25203 are used to monitor the North Plants-Bedrock Ridge western plume boundary and evaluate potential impacts of the plume to the HWL groundwater monitoring program. The analytical data from the SOM wells are not used in the HWL statistical evaluations.

Well 25203, located on the southwestern side of the HWL, supports monitoring the UFS in this area. Indicator compound, lead, was detected in well 25203.

The ICs detected in the SOM wells 25091, 25099, and 25189 include:

- 1,1,1-Trichloroethane
- 1,1-Dichloroethene
- 1,1-Dichloroethane
- 1,2-Dichloroethane
- Carbon tetrachloride
- Chloroform
- DIMP
- Dieldrin
- Lead

Additional compounds detected in the SOM wells 25091, 25099, and 25189 include:

- Aluminum
- Ammonia
- Barium
- Boron
- Calcium
- Chloride
- Fluoride
- Iron
- Kjeldahl nitrogen
- Magnesium
- n-Nitrosodimethylamine
- Nitrate
- Selenium
- Sodium
- Sulfate
- Zinc

Additional compounds detected in SOM well 25203 include:

- alpha-Endosulfan
- Aluminum
- Ammonia
- Barium
- Boron
- Calcium
- Chloride
- Copper
- Fluoride
- Iron
- Kjeldahl nitrogen
- Magnesium
- Nitrate
- Selenium
- Sodium
- Sulfate
- Zinc

2.3.3 HWL LCS and LDS Sumps Analytical Results

Per the HWL PCGMP (Navarro 2019b) sump sampling shall be performed prior to removal of wastewater from an HWL sump. Wastewater removal may be triggered by a high sump level or other wastewater management considerations.

The samples were collected from the LDS 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 2022 sampling events at the LCS and LDS sumps are included in the Supporting Documentation Investigative Data subfolder.

2.3.3.1 LCS Sumps

The ICs detected in the HWL LCS sumps in 2021 include benzene, dichlorodifluoromethane, dicyclopentadiene, dieldrin, DIMP, and lead.

The LCS analytical results are not used in the prediction limit calculations. The concentrations of ICs detected in the LCS sumps are consistent with wastes placed in the landfills, and the chemical groups used to determine potential groundwater impacts.

2.3.3.2 LDS Sumps

It is common for analytes to be detected in HWL LDS sump samples. 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. The soil used to construct the compacted clay liners of the HWL contained low levels of RMA contaminants that only became detectable after they were mobilized in water and analyzed using methods with much lower method reporting limits (MRL) than what can be achieved in soil sample analyses.

The ICs detected in the HWL LDS sumps include dieldrin and dichlorodifluoromethane. The concentrations of ICs detected in the LDS sumps included:

LDS1

No detections

LDS2

Water levels were not high enough in 2022 to initiate sampling.

LDS3

- Dieldrin
  - 0.0263 µg/L (April)
- Dichlorodifluoromethane
  - 1.22 µg/L (April)

LDS4

Water levels were not high enough in 2022 to initiate sampling.

Additional compounds detected in the LDS HWL sumps include the following:

- alpha-Endosulfan
- Barium
- Boron
- Bromide
- Calcium
- Chloride
- Copper
- Dichlorodiphenyl dichloroethane (PPDDD)
- Endrin
- Endrin ketone
- Fluoride
- gamma-Chlordane
- Heptachlor epoxide
- Kjeldahl nitrogen
- Magnesium
- Manganese
- Nickel
- Potassium
- Sodium
- Sulfate
- Zinc

There were no LDS analytical results in 2022 that required regulatory agency notification per Table 3.0-2 of the *Hazardous Waste Landfill Post-Closure Plan* (Navarro 2019a).

2.4 Analytical Data Review

The objective of the data review process 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 Precision, Accuracy, Representativeness, Completeness, and Comparability (PARCC). These five parameters are identified in the SQAPP (Navarro 2019d) as important data quality indicators. The RMA OMC reviewed the PARCC parameters with respect to the data QC goals stated in the SQAPP (Navarro 2019d).

The sample results were evaluated against the data quality requirements and compared to the data quality objectives as presented in the HWL PCGMP (Navarro 2019b) and SQAPP (Navarro 2019d). Data review and verification activities were conducted in accordance with the SQAPP (Navarro 2019d). The evaluation limits discussed below are internal OMC limits based on historical data, and independent of evaluations performed by the laboratory. The results of these evaluations are described below.

The OMC conducted data validation 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 goal. No data were flagged as rejected in 2022.

2.4.1 Precision

Precision is the measure of mutual agreement among measurements. Field precision was evaluated by collection and analysis of duplicate samples using the same analytical methods as investigative samples. Precision was evaluated quantitatively by measuring the variability, in terms of relative percent difference (RPD), between the pairs of results for the investigative and duplicate samples. The RPD values provide a relative measure of precision; lower RPD values indicate better precision between the results. Relative percent difference values less than or equal to 35 percent are considered acceptable. The RPD for a duplicate investigative sample pair is calculated using the following steps:

- Identify the field and laboratory duplicate investigative sample pair results.
- Identify parameters detected in both results for the pair identified in Step 1.
    - Calculate the RPD value for the detected parameters identified in Step 2 using the following equation:

$$RPD = \frac{|x - y|}{\frac{(x + y)}{2}} \times 100$$

where:

x = Investigative sample result
y = Duplicate sample result

The duplicate/investigative pairs are evaluated for comparability. The RPD upper evaluation limit is 35 percent for all analytes. The investigative and duplicate results will be considered comparable if any of the following statements are true:

- If both sample results are less than the MRL
- If both sample results are greater than the MRL; but less than or equal to twice the MRL
- If both sample results are greater than twice the MRL and the RPD is less than or equal to the specified upper RPD limit
- If both sample results are greater than the MRL; one result is less than or equal to twice the MRL; one result is greater than twice the MRL; and the RPD is less than or equal to the specified upper limit
    - If one sample result is less than the MRL; and one result is greater than the MRL and less than or equal to twice the MRL

The investigative and duplicate results will be considered not comparable if any of the following statements are true:

- If both sample results are greater than twice the MRL and the RPD is greater than the specified upper RPD limit
- If both sample results are greater than the MRL; one result is less than or equal to twice the MRL; one result is greater than twice the MRL; and the RPD is greater than the specified upper limit

- If one sample result is less than the MRL; and one result is greater than twice the MRL

A total of 298 duplicate pair analyses of HWL target analytes were performed. Duplicate and investigative results are considered comparable in 295 cases and not comparable in 3 cases. The RPD values for duplicate pairs identified as comparable and not comparable are provided in Excel files within the Supporting Documentation folder. The non-comparable investigative and duplicate data will be assigned a "Z" data qualifier with the comment "Duplicate and investigative values are not comparable." The data are considered acceptable for their intended use and no additional action in addition to the data qualification is considered necessary.

2.4.2 Accuracy/Bias

Accuracy is the degree of agreement between an observed value (sample result) and an accepted reference value. Bias is the systematic or persistent distortion of a measurement process that causes errors in one direction (high or low). The terms accuracy and bias are used interchangeably. Accuracy/bias is indicated by percent recovery calculated from laboratory spike data using the following formula:

$$Recovery\ Rate\ (\%) = \frac{Measured\ Value}{True\ Value} \times 100$$

where:

Measured value = Value after the spike minus the value before the spike
True value = Value of the spike added

Accuracy/bias will be calculated based on results of laboratory control spikes and matrix spikes (MS). Laboratory control spikes utilize laboratory grade water with some additions of inorganic constituents to mimic RMA water. Matrix spikes utilize RMA water to account for matrix-related interferences.

The calculated recovery rate is compared to the lower and upper recovery rate limits specific to each analyte based on historical data. The 25^{th} and 75^{th} percentiles for each analyte are calculated. The interquartile range (IQR) is calculated by subtracting the 25^{th} percentile value from the 75^{th} percentile value. The lower and upper recovery warning limits for each analyte are determined by subtracting and adding 1.5 times the IQR to the 25^{th} and 75^{th} percentile values, respectively. The lower and upper recovery control limits are determined by subtracting and adding three times the IQR to the 25^{th} and 75^{th} percentile values, respectively. Data will not be qualified solely on a recovery rate outside the calculated recovery limits. Additional factors must be present to justify the data qualification. The historical spike recoveries used for the calculation of recovery evaluation limits for matrix spikes and laboratory control spikes are included in the Supporting Documentation folder.

The data utilized for the recovery rate calculations are limited to the spike values for the analytical lots of the investigative data included in the Supporting Documentation folder. Matrix spike values exceeding four times the spiked amount are excluded from the calculation since the MS could possibly be diluted out due to the high original concentration. Analyses with an

ampersand (@) flag code (i.e., value is estimated) or "B" flag code (i.e., analyte found in the method blank or QC blank as well as the sample) were also excluded from recovery rate calculations. The spike recoveries used in the calculations are also included in the Supporting Documentation folder.

The average recovery rate for the 1,355 MS analyses was 87.8 percent. Recovery rates outside the lower or upper warning limits were observed in 52 analyses. Recovery rates outside the lower or upper control limits were observed in 10 analyses. A listing of the MS sample results outside the evaluation limits is included in the Supporting Documentation folder.

The average recovery rate for the 1,355 corresponding laboratory control spike analyses was 96.5 percent. Recovery rates outside the lower or upper warning limits were observed in 48 analyses. Recovery rates outside the lower or upper control limits were observed in four analyses. The laboratory control spike sample results outside the warning or control limits are included in the Supporting Documentation folder.

Laboratory control spike and MS recoveries outside the designated warning limits in both instances were observed in four analyses, while laboratory control spike and MS recoveries outside the designated control limits in both instances were not observed. No issues were identified requiring data qualification. Charts including the evaluation limits and spike recoveries for the HWL are included in the Supporting Documentation folder.

2.4.3 Representativeness

Representativeness refers to the selection and implementation of analytical methods, sampling protocols, and sample locations to ensure the analytical data results are representative of the media being sampled (e.g., water, soil, etc.) and the conditions being measured. Representativeness is evaluated by reviewing monitoring program design and implementation, as well as field and laboratory blank samples. Design of the monitoring program is reviewed qualitatively to assess whether the objectives were satisfied. Implementation of the monitoring program is reviewed qualitatively to evaluate whether the planned procedures were followed. A quantitative review of the quality QC blank results indicates whether influences outside the measurement systems have affected the analyses and interpretation of the media and conditions.

Sample locations, sampling frequency, and sample collection procedures applied during groundwater monitoring are described in the HWL PCGMP (Navarro 2019b). The program is designed to provide water quality data in the area of the landfill and implemented as defined in the PCGMP. Thus, the data are judged representative of the water quality characteristics for the program.

Field blanks are collected and analyzed to evaluate possible cross contamination of the investigative samples. Rinse blanks are not required since dedicated equipment is used to sample the wells and sumps. The number of QC samples collected, and QC results evaluated for qualification are included in Table 2.3-3 and are also provided in the Supporting Documentation folder.

A total of 81 field blank analyses were performed. There were no field blank analyses above the MRL. No qualification of the data is required.

In addition, 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 1,573 method blank analyses in 2022 with one detection above the MRL. Data qualification is not necessary as the associated investigative data is below the MRL.

2.4.4 Completeness

Completeness is the amount of valid data obtained from a measurement system compared to the amount that were expected and needed to meet the project goals. Valid analytical data are those data that have been identified as usable and included in the Rocky Mountain Arsenal Environmental Database (RMAED). The SQAPP (Navarro 2019d) sets the completeness goal for the sampling program at 90 percent.

In 2022, there were no rejected data. The analytical results of monitoring are representative of the groundwater quality with the exception of qualified data. Rejected data are not removed from the RMAED; however, they are not used to evaluate the HWL groundwater data. Data qualified as "@" are not filtered out of the database. While not rejected, these qualified data are considered estimated due to the concentration being above the linear range of the instrument.

Completeness was calculated at 100 percent. The completeness goal of 90 percent was achieved. All results were determined to be acceptable by the laboratory.

2.4.5 Comparability

Comparability is the confidence with which one data set can be evaluated relative to another. Standard sampling and analysis techniques, based on certified analytical methods approved by the OMC 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.

2.4.6 Summary

The purpose of the PARCC evaluation is to evaluate whether the data are usable and adequate to properly characterize the water quality conditions present at the site. Based on the findings of the PARCC evaluation, the sample results are considered valid and usable for their intended purpose. Qualified data are not rejected but should be appropriately considered when used. 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.

2.4.7 Data Usability Evaluation

A data usability evaluation was conducted on 2,147 records. The evaluation identified eight statistical outliers. The data are considered acceptable for their intended use and no additional action is considered necessary.

The Mann-Kendall test for trends identified 94 decreasing analyte trends and 93 increasing analyte trends. A listing of the identified outliers and trends is included on the attached data CD in the Supporting Documentation HWL 2022 Data Usability subfolder (HWL Data_Usability_Summary_FY22.xlsx).

The evaluation did not positively identify data quality issues; thus, the data are considered to be of acceptable quality and meets or exceeds the established data quality objectives. The data are of the correct type, quality, and quantity to support the intended use.

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 2021 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).

The MRLs can change based on the analytical method re-certification every three years as required by the SQAPP. In January 2022, the MRLs for 11DCE, BCHPD, DCPD and DIMP were revised, and the current MRLs are reflected in Table 3.0-3.

ChemStat statistical analysis software (StarPoint Software 2016) is utilized to calculate the prediction limit values, and statistical software output is available in the Supporting Documentation folder. The prediction limit values for 2023 are included in Table 3.0-3. If a compound is not detected in any sample, the non-parametric prediction limit for the 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.

3.1 2022 Prediction Limits and the Current HWL Water Quality Data

Table 3.0-2 presents the 2022 prediction limits that were calculated from upgradient well data collected during the pre-operational, operational, closure, and post-closure groundwater monitoring periods (1996-2021).

The downgradient results from the water quality sampling completed during the 2022 post-closure groundwater monitoring period were compared with the prediction limits presented in Table 3.0-2 to determine if groundwater quality was impacted by the HWL in 2021.

Dieldrin and lead were the only ICs detected in the downgradient wells. Lead was detected in UFS wells 25087 and 25194 at concentrations of 4.7 and 4.8 µg/L, respectively. Lead was detected in two of the three CFS wells at concentrations ranging from 3.1 to 8.1 µg/L. The lead detections did not exceed the 2022 prediction limit (15 µg/L). Dieldrin was detected at concentrations ranging from 0.0165 to 0.0242 µg/L in downgradient well 25194. Dieldrin concentrations in well 25194 did not exceed the 2022 prediction limit of 0.05 µg/L.

Further evaluation of dieldrin included an intrawell comparison performed using a combined Shewhart-CUSUM control chart to determine whether the HWL impacted the presence of dieldrin in groundwater at well 25194. The plotted data were collected quarterly from July 2011 through October 2022, 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 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 calculated the CUSUM has generally been decreasing since December 2017.

Interpretation of the current control chart shows an apparent decreasing trend, as is also evident in measured concentrations and the calculated CUSUM, which is less than the control limit (Figure 3.1-1). Fluctuations in dieldrin concentrations may indicate seasonal variability related to the water level changes. Additionally, the 2022 dieldrin concentrations in well 25194 are lower than those measured in LDS3 during the post-closure period, which is the nearest LDS sump to well 25194, indicating that the sump is not a likely source of groundwater contamination in this well.

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 PCGMP as another method to evaluate groundwater data in the HWL monitoring wells in addition to the use of prediction limits.

The HWL PCP also provides for the use of trend analysis to evaluate groundwater quality. Further evaluation of dieldrin concentrations using Mann-Kendall trend analysis shows that for data collected from 2013 through 2022, dieldrin concentrations have exhibited a decreasing trend. Supporting documentation related to the Mann-Kendall trend analysis is provided in the Supporting Documentation folder.

The source of dieldrin in well 25194 was evaluated in accordance with 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.

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 2023 Prediction Limits and the Future HWL Water Quality Data

Table 3.0-3 presents the upper prediction limits that will be applied to downgradient wells 25085, 25087, 25183, 25194, and 25195 for the 2023 sampling events. The MRLs can change based on the method re-certification required every three years by the SQAPP. The MRLs for 11DCE, BCHPD, DCPD and DIMP were revised in January 2022. The prediction limits calculated for 2023 were minimally affected by MRL change as presented in Table 3.0-3.

4.0 SUMMARY

The following summary is based on the groundwater and wastewater monitoring results for the 2021 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 PARCC evaluation, the analytical data collected are of acceptable quality for intended uses.
- 1,1-Dichloroethene, carbon tetrachloride, chloroform and lead were detected in the upgradient wells.
- Dieldrin and lead were the only ICs detected in the downgradient wells. Fluctuations in the concentrations of dieldrin in groundwater may indicate seasonal variability related to the water level changes.
- Statistical evaluations indicated that no detected ICs exceeded their respective prediction limits.

- The LCS sample results indicate that the ICs used in the statistical evaluations for the HWL are appropriate for the types of contaminants present in the HWL leachate. The ICs detected in the LCS are representative of the waste placed in the HWL.
- The ICs detected in 2022 in the HWL LDS sumps include dieldrin and dichlorodifluoromethane.
- The combined Shewhart-CUSUM control chart for dieldrin showed concentrations did not exceed the control limit or the upper prediction limit, and the calculated CUSUM did not exceed the control limit, thus supporting the general downward trend in dieldrin concentrations. Based on statistical trend analysis for dieldrin using the Mann-Kendall test, dieldrin concentrations also show a decreasing trend since 2013.
- Prediction limit values for all ICs were re-evaluated for 2023. 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.

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.)

2019a *Hazardous Waste Landfill, Post Closure Plan*, Revision 4. December 9, 2019.

2019b *Hazardous Waste Landfill, Post-Closure Groundwater Monitoring Plan.* Revision 4. December 9, 2019.

2019c *Hazardous Waste Landfill Groundwater Monitoring Wells 25194 and 25184 Subsurface Soil and Landfill Stormwater Runoff Data Summary Report*. Revision 0. November 18, 2019.

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

2016 *Hazardous Waste Landfill Groundwater Monitoring Wells 25194 and 25184 Subsurface Soil and Landfill Stormwater Runoff Sampling and Analysis Plan*. Revision 0. November 17, 2016.

Starpoint Software, Inc. (Starpoint Software)

2016 ChemStat Statistical Analysis Software for Environmental Data. Version 6.4, July 2016.

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. April 1, 2004.

TABLES

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Table 2.2-1. HWL Water Level Monitoring Network

Well ID	Aquifer	Top of Casing Elevation (feet amsl)	Bottom of Screen Elevation (feet amsl)
Unconfined Flow System			
25003	Alluvial	5194.26	5151.60
25041	Alluvial	5210.81	5179.61
25048	Alluvial	5190.01	5150.20
25054	Alluvial	5207.94	5168.10
26178	Alluvial	5214.73	5181.56
26182	Alluvial	5217.22	5174.27
26184	Alluvial	5214.94	5173.84
25018	Alluvial/Denver Formation	5195.61	5148.30
25059	Alluvial/Denver Formation	5208.97	5162.97
25184[1]	Alluvial/Denver Formation	5206.83	5179.24
25189	Alluvial/Denver Formation	5202.30	5141.30
25194	Alluvial/Denver Formation	5215.60	5179.40
25203	Alluvial/Denver Formation	5236.10	5176.10
25004	Denver Formation	5264.96	5183.20
25015	Denver Formation	5197.23	5154.50
25022	Denver Formation	5263.66	5211.70
25023	Denver Formation	5265.08	5197.40
25027	Denver Formation	5224.84	5179.00
25032	Denver Formation	5254.89	5220.20
25086	Denver Formation	5212.53	5183.14
25087	Denver Formation	5209.75	5141.37
25088	Denver Formation	5209.61	5190.87
25091	Denver Formation	5217.43	5132.51
25092	Denver Formation	5246.11	5179.49
25098	Denver Formation	5212.80	5184.34
25099	Denver Formation	5212.40	5139.73
25100	Denver Formation	5216.99	5185.87
25102	Denver Formation	5243.61	5171.62
25105	Denver Formation	5255.46	5204.69
25106	Denver Formation	5261.43	5188.97
25120	Denver Formation	5237.95	5177.80
25121	Denver Formation	5251.67	5179.06
25122	Denver Formation	5260.58	5219.37
25500	Denver Formation	5258.74	5201.09
25502	Denver Formation	5223.60	5169.10

Table 2.2-1. HWL Water Level Monitoring Network

Well ID	Aquifer	Top of Casing Elevation (feet amsl)	Bottom of Screen Elevation (feet amsl)
26040	Denver Formation	5197.40	5146.40
26051	Denver Formation	5218.60	5158.30
26073	Denver Formation	5225.41	5173.05
26097	Denver Formation	5242.25	5172.70
26099	Denver Formation	5232.31	5232.70
26158	Denver Formation	5214.88	5160.30
26159	Denver Formation	5233.75	5188.00
26164	Denver Formation	5189.26	5136.70
26170	Denver Formation	5184.02	5133.90
26175	Denver Formation	5206.29	5145.43
26176	Denver Formation	5206.02	5159.89
26177	Denver Formation	5214.92	5153.10
26179	Denver Formation	5224.89	5156.24
26180	Denver Formation	5224.57	5170.86
26181	Denver Formation	5217.82	5161.29
26183	Denver Formation	5214.81	5157.29
26186	Denver Formation	5207.79	5140.58
36186	Denver Formation	5286.23	5122.70
Confined Flow System			
25016	Denver Formation	5198.31	5132.10
25017	Denver Formation	5197.67	5117.40
25019	Denver Formation	5193.85	5109.73
25020	Denver Formation	5195.25	5040.27
25021	Denver Formation	5240.10	5111.50
25024	Denver Formation	5265.04	5165.20
25034	Denver Formation	5255.60	5130.60
25085	Denver Formation	5212.91	5134.48
25093	Denver Formation	5245.76	5123.03
25101	Denver Formation	5251.19	5124.83
25123	Denver Formation	5259.86	5123.34
25183	Denver Formation	5206.80	5147.30
25195	Denver Formation	5215.50	5134.50
26150	Denver Formation	5220.96	5111.90
26185	Denver Formation	5208.53	5115.64

Notes: [1]Well 25184 installed per OCN-HWL-2017-001. amsl – above mean sea level

Table 2.2-2. 2022 Water Level Measurements Summary

Well ID	Date	Depth to Water (feet amsl)	Top of Casing Elevation (feet amsl)	Water Level Elevation (feet amsl)
Unconfined Flow System				
25003	1/10/2022	41.75	5194.26	5152.51
25003	4/26/2022	41.78	5194.26	5152.48
25003	8/2/2022	41.84	5194.26	5152.42
25003	10/31/2022	41.84	5194.26	5152.42
25004	1/10/2022	47.03	5264.96	5217.93
25004	4/26/2022	47.03	5264.96	5217.93
25004	8/2/2022	47.22	5264.96	5217.74
25004	10/31/2022	47.41	5264.96	5217.55
25015	1/10/2022	37.99	5197.23	5159.24
25015	4/26/2022	37.72	5197.23	5159.51
25015	8/2/2022	37.81	5197.23	5159.42
25015	10/31/2022	37.84	5197.23	5159.39
25018	1/10/2022	31.59	5195.61	5164.02
25018	4/26/2022	31.32	5195.61	5164.29
25018	8/2/2022	31.50	5195.61	5164.11
25018	10/31/2022	31.76	5195.61	5163.85
25022	1/10/2022	43.68	5263.66	5219.98
25022	4/26/2022	43.61	5263.66	5220.05
25022	8/2/2022	43.72	5263.66	5219.94
25022	10/31/2022	43.83	5263.66	5219.83
25023	1/10/2022	46.75	5265.08	5218.33
25023	4/26/2022	46.44	5265.08	5218.64
25023	8/2/2022	46.48	5265.08	5218.60
25023	10/31/2022	46.57	5265.08	5218.51
25027	1/10/2022	44.30	5224.84	5180.54
25027	4/26/2022	44.32	5224.84	5180.52
25027	8/2/2022	43.37	5224.84	5181.47
25027	10/25/2022	44.44	5224.84	5180.40
25032	1/10/2022	28.34	5254.89	DRY
25032	4/26/2022	28.35	5254.89	DRY
25032	8/2/2022	28.35	5254.89	DRY
25032	10/25/2022	28.34	5254.89	DRY
25041	1/10/2022	26.30	5210.81	5184.51
25041	4/26/2022	26.09	5210.81	5184.72
25041	8/2/2022	26.34	5210.81	5184.47
25041	10/31/2022	26.55	5210.81	5184.26
25048	1/10/2022	18.57	5190.01	5171.44
25048	4/26/2022	18.31	5190.01	5171.70
25048	8/2/2022	18.51	5190.01	5171.50
25048	10/31/2022	18.78	5190.01	5171.23
25054	1/10/2022	34.13	5207.94	5173.81
25054	4/26/2022	33.93	5207.94	5174.01

Table 2.2-2. 2022 Water Level Measurements Summary

Well ID	Date	Depth to Water (feet amsl)	Top of Casing Elevation (feet amsl)	Water Level Elevation (feet amsl)
25054	8/2/2022	34.02	5207.94	5173.92
25054	10/31/2022	34.24	5207.94	5173.70
25059	1/10/2022	30.56	5208.97	5178.41
25059	4/26/2022	30.34	5208.97	5178.63
25059	8/2/2022	30.53	5208.97	5178.44
25059	10/31/2022	30.74	5208.97	5178.23
25086	1/10/2022	29.72	5212.53	DRY
25086	4/26/2022	29.72	5212.53	DRY
25086	8/2/2022	29.73	5212.53	DRY
25086	10/25/2022	29.73	5212.53	DRY
25087	1/10/2022	44.14	5209.75	5165.61
25087	4/26/2022	43.80	5209.75	5165.95
25087	8/2/2022	43.72	5209.75	5166.03
25087	10/25/2022	44.00	5209.75	5165.75
25088	1/10/2022	19.29	5209.61	DRY
25088	4/26/2022	19.35	5209.61	DRY
25088	8/2/2022	19.38	5209.61	DRY
25088	10/25/2022	19.36	5209.61	DRY
25091	1/10/2022	48.06	5217.43	5169.37
25091	4/26/2022	47.80	5217.43	5169.63
25091	8/2/2022	47.60	5217.43	5169.83
25091	10/25/2022	47.97	5217.43	5169.46
25092	1/10/2022	65.50	5246.11	5180.61
25092	4/26/2022	65.31	5246.11	5180.80
25092	8/2/2022	65.29	5246.11	5180.82
25092	10/25/2022	65.51	5246.11	5180.60
25098	1/10/2022	28.84	5212.80	DRY
25098	4/26/2022	28.86	5212.80	DRY
25098	8/2/2022	29.19	5212.80	DRY
25098	10/25/2022	29.19	5212.80	DRY
25099	1/10/2022	44.08	5212.40	5168.32
25099	4/26/2022	43.79	5212.40	5168.61
25099	8/2/2022	43.28	5212.40	5169.12
25099	10/25/2022	43.95	5212.40	5168.45
25100	1/10/2022	31.32	5216.99	DRY
25100	4/26/2022	31.32	5216.99	DRY
25100	8/2/2022	31.70	5216.99	DRY
25100	10/25/2022	31.71	5216.99	DRY
25102	1/10/2022	63.22	5243.61	5180.39
25102	4/26/2022	63.00	5243.61	5180.61
25102	8/2/2022	60.78	5243.61	5182.83
25102	10/25/2022	63.29	5243.61	5180.32
25105	1/10/2022	38.42	5255.46	5217.04

Table 2.2-2. 2022 Water Level Measurements Summary

Well ID	Date	Depth to Water (feet amsl)	Top of Casing Elevation (feet amsl)	Water Level Elevation (feet amsl)
25105	4/26/2022	38.04	5255.46	5217.42
25105	8/2/2022	37.98	5255.46	5217.48
25105	10/31/2022	38.08	5255.46	5217.38
25106	1/10/2022	56.68	5261.43	5204.75
25106	4/26/2022	56.29	5261.43	5205.14
25106	8/2/2022	56.21	5261.43	5205.22
25106	10/31/2022	56.19	5261.43	5205.24
25120	1/10/2022	48.54	5237.95	5189.41
25120	4/26/2022	48.65	5237.95	5189.30
25120	8/2/2022	48.94	5237.95	5189.01
25120	10/25/2022	49.25	5237.95	5188.70
25121	1/10/2022	71.62	5251.67	5180.05
25121	4/26/2022	71.29	5251.67	5180.38
25121	8/2/2022	71.13	5251.67	5180.54
25121	10/25/2022	71.49	5251.67	5180.18
25122	1/10/2022	Water not encountered at depth due to obstruction in well comprised of sand filter pack	5260.58	—
25122	4/26/2022		5260.58	—
25122	8/2/2022		5260.58	—
25122	10/25/2022		5260.58	—
25189	1/10/2022	35.75	5202.30	5166.55
25189	4/26/2022	35.65	5202.30	5166.65
25189	8/2/2022	35.49	5202.30	5166.81
25189	10/31/2022	35.81	5202.30	5166.49
25194	1/10/2022	34.55	5215.60	5181.05
25194	4/26/2022	34.67	5215.60	5180.93
25194	8/2/2022	34.75	5215.60	5180.85
25194	10/25/2022	34.74	5215.60	5180.86
25203	1/10/2022	55.67	5236.10	5180.43
25203	4/26/2022	55.69	5236.10	5180.41
25203	8/2/2022	55.78	5236.10	5180.32
25203	10/25/2022	55.82	5236.10	5180.28
25500	1/10/2022	40.80	5258.74	5217.94
25500	4/26/2022	40.88	5258.74	5217.86
25500	8/3/2022	41.15	5258.74	5217.59
25500	10/31/2022	41.23	5258.74	5217.51
25502	1/10/2022	39.06	5223.60	5184.54
25502	4/26/2022	38.89	5223.60	5184.71
25502	8/2/2022	39.00	5223.60	5184.60
25502	10/31/2022	39.20	5223.60	5184.40
26040	1/11/2022	49.93	5197.40	5147.47
26040	4/25/2022	50.02	5197.40	5147.38
26040	8/2/2022	50.01	5197.40	5147.39
26040	10/31/2022	49.98	5197.40	5147.42

Table 2.2-2. 2022 Water Level Measurements Summary

Well ID	Date	Depth to Water (feet amsl)	Top of Casing Elevation (feet amsl)	Water Level Elevation (feet amsl)
26051	1/10/2022	56.02	5218.60	5162.58
26051	4/25/2022	56.15	5218.60	5162.45
26051	8/2/2022	56.17	5218.60	5162.43
26051	10/31/2022	56.31	5218.60	5162.29
26073	1/10/2022	47.68	5225.41	5177.73
26073	4/25/2022	47.74	5225.41	5177.67
26073	8/3/2022	47.71	5225.41	5177.70
26073	10/31/2022	47.74	5225.41	5177.67
26097	1/10/2022	57.83	5242.25	5184.42
26097	4/25/2022	57.84	5242.25	5184.41
26097	8/3/2022	57.82	5242.25	5184.43
26097	10/31/2022	57.87	5242.25	5184.38
26099	1/10/2022	50.09	5232.31	5182.22
26099	4/25/2022	50.18	5232.31	5182.13
26099	8/2/2022	50.06	5232.31	5182.25
26099	10/25/2022	50.35	5232.31	5181.96
26158	1/10/2022	35.30	5214.88	5179.58
26158	4/25/2022	35.40	5214.88	5179.48
26158	8/3/2022	35.28	5214.88	5179.60
26158	10/31/2022	35.32	5214.88	5179.56
26159	1/10/2022	31.16	5233.75	5202.59
26159	4/25/2022	31.31	5233.75	5202.44
26159	8/3/2022	31.45	5233.75	5202.30
26159	10/31/2022	31.30	5233.75	5202.45
26164	1/10/2022	44.90	5189.26	5144.36
26164	4/25/2022	44.94	5189.26	5144.32
26164	8/2/2022	44.96	5189.26	5144.30
26164	10/31/2022	44.98	5189.26	5144.28
26170	1/10/2022	44.15	5184.02	5139.87
26170	4/25/2022	44.22	5184.02	5139.80
26170	8/2/2022	44.25	5184.02	5139.77
26170	10/31/2022	44.30	5184.02	5139.72
26175	1/10/2022	49.50	5206.29	5156.79
26175	4/25/2022	49.52	5206.29	5156.77
26175	8/2/2022	49.29	5206.29	5157.00
26175	10/31/2022	49.48	5206.29	5156.81
26176	1/10/2022	47.28	5206.02	DRY
26176	4/25/2022	47.40	5206.02	DRY
26176	8/2/2022	47.40	5206.02	DRY
26176	10/31/2022	47.30	5206.02	DRY
26177	1/10/2022	56.37	5214.92	5158.55
26177	4/25/2022	56.58	5214.92	5158.34
26177	8/2/2022	56.22	5214.92	DRY

Table 2.2-2. 2022 Water Level Measurements Summary

Well ID	Date	Depth to Water (feet amsl)	Top of Casing Elevation (feet amsl)	Water Level Elevation (feet amsl)
26177	10/31/2022	56.69	5214.92	5158.23
26178	1/10/2022	34.31	5214.73	DRY
26178	4/25/2022	34.35	5214.73	DRY
26178	8/2/2022	34.41	5214.73	DRY
26178	10/31/2022	34.36	5214.73	DRY
26179	1/10/2022	56.75	5224.89	5168.14
26179	4/25/2022	56.62	5224.89	5168.27
26179	8/2/2022	56.19	5224.89	5168.70
26179	10/31/2022	56.49	5224.89	5168.40
26180	1/10/2022	46.85	5224.57	5177.72
26180	4/25/2022	46.94	5224.57	5177.63
26180	8/2/2022	46.88	5224.57	5177.69
26180	10/31/2022	47.03	5224.57	5177.54
26181	1/10/2022	50.65	5217.82	5167.17
26181	4/25/2022	50.60	5217.82	5167.22
26181	8/2/2022	49.38	5217.82	5168.44
26181	10/31/2022	50.65	5217.82	5167.17
26182	1/10/2022	40.93	5217.22	5176.29
26182	4/25/2022	41.01	5217.22	5176.21
26182	8/2/2022	40.99	5217.22	5176.23
26182	10/31/2022	41.06	5217.22	5176.16
26183	1/10/2022	49.05	5214.81	5165.76
26183	4/25/2022	49.12	5214.81	5165.69
26183	8/2/2022	48.44	5214.81	5166.37
26183	10/31/2022	49.30	5214.81	5165.51
26184	1/10/2022	42.45	5214.94	DRY
26184	4/25/2022	42.48	5214.94	DRY
26184	8/2/2022	42.49	5214.94	DRY
26184	10/31/2022	42.48	5214.94	DRY
26186	1/10/2022	43.41	5207.79	5164.38
26186	4/25/2022	43.50	5207.79	5164.29
26186	8/2/2022	43.40	5207.79	5164.39
26186	10/31/2022	43.61	5207.79	5164.18
36186	3/31/2022	48.41	5286.23	5237.82
36186	4/26/2022	48.42	5286.23	5237.81
36186	8/2/2022	49.65	5286.23	5236.58
36186	10/31/2022	50.16	5286.23	5236.07
Confined Flow System				
25016	1/10/2022	45.03	5198.31	5153.28
25016	4/26/2022	44.95	5198.31	5153.36
25016	8/2/2022	45.02	5198.31	5153.29
25016	10/31/2022	45.09	5198.31	5153.22
25017	1/10/2022	43.24	5197.67	5154.43

Table 2.2-2. 2022 Water Level Measurements Summary

Well ID	Date	Depth to Water (feet amsl)	Top of Casing Elevation (feet amsl)	Water Level Elevation (feet amsl)
25017	4/26/2022	43.11	5197.67	5154.56
25017	8/2/2022	43.18	5197.67	5154.49
25017	10/31/2022	43.28	5197.67	5154.39
25019	1/10/2022	31.76	5193.85	5162.09
25019	4/26/2022	31.67	5193.85	5162.18
25019	8/2/2022	31.66	5193.85	5162.19
25019	10/31/2022	31.77	5193.85	5162.08
25020	1/10/2022	47.17	5195.25	5148.08
25020	4/26/2022	46.79	5195.25	5148.46
25020	8/2/2022	46.93	5195.25	5148.32
25020	10/31/2022	47.15	5195.25	5148.10
25021	1/10/2022	66.06	5240.10	5174.04
25021	4/26/2022	66.01	5240.10	5174.09
25021	8/4/2022	66.10	5240.10	5174.00
25021	10/31/2022	66.13	5240.10	5173.97
25024	1/10/2022	62.78	5265.04	5202.26
25024	4/26/2022	63.18	5265.04	5201.86
25024	8/2/2022	62.39	5265.04	5202.65
25024	10/31/2022	62.75	5265.04	5202.29
25034	1/10/2022	83.54	5255.60	5172.06
25034	4/26/2022	83.09	5255.60	5172.51
25034	8/2/2022	82.79	5255.60	5172.81
25034	10/25/2022	83.14	5255.60	5172.46
25085	1/10/2022	48.78	5212.91	5164.13
25085	4/26/2022	48.63	5212.91	5164.28
25085	8/2/2022	48.45	5212.91	5164.46
25085	10/25/2022	48.71	5212.91	5164.20
25093	1/10/2022	75.01	5245.76	5170.75
25093	4/26/2022	74.63	5245.76	5171.13
25093	8/2/2022	74.48	5245.76	5171.28
25093	10/25/2022	74.62	5245.76	5171.14
25101	1/10/2022	77.91	5251.19	5173.28
25101	4/26/2022	77.69	5251.19	5173.50
25101	8/2/2022	77.58	5251.19	5173.61
25101	10/25/2022	77.67	5251.19	5173.52
25123	1/10/2022	84.60	5259.86	5175.26
25123	4/26/2022	84.51	5259.86	5175.35
25123	8/2/2022	84.56	5259.86	5175.30
25123	10/25/2022	84.63	5259.86	5175.23
25183	1/10/2022	43.20	5206.80	5163.60
25183	4/26/2022	43.16	5206.80	5163.64
25183	8/2/2022	43.07	5206.80	5163.73
25183	10/25/2022	43.24	5206.80	5163.56

Table 2.2-2. 2022 Water Level Measurements Summary

Well ID	Date	Depth to Water (feet amsl)	Top of Casing Elevation (feet amsl)	Water Level Elevation (feet amsl)
25195	1/10/2022	50.08	5215.50	5165.42
25195	4/26/2022	50.21	5215.50	5165.29
25195	8/2/2022	50.12	5215.50	5165.38
25195	10/25/2022	50.26	5215.50	5165.24
26150	1/10/2022	49.63	5220.96	5171.33
26150	4/25/2022	49.80	5220.96	5171.16
26150	8/3/2022	49.72	5220.96	5171.24
26150	10/31/2022	49.84	5220.96	5171.12
26185	1/10/2022	56.85	5208.53	5151.68
26185	4/25/2022	56.89	5208.53	5151.64
26185	8/2/2022	57.00	5208.53	5151.53
26185	10/31/2022	57.11	5208.53	5151.42

Notes:

amsl – above mean sea level

Table 2.3-1. HWL Water Quality Monitoring Networks

Well Network	Well Number	Groundwater Flow System	Aquifer	Upgradient/ Downgradient
HWL	25034	Confined	Denver Formation	Upgradient
HWL	25183	Confined	Denver Formation	Downgradient
HWL	25085	Confined	Denver Formation	Downgradient
HWL	25086	Unconfined	Denver Formation	Downgradient (DRY)
HWL	25087	Unconfined	Denver Formation	Downgradient
HWL	25088	Unconfined	Denver Formation	Downgradient (DRY)
HWL	25194	Unconfined	Denver Formation	Downgradient
HWL	25195	Confined	Denver Formation	Downgradient
HWL	25101	Confined	Denver Formation	Upgradient
HWL	25102	Unconfined	Denver Formation	Upgradient
HWL	25121	Unconfined	Denver Formation	Upgradient
SOM	25189	Unconfined	Denver Formation	NA
SOM	25091	Unconfined	Denver Formation	NA
SOM	25098	Unconfined	Denver Formation	NA
SOM	25099	Unconfined	Denver Formation	NA
SOM	25100	Unconfined	Denver Formation	NA
SOM	25203	Unconfined	Denver Formation	NA

Note: Upgradient HWL wells and SOM wells are sampled annually each spring.

DRY – Dry well in 2022
HWL – Hazardous Waste Landfill
SOM – Supplemental Operational Monitoring

Table 2.3-2. Water Quality Monitoring Analyte List

Method/Analyte Name	Test Name
Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry	
1,1,1-Trichloroethane	**111TCE**
1,1,2-Trichloroethane	112TCE
1,1-Dichloroethane	**11DCLE**
1,1-Dichloroethene	**11DCE**
1,2-Dichloroethane	**12DCLE**
1,2-Dichlorobenzene	12DCLB
1,3-Dichlorobenzene	13DCLB
1,4-Dichlorobenzene	14DCLB
1,2-Dichloropropane	12DCLP
1,2-Dimethylbenzene	12DMB
Acetone	ACET
Acrylonitrile	ACRYLO
Benzene	**C6H6**
Bicycloheptadiene	**BCHPD**
Bromodichloromethane	BRDCLM
Bromoform	CHBR3
Bromomethane	CH3BR
Carbon Disulfide	CS2
Carbon tetrachloride	**CCL4**
Chloroethane	C2H5CL
cis-1,2-Dichloroethene	C12DCE
cis-1,3-Dichloropropene	C13DCP
Dichlorodifluoromethane	**CCL2F2**
Chlorobenzene	CLC6H5
Chloroform	**CHCL3**
Chloromethane	CH3CL
Dibromochloromethane	DBRCLM
Dibromochloropropane	DBCP
Dicyclopentadiene	**DCPD**
Ethylbenzene	ETC6H5
Methylene chloride	CH2CL2
Methyl ethyl ketone	MEK
Methyl isobutyl ketone	MIBK
Methyl-n-butyl ketone	MNBK
Styrene	STYR
1,1,2,2-Tetrachloroethane	TCLEA
trans-1,2-Dichloroethene	T12DCE
trans-1,3-Dichloropropene	T13DCP
Tetrachloroethene	TCLEE
Toluene	MEC6H5
Trichloroethene	TRCLE

Table 2.3-2. Water Quality Monitoring Analyte List

Method/Analyte Name	Test Name
Vinyl chloride	C2H3CL
Xylenes	XYLEN
Organochlorine Pesticides	
Dichlorodiphenyl dichloroethane	PPDDD
Dichlorodiphenyl dichloroethene	PPDDE
Dichlorodiphenyl trichloroethane	PPDDT
Aldrin	ALDRN
alpha-Endosulfan	AENSLF
alpha-Chlordane	ACLDAN
Dieldrin	**DLDRN**
Endrin	ENDRN
Endrin aldehyde	ENDRNA
Endrin ketone	ENDRNK
gamma-Chlordane	GCLDAN
Heptachlor	HPCL
Heptachlor epoxide	HPCLE
Hexachlorocyclopentadiene	CL6CP
Isodrin	ISODR
Methoxychlor	MEXCLR
Organosulfur Compounds	
1,4-Oxathiane	OXAT
Benzothiazole	BTZ
Dimethyl disulfide	DMDS
Dithiane	DITH
p-Chlorophenylmethyl sulfide	CPMS
p-Chlorophenylmethyl sulfoxide	CPMSO
p-Chlorophenylmethyl sulfone	CPMSO2
Organophosphorus Compounds by Gas Chromatography	
Dimethyl methyl phosphonate	DMMP
Diisopropyl methyl phosphonate	**DIMP**
Mercury by Cold Vapor Atomic Absorption	
Mercury	HG
Arsenic by Graphite Furnace Atomic Adsorption	
Arsenic	AS
Metals/Cations by Inductively Coupled Argon Plasma	
Aluminum	AL
Barium	BA
Beryllium	BE
Boron	B
Antimony	SB
Cadmium	CD

Table 2.3-2. Water Quality Monitoring Analyte List

Method/Analyte Name	Test Name
Calcium	CA
Chromium	**CR**
Cobalt	CO
Copper	CU
Iron	FE
Lead	**PB**
Magnesium	MG
Manganese	MN
Nickel	NI
Potassium	K
Selenium	SE
Silver	AG
Sodium	NA
Thallium	TL
Vanadium	V
Zinc	ZN
Cyanide by Colorimetric Method	
Cyanide	CYN
Ammonia	
Ammonia	NH3
Alkalinity	
Alkalinity	ALK
Anions	
Bromide	BR
Chloride	CL
Fluoride	F
Nitrate	NO3
Nitrite	NO2
Sulfate	SO4
Nitrosamines	
n-Nitrosodimethylamine	NNDMEA
Nitrogen-Phosphorus Pesticides	
Atrazine	ATZ
Malathion	MLTHN
Parathion	PRTHN
Supona	SUPONA
Vapona	DDVP
Organic Carbon	
Total organic carbon	TOC
Dissolved organic carbon	DOC

Table 2.3-2. Water Quality Monitoring Analyte List

Method/Analyte Name	Test Name
Agent Degradation Products by High Performance Liquid Chromatography	
Thiodiglycol	TDGCL
Agent Products by Ion Chromatography	
Isopropyl methylphosphonic acid	IMPA
Kjeldahl Nitrogen	
Nitrogen by Kjeldahl method	N2KJEL
Polychlorinated Biphenyls (PCBs)	
Arochlor 1016	PCB016
Arochlor 1221	PCB221
Arochlor 1232	PCB232
Arochlor 1242	PCB242
Arochlor 1248	PCB248
Arochlor 1254	PCB254
Arochlor 1260	PCB260

Note: Individual analytes in **Bold** are Indicator Compounds.

Table 2.3-3: Quality Control Samples

Sample Type/Site ID	Sample Date(s)
Field Duplicates	
25085	1/12/2022
	5/11/2022
25099	5/12/2022
Laboratory Duplicates	
LCS1	2/16/2022
LCS2	4/4/2022
LDS1	4/18/2022
25194	4/27/2022
25183	5/11/2022
25189	5/12/2022
25102	5/31/2022
25101	6/8/2022
25195	6/21/2022
Field Blanks	
37009	2/15/2022
37159	3/2/2022
25183	5/11/2022

Table 3.0-1. HWL Groundwater Monitoring Well Usage

Well/ Designation	Data Used to Calculate Current (2021) Prediction Limits [1]			Prediction Limits Applied to Downgradient Wells (Quarterly in 2022)
	Data Used to Calculate Baseline (2009) Prediction Limits		Upgradient Data Post-Closure Monitoring Period 5/21/2009 to 4/21/2021	
	Upgradient/Downgradient Data Pre-operational Monitoring Period 10/1/1996 to 4/30/1999	Upgradient Data Operational/Closure Monitoring Period 5/11/1999 to 5/20/2009		
Upgradient				
25034	X	X	X	
25101	X	X	X	
25102	X	X	X	
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			

[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 folder.

Table 3.0-2. Prediction Limits for HWL 2022 Water Quality Monitoring

Indicator Compound	Current Method Reporting Limit (µg/L)	Proportion of Upgradient Non-detected Sample Values (2006-2021)	Statistical Method Used	Statistical Distribution	Selected Prediction Limit (µg/L)
Volatile Organic Compounds					
1,1,1-Trichloroethane	0.2	97.5	Non-parametric	Unknown	0.395
1,1-Dichloroethane[1]	0.2	100	Non-parametric	Unknown	0.26
1,1-Dichloroethene	0.202	89.7	Non-parametric	Unknown	7.79
1,2-Dichloroethane	0.2	94.1	Non-parametric	Unknown	0.9
Benzene	0.2	99.5	Non-parametric	Unknown	1.17
Bicycloheptadiene [1]	0.219	100	Non-parametric	Unknown	0.28
Carbon tetrachloride	0.2	89.7	Non-parametric	Unknown	11.8
Chloroform	0.2	81.3	Non-parametric	Unknown	4.72
Dichlorodifluoromethane [1]	0.6	100	Non-parametric	Unknown	0.78
Dicyclopentadiene [1]	0.205	100	Non-parametric	Unknown	0.27
Organochlorine Pesticides					
Dieldrin	0.002520	98.6	Non-parametric	Unknown	0.05
Organophosphorus Compounds					
DIMP	0.5[2]	100	Non-parametric	Unknown	0.65
Metals					
Arsenic	1	99.0	Non-parametric	Unknown	3.35
Chromium	10	95.1	Non-parametric	Unknown	24.1
Lead	3	80.6	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

Table 3.0-3. 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	Statistical Distribution	Selected Prediction Limit (µg/L)
Volatile Organic Compounds					
1,1,1-Trichloroethane	0.2	97.6	Non-parametric	Unknown	0.395
1,1-Dichloroethane[1]	0.2	100	Non-parametric	Unknown	0.26
1,1-Dichloroethene	0.2[2]	89.5	Non-parametric	Unknown	7.79
1,2-Dichloroethane	0.2	94.3	Non-parametric	Unknown	0.9
Benzene	0.2	99.5	Non-parametric	Unknown	1.17
Bicycloheptadiene [1]	0.22[2]	100	Non-parametric	Unknown	0.29
Carbon tetrachloride	0.2	89.0	Non-parametric	Unknown	11.8
Chloroform	0.2	81.0	Non-parametric	Unknown	4.72
Dichlorodifluoromethane [1]	0.6	100	Non-parametric	Unknown	0.78
Dicyclopentadiene [1]	0.2[2]	100	Non-parametric	Unknown	0.26
Organochlorine Pesticides					
Dieldrin	0.002520	98.6	Non-parametric	Unknown	0.05
Organophosphorus Compounds					
DIMP	0.602[2]	100	Non-parametric	Unknown	0.78
Metals					
Arsenic	1	99.1	Non-parametric	Unknown	3.35
Chromium	10	95.3	Non-parametric	Unknown	24.1
Lead	3	80.3	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.

[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

FIGURES

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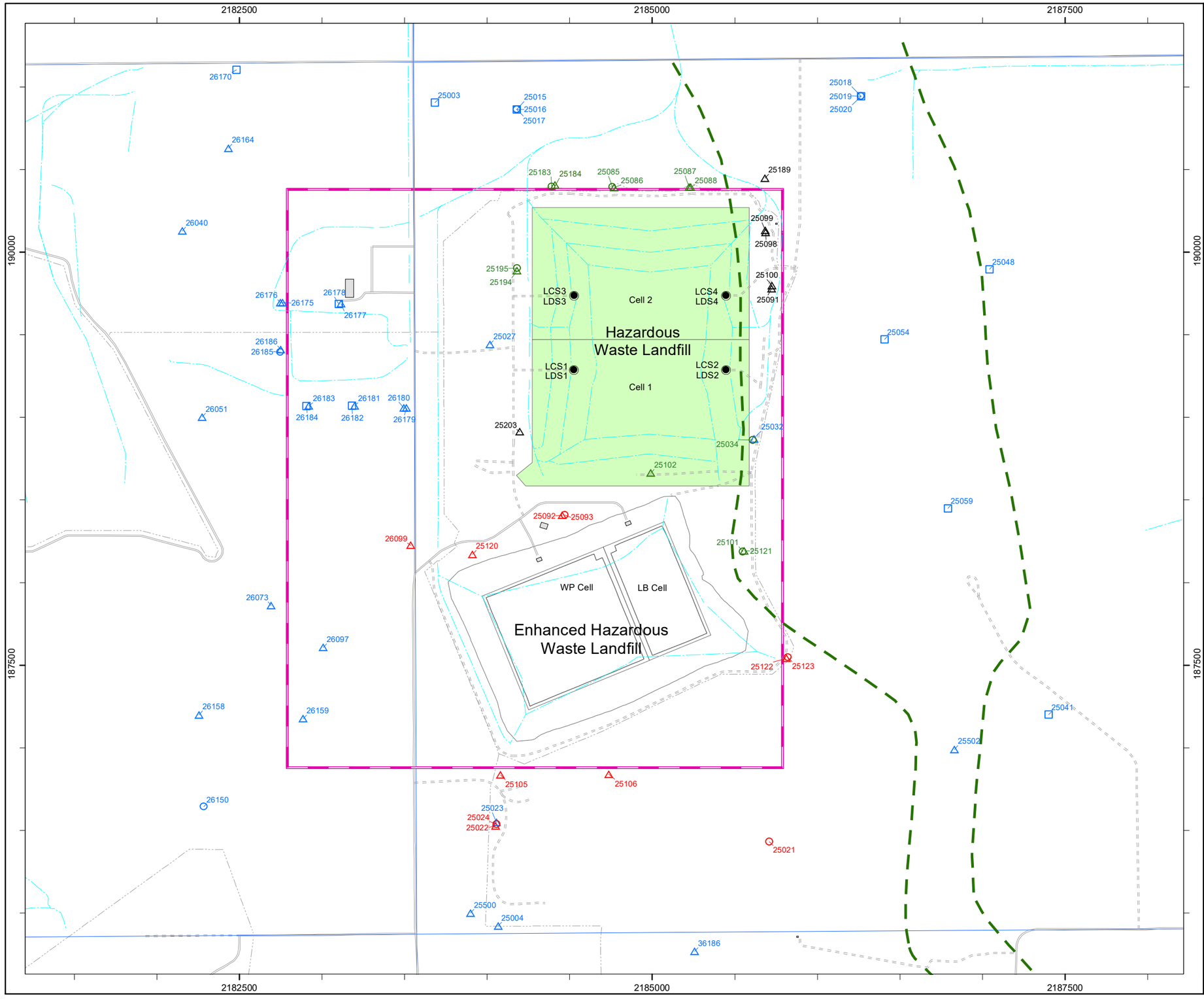

Legend

- 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
2022 Groundwater Monitoring

M:\projects\hwl_post-closure\2021\mxds\hwl_well_piezometer_loc_2021.mxd
6/16/2022

2182500 2185000 2187500

190000 187500

Hazardous Waste Landfill

Cell 2

Cell 1

Enhanced Hazardous Waste Landfill

LB Cell

WP Cell

5140 5145 5150 5155 5160 5165 5170 5175 5180 5185 5190 5195 5200 5205 5210 5215 5220 5225 5230 5235

26170 5139.8
25003 5152.48
25015 5159.51
25018 5164.29
26164 5144.32
25086 DRY
25087 5165.95
25189 5166.65
26040 5147.38
25099 5168.61
25194 5180.93
25091 5169.63
25048 5171.7
26175 5156.77
26177 5158.34
26186 5164.29
25027 5180.52
25054 5174.01
26183 5165.69
26051 5162.45
26180 5177.63
26182 5176.21
25203 5180.41
25102 5180.61
25092 5180.8
25059 5178.63
26099 5182.13
25120 5189.3
25121 5180.38
26073 5177.67
26097 5184.41
25122 5231.56
26156 5179.48
26159 5202.44
25041 5184.72
25502 5184.71
25105 5217.42
25106 5205.14
25021 5174.09
25022 5220.05
25500 5217.86
25004 5217.93
36186 5237.81

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 2022

M:\projects\hwl_post-closure\2022\mxds\hwl_ufs_fy22.mxd
5/30/2023

2182500
2185000
2187500
190000
187500

25016
5153.36
25019
5162.18
26164
5144.32
26040
5147.38
25183
5163.64
25085
5164.28
25087
5165.95
25189
5166.65
25099
5168.61
25195
5165.29
26177
5158.34
26175
5156.77
25091
5169.63
Hazardous
Waste Landfill
26186
5164.29
26179
5168.27
26183
5165.69
26051
5162.45
26181
5167.22
25034
5172.51
25093
5171.13
25101
5173.5
25123
5175.35
25105
5217.42
25106
5205.14
26150
5171.16
25024
5201.86

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

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 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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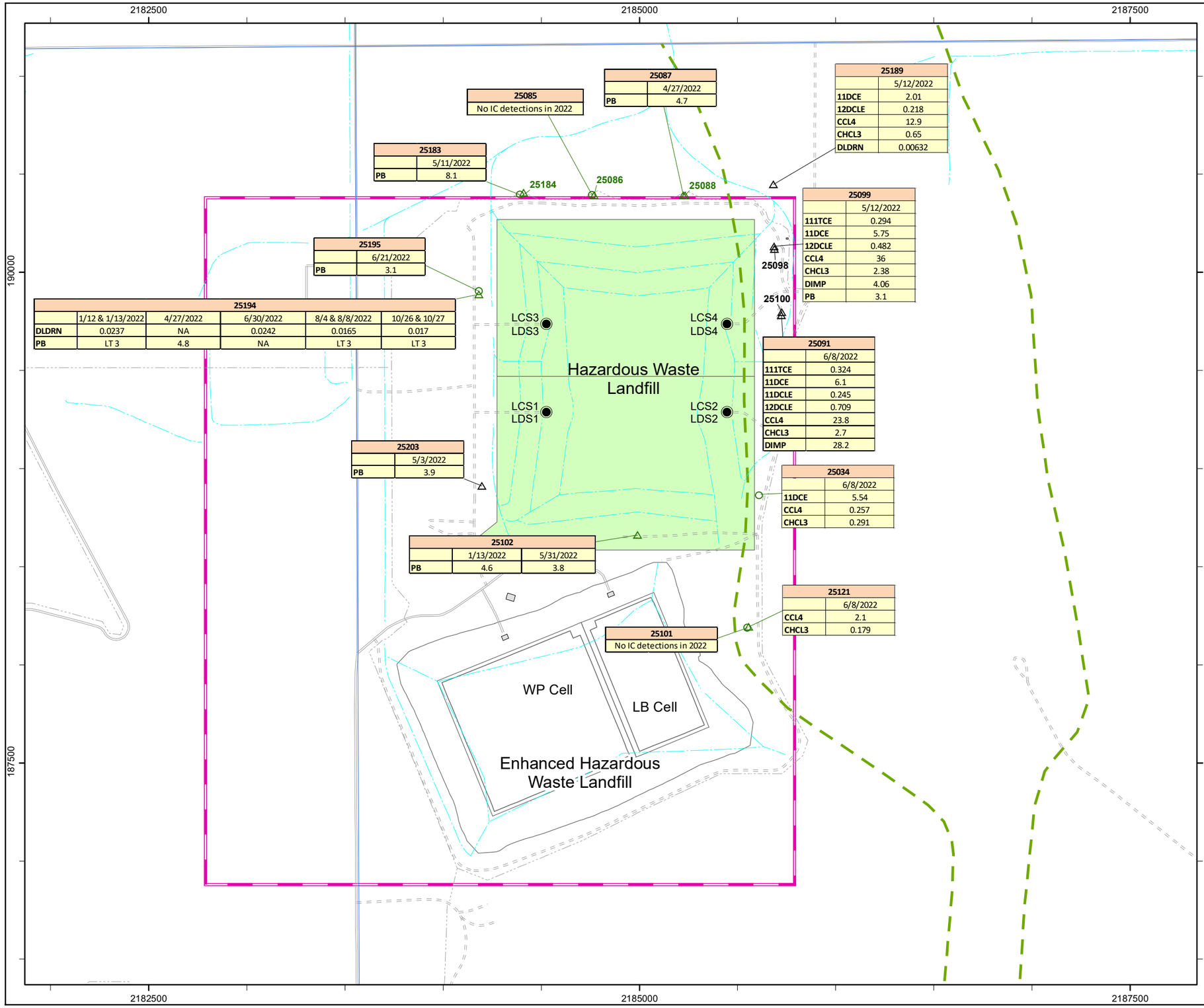
Figure 2.2-3

Potentiometric Surface for the
Lower Sandstone Unit and Equivalent Units,
April and May 2022

M:\projects\hwl_post-closure\2022\mxds\hwl_lwr_sandstoneWL_2022.mxd
5/16/2023



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 2022.

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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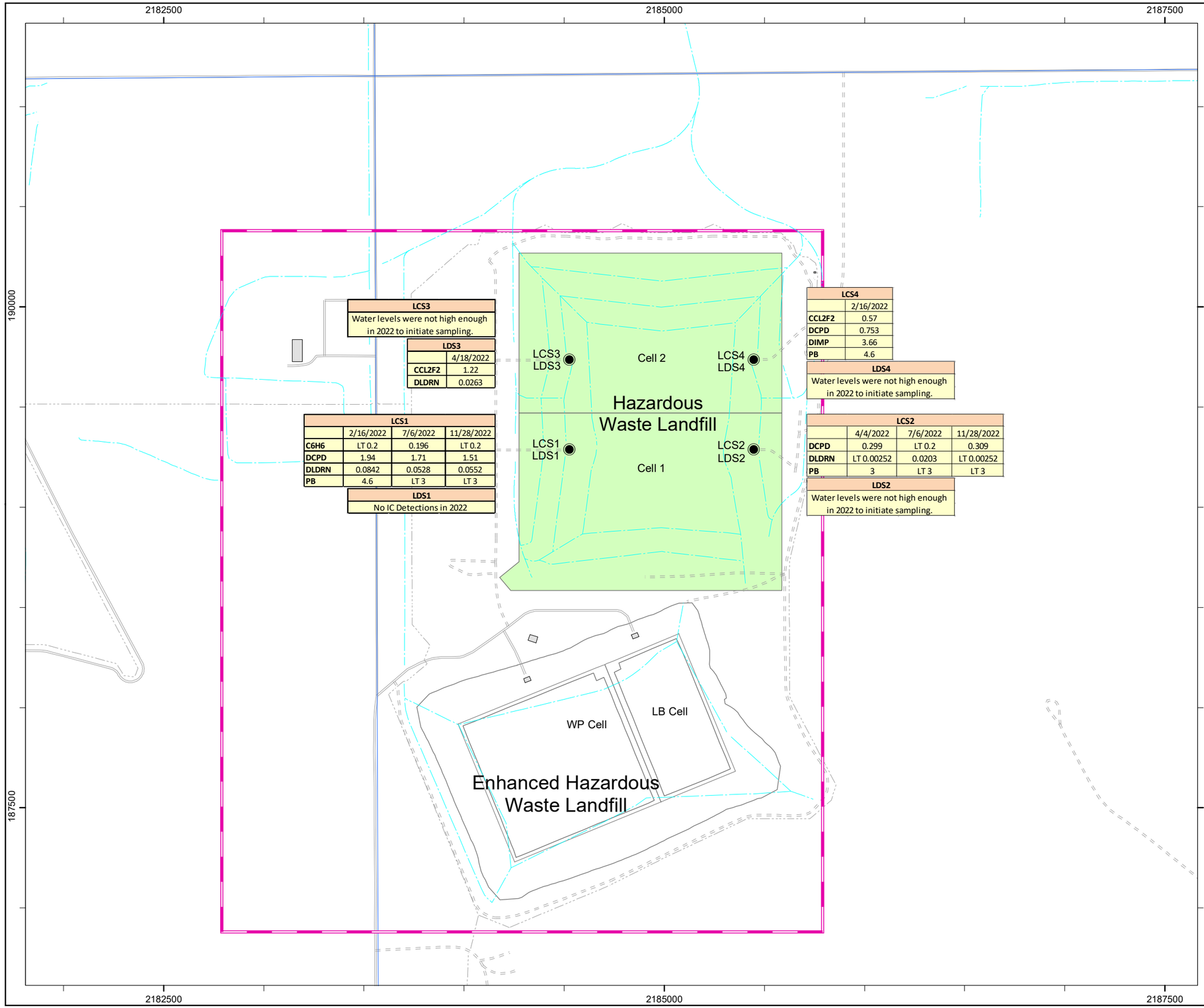
Figure 2.3-1

Indicator Compounds Detection Map
2022 Groundwater Monitoring

M:\projects\hwl_post-closure\2022\mxds\hwl_ind_cmpd_detection_2022.mxd
5/30/2023



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 2022

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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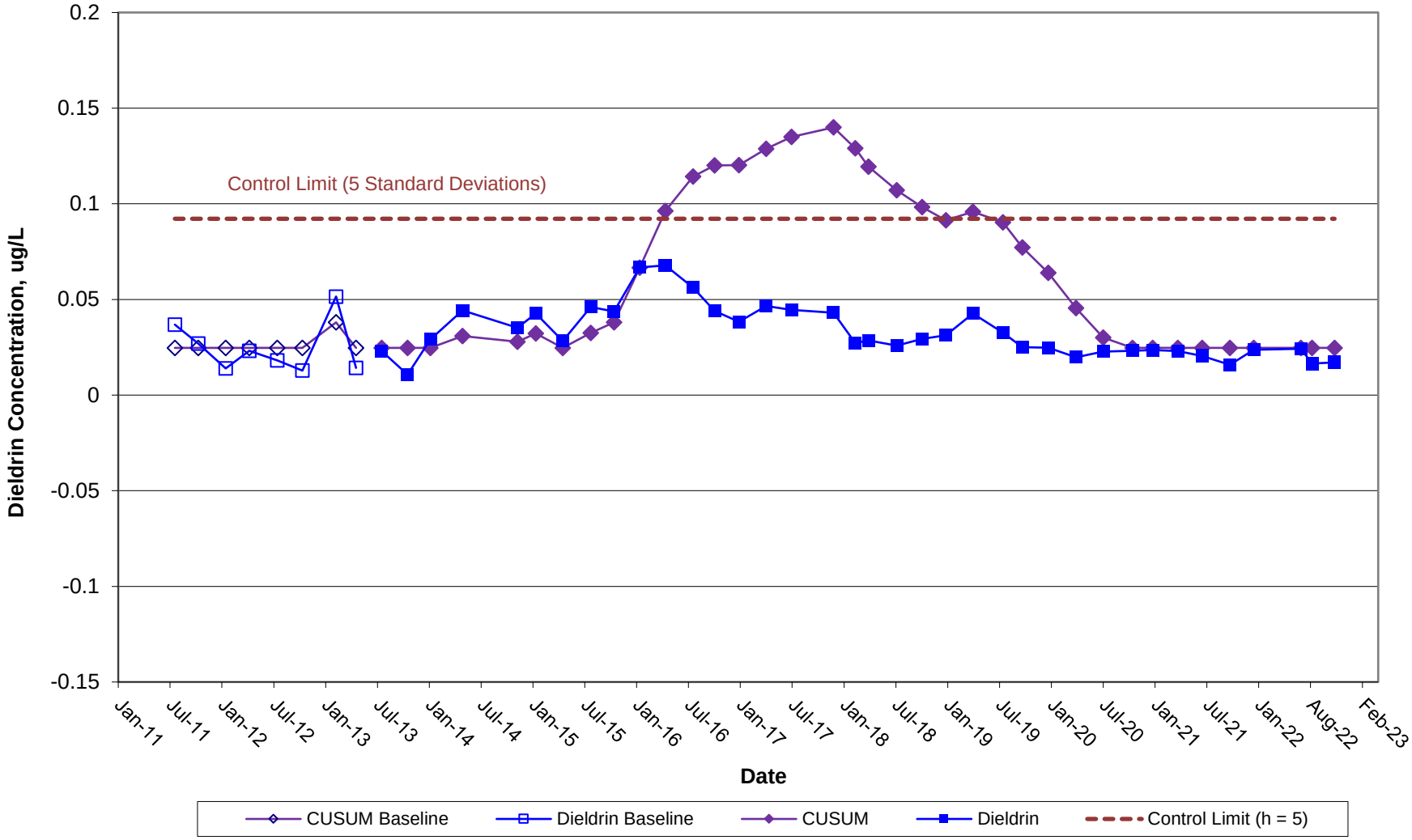
Figure 2.3-2

Indicator Compounds Detection Map
2022 HWL Leachate Collection and
Leak Detection Systems

M:\projects\hwl_post-closure\2022\mxds\hwl_ind_detect_lcs_lds_2022.mxd
5/29/2023

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 2022

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ROCKY MOUNTAIN ARSENAL

ENHANCED HAZARDOUS WASTE LANDFILL
POST-CLOSURE GROUNDWATER MONITORING REPORT

CALENDAR YEAR 2022

Revision 0
June 21, 2023

U.S. Department of the Army
Shell Oil Company

Prepared by:

Navarro Research and Engineering, Inc.

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CONTENTS

Section **Page**

TABLES

FIGURES

SUPPORTING DOCUMENTATION

(available on Data CD)

ACRONYMS

amsl	Above Mean Sea Level
ARDL	Applied Research and Development Laboratory
CAMU	Corrective Action Management Unit
CFS	Confined Flow System
ELF	Enhanced Hazardous Waste Landfill
HWL	Hazardous Waste Landfill
IC	Indicator Compound
IQR	Interquartile Range
LBLCS	LB Leachate Collection System
LBLDS	LB Leak Detection System
LCS	Leachate Collection System
LDS	Leak Detection System
MRL	Method Reporting Limit
MS	Matrix Spike
µg/L	Microgram(s) per liter
O&M	Operations and Maintenance
OCN	Operations and Maintenance Change Notice
OMC	Operations and Maintenance Contractor
PARCC	Precision, Accuracy, Representativeness, Completeness, and Comparability
PCGMP	Post-Closure Groundwater Monitoring Plan
QC	Quality Control
RMA	Rocky Mountain Arsenal
RMAED	Rocky Mountain Arsenal Environmental Database
RPD	Relative Percent Difference
SQAPP	Sampling Quality Assurance Project Plan
UCL	Upper Confidence Limit
UFS	Unconfined Flow System
WPLCS	WP Leachate Collection System
WPLDS	WP Leak Detection System

(Note: All chemical codes are listed in Table 2.3-2)

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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 2022 calendar year quarterly sampling events conducted in January, August, and November, and the annual sampling event conducted between late April and early June. Groundwater flow directions beneath the ELF were consistent over the four quarters of 2022 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 2022 post-closure groundwater monitoring include downgradient monitoring wells 25092, 25093, 25102, 25120, and 26099; upgradient monitoring wells 25021, 25022, 25024, 25105, 25106, and 25123; and cross-gradient monitoring well 25121. The groundwater samples were tested for the analytes and indicator compounds (ICs) listed in Table 2.3-2. The ICs selected as part of the monitoring program include 1,1,1-trichloroethane, 1,1-dichloroethane, 1,1-dichloroethene, 1,2-dichloroethane, arsenic, benzene, carbon tetrachloride, chromium, chloroform, dieldrin, diisopropylmethyl phosphonate, mercury, and lead.

The ICs detected in upgradient wells 25022, 25105 and 25106 include arsenic, lead, and dieldrin. Carbon tetrachloride and chloroform were detected in cross-gradient well 25121.

Lead was the only IC detected in the downgradient wells 25092, 25093, 25102, and 25120. The levels of lead in the downgradient wells ranged from 3.4 to 4.6 micrograms per liter (µg/L), and are 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 2022. They will be sampled prior to the next waste removal event per the *Enhanced Hazardous Waste Landfill Post-Closure Groundwater Monitoring Plan* (ELF PCGMP) (Navarro 2020).

As a component of the data review process, the analytical data were evaluated against the data quality indicators of precision, accuracy, representativeness, completeness, and comparability (PARCC). Based on the findings of the PARCC 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, the groundwater quality around the ELF has not been affected by post-closure operations and maintenance (O&M) of the landfill.

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1.0 INTRODUCTION

The Post-Closure Groundwater Monitoring Report for 2022 quarterly sampling events conducted in January, August, and November, and the annual sampling event conducted between late April and early June document the analytical results and data evaluation of the Enhanced Hazardous Waste Landfill (ELF) post-closure groundwater monitoring on the Rocky Mountain Arsenal (RMA). 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 *Enhanced Hazardous Waste Landfill Post Closure Groundwater Monitoring Plan* (ELF PCGMP) (Navarro 2020), *Rocky Mountain Arsenal Sampling Quality Assurance Project Plan* (SQAPP) (Navarro 2019), and previous annual groundwater reports.

The groundwater monitoring program defined in this document is specifically designed to monitor groundwater flow directions and groundwater quality beneath and around the ELF, and to monitor for potential releases of hazardous constituents from the ELF. Groundwater monitoring for the ELF was completed as required by the ELF PCGMP (Navarro 2020).

2.0 GROUNDWATER MONITORING RESULTS

A summary of water level monitoring, and analytical results for the 2022 post-closure groundwater monitoring at the ELF are presented in the following sections. Also included is an evaluation of the Leachate Collection System (LCS) and Leak Detection System (LDS) wastewater analytical data.

2.1 Monitoring Well Activities

The RMA Operations and Maintenance Contractor (OMC) 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 and documented on the monitoring wells with dedicated pumps. In addition to casing heights, total depths were measured on monitoring wells without dedicated pumps. The casing heights and total depths are documented in the OMC records.

Well 25122 has been noted as a dry well since monitoring began in 2002. In June 2022, a down-well video was recorded and sand within the well casing was noted at a depth of approximately 26.8 feet (top of casing). This obstruction appears to be graded silica filter pack sand that is located 4.4 feet above the top of the well screen, and its origins are unknown. Based on this observation, well 25122 will not provide reliable data to support mapping of the potentiometric surface, and it is recommended that the well be closed, removed from the monitoring network and replaced by a new well.

2.2 Water Level Monitoring

Water levels were measured in 68 wells quarterly 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. The wells used to monitor water levels in the area of the CAMU are presented in Table 2.2-1 and Figure 2.2-1.

Water level monitoring measurements are provided in Table 2.2-2. Figures 2.2-2 and 2.2-3 represent the April 2022 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 Analytical Results

The ELF water quality network wells are identified in Table 2.3-1. Groundwater and leachate samples collected from the ELF wells were submitted to Applied Research and Development Laboratory (ARDL), Mount Vernon, Illinois for analysis of the parameters listed in Table 2.3-2. Included in this table are the 13 indicator compounds (IC) evaluated during quarterly sampling events, and the full suite of analytes evaluated during the annual sampling event.

The groundwater samples were tested for the ICs listed in Table 2.3-2. The ICs are highlighted in bold text in Table 2.3-2.

The 13 ICs selected as part of the monitoring program include the following:

- Arsenic
- Benzene (C6H6)
- Carbon tetrachloride (CCL4)
- Chloroform
- Chromium
- 1,1-Dichloroethane (11DCLE)
- 1,2- Dichloroethane (12DCLE)
- 1,1-Dichloroethene (11DCE)
- Diisopropylmethyl phosphonate (DIMP)
- Dieldrin
- Lead
- Mercury
- 1,1,1-Trichloroethane (111TCE)

The ICs detected in the ELF network wells are shown in Figures 2.3-1. Table 2.3-3 lists the quality control (QC) samples including field blanks, and duplicates that were collected and analyzed as part of the quarterly and annual groundwater monitoring events in accordance with the SQAPP (Navarro 2019).

The full suite of analytes detected in the ELF network wells and sumps during the pre-operational, operational, closure, and post-closure monitoring periods are summarized in the Supporting Documentation folder.

2.3.1 ELF Network Wells Analytical Results

The wells sampled during the quarterly events in January, August, and November 2022, and the annual post-closure groundwater monitoring event competed between late April and early June 2022 at the ELF include the following upgradient and downgradient wells screened in the UFS and CFS.

Upgradient		Downgradient		Cross-Gradient
UFS	**CFS**	**UFS**	**CFS**	**UFS**
25022	25021	25092	25093	25121
25105	25024	25102		
25106	25123	25120		
		26099		

2.3.1.1 Upgradient and Cross-gradient ELF Network Wells

Upgradient wells 25021, 25022, 25024, 25105, 25106, and 25123—as well as cross-gradient monitoring well 25121—were sampled during the second quarter of 2022, consistent with the monitoring program each year.

The following ICs were detected in the upgradient wells:

UFS

Well 25022

- Dieldrin – 0.00422 µg/L
- Lead – 3.5 µg/L

Well 25105

- Lead – 3.4 µg/L

Well 25106

- Arsenic – 6.28 µg/L

CFS

Well 25021

- No detections

Well 25024

- No detections

Well 25123

- No detections

The following ICs were detected in the cross-gradient UFS well:

Well 25121

- Carbon tetrachloride – 2.1 µg/L
- Chloroform – 0.179 µg/L

Detections of chloroform and carbon tetrachloride in cross-gradient well 25121 are consistent with contaminants associated with the North Plants-Bedrock Ridge western plume. Carbon

tetrachloride and chloroform have remained stable or have decreased since 2010. The IC dieldrin was detected in upgradient CFS well 25021 from 2016 to 2021. It was not detected in 2022.

Additional compounds detected in the upgradient wells in 2022 include the following:

- alpha-Chlordane
- Aluminum
- Ammonia
- Barium
- Boron
- Bromide
- Calcium
- Chloride
- Cobalt
- Endrin
- Endrin aldehyde
- Endrin ketone
- Fluoride
- Heptachlor epoxide
- Isodrin
- Iron
- Magnesium
- Manganese
- Nickel
- Nitrate
- Kjeldahl nitrogen
- Potassium
- Dichlorodiphenyl dichloroethene (PPDDE)
- Selenium
- Sodium
- Sulfate
- Thiodiglycol
- Zinc

2.3.1.2 Downgradient ELF Network Wells

Downgradient ELF network wells 25092, 25093, 25102, 25120, and 26099 are sampled quarterly. Lead was the only IC that was detected in the downgradient wells, and the results for detections are listed below.

UFS

Well 25092

- Lead 3.5 µg/L (January)
- Lead 3.4 µg/L (May)

Well 25102

- Lead 4.6 µg/L (January)
- Lead 3.8 µg/L (May)

Well 25120

- Lead 3.8 µg/L (January)
- Lead 3.9 µg/L (May)

Well 26099

- No detections

CFS

Well 25093

- Lead 3.4 µg/L (June)

Additional compounds detected in downgradient wells in 2022 include the following:

- Aluminum
- Barium
- Boron
- Calcium
- Chloride
- Copper
- Fluoride
- Iron
- Kjeldahl nitrogen
- Magnesium
- Manganese
- Nitrate
- Kjeldahl nitrogen
- Potassium
- Selenium
- Sodium
- Sulfate
- Thiodiglycol
- Toluene
- Zinc

2.3.2 ELF LCS and LDS Sumps Analytical Results

Per the ELF PCGMP, sump sampling shall be performed prior to removal of wastewater from an ELF sump. Wastewater removal may be triggered by a high sump level or other wastewater management considerations.

Samples are collected from the LDS to meet the post-closure requirements specified in the ELF PCGMP (Navarro 2020) and are used to evaluate wastewater chemistry in order to evaluate potential leakage from the ELF. If water levels within the LDS sumps are not high enough to initiate sampling in accordance with the ELF PCGMP samples will not be collected and no data will be presented in tables or maps.

2.3.2.1 LCS 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 2022.

2.3.2.2 LDS Sumps

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 2022. Since there were no LDS analytical results in 2022, none required regulatory agency notification per Table 3.0-2 of the *Enhanced Hazardous Waste Landfill Post-Closure Plan* (Navarro 2020).

2.4 Analytical Data Review

The objective of the data review process 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 Precision, Accuracy, Representativeness, Completeness, and Comparability (PARCC). The five parameters are identified in the SQAPP (Navarro 2019) as important data quality indicators. The RMA OMC reviewed the PARCC parameters with respect to the data QC goals stated in the SQAPP (Navarro 2019).

The sample results were evaluated against the data quality requirements and compared to the data quality objectives as presented in the ELF PCGMP (Navarro 2020) and SQAPP (Navarro 2019). Data review and verification activities were conducted in accordance with the SQAPP (Navarro 2019). The evaluation limits discussed below are internal OMC limits based on historical data, and independent of evaluations performed by the laboratory. The results of these evaluations are described below.

The OMC conducted data validation 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. There were no data points flagged as rejected in 2022.

2.4.1 Precision

Precision is the measure of mutual agreement among measurements. Field precision was evaluated by collection and analysis of duplicate samples using the same analytical methods as investigative samples. Precision was evaluated quantitatively by measuring the variability, in terms of relative percent difference (RPD), between the pairs of results for the investigative and duplicate samples. The RPD values provide a relative measure of precision; lower RPD values indicate better precision between the results. Relative percent difference values less than or equal to 35 percent are considered acceptable. The RPD for a duplicate investigative sample pair is calculated using the following steps:

- Identify the duplicate investigative sample pair results.
- Identify parameters detected in both results for the pair identified in Step 1.
- Calculate the RPD value for the detected parameters identified in Step 2 using the following equation:

$$RPD = \frac{|x - y|}{\frac{(x + y)}{2}} \times 100$$

where:

x = Investigative sample result
y = Duplicate sample result

The duplicate/investigative pairs are evaluated for comparability. The RPD upper evaluation limit is 35 percent for all analytes. The investigative and duplicate results will be considered comparable if any of the following statements are true:

- If both sample results are less than the method reporting limit (MRL)
- If both sample results are greater than the MRL; but less than or equal to twice the MRL
- If both sample results are greater than twice the MRL and the RPD is less than or equal to the specified upper RPD limit
- If both sample results are greater than the MRL; one result is less than or equal to twice the MRL; one result is greater than twice the MRL; and the RPD is less than or equal to the specified upper limit

- If one sample result is less than the MRL; and one result is greater than the MRL and less than or equal to twice the MRL

The investigative and duplicate results will be considered not comparable if any of the following statements are true:

- If both sample results are greater than twice the MRL and the RPD is greater than the specified upper RPD limit
- If both sample results are greater than the MRL; one result is less than or equal to twice the MRL; one result is greater than twice the MRL; and the RPD is greater than the specified upper limit
- If one sample result is less than the MRL; and one result is greater than twice the MRL

A total of 127 duplicate pair analyses of ELF target analytes were performed. The average RPD was 3.00 percent. Duplicate and investigative results are considered comparable in 127 cases and non-comparable in 2 cases.

The precision evaluation values and the RPD values are listed in the Supporting Documentation folder. The non-comparable investigative and duplicate data will be assigned a "Z" data qualifier with the comment "Duplicate and investigative values are not comparable." The data are considered acceptable for their intended use and no additional action in addition to the data qualification is considered necessary.

2.4.2 Accuracy/Bias

Accuracy is the degree of agreement between an observed value (sample result) and an accepted reference value. Bias is the systematic or persistent distortion of a measurement process that causes errors in one direction (high or low). The terms accuracy and bias are used interchangeably. Accuracy/bias is indicated by percent recovery calculated from laboratory spike data using the following formula:

$$Recovery\ Rate\ (\%) = \frac{Measured\ Value}{True\ Value} \times 100$$

Where:

Measured Value = Value after the spike minus the value before the spike
True Value = Value of the spike added

Accuracy/bias will be calculated based on results of laboratory control spikes and matrix spikes (MS). Laboratory control spikes utilize laboratory grade water with some additions of inorganic constituents to mimic RMA water. Matrix spikes utilize RMA water to account for matrix-related interferences.

The calculated recovery rate is compared to the lower and upper recovery rate limits specific to each analyte based on historical data. The 25th and 75th percentiles for each analyte are calculated. The interquartile range (IQR) is calculated by subtracting the 25th percentile value from the 75th percentile value. The lower and upper recovery warning limits for each analyte are determined by subtracting and adding 1.5 times the IQR to the 25th and 75th percentile values,

respectively. The lower and upper recovery control limits are determined by subtracting and adding three times the IQR to the 25th and 75th percentile values, respectively. Data will not be qualified solely on a recovery rate outside the calculated recovery limits. Additional factors must be present to justify the data qualification. The historical spike recoveries used for the calculation of recovery evaluation limits for matrix spikes and laboratory control spikes are included in the Supporting Documentation folder.

The data utilized for the recovery rate calculations are limited to the spike values for the analytical lots of the investigative data included in the Supporting Documentation folder. Matrix spike values exceeding four times the spiked amount are excluded from the calculation since the MS could possibly be diluted out due to the high original concentration. Analyses with an ampersand (@) flag code (i.e., value is estimated) or "B" flag code (i.e., analyte found in the method blank or QC blank as well as the sample) were also excluded from recovery rate calculations. The spike recoveries used in the calculations are also included in the Supporting Documentation folder.

The average recovery rate for the 953 MS analyses was 85.4 percent. Recovery rates outside the lower or upper warning limits were observed in 59 analyses. Recovery rates outside the lower or upper control limits were observed in nine analyses. A listing of the MS sample results outside the warning and control evaluation limits is included in the Supporting Documentation folder.

The average recovery rate for the 953 corresponding laboratory control spike analyses was 96.9 percent. Recovery rates outside the lower or upper warning limits were observed in 41 analyses. Recovery rates outside the lower or upper control limits were observed in two analyses. The laboratory control spike sample results outside the evaluation limits are included in the Supporting Documentation folder.

Laboratory control spike and MS recoveries outside the designated warning limits in both instances were not observed. Laboratory control spike and MS recoveries outside the designated control limits in both instances were not observed. No issues were identified requiring data qualification. Charts including the evaluation limits and spike recoveries for the ELF are included in the Supporting Documentation folder.

2.4.3 Representativeness

Representativeness refers to the selection and implementation of analytical methods, sampling protocols and sample locations to ensure that the analytical data results are representative of the media being sampled (e.g., water, soil, etc.) and of the conditions being measured. Representativeness is evaluated by reviewing monitoring program design and implementation, as well as field and laboratory blank samples. Design of the monitoring program is reviewed qualitatively to assess whether the objectives were satisfied. Implementation of the monitoring program is reviewed qualitatively to evaluate whether the planned procedures were followed. A quantitative review of the QC blank results indicates whether influences outside the measurement systems have affected the analyses and interpretation of the media and conditions.

Sample locations, sampling frequency, and sample collection procedures applied during groundwater monitoring are described in the ELF PCGMP (Navarro 2020). The program is designed to provide water quality data in the area of the landfill and implemented as defined in

the work plan. Thus, the data are judged representative of the water quality characteristics for the program.

Field blanks are collected and analyzed to evaluate possible cross contamination of the investigative samples. Rinse blanks are not required since dedicated pumps and tubing are used to sample the wells and sumps. The number of QC samples collected, and QC results evaluated for qualification are included in Table 2.3-3 and the Supporting Documentation folder.

A total of 159 field blank analyses were performed. Field blank results above the MRL were observed in three analyses. Qualification is not required as the investigative value is greater than the field blank value in one analysis and below the MRL for two analyses. Field blank results are included in the Supporting Documentation folder.

In addition, 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 906 method blank analyses in 2022. A single method blank analysis was above the MRL. Method blank results above the MRL were observed in three analyses. Qualification is not required because the associated investigative value is below the MRL. Method blank results are included in the Supporting Documentation folder.

2.4.4 Completeness

Completeness is the amount of valid data obtained from a measurement system compared to the amount that was expected and needed to meet the project goals. Valid analytical data are those data that have been identified as usable and included in the RMA Environmental Database (RMAED). The SQAPP (Navarro 2019) sets the completeness goal for the sampling program at 90 percent.

There was no rejected data in 2022. The analytical results of monitoring are representative of the groundwater quality with the exception of qualified data. Rejected data are not removed from the RMAED; however, they are not used to evaluate the ELF groundwater data. Data qualified as "@" are not filtered out of the database. While not rejected, the data are considered estimated due to the concentration being outside the linear range of the instrument.

Completeness was calculated as 100 percent. The completeness goal of 90 percent was achieved. All results were determined to be acceptable by the laboratory.

2.4.5 Comparability

Comparability is the confidence with which one data set can be evaluated relative to another. Standard sampling and analysis techniques, based on certified analytical methods approved by the OMC 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 followed. All data are considered comparable.

2.4.6 Summary

The purpose of the PARCC evaluation is to evaluate whether the data are usable and adequate to properly characterize the water quality conditions present at the site. Based on the findings of the PARCC evaluation, the sample results are considered valid and usable for their intended purpose. Qualified data are not rejected but should be appropriately considered when used. Data quality requirements were sufficiently met for the analytical data, and the 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.

2.4.7 Data Usability Evaluation

A data usability evaluation was conducted on 2,632 records. The evaluation identified no statistical outlier.

The Mann-Kendall test for trends identified 38 decreasing analyte trends and 55 increasing analyte trends. A listing of the trends is included on the attached data CD in the Data Usability subfolder (Data_Usability_Summary_2022.xlsx).

The evaluation did not positively identify data quality issues; thus, the data are considered to be of acceptable quality and meets or exceeds the established data quality objectives. The data are of the correct type, quality, and quantity to support the intended use.

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 2021 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).

The MRLs can change based on the analytical method re-certification every three years as required by the SQAPP. In January 2022, the MRL for DIMP was raised. The new MRL is reflected in Table 3.0-2.

ChemStat statistical analysis software (Starpoint Software 2016) was utilized to determine the prediction limit values and documentation is available in the Supporting Documentation folder. The prediction limit values for 2023 are included in Table 3.0-3. If a compound is not detected in any sample, the non-parametric predication limit for the 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.

3.1 2022 Prediction Limits and the Current ELF Water Quality Data

Table 3.0-2 presents the 2022 prediction limits that were calculated from upgradient well data collected during the pre-operational, operational, closure, and post-closure groundwater monitoring periods (2003–2021).

The downgradient results from the water quality sampling completed during 2022 post-closure groundwater monitoring period were compared with the prediction limit values presented in Table 3.0-2 to determine whether groundwater quality was impacted by the ELF in 2022.

Lead was the only IC detected in the downgradient wells. Lead was detected in wells 25092, 25093, 25102, and 25120 at concentrations ranging from 3.4 µg/L to 4.6 µg/L. The range of values 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 2023 Prediction Limits and the Future ELF Water Quality Data

Table 3.0-3 presents the prediction limit values that will be applied to downgradient wells during 2023 sampling events. The ELF prediction limits will be applied to wells 25092, 25093, 25102, 25120, and 26099. The MRLs can change based on the analytical method re-certification required every three years by the SQAPP (Navarro 2019). The MRL for DIMP was raised in January 2022, but it did not impact the prediction limits calculated for 2023 as presented in Table 3.0-3.

4.0 SUMMARY

The following conclusions are based on the groundwater and wastewater monitoring results for the 2022 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 PARCC evaluation, the analytical data collected are of acceptable quality for intended uses.
- Arsenic, dieldrin, and lead were detected in the upgradient UFS wells. There were no IC detections in the upgradient CFS wells.
- Carbon tetrachloride and chloroform 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 western plume.
- Lead was the only IC detected in three of the four downgradient UFS wells. In the CFS, lead was detected in downgradient well 25093. The detections of lead were below the prediction limit of 26.3 µg/L. Historically, lead was detected in the downgradient wells prior to the placement of waste in the ELF in April 2006.

- ELF LCS and LDS sumps were not sampled in 2022. They will be sampled prior to the next waste removal event per the ELF PCGMP.
- No ICs exceeded the 2022 prediction limits. Based on the statistical evaluation, groundwater quality around the ELF has not been affected by operations, closure, or post-closure O&M of the landfill.
- Prediction limit values for all ICs were re-evaluated for 2023 and the values did not change from 2022 to 2023.

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.)

2020 *Enhanced Hazardous Waste Landfill Post-Closure 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)

2016 ChemStat Statistical Analysis Software for Environmental Data. Version 6.4, July 2016.

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.

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TABLES

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Table 2.2-1. ELF Water Level Monitoring Network

Well ID	Aquifer	Top of Casing Elevation (feet amsl)	Bottom of Screen Elevation (feet amsl)
Unconfined Flow System			
25003	Alluvial	5194.26	5151.60
25041	Alluvial	5210.81	5179.61
25048	Alluvial	5190.01	5150.20
25054	Alluvial	5207.94	5168.10
26178	Alluvial	5214.73	5181.56
26182	Alluvial	5217.22	5174.27
26184	Alluvial	5214.94	5173.84
25018	Alluvial/Denver Formation	5195.61	5148.30
25059	Alluvial/Denver Formation	5208.97	5162.97
25189	Alluvial/Denver Formation	5202.30	5141.30
25194	Alluvial/Denver Formation	5215.60	5179.40
25203	Alluvial/Denver Formation	5236.10	5176.10
25004	Denver Formation	5264.96	5183.20
25015	Denver Formation	5197.23	5154.50
25022	Denver Formation	5263.66	5211.70
25023	Denver Formation	5265.08	5197.40
25027	Denver Formation	5224.84	5179.00
25032	Denver Formation	5254.89	5220.20
25086	Denver Formation	5212.53	5183.14
25087	Denver Formation	5209.75	5141.37
25088	Denver Formation	5209.61	5190.87
25091	Denver Formation	5217.43	5132.51
25092	Denver Formation	5246.11	5179.49
25098	Denver Formation	5212.80	5184.34
25099	Denver Formation	5212.40	5139.73
25100	Denver Formation	5216.99	5185.87
25102	Denver Formation	5243.61	5171.62
25105	Denver Formation	5255.46	5204.69
25106	Denver Formation	5261.43	5188.97
25120	Denver Formation	5237.95	5177.80
25121	Denver Formation	5251.67	5179.06
25122	Denver Formation	5260.58	5219.37
25500	Denver Formation	5258.74	5201.09
25502	Denver Formation	5223.60	5169.10
26040	Denver Formation	5197.40	5146.40
26051	Denver Formation	5218.60	5158.30
26073	Denver Formation	5225.41	5173.05
26097	Denver Formation	5242.25	5172.70

Table 2.2-1. ELF Water Level Monitoring Network

Well ID	Aquifer	Top of Casing Elevation (feet amsl)	Bottom of Screen Elevation (feet amsl)
26099	Denver Formation	5232.31	5232.70
26158	Denver Formation	5214.88	5160.30
26159	Denver Formation	5233.75	5188.00
26164	Denver Formation	5189.26	5136.70
26170	Denver Formation	5184.02	5133.90
26175	Denver Formation	5206.29	5145.43
26176	Denver Formation	5206.02	5159.89
26177	Denver Formation	5214.92	5153.10
26179	Denver Formation	5224.89	5156.24
26180	Denver Formation	5224.57	5170.86
26181	Denver Formation	5217.82	5161.29
26183	Denver Formation	5214.81	5157.29
26186	Denver Formation	5207.79	5140.58
36186	Denver Formation	5286.23	5122.70
Confined Flow System			
25016	Denver Formation	5198.31	5132.10
25017	Denver Formation	5197.67	5117.40
25019	Denver Formation	5193.85	5109.73
25020	Denver Formation	5195.25	5040.27
25021	Denver Formation	5240.10	5111.50
25024	Denver Formation	5265.04	5165.20
25034	Denver Formation	5255.60	5130.60
25085	Denver Formation	5212.91	5134.48
25093	Denver Formation	5245.76	5123.03
25101	Denver Formation	5251.19	5124.83
25123	Denver Formation	5259.86	5123.34
25183	Denver Formation	5206.80	5147.30
25195	Denver Formation	5215.50	5134.50
26150	Denver Formation	5220.96	5111.90
26185	Denver Formation	5208.53	5115.64

Notes:
amsl – above mean sea level

Table 2.2-2. 2022 Water Level Measurements Summary

Well ID	Date	Depth to Water (feet amsl)	Top of Casing Elevation (feet amsl)	Water Level Elevation (feet amsl)
Unconfined Flow System				
25003	1/10/2022	41.75	5194.26	5152.51
25003	4/26/2022	41.78	5194.26	5152.48
25003	8/2/2022	41.84	5194.26	5152.42
25003	10/31/2022	41.84	5194.26	5152.42
25004	1/10/2022	47.03	5264.96	5217.93
25004	4/26/2022	47.03	5264.96	5217.93
25004	8/2/2022	47.22	5264.96	5217.74
25004	10/31/2022	47.41	5264.96	5217.55
25015	1/10/2022	37.99	5197.23	5159.24
25015	4/26/2022	37.72	5197.23	5159.51
25015	8/2/2022	37.81	5197.23	5159.42
25015	10/31/2022	37.84	5197.23	5159.39
25018	1/10/2022	31.59	5195.61	5164.02
25018	4/26/2022	31.32	5195.61	5164.29
25018	8/2/2022	31.5	5195.61	5164.11
25018	10/31/2022	31.76	5195.61	5163.85
25022	1/10/2022	43.68	5263.66	5219.98
25022	4/26/2022	43.61	5263.66	5220.05
25022	8/2/2022	43.72	5263.66	5219.94
25022	10/31/2022	43.83	5263.66	5219.83
25023	1/10/2022	46.75	5265.08	5218.33
25023	4/26/2022	46.44	5265.08	5218.64
25023	8/2/2022	46.48	5265.08	5218.60
25023	10/31/2022	46.57	5265.08	5218.51
25027	1/10/2022	44.30	5224.84	5180.54
25027	4/26/2022	44.32	5224.84	5180.52
25027	8/2/2022	43.37	5224.84	5181.47
25027	10/25/2022	44.44	5224.84	5180.40
25032	1/10/2022	28.34	5254.89	DRY
25032	4/26/2022	28.35	5254.89	DRY
25032	8/2/2022	28.35	5254.89	DRY
25032	10/25/2022	28.34	5254.89	DRY
25041	1/10/2022	26.30	5210.81	5184.51
25041	4/26/2022	26.09	5210.81	5184.72
25041	8/2/2022	26.34	5210.81	5184.47
25041	10/31/2022	26.55	5210.81	5184.26
25048	1/10/2022	18.57	5190.01	5171.44
25048	4/26/2022	18.31	5190.01	5171.70
25048	8/2/2022	18.51	5190.01	5171.50

Table 2.2-2. 2022 Water Level Measurements Summary

Well ID	Date	Depth to Water (feet amsl)	Top of Casing Elevation (feet amsl)	Water Level Elevation (feet amsl)
25048	10/31/2022	18.78	5190.01	5171.23
25054	1/10/2022	34.13	5207.94	5173.81
25054	4/26/2022	33.93	5207.94	5174.01
25054	8/2/2022	34.02	5207.94	5173.92
25054	10/31/2022	34.24	5207.94	5173.70
25059	1/10/2022	30.56	5208.97	5178.41
25059	4/26/2022	30.34	5208.97	5178.63
25059	8/2/2022	30.53	5208.97	5178.44
25059	10/31/2022	30.74	5208.97	5178.23
25086	1/10/2022	29.72	5212.53	DRY
25086	4/26/2022	29.72	5212.53	DRY
25086	8/2/2022	29.73	5212.53	DRY
25086	10/25/2022	29.73	5212.53	DRY
25087	1/10/2022	44.14	5209.75	5165.61
25087	4/26/2022	43.80	5209.75	5165.95
25087	8/2/2022	43.72	5209.75	5166.03
25087	10/25/2022	44.00	5209.75	5165.75
25088	1/10/2022	19.29	5209.61	DRY
25088	4/26/2022	19.35	5209.61	DRY
25088	8/2/2022	19.38	5209.61	DRY
25088	10/25/2022	19.36	5209.61	DRY
25091	1/10/2022	48.06	5217.43	5169.37
25091	4/26/2022	47.80	5217.43	5169.63
25091	8/2/2022	47.60	5217.43	5169.83
25091	10/25/2022	47.97	5217.43	5169.46
25092	1/10/2022	65.50	5246.11	5180.61
25092	4/26/2022	65.31	5246.11	5180.80
25092	8/2/2022	65.29	5246.11	5180.82
25092	10/25/2022	65.51	5246.11	5180.60
25098	1/10/2022	28.84	5212.80	DRY
25098	4/26/2022	28.86	5212.80	DRY
25098	8/2/2022	29.19	5212.80	DRY
25098	10/25/2022	29.19	5212.80	DRY
25099	1/10/2022	44.08	5212.40	5168.32
25099	4/26/2022	43.79	5212.40	5168.61
25099	8/2/2022	43.28	5212.40	5169.12
25099	10/25/2022	43.95	5212.40	5168.45
25100	1/10/2022	31.32	5216.99	DRY
25100	4/26/2022	31.32	5216.99	DRY
25100	8/2/2022	31.70	5216.99	DRY

Table 2.2-2. 2022 Water Level Measurements Summary

Well ID	Date	Depth to Water (feet amsl)	Top of Casing Elevation (feet amsl)	Water Level Elevation (feet amsl)
25100	10/25/2022	31.71	5216.99	DRY
25102	1/10/2022	63.22	5243.61	5180.39
25102	4/26/2022	63.00	5243.61	5180.61
25102	8/2/2022	60.78	5243.61	5182.83
25102	10/25/2022	63.29	5243.61	5180.32
25105	1/10/2022	38.42	5255.46	5217.04
25105	4/26/2022	38.04	5255.46	5217.42
25105	8/2/2022	37.98	5255.46	5217.48
25105	10/31/2022	38.08	5255.46	5217.38
25106	1/10/2022	56.68	5261.43	5204.75
25106	4/26/2022	56.29	5261.43	5205.14
25106	8/2/2022	56.21	5261.43	5205.22
25106	10/31/2022	56.19	5261.43	5205.24
25120	1/10/2022	48.54	5237.95	5189.41
25120	4/26/2022	48.65	5237.95	5189.30
25120	8/2/2022	48.94	5237.95	5189.01
25120	10/25/2022	49.25	5237.95	5188.70
25121	1/10/2022	71.62	5251.67	5180.05
25121	4/26/2022	71.29	5251.67	5180.38
25121	8/2/2022	71.13	5251.67	5180.54
25121	10/25/2022	71.49	5251.67	5180.18
25122	1/10/2022	Water not encountered at depth due to obstruction in well comprised of sand filter pack	5260.58	—
25122	4/26/2022		5260.58	—
25122	8/2/2022		5260.58	—
25122	10/25/2022		5260.58	—
25189	1/10/2022	35.75	5202.30	5166.55
25189	4/26/2022	35.65	5202.30	5166.65
25189	8/2/2022	35.49	5202.30	5166.81
25189	10/31/2022	35.81	5202.30	5166.49
25194	1/10/2022	34.55	5215.60	5181.05
25194	4/26/2022	34.67	5215.60	5180.93
25194	8/2/2022	34.75	5215.60	5180.85
25194	10/25/2022	34.74	5215.60	5180.86
25203	1/10/2022	55.67	5236.10	5180.43
25203	4/26/2022	55.69	5236.10	5180.41
25203	8/2/2022	55.78	5236.10	5180.32
25203	10/25/2022	55.82	5236.10	5180.28
25500	1/10/2022	40.80	5258.74	5217.94
25500	4/26/2022	40.88	5258.74	5217.86
25500	8/3/2022	41.15	5258.74	5217.59

Table 2.2-2. 2022 Water Level Measurements Summary

Well ID	Date	Depth to Water (feet amsl)	Top of Casing Elevation (feet amsl)	Water Level Elevation (feet amsl)
25500	10/31/2022	41.23	5258.74	5217.51
25502	1/10/2022	39.06	5223.60	5184.54
25502	4/26/2022	38.89	5223.60	5184.71
25502	8/2/2022	39.00	5223.60	5184.60
25502	10/31/2022	39.20	5223.60	5184.40
26040	1/11/2022	49.93	5197.40	5147.47
26040	4/25/2022	50.02	5197.40	5147.38
26040	8/2/2022	50.01	5197.40	5147.39
26040	10/31/2022	49.98	5197.40	5147.42
26051	1/10/2022	56.02	5218.60	5162.58
26051	4/25/2022	56.15	5218.60	5162.45
26051	8/2/2022	56.17	5218.60	5162.43
26051	10/31/2022	56.31	5218.60	5162.29
26073	1/10/2022	47.68	5225.41	5177.73
26073	4/25/2022	47.74	5225.41	5177.67
26073	8/3/2022	47.71	5225.41	5177.70
26073	10/31/2022	47.74	5225.41	5177.67
26097	1/10/2022	57.83	5242.25	5184.42
26097	4/25/2022	57.84	5242.25	5184.41
26097	8/3/2022	57.82	5242.25	5184.43
26097	10/31/2022	57.87	5242.25	5184.38
26099	1/10/2022	50.09	5232.31	5182.22
26099	4/25/2022	50.18	5232.31	5182.13
26099	8/2/2022	50.06	5232.31	5182.25
26099	10/25/2022	50.35	5232.31	5181.96
26158	1/10/2022	35.30	5214.88	5179.58
26158	4/25/2022	35.40	5214.88	5179.48
26158	8/3/2022	35.28	5214.88	5179.60
26158	10/31/2022	35.32	5214.88	5179.56
26159	1/10/2022	31.16	5233.75	5202.59
26159	4/25/2022	31.31	5233.75	5202.44
26159	8/3/2022	31.45	5233.75	5202.30
26159	10/31/2022	31.30	5233.75	5202.45
26164	1/10/2022	44.90	5189.26	5144.36
26164	4/25/2022	44.94	5189.26	5144.32
26164	8/2/2022	44.96	5189.26	5144.30
26164	10/31/2022	44.98	5189.26	5144.28
26170	1/10/2022	44.15	5184.02	5139.87
26170	4/25/2022	44.22	5184.02	5139.80
26170	8/2/2022	44.25	5184.02	5139.77

Table 2.2-2. 2022 Water Level Measurements Summary

Well ID	Date	Depth to Water (feet amsl)	Top of Casing Elevation (feet amsl)	Water Level Elevation (feet amsl)
26170	10/31/2022	44.30	5184.02	5139.72
26175	1/10/2022	49.50	5206.29	5156.79
26175	4/25/2022	49.52	5206.29	5156.77
26175	8/2/2022	49.29	5206.29	5157.00
26175	10/31/2022	49.48	5206.29	5156.81
26176	1/10/2022	47.28	5206.02	DRY
26176	4/25/2022	47.40	5206.02	DRY
26176	8/2/2022	47.40	5206.02	DRY
26176	10/31/2022	47.30	5206.02	DRY
26177	1/10/2022	56.37	5214.92	5158.55
26177	4/25/2022	56.58	5214.92	5158.34
26177	8/2/2022	56.22	5214.92	DRY
26177	10/31/2022	56.69	5214.92	5158.23
26178	1/10/2022	34.31	5214.73	DRY
26178	4/25/2022	34.35	5214.73	DRY
26178	8/2/2022	34.41	5214.73	DRY
26178	10/31/2022	34.36	5214.73	DRY
26179	1/10/2022	56.75	5224.89	5168.14
26179	4/25/2022	56.62	5224.89	5168.27
26179	8/2/2022	56.19	5224.89	5168.70
26179	10/31/2022	56.49	5224.89	5168.40
26180	1/10/2022	46.85	5224.57	5177.72
26180	4/25/2022	46.94	5224.57	5177.63
26180	8/2/2022	46.88	5224.57	5177.69
26180	10/31/2022	47.03	5224.57	5177.54
26181	1/10/2022	50.65	5217.82	5167.17
26181	4/25/2022	50.60	5217.82	5167.22
26181	8/2/2022	49.38	5217.82	5168.44
26181	10/31/2022	50.65	5217.82	5167.17
26182	1/10/2022	40.93	5217.22	5176.29
26182	4/25/2022	41.01	5217.22	5176.21
26182	8/2/2022	40.99	5217.22	5176.23
26182	10/31/2022	41.06	5217.22	5176.16
26183	1/10/2022	49.05	5214.81	5165.76
26183	4/25/2022	49.12	5214.81	5165.69
26183	8/2/2022	48.44	5214.81	5166.37
26183	10/31/2022	49.30	5214.81	5165.51
26184	1/10/2022	42.45	5214.94	DRY
26184	4/25/2022	42.48	5214.94	DRY
26184	8/2/2022	42.49	5214.94	DRY

Table 2.2-2. 2022 Water Level Measurements Summary

Well ID	Date	Depth to Water (feet amsl)	Top of Casing Elevation (feet amsl)	Water Level Elevation (feet amsl)
26184	10/31/2022	42.48	5214.94	DRY
26186	1/10/2022	43.41	5207.79	5164.38
26186	4/25/2022	43.50	5207.79	5164.29
26186	8/2/2022	43.40	5207.79	5164.39
26186	10/31/2022	43.61	5207.79	5164.18
36186	3/31/2022	48.41	5286.23	5237.82
36186	4/26/2022	48.42	5286.23	5237.81
36186	8/2/2022	49.65	5286.23	5236.58
36186	10/31/2022	50.16	5286.23	5236.07
Confined Flow System				
25016	1/10/2022	45.03	5198.31	5153.28
25016	4/26/2022	44.95	5198.31	5153.36
25016	8/2/2022	45.02	5198.31	5153.29
25016	10/31/2022	45.09	5198.31	5153.22
25017	1/10/2022	43.24	5197.67	5154.43
25017	4/26/2022	43.11	5197.67	5154.56
25017	8/2/2022	43.18	5197.67	5154.49
25017	10/31/2022	43.28	5197.67	5154.39
25019	1/10/2022	31.76	5193.85	5162.09
25019	4/26/2022	31.67	5193.85	5162.18
25019	8/2/2022	31.66	5193.85	5162.19
25019	10/31/2022	31.77	5193.85	5162.08
25020	1/10/2022	47.17	5195.25	5148.08
25020	4/26/2022	46.79	5195.25	5148.46
25020	8/2/2022	46.93	5195.25	5148.32
25020	10/31/2022	47.15	5195.25	5148.10
25021	1/10/2022	66.06	5240.10	5174.04
25021	4/26/2022	66.01	5240.10	5174.09
25021	8/4/2022	66.10	5240.10	5174.00
25021	10/31/2022	66.13	5240.10	5173.97
25024	1/10/2022	62.78	5265.04	5202.26
25024	4/26/2022	63.18	5265.04	5201.86
25024	8/2/2022	62.39	5265.04	5202.65
25024	10/31/2022	62.75	5265.04	5202.29
25034	1/10/2022	83.54	5255.60	5172.06
25034	4/26/2022	83.09	5255.60	5172.51
25034	8/2/2022	82.79	5255.60	5172.81
25034	10/25/2022	83.14	5255.60	5172.46
25085	1/10/2022	48.78	5212.91	5164.13
25085	4/26/2022	48.63	5212.91	5164.28

Table 2.2-2. 2022 Water Level Measurements Summary

Well ID	Date	Depth to Water (feet amsl)	Top of Casing Elevation (feet amsl)	Water Level Elevation (feet amsl)
25085	8/2/2022	48.45	5212.91	5164.46
25085	10/25/2022	48.71	5212.91	5164.20
25093	1/10/2022	75.01	5245.76	5170.75
25093	4/26/2022	74.63	5245.76	5171.13
25093	8/2/2022	74.48	5245.76	5171.28
25093	10/25/2022	74.62	5245.76	5171.14
25101	1/10/2022	77.91	5251.19	5173.28
25101	4/26/2022	77.69	5251.19	5173.50
25101	8/2/2022	77.58	5251.19	5173.61
25101	10/25/2022	77.67	5251.19	5173.52
25123	1/10/2022	84.60	5259.86	5175.26
25123	4/26/2022	84.51	5259.86	5175.35
25123	8/2/2022	84.56	5259.86	5175.30
25123	10/25/2022	84.63	5259.86	5175.23
25183	1/10/2022	43.20	5206.80	5163.60
25183	4/26/2022	43.16	5206.80	5163.64
25183	8/2/2022	43.07	5206.80	5163.73
25183	10/25/2022	43.24	5206.80	5163.56
25195	1/10/2022	50.08	5215.50	5165.42
25195	4/26/2022	50.21	5215.50	5165.29
25195	8/2/2022	50.12	5215.50	5165.38
25195	10/25/2022	50.26	5215.50	5165.24
26150	1/10/2022	49.63	5220.96	5171.33
26150	4/25/2022	49.80	5220.96	5171.16
26150	8/3/2022	49.72	5220.96	5171.24
26150	10/31/2022	49.84	5220.96	5171.12
26185	1/10/2022	56.85	5208.53	5151.68
26185	4/25/2022	56.89	5208.53	5151.64
26185	8/2/2022	57.00	5208.53	5151.53
26185	10/31/2022	57.11	5208.53	5151.42

Notes:
amsl – above mean sea level

Table 2.3-1. ELF Water Quality Monitoring Network

Well Number	Groundwater Flow System	Aquifer	Upgradient/ Downgradient
25021	Confined	Denver Formation	Upgradient
25022	Unconfined	Denver Formation	Upgradient
25024	Confined	Denver Formation	Upgradient
25092	Unconfined	Denver Formation	Downgradient
25093	Confined	Denver Formation	Downgradient
25102	Unconfined	Denver Formation	Downgradient
25105	Unconfined	Denver Formation	Upgradient
25106	Unconfined	Denver Formation	Upgradient
25120	Unconfined	Denver Formation	Downgradient
25121	Unconfined	Denver Formation	Cross-gradient
25123	Confined	Denver Formation	Upgradient
26099	Unconfined	Denver Formation	Downgradient

Note:
Well 25106 reclassified as being screened in the Denver Formation based on records evaluation.

Table 2.3-2. Water Quality Monitoring Analyte List

Method/Analyte Name	Test Name
Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry	
1,1,1-Trichloroethane	**111TCE**
1,1,2-Trichloroethane	112TCE
1,1-Dichloroethane	**11DCLE**
1,1-Dichloroethene	**11DCE**
1,2-Dichloroethane	**12DCLE**
1,2-Dichlorobenzene	12DCLB
1,3-Dichlorobenzene	13DCLB
1,4-Dichlorobenzene	14DCLB
1,2-Dichloropropane	12DCLP
1,2-Dimethylbenzene	12DMB
1,1,2,2-Tetrachloroethane	TCLEA
Acetone	ACET
Acrylonitrile	ACRYLO
Benzene	**C6H6**
Bicycloheptadiene	BCHPD
Bromodichloromethane	BRDCLM
Bromoform	CHBR3
Bromomethane	CH3BR
Carbon Disulfide	CS2
Carbon tetrachloride	**CCL4**
Chlorobenzene	CLC6H5
Chloroethane	C2H5CL
cis-1,2-Dichloroethene	C12DCE
cis-1,3-Dichloropropene	C13DCP
Dichlorodifluoromethane	CCL2F2
Chloroform	**CHCL3**
Chloromethane	CH3CL
Dibromochloromethane	DBRCLM
Dibromochloropropane	DBCP
Dicyclopentadiene	DCPD
Ethylbenzene	ETC6H5
Methylene chloride	CH2CL2
Methyl ethyl ketone	MEK
Methyl isobutyl ketone	MIBK
Methyl-n-butyl ketone	MNBK
Styrene	STYR
trans-1,2-Dichloroethene	T12DCE
trans-1,3-Dichloropropene	T13DCP
Tetrachloroethene	TCLEE
Trichlorofluoromethane	CCL3F

Table 2.3-2. Water Quality Monitoring Analyte List

Method/Analyte Name	Test Name
Toluene	MEC6H5
Trichloroethene	TRCLE
Vinyl chloride	C2H3CL
Xylenes	XYLEN
Organochlorine Pesticides	
Dichlorodiphenyl dichloroethane	PPDDD
Dichlorodiphenyl dichloroethene	PPDDE
Dichlorodiphenyl trichloroethane	PPDDT
Aldrin	ALDRN
alpha-Endosulfan	AENSLF
alpha-Chlordane	ACLDAN
Dieldrin	**DLDRN**
Endrin	ENDRN
Endrin aldehyde	ENDRNA
Endrin ketone	ENDRNK
gamma-Chlordane	GCLDAN
Hexachlorocyclopentadiene	CL6CP
Isodrin	ISODR
Methoxychlor	MEXCLR
Organosulfur Compounds	
1,4-Oxathiane	OXAT
Benzothiazole	BTZ
Dimethyl disulfide	DMDS
Dithiane	DITH
p-Chlorophenylmethyl sulfide	CPMS
p-Chlorophenylmethyl sulfoxide	CPMSO
p-Chlorophenylmethyl sulfone	CPMSO2
Organophosphorus Compounds by Gas Chromatography	
Dimethyl methyl phosphonate	DMMP
Diisopropyl methyl phosphonate	**DIMP**
Mercury by Cold Vapor Atomic Absorption	
Mercury	HG
Arsenic by Graphite Furnace Atomic Adsorption	
Arsenic	AS
Metals/Cations by Inductively Coupled Argon Plasma	
Aluminum	AL
Barium	BA
Beryllium	BE
Boron	B
Antimony	SB
Cadmium	CD

Table 2.3-2. Water Quality Monitoring Analyte List

Method/Analyte Name	Test Name
Calcium	CA
Chromium	**CR**
Cobalt	CO
Copper	CU
Iron	FE
Lead	**PB**
Magnesium	MG
Manganese	MN
Nickel	NI
Potassium	K
Selenium	SE
Silver	AG
Sodium	NA
Thallium	TL
Vanadium	V
Zinc	ZN
Cyanide by Colorimetric Method	
Cyanide	CYN
Ammonia	
Ammonia	NH3
Alkalinity	
Alkalinity	ALK
Anions	
Bromide	BR
Chloride	CL
Fluoride	F
Nitrate	NO3
Nitrite	NO2
Orthophosphate	PO4ORT
Sulfate	SO4
Nitrosamines	
n-Nitrosodimethylamine	NNDMEA
Nitrogen-Phosphorus Pesticides	
Atrazine	ATZ
Malathion	MLTHN
Parathion	PRTHN
Supona	SUPONA
Vapona	DDVP
Organic Carbon	
Total organic carbon	TOC
Dissolved organic carbon	DOC

Table 2.3-2. Water Quality Monitoring Analyte List

Method/Analyte Name	Test Name
Agent Degradation Products by High Performance Liquid Chromatography	
Thiodiglycol	TDGCL
Agent Products by Ion Chromatography	
Isopropyl methylphosphonic acid	IMPA
Kjeldahl Nitrogen	
Nitrogen by Kjeldahl method	N2KJEL

Note:

Individual analytes in **Bold** are Indicator Compounds.

Table 2.3-3: Quality Control Samples

Sample Type/Site ID	Sample Date(s)
Field Duplicate	
25105	5/10/2022
Lab Duplicates	
25022	4/28/2022
25092	5/3/2022
25105	5/10/2022
25102	5/31/2022
25093	6/7/2022
Field Blanks	
22512	1/18/2022
22106	5/10/2022
25183	5/11/2022

Table 3.0-1. ELF Groundwater Monitoring Well Usage

Well/ Designation	Data Used to Calculate Current (2022) Prediction Limits			Prediction Limits Applied to Downgradient Wells (Quarterly in 2022)
	Data Used to Calculate Baseline (2010) Prediction Limits		Upgradient Data from Post-Closure Monitoring Period used to Calculate Prediction Limits 5/27/2010 to 5/4/2021	
	Upgradient Data from Preoperational Monitoring Period used to Calculate Prediction Limits 10/1/2003 to 3/31/2006	Upgradient Data from Operational/Closure Monitoring Period used to Calculate Prediction Limits 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. Detection of carbon tetrachloride and chloroform in cross-gradient well 25121 suggests the well is in a flow path with the NP/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 NP/Bedrock Ridge plume contaminants. It is not used to calculate the prediction limits for ELF.

Analytical results from the pre-operational, operational, closure, and post-closure monitoring periods utilized to calculate the current ELF prediction limits are available in the Supporting Documentation folder.

Table 3.0-2. Prediction Limits for ELF 2022 Water Quality Monitoring

Indicator Compound	Current Method Reporting Limit (µg/L)	Proportion of Upgradient Non-detected Sample Values (2003-2021)	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]	0.202	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	0.5	98.3	Non-parametric	1.21
Metals				
Arsenic	1	78	Non-parametric	11.5
Chromium	10	99.6	Non-parametric	10.4
Lead	3	70.2	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

Table 3.0-3. Prediction Limits for ELF 2023 Water Quality Monitoring

Indicator Compound	Current Method Reporting Limit (µg/L)	Proportion of Upgradient Non-detected Sample Values (2003-2022)	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 purposes 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

FIGURES

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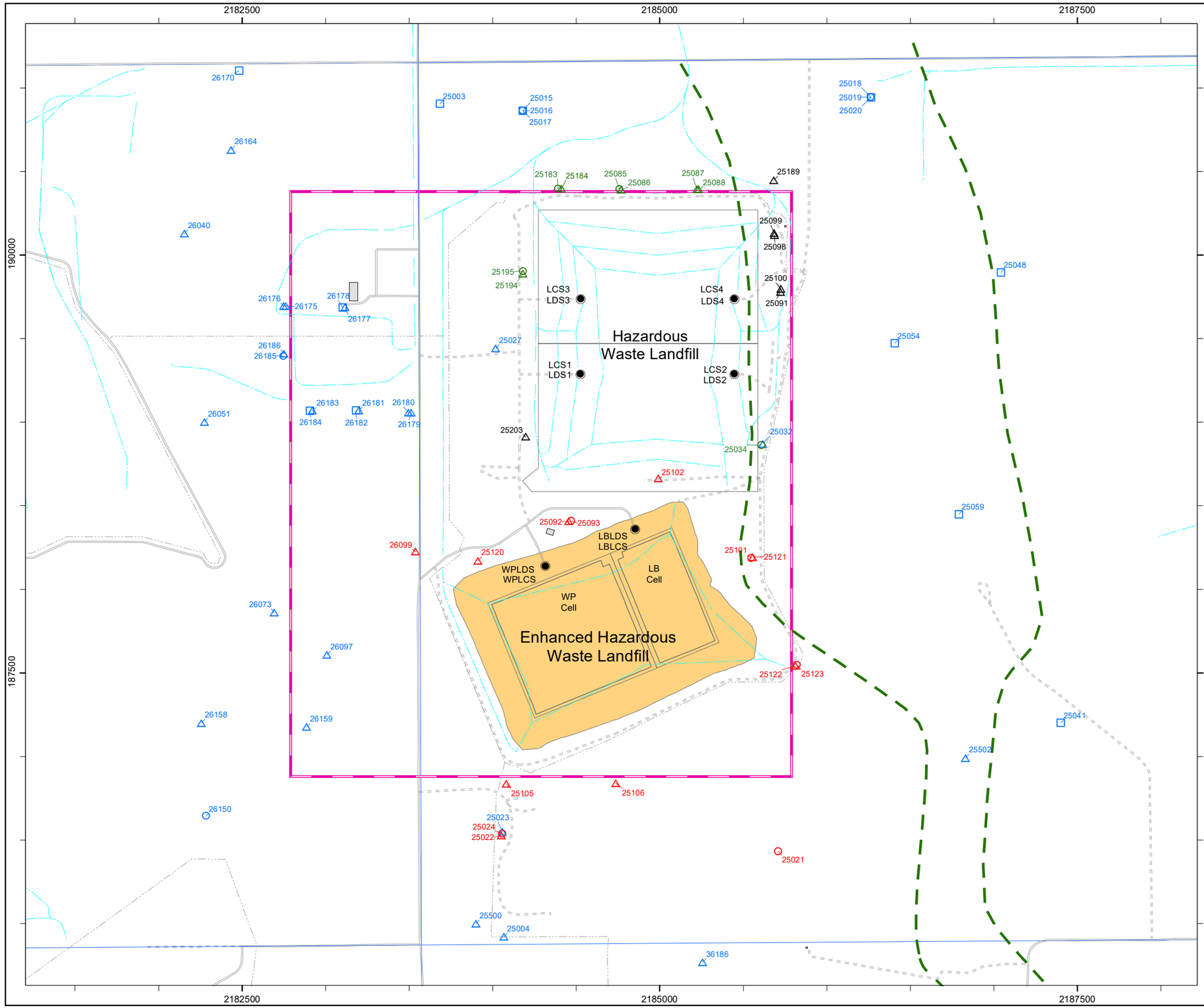

Legend

- 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

Program Manager
Rocky Mountain Arsenal

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Figure 2.2-1

Well/Piezometer/Sump Location Map
2022 Groundwater Monitoring

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5/25/2022

2182500 2185000 2187500

190000 187500

Hazardous Waste Landfill

Cell 2

Cell 1

Enhanced Hazardous Waste Landfill

WP Cell

LB Cell

26170 5139.8
26164 5144.32
26040 5147.38
26175 5156.77
26177 5158.34
26186 5164.29
26051 5162.45
26183 5165.69
26182 5176.21
26180 5177.63
26073 5171.67
26097 5184.41
26156 5179.48
26159 5202.44
25003 5152.48
25015 5159.51
25018 5164.29
25086 DRY
25087 5165.95
25189 5166.65
25099 5168.61
25194 5180.93
25091 5169.63
25048 5171.7
25027 5180.52
25054 5174.01
25203 5180.41
25102 5180.61
25092 5180.8
25059 5178.63
26099 5182.13
25120 5189.3
25121 5180.38
25122 5231.56
25041 5184.72
25502 5184.71
25105 5217.42
25106 5205.14
25022 5220.05
25021 5174.09
25500 5217.86
25004 5217.93
36186 5237.81

5140 5145 5150 5155 5160 5165 5170 5175 5180 5185 5190 5195 5200 5205 5210 5215 5220 5225 5230 5235

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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Rocky Mountain Arsenal

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Figure 2.2-2

Potentiometric Surface of the Unconfined Flow System, Enhanced Hazardous Waste Landfill April 2022

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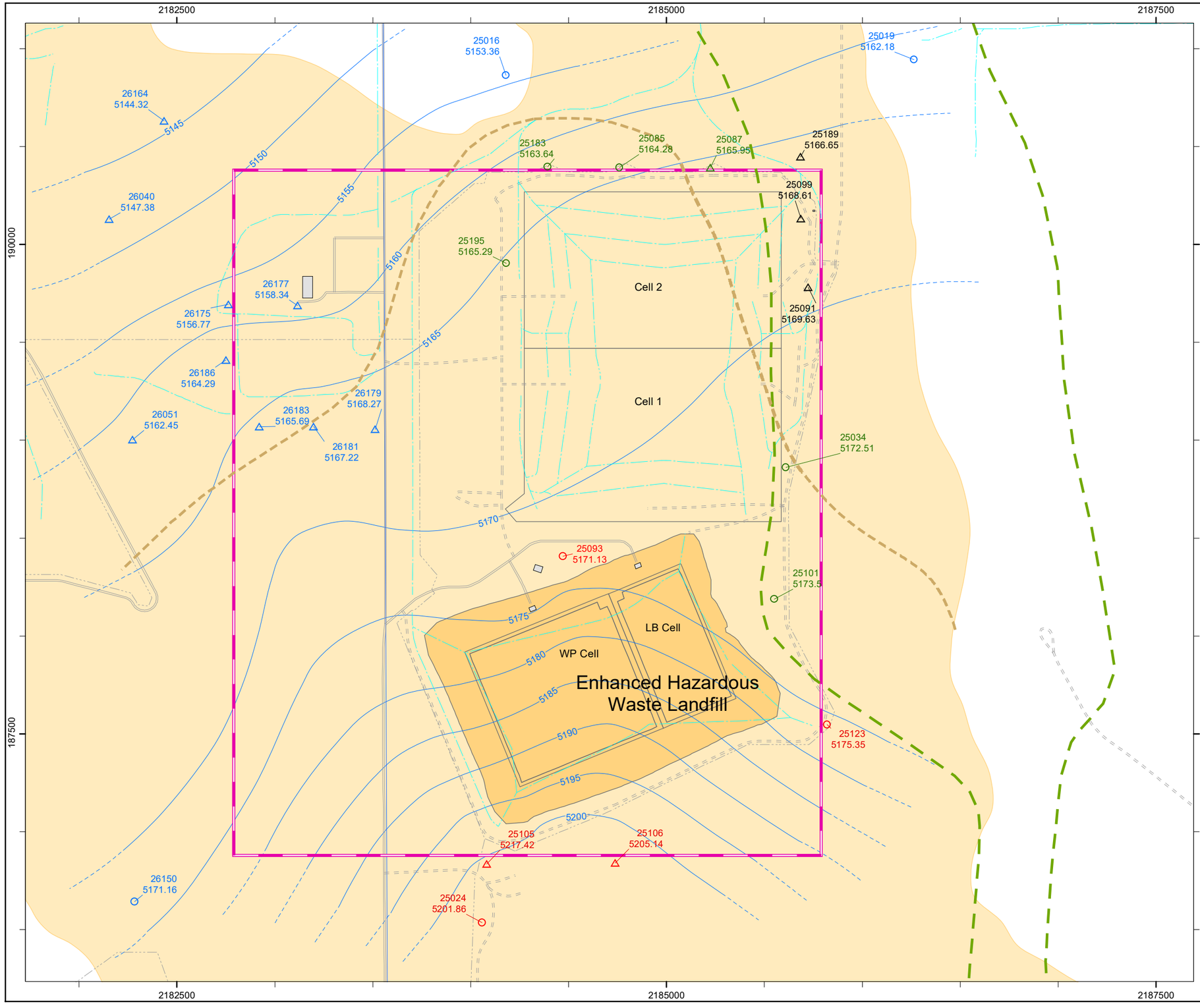
5/30/2023



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 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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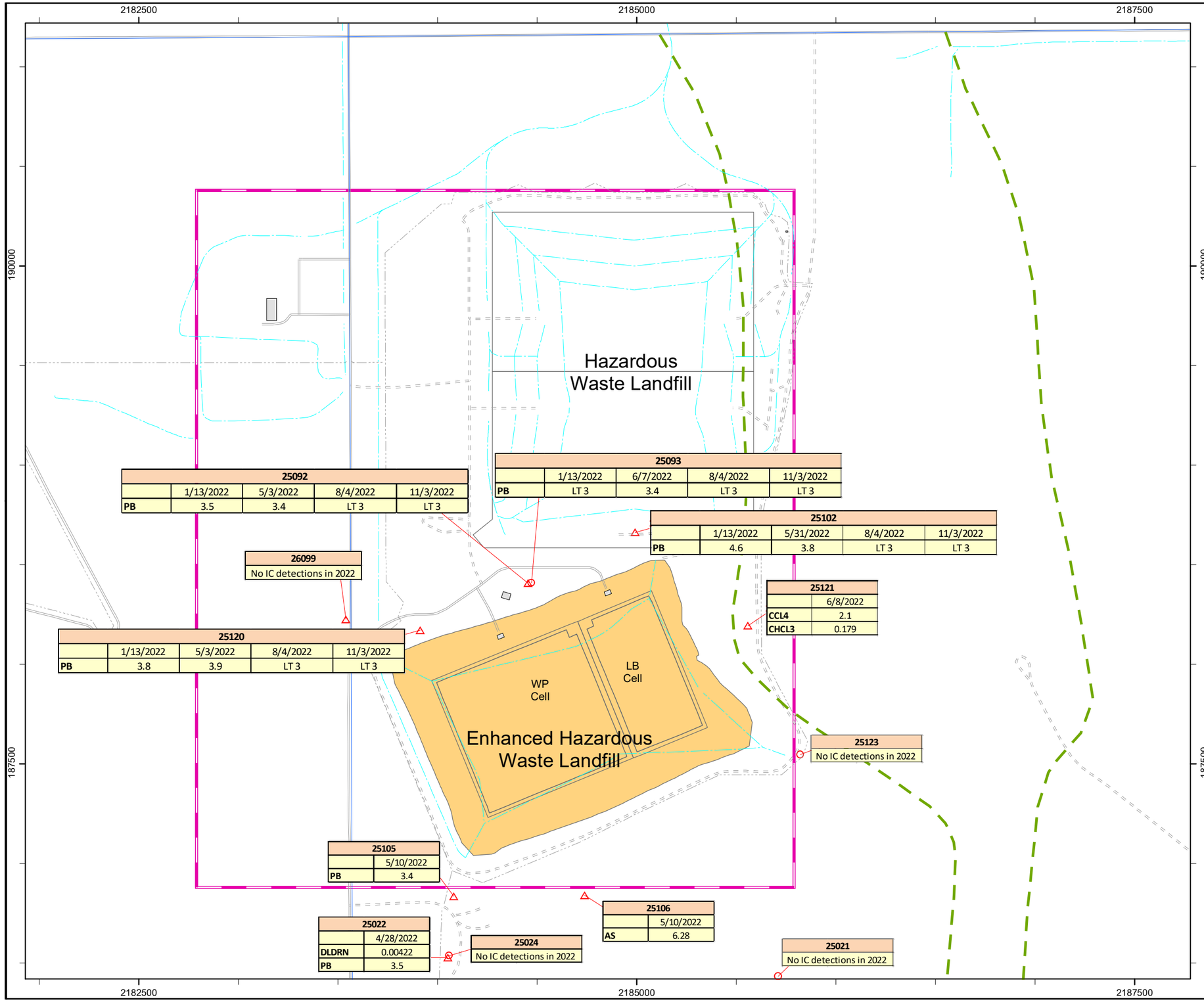
Figure 2.2-3

Potentiometric Surface for the
Lower Sandstone Unit and Equivalent Units,
April and May 2022

M:\projects\elf_post-closure\2022\mxds\elf_lwr_sandstoneWL2022.mxd
5/16/2023



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 2022
[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

Program Manager
Rocky Mountain Arsenal

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Figure 2.3-1

Indicator Compounds Detection Map
2022 Groundwater Monitoring

M:\projects\elf_post-closure\2022\mxds\elf_ind_cmpd_detection_2022_new.mxd
5/30/2023