LMS/43755

2023 Annual Site Inspection and Monitoring Report for Uranium Mill Tailings Radiation Control Act Title I Disposal Sites

March 2024

U.S. DEPARTMENT OF ENERGY | Legacy Management

This document has been designed for online viewing.

Contents

Abbreviations

ACL	alternate concentration limit
AML	Abandoned Mine Lands
BLM	U.S. Bureau of Land Management
CFR	*Code of Federal Regulations*
D_{50}	mean diameter
DEP	Department of Environmental Protection
DOE	U.S. Department of Energy
EDA	energy dissipation area
EPA	U.S. Environmental Protection Agency
ft	feet
FY	fiscal year
GCAP	Groundwater Compliance Action Plan
GEMS	Geospatial Environmental Mapping System
gpm	gallons per minute
GSMT	geotechnical sampling and materials testing
GWTP	groundwater treatment plant
HDPE	high-density polyethylene
IC	institutional control
ICP	interim cover protection
lidar	light detection and ranging
LM	Office of Legacy Management
LMS	Legacy Management Support
LOESS	locally estimated scatterplot smoothing
LTSP	Long-Term Surveillance Plan
MCL	maximum concentration limit
mg/L	milligrams per liter
N	nitrogen
NAVD 88	North American Vertical Datum of 1988
NGVD 29	National Geodetic Vertical Datum of 1929
NLN	National Laboratory Network
NMED	New Mexico Environment Department
NRC	U.S. Nuclear Regulatory Commission

PCB	polychlorinated biphenyl
PL	photograph location
POC	point of compliance
POE	point of exposure
SOARS	System Operation and Analysis at Remote Sites
TDS	total dissolved solids
UAS	unmanned aircraft system
UBL	upper baseline limit
UMTRCA	Uranium Mill Tailings Radiation Control Act
USDA	U.S. Department of Agriculture

Executive Summary

This report, in fulfillment of a U.S. Nuclear Regulatory Commission (NRC) license requirement, presents the results of long-term surveillance and maintenance activities conducted by the U.S. Department of Energy (DOE) Office of Legacy Management (LM) in 2023. These activities occurred at the 19 uranium mill tailings disposal sites established under Title I of the Uranium Mill Tailings Radiation Control Act (UMTRCA)[1] and verify that the UMTRCA Title I disposal sites remain in compliance with license requirements and Long-Term Surveillance Plans (LTSPs). Individual chapters for each site are available on the LM public website at https://energy.gov/lm/sites/lm-sites.

LM manages 18 UMTRCA Title I disposal sites under a general license granted by NRC in accordance with Title 10 *Code of Federal Regulations* Section 40.27 (10 CFR 40.27). LM also manages the UMTRCA Title I Grand Junction, Colorado, Disposal Site, which will not be included under the general license until the operating portion of the disposal cell is closed. Low-level radioactive waste will be received until the disposal cell's legally mandated closure date or until it is filled to capacity, whichever comes first. In December 2020, Congress passed legislation that extended the final disposal cell closure date from 2023 to 2031. Unless additional legislation is enacted by Congress that further extends the final cell closure date, LM's receipt of radioactive waste at the site will cease in September 2031.

Long-term surveillance and maintenance activities for these sites include inspecting and maintaining the sites; monitoring environmental media and institutional controls; conducting any necessary corrective actions; and performing stakeholder relations and administrative, recordkeeping, and other regulatory stewardship functions.

Annual site inspections and monitoring are conducted in accordance with site-specific LTSPs[2] and procedures established by DOE to comply with license requirements. Each site inspection is performed to verify the integrity of visible features at the site; identify changes or new conditions that may affect the long-term performance of the site; and determine the need for maintenance, follow-up inspections, or corrective action in accordance with the LTSPs.

All sites require some degree of routine monitoring and maintenance, which may include groundwater and surface water monitoring, minor erosion control, vegetation control, fence and gate repairs, sign replacement, and minor trash removal.

The following nonroutine activities[3] occurred in 2023:

- The Rifle, Colorado, Disposal/Processing Site continues to accumulate pore water, and water levels in the disposal cell are increasing despite active pumping of pore water from the disposal cell into an evaporation pond. Three unplanned system shutdowns occurred since the 2022 annual site inspection that caused the elevation of the pore water within the disposal cell to rise above the elevation of the top of the disposal cell liner for short durations. To address these issues, DOE has initiated accelerated planning and associated

[1] Congress directed that the Moab, Utah, Processing Site be remediated under Title I of UMTRCA. This site eventually will become the 20th Title I disposal site.

[2] The Grand Junction disposal site is inspected in accordance with an interim LTSP.

[3] Nonroutine activities are implemented in response to changes in site conditions, regulatory setting, or management structure following a regulatory compliance review.

actions to increase the extraction and management of pore water building up within the disposal cell. This will include optimization of the existing pumping infrastructure and installation of additional extraction wells, power, and evaporation capacity. DOE plans to complete the work in fiscal year (FY) 2024. In November 2023, new discharge pipelines were installed and buried in the disposal cell frost barrier to protect against freezing. The NRC-approved evapotranspiration cover conversion pilot study at the Grand Junction disposal site was initiated in 2020 and continued in 2023. The pilot study is conducted on the in-service disposal cell cover and focuses on investigating vegetation management, radon diffusion, plant uptake of contaminants, monitoring techniques, and water balance. The study was designed as a long-term investigation and is expected to continue for several more years.

- To facilitate operational safety associated with the receipt and placement of additional material in the disposal cell, DOE initiated upgrades to the Grand Junction disposal site infrastructure in 2023. The upgrades are planned for completion in 2024.

Results of the annual site inspection, maintenance, and monitoring activities are reported in the site-specific chapters that follow this summary. Table ES-1 summarizes actions and issues.

Table ES-1. 2023 Summary of UMTRCA Title I Site Actions and Issues

Site	Chapter	Page	Actions and Issues
Ambrosia Lake, New Mexico	1	1-6	No maintenance needs were identified
		1-6	Groundwater monitoring was conducted
Burrell, Pennsylvania	2	2-8	No-trespassing signs were installed along the southern edge of the property
		2-8	Groundwater monitoring was conducted
Canonsburg, Pennsylvania	3	3-7	Well pads will be repaired at monitoring wells 0424 and 0412
		3-8	Groundwater monitoring was conducted
Durango, Colorado	4	4-6	Weeds and trees on the side and top slopes of the disposal cell were treated
		4-6	Groundwater monitoring was conducted
Falls City, Texas	5	5-7	A portion of the perimeter fence was replaced
		5-8	Groundwater monitoring was conducted
Grand Junction, Colorado	6	6-8	Repairs on the areas adjacent to the perimeter road were continued
		6-8	Groundwater monitoring was conducted
Green River, Utah	7	7-6	Vegetation along the security fence was treated
		7-6	Groundwater monitoring was conducted
Gunnison, Colorado	8	8-6	Barbed-wire gates were replaced with metal gates
		8-6	No groundwater monitoring was required in 2023
Lakeview, Oregon	9	9-7	Fence repairs will be conducted
		9-7	No groundwater monitoring was required in 2023
Lowman, Idaho	10	10-5	Coniferous ponderosa pine and Douglas fir trees on the disposal cell cover were treated
		10-5	No groundwater monitoring was required

Table ES-1. 2023 Summary of UMTRCA Title I Site Actions and Issues (continued)

Site	Chapter	Page	Actions and Issues
Maybell, Colorado	11	11-6	The damaged fence line was repaired
		11-6	No groundwater monitoring was required
Mexican Hat, Utah	12	12-7	Fence and perimeter sign improvements were made
		12-8	Observational seep monitoring was conducted
Naturita, Colorado	13	13-5	Erosion near the gate post between boundary monuments BM-9 and BM-10 was repaired
		13-6	Vegetation monitoring was conducted
Rifle, Colorado	14	14-7	Tamarisk was treated in the toe drain
		14-8	Disposal cell pore-water level monitoring was conducted
		14-8	New discharge pipelines were installed and buried in the disposal cell
Salt Lake City, Utah	15	15-6	Vegetation was removed along the eastern perimeter fence
		15-7	No groundwater monitoring was required
Shiprock, New Mexico	16	16-6	Deep-rooted woody shrubs on the disposal cell were treated
		16-6	No disposal cell performance monitoring was required
Slick Rock, Colorado	17	17-6	Rills and gullies forming along site marker SMK-1 were repaired
		17-6	No groundwater monitoring was required
Spook, Wyoming	18	18-5	The label on quality control monument QC-3 was corrected
		18-5	No groundwater monitoring was required
Tuba City, Arizona	19	19-7	The sand deposition gage at perimeter sign P9 was installed
		19-7	Semiannual groundwater monitoring was conducted

1.0 Ambrosia Lake, New Mexico, Disposal Site

1.1 Compliance Summary

The Ambrosia Lake, New Mexico, Uranium Mill Tailings Radiation Control Act (UMTRCA) Title I Disposal Site was inspected on March 7, 2023. No changes were observed on the disposal cell or in the associated drainage features. Inspectors identified no immediate maintenance needs and found no cause for a follow-up or contingency inspection.

Groundwater monitoring is not required at the site. However, the U.S. Department of Energy (DOE) Office of Legacy Management (LM) conducts groundwater monitoring every 3 years at three wells as a best management practice at the request of the New Mexico Environment Department (NMED). The most recent groundwater sampling event with results to report occurred on November 1, 2022. The results from that sampling event are included in Section 1.7 of this chapter.

1.2 Compliance Requirements

Requirements for the long-term surveillance and maintenance of the site are specified in the site-specific Long-Term Surveillance Plan (DOE 1996) (LTSP) in accordance with procedures established to comply with the requirements of the U.S. Nuclear Regulatory Commission (NRC) general license at Title 10 *Code of Federal Regulations* Section 40.27 (10 CFR 40.27). Table 1-1 lists these requirements.

Table 1-1. License Requirements for the Ambrosia Lake, New Mexico, Disposal Site

Requirement	LTSP	This Report	10 CFR 40.27
Annual Inspection and Report	Section 6.0	Section 1.4	(b)(3)
Follow-Up or Contingency Inspections	Section 7.0	Section 1.5	(b)(4)
Maintenance and Repairs	Section 8.0	Section 1.6	(b)(5)
Groundwater Monitoring	Section 5.0	Section 1.7	(b)(2)
Corrective Action	Section 9.0	Section 1.8	--

1.3 Institutional Controls

The 288-acre site, identified by the property boundary shown in Figure 1-1, is owned by the United States and was accepted under the NRC general license in 1998. DOE is the licensee and, in accordance with the requirements for UMTRCA Title I sites, LM is responsible for the custody and long-term care of the site. Institutional controls (ICs) at the site include federal ownership of the property, administrative controls, and the following physical ICs that are inspected annually: the disposal cell and associated drainage features, access road, entrance sign, perimeter signs, site markers, survey and boundary monuments, mine vent shaft, quality control monuments, and wellhead protectors.

1.4 Inspection Results

Inspection of the site, 25 miles north of Grants, New Mexico, was conducted by J. Cario, C. Murphy, and T. Santonastaso of the Legacy Management Support contractor. J. Tallbull (LM), M. Young (LM site manager), and A. Rheubottom (NMED) attended the inspection. The purposes of the inspection were to confirm the integrity of visible features at the site, identify changes in conditions that might affect conformance with the LTSP, and evaluate whether maintenance or follow-up inspection and monitoring are needed.

1.4.1 Site Surveillance Features

Figure 1-1 shows the locations of site features, including site surveillance features and inspection areas, in black and gray font. Some site features that are present but not required to be inspected are shown in italic font. Observations from previous inspections that are currently monitored are shown in blue, and new observations identified during the 2023 annual inspection are shown in red. Inspection results and recommended maintenance activities associated with site surveillance features are described in the following subsections. Photographs to support specific observations are noted in the text and in Figure 1-1 by photograph location (PL) numbers. The photographs and photograph log are presented in Section 1.10.

1.4.1.1 Access Road, Entrance Gate, and Entrance Sign

Access to the site is from a gravel road that crosses private property and leads to the site approximately 1 mile from New Mexico Highway 509. Entrance to the site is through a locked steel gate at the intersection of the access road and Highway 509. The access road continues east past the site to private mining and grazing interests. The gate and access road are owned by Rio Algom Mining LLC. LM has been granted permanent access to the site but does not maintain the gate or the access road. The entrance sign is near the access road next to site marker SMK-1 (PL-1). No maintenance needs were identified.

1.4.1.2 Perimeter Signs

There are 70 perimeter signs, attached to steel posts set in concrete, positioned along the unfenced property boundary. Posts for perimeter signs P1 through P15 include additional warning signs about mining restrictions. Many of the perimeter signs were cracked and weathered but remain legible. Erosional gullies have formed around the base of perimeter signs P12 (PL-2), P38, and P41, but all perimeter signs are stable. Prairie dog colonies were identified near perimeter signs P17 and P18 during the 2021 inspection and observed again in 2022 and 2023. The colony does not threaten the integrity of either of the perimeter signs, therefore, no additional action is needed. No maintenance needs were identified.

1.4.1.3 Site Markers

The site has two granite site markers. Site marker SMK-1 (PL-3) is just inside the site entrance, and site marker SMK-2 is on the top slope of the disposal cell. No maintenance needs were identified.

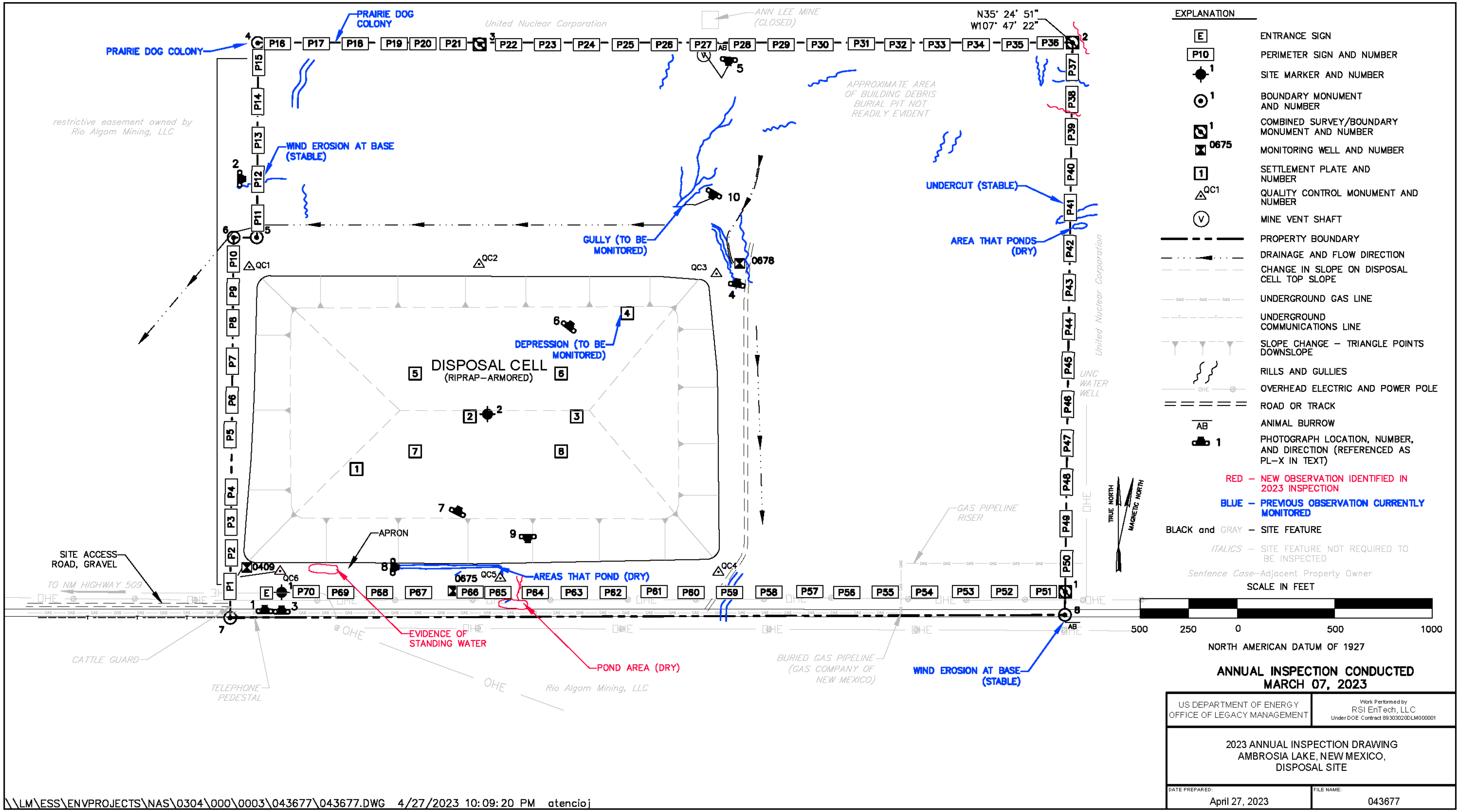


Figure 1-1. 2023 Annual Inspection Drawing for the Ambrosia Lake, New Mexico, Disposal Site

1.4.1.4 Survey and Boundary Monuments

Three combined survey and boundary monuments and five additional boundary monuments delineate the property corners and boundary. Steel T-posts were installed next to boundary monuments to help inspectors locate them. At boundary monument BM-2, a new erosional gully has developed since 2022 inspection. The boundary monument is stable but monitoring will continue. Erosion has occurred around the base of boundary monument BM-8, but the monument is stable. Prairie dog colonies were observed near boundary monument BM-4 in 2021. Neither the erosion nor the colony threaten the integrity of the boundary monuments and inspectors will continue to monitor these locations. No maintenance needs were identified.

1.4.1.5 Aerial Survey Quality Control Monuments

Six aerial survey quality control monuments were inspected during the 2023 annual inspection. No maintenance needs were identified.

1.4.1.6 Monitoring Wells

The site has three monitoring wells. A gully adjacent to well 0678 appears to be stable, and the well is not affected by the erosion (PL-4). All wellhead protectors observed during the inspection were undamaged, locked, and properly labeled. No maintenance needs were identified.

1.4.1.7 Mine Vent

A mine vent shaft associated with an abandoned underground mine is within the site boundary in the northern portion of the site (PL-5). Inspectors monitor the condition of the vent to ensure that the closure remains secure. The vent has a spot-welded cover and a casing that rises approximately 3 feet (ft) above the ground. The vent was secure at the time of the inspection. No maintenance needs were identified.

1.4.2 Inspection Areas

In accordance with the LTSP, the site is divided into four inspection areas to ensure a thorough and efficient inspection. The inspection areas are (1) the top of the disposal cell, (2) the side slopes and apron of the cell, (3) the graded and revegetated area between the disposal cell and the site perimeter, and (4) the outlying area. Inspectors examined specific site surveillance features within each area and looked for evidence of erosion, settling, slumping, or other modifying processes that might affect the site’s conformance with LTSP requirements.

1.4.2.1 Top of Disposal Cell

The disposal cell, completed in 1994, occupies 91 acres and is armored with basalt riprap to control erosion and deter animal and human intrusion. The top slope showed no evidence of cracking, slumping, or erosion, and there was no indication of riprap degradation. A shallow depression around settlement plate SP-4, near the northeast corner of the disposal cell cover, was first noted during the 1997 inspection and continued to grow in depth and area in subsequent years. The depression was repaired in August 2005. Continual visual observations since the 2017 annual inspection indicate that minor additional settlement has occurred since the depression was repaired. During the 2023 annual inspection, the settlement was shallow enough that it was determined not to have changed significantly (PL-6). Inspectors will continue to monitor this area during each annual inspection, document surface topography, and note any developing erosional features.

Annual weeds and perennial grasses are sporadically growing on the top of the disposal cell top (PL-7). In accordance with the LTSP, deep-rooted shrubs are to be removed from the disposal cell cover. No deep-rooted shrubs were noted during the inspection. Weed control will be conducted before the next inspection in 2024.

1.4.2.2 Side Slopes and Apron

The basalt riprap-covered side slopes and apron showed no evidence of erosion, settling, slumping, or cracking. Standing water is occasionally observed in a portion of the south apron, but the area was dry during the inspection (PL-8). An additional ponding area, which was dry, was identified during the 2023 inspection. This location is south of the current standing water area near the apron and closer to the access road. These locations are in a topographic low spot along the base of the disposal cell, and stormwater runoff collects in these areas. During the 2022 inspection, rilling and erosion were observed on the south side slope (PL-9) near aerial survey quality control monument QC-5. During the 2023 inspection, these features seemed to be stable. Inspectors will continue to monitor this area. No maintenance needs were identified.

1.4.2.3 Graded and Revegetated Area

In general, site vegetation appeared to be healthy. However, some areas are windswept and have little growth, particularly in an area north of the disposal cell where mill tailings had formerly been stockpiled. Because the site is not fenced, grazing animals occasionally enter it. Inspectors did not observe cattle near the disposal cell, but there was evidence of recent grazing on other areas of the site. Occasional grazing will not affect the long-term or short-term performance of the disposal cell.

Onsite rills and gullies north and east of the disposal cell have been visually monitored for several years, and existing features have continued to develop, particularly to the northeast of the disposal cell. One gully, northeast of the disposal cell, has grown to a depth of 6–8 ft and a width of 8–10 ft (PL-10). Inspectors collected GPS locations and measurements of this gully in 2021. While no immediate maintenance needs were identified during the 2023 inspection, an evaluation of the need for erosion control structures around the large gully northeast of the disposal cell is ongoing. Newly forming small rills were observed around the site during the 2022 annual inspection near perimeter signs P17, P59, and P65.

1.4.2.4 Outlying Area

The area 0.25 mile beyond the site boundary was visually observed for erosion, changes in land use, or other phenomena that might affect the long-term integrity of the site. No such impacts were identified. Rills and gullies continue to be observed east of perimeter sign P41. These erosional features do not threaten the long-term integrity of the site because headward erosion is progressing away from the site. Inspectors will continue to monitor these features to ensure that they do not impact site features.

1.5 Follow-Up or Contingency Inspections

LM will conduct follow-up or contingency inspections if (1) a condition is identified during the annual inspection or other site visit that requires a return to the site to evaluate the condition or (2) LM is notified by a citizen or outside agency that conditions at the site are substantially changed. No need for a follow-up or contingency inspection was identified.

1.6 Maintenance and Repairs

No immediate maintenance needs were identified during the 2023 inspection.

1.7 Groundwater Monitoring

In accordance with the LTSP, groundwater monitoring is not required at this site because (1) the groundwater is heavily contaminated from underground uranium mining and naturally occurring mineralization and (2) the uppermost aquifer is of limited use due to its low yield. Consequently, NRC concurred with the application of supplemental standards at the site and the exemption of both compliance and performance groundwater monitoring. However, LM conducts groundwater monitoring at wells 0409, 0675, and 0678 as a best management practice at the request of NMED (Table 1-2 and Figure 1-2) (Kleinrath 2001). LM originally agreed to sample these locations once every 3 years for 30 years; however, LM sampled annually from November 2010 to November 2016 at the request of NMED. After the November 2016 sampling event, sampling returned to a triennial, or once every 3 years, schedule. The most recent sampling event occurred on November 1, 2022.

Table 1-2. Groundwater Monitoring Network at the Ambrosia Lake, New Mexico, Disposal Site

Monitoring Well	Well Screen Elevation, ft NAVD88	Hydrologic Interval Monitored
0409	6934.73–6939.49	Contact between alluvium and Tres Hermanos C unit, downgradient
0675	6934.89–6944.89	Weathered Mancos Shale, downgradient
0678	6731.71–6751.71	Tres Hermanos B unit, downgradient

Abbreviation:
NAVD88 = North American Vertical Datum of 1988

Well 0675 is completed in weathered Mancos Shale just below its contact with the overlying alluvium, and well 0678 is completed in the Tres Hermanos B Sandstone unit of the Mancos Shale. LM installed well 0409 in May 2011 in support of a regional groundwater investigation being conducted by NMED. Well 0409, on DOE property adjacent to the southwest corner of the disposal cell, is completed in an alluvium-filled paleochannel. The bottom of the well screen is at the contact between the alluvium and the sandstone of the Tres Hermanos Unit C member of the Mancos Shale Formation.

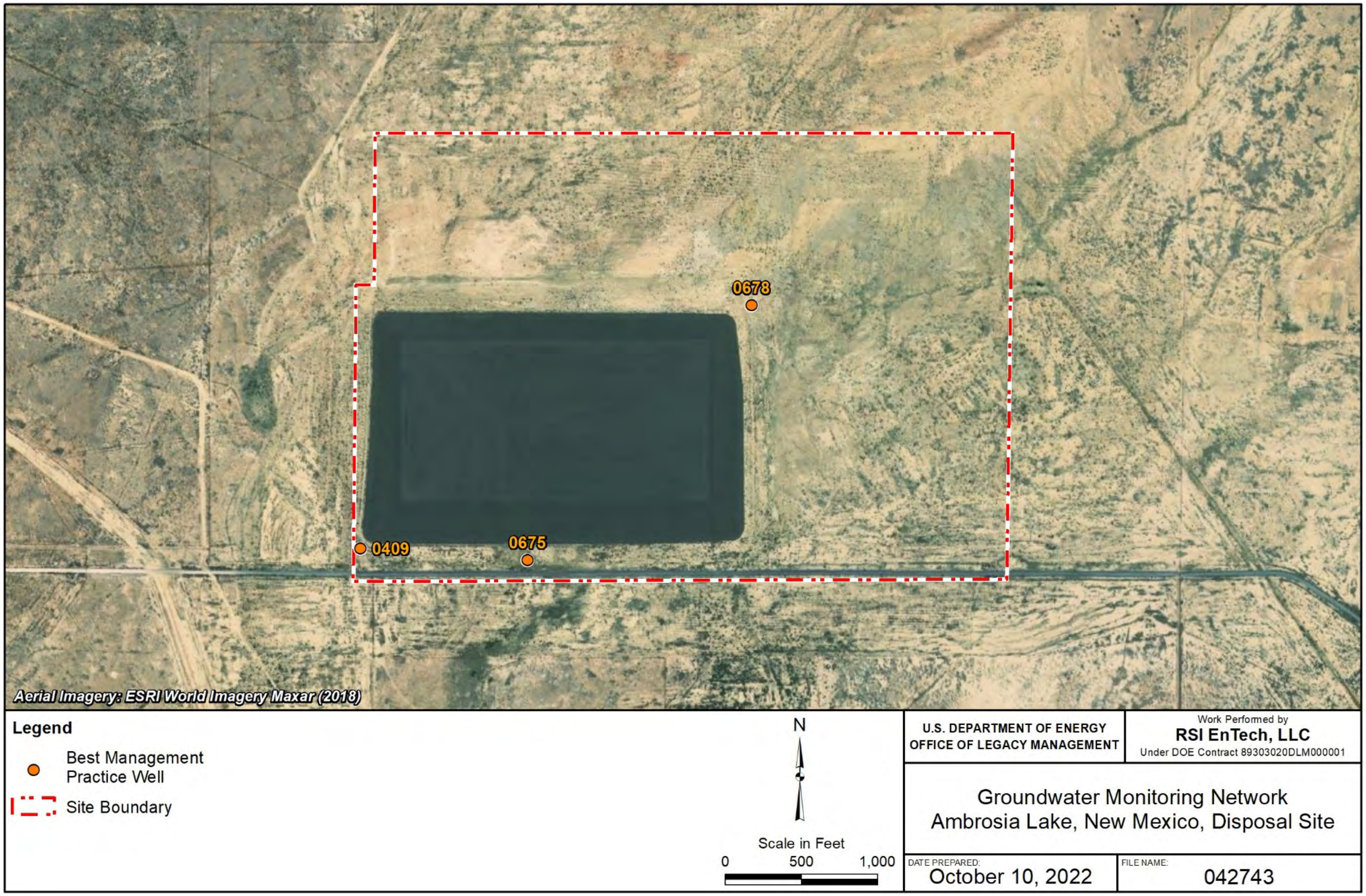


Figure 1-2. Ambrosia Lake, New Mexico, Groundwater Best Practice Monitoring Locations

For groundwater elevations, well 0409 has been dry at the time of every sampling event since being installed in 2011. Water-level elevations in well 0675 have fluctuated between 6943.8 and 6953.0 ft since the well was installed in 1989; the lowest water elevations were measured in 2019 and 2022 (Figure 1-3). Over the same duration, water-level elevations in well 0678 have fluctuated between 6764.8 and 6770.8 ft. The vertical hydraulic gradient between the two wells is strongly downward and averages 0.86 ft/ft suggesting that unsaturated conditions potentially exist between the two well screens.

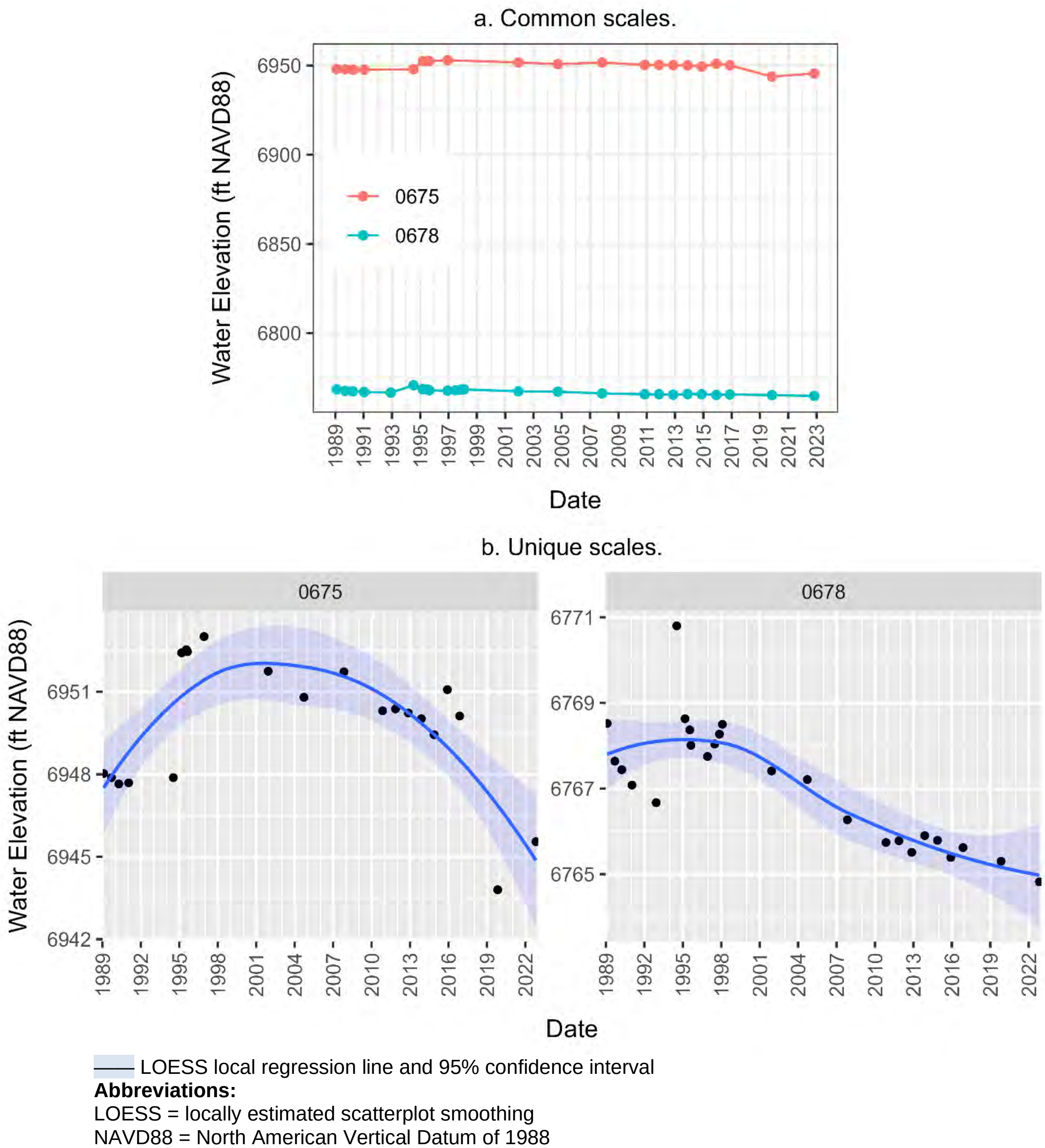


Figure 1-3. Groundwater Elevation Trends in Ambrosia Lake, New Mexico, Disposal Site Monitoring Wells

The plotting approach used in Figure 1-3b and in remaining time-concentration plots provided in this section entails a faceting approach, whereby data for the two wells (0675 and 0678) are plotted separately. A nonparametric locally estimated scatterplot smoothing (LOESS) method is applied to facilitate interpretation of the figures. Using this approach, overall trends in the data are more apparent and not obscured by “noise” or random variation.

All groundwater monitoring results for the site are reported and published on the LM Geospatial Environmental Mapping System website (https://gems.lm.doe.gov/#site=AMB). In accordance with the LTSP, groundwater monitoring results are included in this report. In 2022, wells 0675 and 0678 were sampled for molybdenum, nitrate, selenium, sulfate, uranium, and field parameters. Consistent with previous sampling events, well 0409 was dry.

Molybdenum concentrations in well 0675, screened in the weathered Mancos Shale, have fluctuated widely at times, ranging from 0.004 milligram per liter (mg/L) to 63.0 mg/L from 1989 to 2023 and averaging about 5 mg/L (Figure 1-4). The highest concentrations were measured in 2014 and 2015 (63.0 and 13.0 mg/L, respectively), but levels have since declined (the most recent result was 0.37 mg/L). Well 0678, screened in the Tres Hermanos B Sandstone unit of the Mancos Shale at an elevation approximately 200 ft deeper than well 0675, historically has had molybdenum concentrations below 0.1 mg/L. The most recent result was below the detection limit (<0.0053 mg/L) (Figure 1-4).

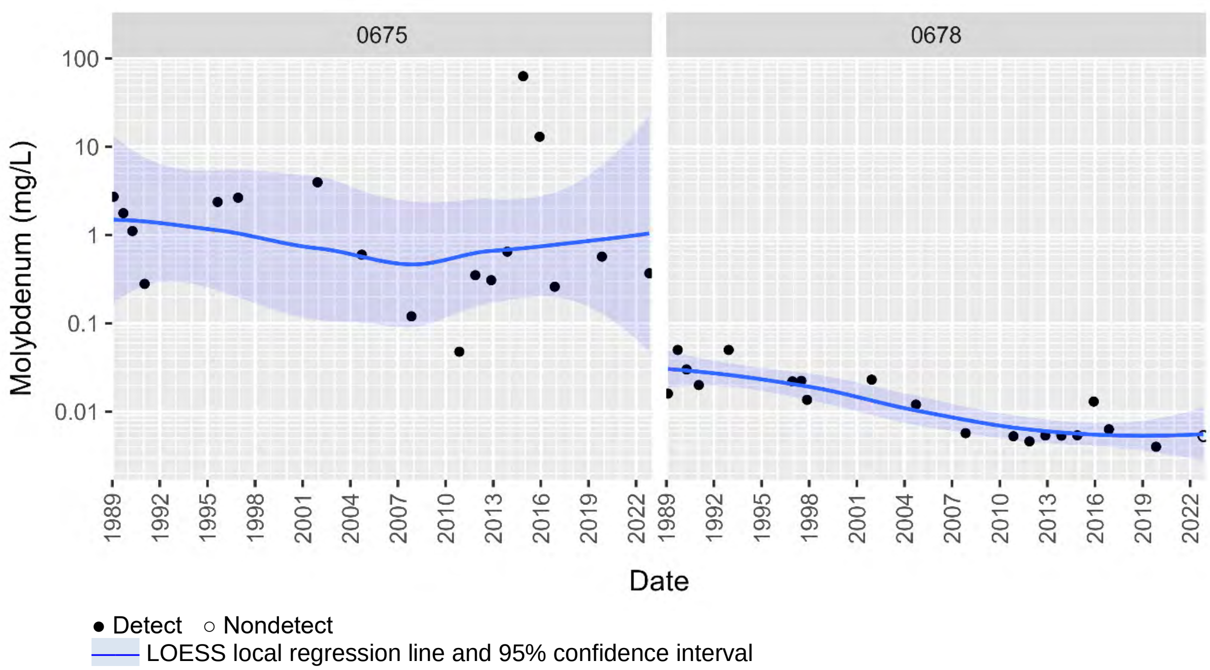
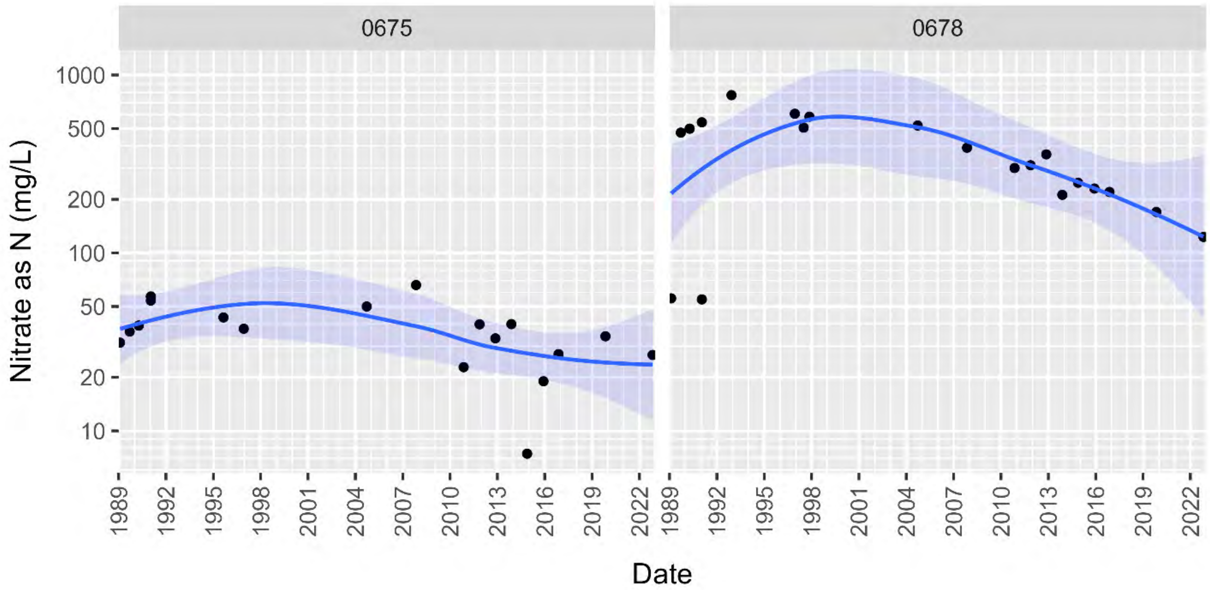


Figure 1-4. Molybdenum Concentrations in Groundwater at the Ambrosia Lake, New Mexico, Disposal Site

Nitrate as nitrogen (N) concentrations in well 0675 have historically remained below 70 mg/L (Figure 1-5). Nitrate (as N) concentrations in the deeper well (0678) reached a maximum concentration of 770.3 mg/L in 1992 and have steadily decreased to a present-day concentration of 123.0 mg/L (Figure 1-5).

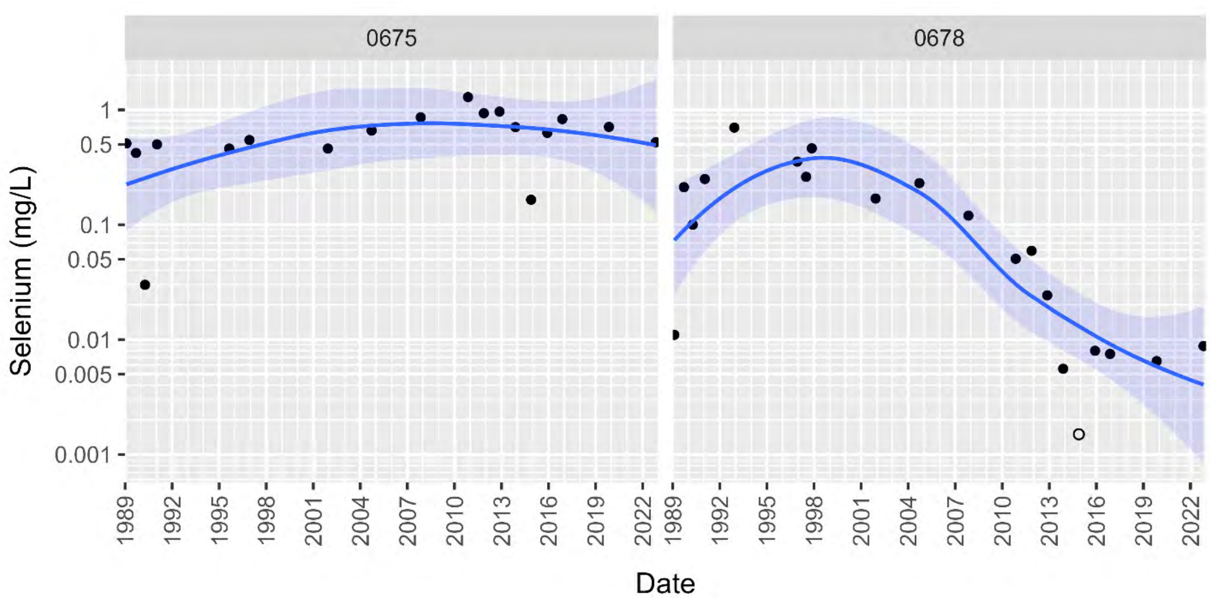


LOESS local regression line and 95% confidence interval

Note: Between 1989 and 2004, groundwater samples were analyzed for nitrate as NO_3. These initial results were converted to nitrate as N equivalents by applying a conversion factor of 0.2259.

Figure 1-5. Nitrate as N Concentrations in Groundwater at the Ambrosia Lake, New Mexico, Disposal Site

Well 0675 had an initial selenium concentration of 0.51 mg/L. Concentrations trended upwards and peaked in 2010 at 1.29 mg/L and then declined to 0.17 mg/L in 2014. The most recent result, 0.52 mg/L, is essentially equivalent to the initial (1989) concentration. Selenium concentrations in the deeper well (0678) reached a peak concentration of 0.7 mg/L in 1992 and have declined to present-day concentrations of less than 0.01 mg/L (Figure 1-6).



● Detect ○ Nondetect
LOESS local regression line and 95% confidence interval

Figure 1-6. Selenium Concentrations in Groundwater at the Ambrosia Lake, New Mexico, Disposal Site

Historically, sulfate concentrations in well 0675 have generally ranged between 3000 and at or just above 4000 mg/L (Figure 1-7). There are two exceptions: the 2014 measurement (5380 mg/L) and the most recent (2022) result of 7180 mg/L, the maximum sulfate concentration measured in that well. The deeper well (0678) had an initial sulfate concentration of 2638 mg/L; this early measurement is an outlier relative to subsequent results that have exceeded 6000 mg/L. Since September 1989 (6240 mg/L), sulfate concentrations gradually increased to levels between 7000 and 10,000 mg/L (Figure 1-7). The most recent result was 7920 mg/L.

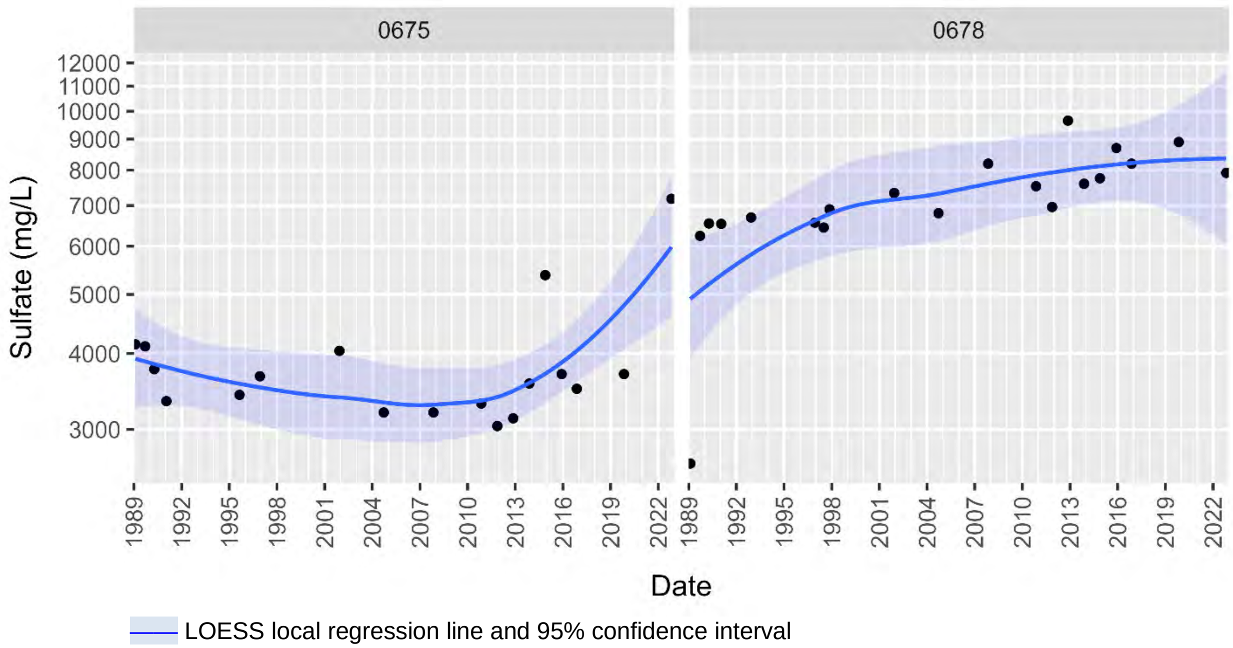


Figure 1-7. Sulfate Concentrations in Groundwater at the Ambrosia Lake, New Mexico, Disposal Site

Uranium concentrations in well 0675 ranged from 0.91 to 3.24 mg/L from 1989–2001 and then declined to a low of 0.14 mg/L in 2010 (Figure 1-8). Concentrations then increased to a high of 11.4 mg/L in 2014 and have declined to a present-day concentration of 1.17 mg/L. Uranium concentrations in the deeper well (0678) have historically remained below 0.1 mg/L (Figure 1-8).

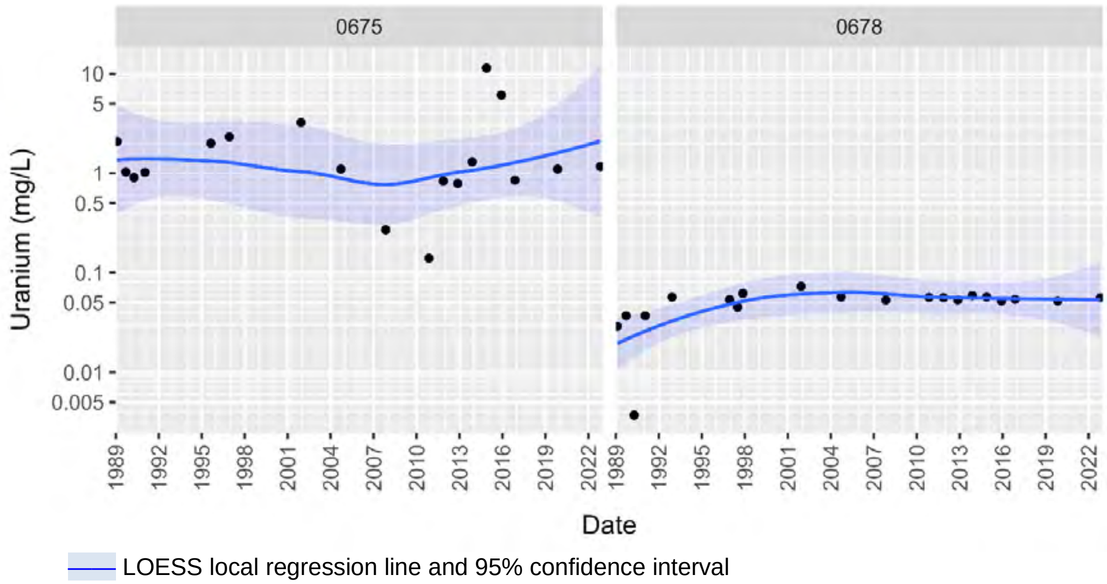


Figure 1-8. Uranium Concentrations in Groundwater at the Ambrosia Lake, New Mexico, Disposal Site

In accordance with its agreement with NMED, LM will continue to monitor groundwater at the Ambrosia Lake site every 3 years until 2031. The next sampling event will be in November 2025.

1.8 Corrective Action

Corrective action is taken to correct out-of-compliance or hazardous conditions that create a potential health and safety problem or that may affect the integrity of the disposal cell or compliance with 40 CFR 192. No need for corrective action was identified.

1.9 References

10 CFR 40.27. U.S. Nuclear Regulatory Commission, "General License for Custody and Long-Term Care of Residual Radioactive Material Disposal Sites," *Code of Federal Regulations*.

40 CFR 192. U.S. Environmental Protection Agency, "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings," *Code of Federal Regulations*.

DOE (U.S. Department of Energy), 1996. *Long-Term Surveillance Plan for the Ambrosia Lake, New Mexico, Disposal Site*, DOE/AL/62350-211, Rev. 1, Office of Legacy Management, July, https://lmpublicsearch.lm.doe.gov/lmsites/4319-ambrosia_ltsp.pdf.

Kleinrath, 2001. Art Kleinrath, program manager, Office of Legacy Management, U.S. Department of Energy, letter (about Contract No. DE-AC13-96GJ87335, Response to New Mexico Environment Department Regarding Monitor Well Decommissioning and Ongoing Groundwater Monitoring at the Ambrosia Lake UMTRCA Title I Disposal Site) to Marcy Leavitt, branch chief, New Mexico Environment Department, Groundwater Quality Bureau, August 29.

1.10 Photographs

Photograph Location Number	Azimuth	Photograph Description
PL-1	0	Entrance Sign
PL-2	90	Erosion at Base of Perimeter Sign P12
PL-3	0	Site Marker SMK-1
PL-4	10	Monitoring Well 0678 and Adjacent Gully
PL-5	185	Mine Vent Shaft
PL-6	55	Depression Area near Settlement Plate 4 (Not Discernible)
PL-7	25	Weeds and Grasses on Disposal Cell Top Slope
PL-8	90	Evidence of Ponding Water; Evaporite Forming on Riprap of Cell Apron
PL-9	180	Disposal Cell South Side Slope Toe Drain
PL-10	210	Gully Outlet Northeast of Disposal Cell

PL-1. Entrance Sign

PL-2. Erosion at Base of Perimeter Sign P12

PL-3. Site Marker SMK-1

PL-4. Monitoring Well 0678 and Adjacent Gully

PL-5. Mine Vent Shaft

PL-6. Depression Area near Settlement Plate 4 (Not Discernible)

PL-7. Weeds and Grasses on Disposal Cell Top Slope

PL-8. Evidence of Ponding Water; Evaporite Forming on Riprap of Cell Apron

PL-9. Disposal Cell South Side Slope Toe Drain

PL-10. Gully Outlet Northeast of Disposal Cell

2.0 Burrell, Pennsylvania, Disposal Site

2.1 Compliance Summary

The Burrell, Pennsylvania, Uranium Mill Tailings Radiation Control Act (UMTRCA) Title I Disposal Site was inspected on October 25, 2023. No changes were observed on the disposal cell or in the associated drainage features. Inspectors identified minor maintenance needs but found no cause for a follow-up inspection.

The U.S. Department of Energy (DOE) Office of Legacy Management (LM) conducts routine groundwater monitoring every 5 years as a best management practice to aid evaluation of the disposal cell's performance. Though 2023 was a sampling year, the results were not available to include in this report. They will be included in the 2024 report. It should be noted that two of the monitoring wells (wells 0422 and 0423) and surface seep locations (seeps 0611 and 0612) were dry during the sampling event, which resulted in no samples being collected from these locations. Resampling plans will be addressed following review of the sampling results. Locks at all of the monitoring wells were replaced with new locks in 2023. In 2018, all sampling results were below U.S. Environmental Protection Agency (EPA) drinking water standards. Four downgradient wells were sampled on October 19, 2020, ahead of the required 5-year sampling frequency, to observe whether an identified increase in molybdenum in 2018 persisted. Results from the 2020 samples showed that molybdenum did not continue to increase. All sampling results are reported on the LM Geospatial Environmental Mapping System (GEMS) website (https://gems.lm.doe.gov/#site=BUR).

2.2 Compliance Requirements

Requirements for the long-term surveillance and maintenance of the site are specified in the site-specific Long-Term Surveillance Plan (DOE 2000) (LTSP) in accordance with procedures established to comply with the requirements of the U.S. Nuclear Regulatory Commission (NRC) general license at Title 10 *Code of Federal Regulations* Section 40.27 (10 CFR 40.27). Table 2-1 lists these requirements.

Table 2-1. License Requirements for the Burrell, Pennsylvania, Disposal Site

Requirement	LTSP	This Report	10 CFR 40.27
Annual Inspection and Report	Sections 3.3 and 3.4	Section 2.4	(b)(3)
Follow-Up Inspections	Section 3.5	Section 2.5	(b)(4)
Maintenance	Section 3.6	Section 2.6	(b)(5)
Emergency Measures	Section 3.6	Section 2.7	(b)(5)
Environmental Monitoring	Section 3.7	Section 2.8	(b)(2)

2.3 Institutional Controls

The 72-acre site, identified by the property boundary shown in Figure 2-1, is owned by the United States and was accepted under the NRC general license in 1994. DOE is the licensee and, in accordance with the requirements for UMTRCA Title I sites, LM is responsible for the custody and long-term care of the site. Institutional controls (ICs) at the site include federal ownership of the property, administrative controls, and the following physical ICs that are inspected annually: the disposal cell and associated drainage features, entrance gate and sign, security fence, perimeter signs, site marker, survey and boundary monuments, erosion control markers, quality control monuments, and wellhead protectors.

2.4 Inspection Results

The site, 1 mile east of Blairsville, Pennsylvania, was inspected on October 25, 2023. The inspection was conducted by K. Broberg and L. McHenry of the Legacy Management Support contractor. T. Drake and N. Olin (LM); A. Taverna (NRC); B. Kautz, T. Raraigh, and J. Kime (Pennsylvania Department of Environmental Protection [DEP]); and T. Biller (Lawn RX, the site herbicide subcontractor) attended the inspection. The purposes of the inspection were to confirm the integrity of visible features at the site, identify changes in conditions that might affect conformance with the LTSP, and evaluate whether maintenance or follow-up inspection and monitoring are needed.

2.4.1 Site Surveillance Features

Figure 2-1 shows the locations of site features, including site surveillance features and inspection areas, in black and gray font. Some site features that are present but not required to be inspected are shown in italic font. Observations from previous inspections that are currently monitored are shown in blue, and new observations identified during the 2023 annual inspection are shown in red. Inspection results and recommended maintenance activities associated with site surveillance features are described in the following subsections. Photographs to support specific observations are noted in the text and in Figure 2-1 by photograph location (PL) numbers. The photographs and photograph log are presented in Section 2.10.

2.4.1.1 Access Road, Entrance Gate, and Entrance Sign

Access to the site is from a road leading from Strangford Road, along a DOE right-of-way through a parcel of private property (Tract 201-E), and across DOE’s leased crossing over Norfolk Southern Railroad tracks. Entrance to the site is through a locked gate on the east end of the security fence. Residents have historically used the area along the DOE right-of-way for unpermitted dumping, hunting, target shooting, and all-terrain vehicle use. Personnel associated with commercial interests use the road for access to the railroad tracks and several nearby natural gas wells. Because the DOE right-of-way cannot be controlled, NRC concurred that the entrance gate in the site security fence is the IC for site access rather than the gate across the access road. The entrance gate was locked and functional. Entrance signage on the main vehicle entrance gate was current. The railroad crossing was improved in 2022 with the installation of an asphalt crossing. No maintenance needs were identified.

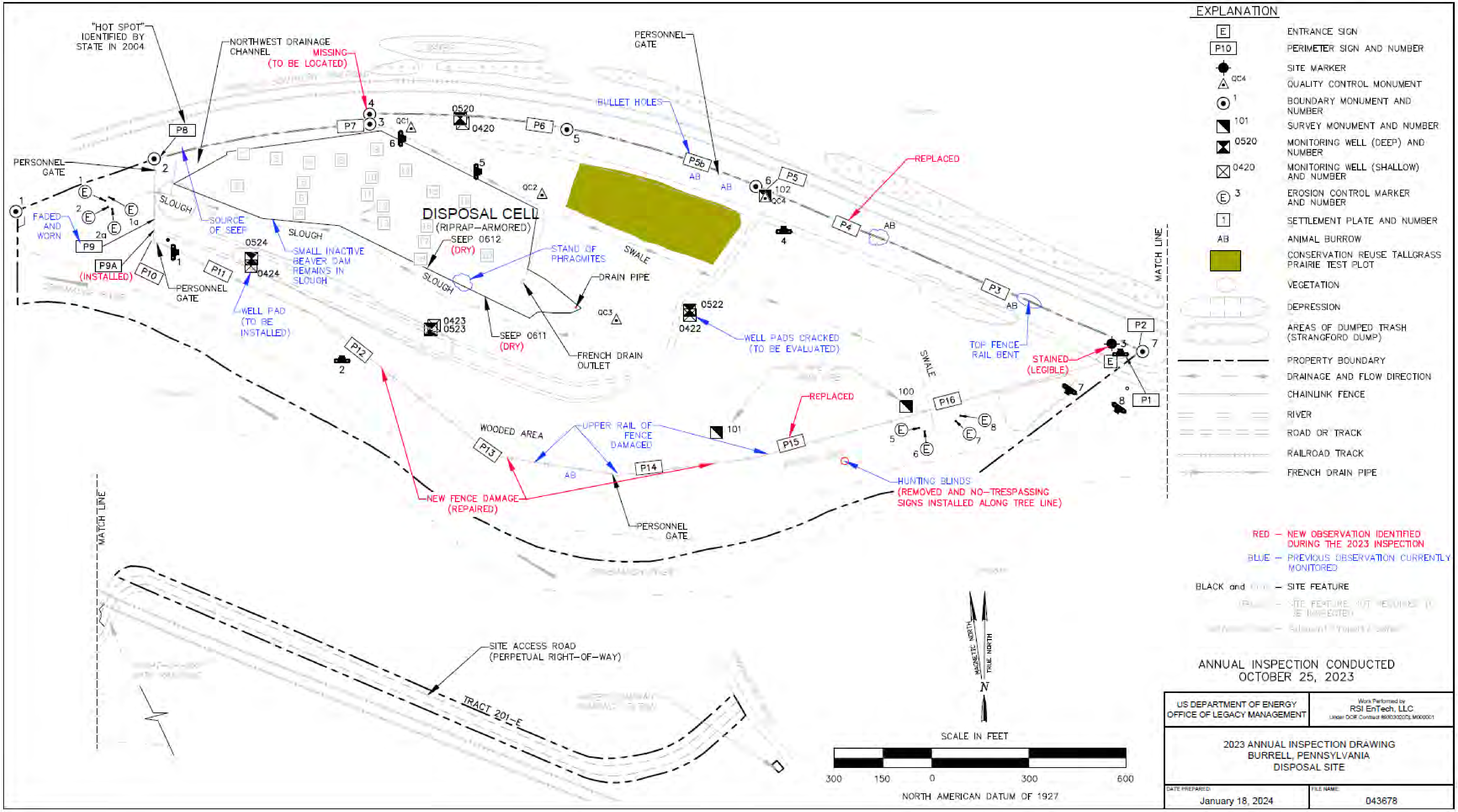


Figure 2-1. 2023 Annual Inspection Drawing for the Burrell, Pennsylvania, Disposal Site

2.4.1.2 Security Fence and Perimeter Signs

A chainlink security fence encloses the disposal cell and drainage features. The site herbicide subcontractor keeps the fence line clear of vegetation, which should prolong the life of the security fence (PL-1). In 2023, trees felled by strong winds damaged the fence. The top rail of the fence was separated in three areas, which compromised the integrity of the fence (PL-2). Repairs to this area were completed following the inspection. Other trees felled by strong storms have bent the upper rail of the fence along the southern boundary, but the fence remains serviceable, and repairs are not required at this time.

There are 17 perimeter signs attached to the outside of the security fence. All perimeter signs are present. Perimeter sign P9 has been faded and worn since 2019. It is difficult to replace given its location in a wet slough area. A companion sign was installed during the inspection a few feet south of perimeter sign P9 (identified in Figure 2-1 as perimeter sign P9A). Perimeter signs P4 and P15 were replaced during the inspection. No other maintenance needs were identified.

2.4.1.3 Site Marker

The site has one granite site marker just inside the main entrance gate. The concrete pad is cracked but remains functional. The surface of the marker is stained but remains legible (PL-3). No maintenance needs were identified.

2.4.1.4 Survey and Boundary Monuments

The site has three survey monuments and seven boundary monuments. Survey monument SM-102 was noted as missing in the 2017 and 2018 inspections. Quality control monument QC-4 was installed in 2019 as a replacement for survey monument SM-102 (PL-4).

All seven boundary monuments were located during the inspection, except for boundary monument BM-4. Efforts will be made before the next inspection to relocate it. During the 2022 inspection, it was noted that the top plate (cap) of boundary monument BM-7 had been knocked off and was found lying next to the post. The cap was secured back to the post before the 2023 inspection. No other maintenance needs were identified.

2.4.1.5 Aerial Survey Quality Control Monuments

Four aerial survey quality control monuments were inspected during the 2023 annual inspection. No maintenance needs were identified.

2.4.1.6 Erosion Control Markers

The site has eight erosion control markers, which were inspected during this visit. No maintenance needs were identified.

2.4.1.7 Monitoring Wells

The site has eight monitoring wells that are sampled as a best management practice every 5 years. Though 2023 was a sampling year, the results were not available to include in this report. They will be included in the 2024 report. It should be noted that two of the monitoring wells (wells 0422 and 0423) and surface seep locations (seeps 0611 and 0612) were dry during the sampling event, which resulted in no samples being collected from these locations. Resampling plans will be addressed following review of the sampling results. Since sampling was taking place during the inspection, NRC personnel took the time to observe the sampling process at one of the wells.

Samples collected in 2018 were all below EPA drinking water standards. Due to an increase in the molybdenum result at one well, four downgradient wells were resampled on October 19, 2020. The increase in molybdenum did not persist.

As a best management practice, concrete well pads were installed at five monitoring wells (wells 0420, 0520, 0422, 0522, and 0523) during the October 2018 sampling event. Monitoring well 0423 already had a concrete well pad. The ground was saturated, which prevented the installation of concrete well pads at monitoring wells 0424 and 0524 in 2018. Installation of these well pads is planned for 2024. Monitoring well pads 0522 and 0422 have developed cracks. The impact of the cracks will be better assessed in 2024 when the crew is installing the remaining well pads. All wellhead protectors that were observed during the annual inspection were locked and undamaged. New locks were installed at all of the monitoring wells during the sampling event.

NRC measured a gamma radiation level of 30–40 microrem per hour around the base of the well pad at monitoring well 0420. Background gamma radiation is approximately 10 microrem per hour. The gamma radiation level was assessed by Pennsylvania DEP in spring 2023 and was unchanged. The level will continue to be monitored but is not considered a risk to human health or the environment. No other maintenance needs were identified.

2.4.2 Inspection Areas

In accordance with the LTSP, the site is divided into four inspection areas (referred to as “transects” in the LTSP) to ensure a thorough and efficient inspection. The inspection areas are (1) the disposal cell, (2) the area adjacent to the disposal cell, (3) the site perimeter, and (4) the outlying area, including the access road that leads to the site. Inspectors examined specific site surveillance features within each area and looked for evidence of erosion, settling, slumping, or other modifying processes that might affect the site’s conformance with LTSP requirements.

2.4.2.1 Disposal Cell

The disposal cell, completed in 1987, occupies 5 acres and is armored with riprap to control erosion and deter animal intrusion (PL-5). There was no evidence of erosion, settling, slumping, or any other modifying processes that might affect the integrity of the disposal cell.

Control of vegetation (including woody vegetation) on the disposal cell is not required by the LTSP. A screening-level risk assessment conducted by DOE from 1996 to 1997 concluded that plant succession on the disposal cell does not present significant or credible risk to human health or the environment and, due to reduced hydraulic flux through the cover from evapotranspiration, may improve the long-term performance of the disposal cell. The LTSP was revised in 2000 to reflect these findings; at that time, NRC suggested that LM reevaluate the effects of vegetation on cover performance in 10 or 20 years (i.e., between 2010 and 2020) to confirm performance parameters and predictions. The assessment will revisit the issue of vegetation growth on the disposal cell cover to evaluate whether it remains protective of human health and the environment or interferes with the ability of inspectors to assess disposal cell cover stability. LM planned to conduct a follow-up assessment in fiscal year 2019, but it was delayed by LM to further consult with NRC on the scope of the study. NRC and LM are jointly analyzing disposal cell cover performance and pedogenesis at other UMTRCA sites to either support development of the scope for a Burrell site study or conclude that the additional Burrell site assessment is not required.

Although vegetation is allowed to grow on the disposal cell, noxious weeds and invasive plants are controlled on the disposal cell and the site through spraying and mowing. In 2008, a site Vegetation Management Plan (DOE 2008) was issued that included the control of noxious and invasive vegetation on the disposal cell cover to facilitate inspection activities. Vegetation management effectively limits the spread of noxious weeds. Other woody species continue to establish on the disposal cell cover.

Woody vegetation growth on the disposal cell cover since 2000 has progressed to a point where trees are becoming tall enough to create concern that a tree could fall (e.g., die or be blown down) in a manner that displaces a large root ball under the tree and perhaps impacts or exposes the underlying clay layer of the cell cover. DOE will work with NRC to develop a path forward to address the trees on the disposal cell cover considering the potential root ball concern.

2.4.2.2 Area Adjacent to the Disposal Cell

A French drain was installed parallel to the north slope of the disposal cell in 1998 to prevent the ponding of water next to the cell. The outlet for the French drain, on the south slope of the disposal cell, was not flowing during the inspection, and no outflow has ever been observed during past inspections. Water was not ponded anywhere along the French drain, and no wetland vegetation was observed, which indicate that the drain is operating properly (PL-6). Inspectors will continue to monitor this area to verify that it continues to operate as designed.

A large tree fell in the slough south of the disposal cell in 2019. As of the 2023 inspection, the downed tree is not interfering with drainage in the slough.

A small, inactive beaver dam remains in the slough south of the disposal cell. The site herbicide contractor indicated that the dam was inactive in 2022, as no evidence of recent activity was observed around the dam (e.g., animal tracks, new cuts). In its current state, it does not interfere with the flow of water enough to warrant action. No maintenance needs were identified.

A hole on the east side of the Conservation Reuse Tallgrass Prairie Test Plot was safely filled in with clay-based topsoil in 2022. Given that the Burrell site was once a railroad landfill, the hole is believed to be settlement around some buried railroad landfill debris.

2.4.2.3 Site Perimeter

A seep that has been active in the past is near the north security fence, about 60 feet east of perimeter sign P8 and west of the disposal cell. Access to the seep requires walking down a steep slope of riprap that is difficult to walk on. During the inspection, the seep was not flowing, but the area around the seep was moist. The water for the seep along the fence line appears to be coming from the bluffs north of the railroad tracks. Conceivably, the seep could destabilize the nearby railroad embankment. The seep does not pose a threat to the integrity of the disposal cell, and the inspectors will continue to monitor this area. No maintenance needs were identified.

2.4.2.4 Outlying Area

The 0.25-mile area beyond the site boundary was visually observed for erosion, changes in land use, or other phenomena that might affect the long-term integrity of the site. No activities that could affect the long-term integrity of the site were observed.

North of the site, a dirt road parallels the railroad tracks and provides access to a long, narrow wooded area that has been used as an illegal dump. No new piles of trash were observed during the inspection. Inspectors will continue to note any dumping activity. The south side of the site is bordered by the Conemaugh River.

In 2004, a representative from Pennsylvania DEP showed inspectors a “hot spot” (an area with gamma radiation levels of 5 millirem per hour) in the rock ballast adjacent to the railroad tracks northeast of perimeter sign P8. A review of LM records confirmed that the area in question was addressed in a property completion report for the Uranium Mill Tailings Remedial Action Project. Supplemental standards have been applied to contamination beneath the tracks because the benefit of removal does not justify the cost. LM communicated the results of a records search to the Commonwealth of Pennsylvania in late 2004. The hot spot was the subject of a follow-up discussion with Pennsylvania representatives in 2006. In October 2018, NRC personnel revisited the hot spot area and measured a gamma radiation level of 200 microrem per hour, which is considerably lower than the 2004 measurement. During the 2022 inspection, NRC personnel measured a gamma radiation level of 120 microrem per hour. The area is marked on the site inspection map for future reference. The area is not on DOE property; the Commonwealth of Pennsylvania is the responsible authority. No maintenance needs were identified.

During the 2022 inspection, a temporary hunting blind was discovered on the south side of the site outside of the site security fence. In 2023, the blind was removed, and several no-trespassing signs were installed along the tree line (PL-7). A removable chain was also installed south of the main entrance gate to further delineate the no-trespassing area (PL-8).

2.5 Follow-Up Inspections

LM will conduct follow-up inspections if (1) a condition is identified during the annual inspection or other site visit that requires a return to the site to evaluate the condition or (2) LM is notified by a citizen or outside agency that conditions at the site are substantially changed. No need for a follow-up inspection was identified.

2.6 Maintenance

The following maintenance items were completed before the inspection:

- Installing no-trespassing signs along the south edge of the property
- Installing a chain with no-trespassing signs attached across the mowed pathway along the perimeter fence
- Removing the temporary hunting blind
- Securing the top cap on boundary monument BM-7

Installation of a companion perimeter sign, P9A, as well as replacement of perimeter signs P4 and P15 were completed during the inspection. The following maintenance item was completed after the inspection:

- Repairing the damaged fence line between perimeter signs P12 and P15

Boundary monument BM-4 will be relocated and well pads 0424 and 0524 will be installed before the next inspection.

2.7 Emergency Measures

Emergency measures are actions LM will take in response to unusual damage or disruption that threatens or compromises site safety, security, or integrity in compliance with 10 CFR 40 Appendix A. No need for emergency measures was identified.

2.8 Environmental Monitoring

2.8.1 Groundwater Monitoring

In accordance with the LTSP, LM conducts routine groundwater monitoring every 5 years as a best management practice as an evaluation of the disposal cell's performance. Though 2023 was a sampling year, the results were not available to include in this report. They will be included in the 2024 report. It should be noted that two of the monitoring wells (wells 0422 and 0423) were dry during the 2023 sampling event, which resulted in no measurements from these locations.

The groundwater monitoring network consists of four sets of monitoring wells (eight monitoring wells total) and two seeps (Table 2-2 and Figure 2-2). Each set of wells consists of a shallow well completed in unconsolidated fill and alluvium (400-series wells) and a deeper well completed in the bedrock of the Casselman Formation (500-series wells). Groundwater is sampled for standard water quality indicators and four analytes: lead, molybdenum, selenium, and uranium. The maximum concentration limits (MCLs) for these four analytes in groundwater (40 CFR 192 Table 1 Subpart A) are listed in Table 2-3.

Table 2-2. Groundwater Monitoring Network for the Burrell, Pennsylvania, Disposal Site

Monitoring Well or Seep	Hydrologic Relationship
0420 and 0520	Upgradient or background monitoring well
0422 and 0522	Cross-gradient monitoring well
0423 and 0523	Downgradient monitoring well
0424 and 0524	Downgradient monitoring well
0611 and 0612	Seep

Table 2-3. Maximum Concentration Limits for Groundwater at the Burrell, Pennsylvania, Disposal Site

Constituent	MCL[a] (mg/L)
Lead	0.05
Molybdenum	0.1
Selenium	0.01
Uranium	0.044

Note:
[a] MCLs as listed in 40 CFR 192 Table 1 Subpart A.

Abbreviation:
mg/L = milligrams per liter

LM resampled the four downgradient wells on October 19, 2020. This sampling was 3 years ahead of the required 5-year sampling frequency to determine if the increase in molybdenum that was noted previously was continuing. Samples were also analyzed for lead, selenium, and uranium. The results of the 2020 sampling showed that all constituents remained well below the MCLs. These nonroutine sampling results are reported in the 2021 annual report (DOE 2022) and on the GEMS website (https://gems.lm.doe.gov/#site=BUR). Routine sampling results from the 2018 sampling event are reported in the 2018 annual report (DOE 2019).

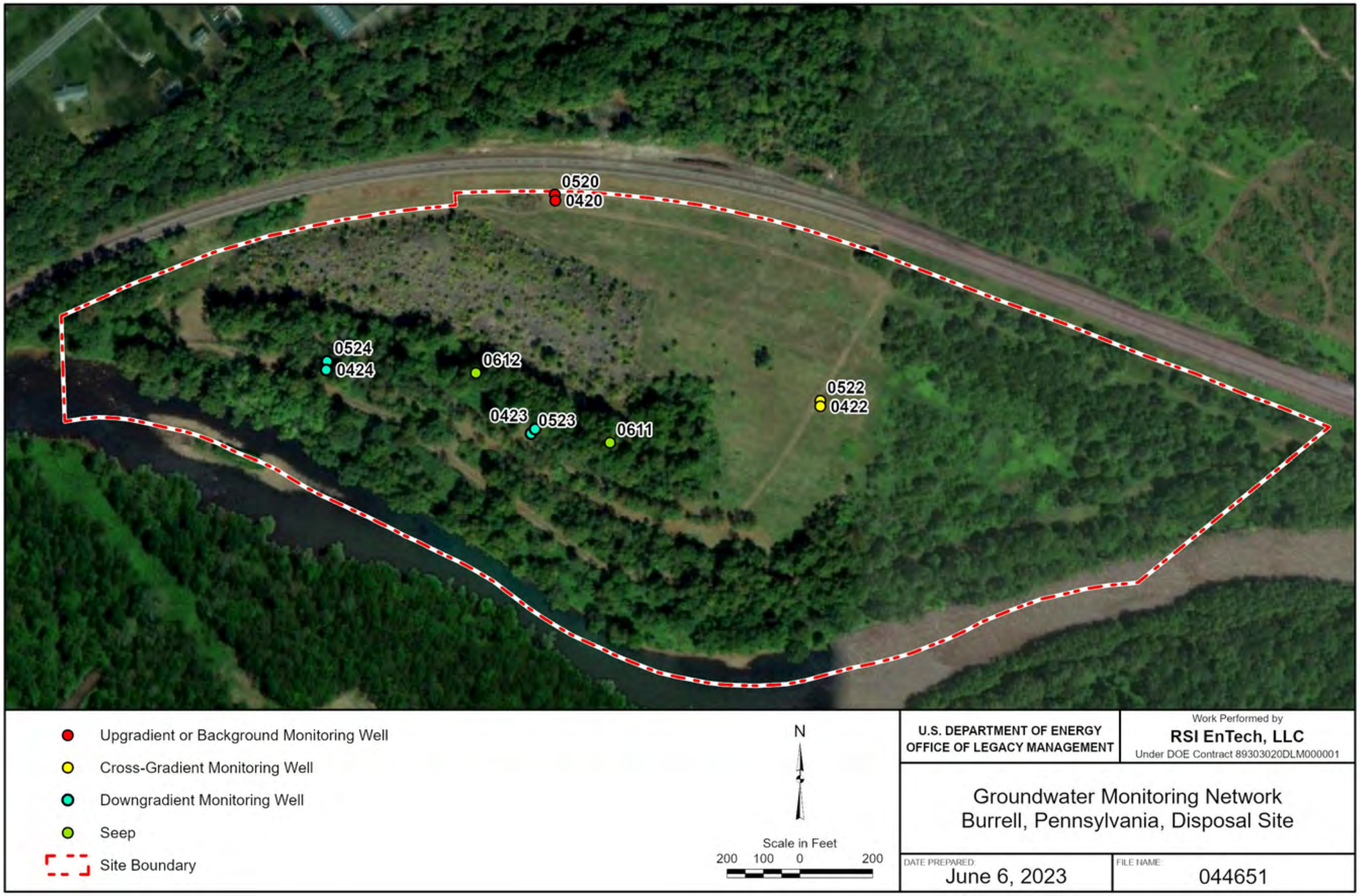


Figure 2-2. Groundwater Monitoring Network for the Burrell, Pennsylvania, Disposal Site

2.8.2 Vegetation Management

In accordance with the Vegetation Management Plan, mowing and spot herbicide application continue. Vegetation management activities include ensuring that the fence line and access paths remain clear of the invasive species Japanese knotweed (*Reynoutria japonica*), applying herbicides where needed, and regularly mowing open areas of the site. These activities have been successful in controlling Pennsylvania-listed noxious weeds onsite. Pennsylvania-listed noxious weeds purple loosestrife (*Lythrum salicaria*), poison hemlock (*Conium maculatum*), and multiflora rose (*Rosa multiflora*) were not observed in 2023, except for sporadic resprouts following mowing. Several other invasive plants, including Japanese knotweed and common reed (*Phragmites australis*), persist. A stand of common reed that was identified during previous inspections remains at the west end of the disposal cell and has spread along the southern edge of the disposal cell. This stand is very difficult to access because of standing water and its location adjacent to the perimeter fence. Wooded areas remained heavily vegetated with Japanese knotweed. Privet (*Ligustrum sp.*) is an invasive shrub that was observed in several areas. Oriental bittersweet (*Celastrus orbiculatus*) is an invasive vine listed as a noxious weed in Pennsylvania. It was observed in several wooded areas and growing on the disposal cell cover. Pursuant to the Vegetation Management Plan, access paths to monitoring wells and the fence line have been effectively maintained.

A conservation reuse initiative is being pursued at the site that involves the establishment of a tallgrass prairie. In 2017, a 2-acre plot in the mowed field east of the disposal cell was staked out as a test plot. In October 2018, that area was prepped and seeded. Maintenance through 2019 included mowing that helped prevent the establishment of unwanted vegetation. Following the 2019 inspection, field personnel broadcast Indiangrass (*Sorghastrum nutans*) to augment the 2018 seeding effort. The prairie was not mowed in 2021 or 2022 but was mowed in 2023 to help keep woody vegetation from becoming established.

The test prairie appears to be progressing, though a diverse flowering community is not expected for several years. It is recommended that the prairie continue to be mowed while flowers are on the cool-season grasses and clovers and before they set seed. Mowing the last 2 weeks of May or the first week of June should prevent the cool-season grasses from seeding out and will open the canopy for the native species when they are beginning to leaf out. DOE plans to make a determination on the future of the test prairie in 2024.

2.9 References

10 CFR 40 Appendix A. U.S. Nuclear Regulatory Commission, "Criteria Relating to the Operation of Uranium Mills and the Disposition of Tailings or Wastes Produced by the Extraction or Concentration of Source Material from Ores Processed Primarily for Their Source Material Content," *Code of Federal Regulations*.

10 CFR 40.27. U.S. Nuclear Regulatory Commission, "General License for Custody and Long-Term Care of Residual Radioactive Material Disposal Sites," *Code of Federal Regulations*.

40 CFR 192 Table 1 Subpart A. U.S. Environmental Protection Agency, "Maximum Concentration of Constituents for Groundwater Protection," *Code of Federal Regulations*.

DOE (U.S. Department of Energy), 2000. *Long-Term Surveillance Plan for the U.S. Department of Energy Burrell Vicinity Property, Blairsville, Pennsylvania*, GJO-2002-331-TAR, April.

DOE (U.S. Department of Energy), 2008. *Burrell, Pennsylvania, Site Vegetation Management Plan*, DOE-LM/1566-2008, Office of Legacy Management, January.

DOE (U.S. Department of Energy), 2019. *2018 Annual Site Inspection and Monitoring Report for Uranium Mill Tailings Radiation Control Act Title I Disposal Sites*, LMS/S22053, Office of Legacy Management, March.

DOE (U.S. Department of Energy), 2022. *2021 Annual Site Inspection and Monitoring Report for Uranium Mill Tailings and Radiation Control Act Title I Disposal Sites*, LMS/S33843, Office of Legacy Management, March.

2.10 Photographs

Photograph Location Number	Azimuth	Photograph Description
PL-1	90	South Fence Line
PL-2	0	Fence Damage
PL-3	—	Site Marker
PL-4	0	Quality Control Monument QC-4 and Survey Monument SM-102
PL-5	90	North Side of Disposal Cell
PL-6	90	French Drain Area
PL-7	215	No-Trespassing Sign
PL-8	215	No-Trespassing Sign with Yellow Chain

Note:
— = Photograph taken vertically from above.

PL-1. South Fence Line

PL-2. Fence Damage

PL-3. Site Marker

PL-4. Quality Control Monument QC-4 and Survey Monument SM-102

PL-5. North Side of Disposal Cell

PL-6. French Drain Area

PL-7. No-Trespassing Sign

PL-8. No-Trespassing Sign with Yellow Chain

3.0 Canonsburg, Pennsylvania, Disposal Site

3.1 Compliance Summary

The Canonsburg, Pennsylvania, Uranium Mill Tailings Radiation Control Act (UMTRCA) Title I Disposal Site was inspected on October 24, 2023. No changes were observed on the disposal cell or in the associated drainage features. No evidence of site trespassing was observed. A few minor maintenance items were identified. No cause for a follow-up inspection was identified.

The U.S. Department of Energy (DOE) Office of Legacy Management (LM) conducts groundwater and surface water monitoring every 5 years to provide data to document that the site remains protective of human health, safety, and the environment. Though 2023 was a sampling year, the results were not available to include in this report. They will be included in the 2024 report. In 2018, all sampling results were below the site-specific alternate concentration limit (ACL) for uranium in groundwater and the point of exposure (POE) limit in surface water.

3.2 Compliance Requirements

Requirements for the long-term surveillance and maintenance of the site are specified in the site-specific *Long-Term Surveillance Plan for the U.S. Department of Energy Canonsburg Uranium Mill Tailings Disposal Site, Canonsburg, Pennsylvania* (DOE 2013) (LTSP) in accordance with procedures established to comply with the requirements of the U.S. Nuclear Regulatory Commission (NRC) general license at Title 10 *Code of Federal Regulations* Section 40.27 (10 CFR 40.27). Table 3-1 lists these requirements.

Table 3-1. License Requirements for the Canonsburg, Pennsylvania, Disposal Site

Requirement	LTSP	This Report	10 CFR 40.27
Annual Inspection and Report	Section 3.3	Section 3.4	(b)(3)
Follow-Up Inspections	Section 3.4	Section 3.5	(b)(4)
Maintenance	Section 3.5	Section 3.6	(b)(5)
Environmental Monitoring	Section 3.7	Section 3.7	(b)(2)
Emergency Response	Section 3.6	Section 3.8	(b)(5)

3.3 Institutional Controls

The 34.2-acre site, identified by the property boundary shown in Figure 3-1, is owned by the United States and was accepted under the NRC general license in 1996. DOE is the licensee and, in accordance with the requirements for UMTRCA Title I sites, LM is responsible for the custody and long-term care of the site. Institutional controls (ICs) at the site include federal ownership of the property, administrative controls, and the following physical ICs that are inspected annually: the disposal cell and associated drainage features, entrance gates and sign, security fence, perimeter signs, site markers, survey and boundary monuments, erosion control markers, quality control monuments, and wellhead protectors.

In addition to the area within the property boundary, separate ICs are applied to Area C and the east portion of Tract 117, both of which are southeast of Strabane Avenue. Area C (3.1 acres) was sold and transferred to a private owner in 2005, and the east portion of Tract 117 (0.431 acre) was sold and transferred in 2009 to the same buyer. DOE and the Commonwealth of Pennsylvania complied with restrictions on parcel transfers stipulated in UMTRCA and in the Cooperative Agreement between DOE and the commonwealth. The deeds for Area C and Tract 117 restrict excavation, prohibit disturbance of the streambank, ensure continued access for monitoring and streambank maintenance, and prevent the areas from being used for residential purposes. Use of groundwater is unrestricted. Adherence to these ICs is evaluated during the annual inspection. There was no evidence that any of the ICs were violated.

3.4 Inspection Results

The site, in Canonsburg, Pennsylvania, was inspected on October 24, 2023. The inspection was conducted by K. Broberg and L. McHenry of the Legacy Management Support contractor. T. Drake and N. Olin (LM); Z. St. Hilaire, M. Ross, and K. Barnes (NRC); B. Bookser, B. Kautz, J. Timcik, B. Dowling, J. Kime, and T. Raraigh (Pennsylvania Department of Environmental Protection); and C. Bier (site mowing contractor) attended the inspection. The purposes of the inspection were to confirm the integrity of visible features at the site, identify changes in conditions that might affect conformance with the LTSP, and evaluate whether maintenance or follow-up inspection and monitoring are needed.

3.4.1 Site Surveillance Features

Figure 3-1 shows the locations of site features, including site surveillance features and inspection areas, in black and gray font. Some site features that are present but not required to be inspected are shown in italic font. Observations from previous inspections that are currently monitored are shown in blue, and new observations identified during the 2023 annual inspection are shown in red. Inspection results and recommended maintenance activities associated with site surveillance features are described in the following subsections. Photographs to support specific observations are noted in the text and in Figure 3-1 by photograph location (PL) numbers. The photographs and photograph log are presented in Section 3.10.

3.4.1.1 Site Access, Entrance Gates, and Entrance Sign

Main access to the site is from Strabane Avenue. There are three vehicle gates: the main entrance gate at the southeast corner of the site along Strabane Avenue, a vehicle access gate at the southwest corner of the site, and a vehicle access gate north of the disposal cell between perimeter signs P8 and P9. There are also two personnel access gates. All gates were locked and functional. The entrance sign is posted on the main entrance gate. Three additional information signs are also posted on the main entrance gate. All the signs contained current information.

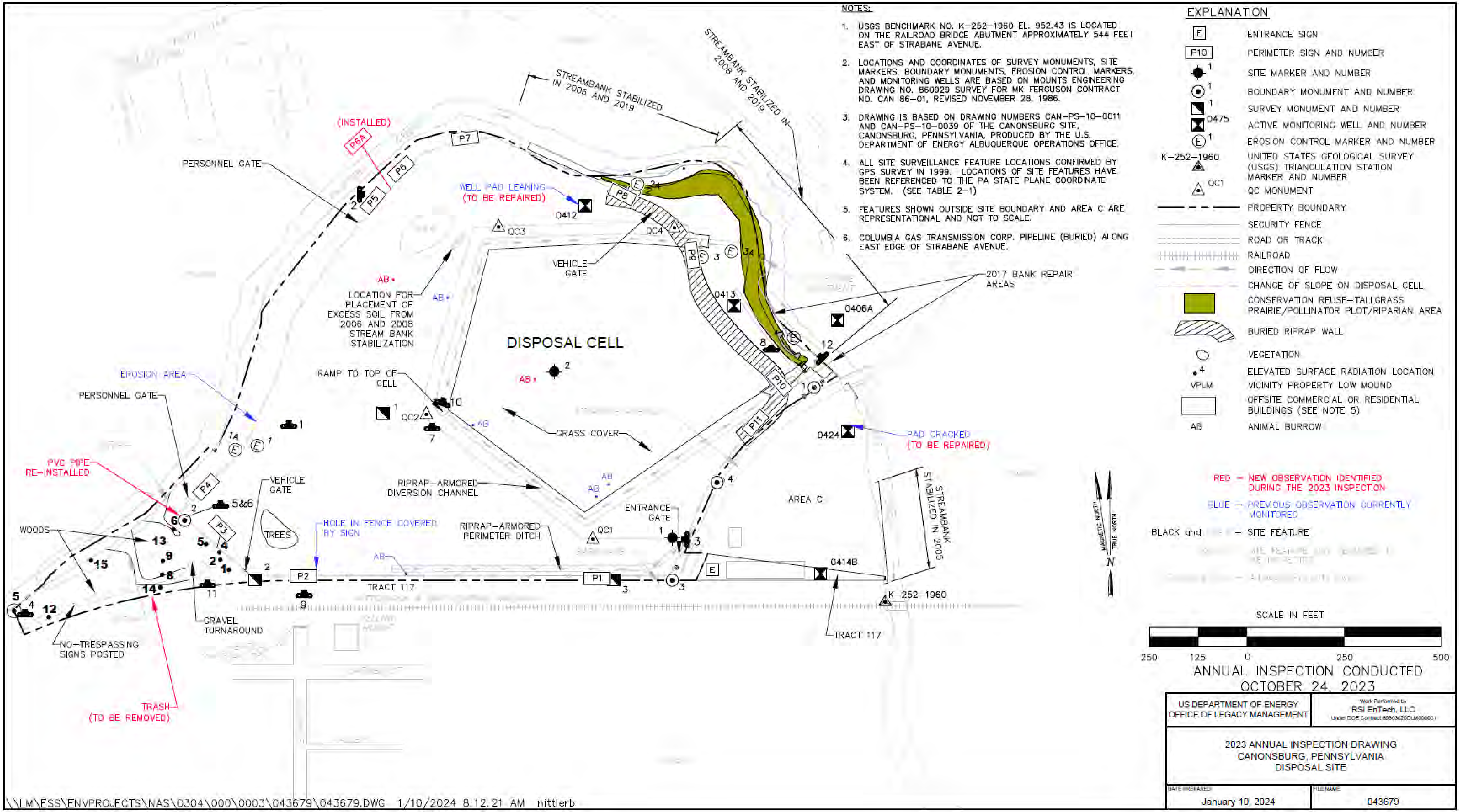


Figure 3-1. 2023 Annual Inspection Drawing for the Canonsburg, Pennsylvania, Disposal Site

3.4.1.2 Security Fence and Perimeter Signs

A chainlink security fence encloses most of the site. A vegetation-free buffer zone is maintained around the entire security fence. An eroded area remains under the west security fence. The area appears to be stable; the erosion area has not expanded in several years. For added security, slats were installed in 2016 in the area beneath the fence to help close the gap. Inspectors noted that the slats were undisturbed (PL-1).

There are 11 perimeter signs attached to the security fence. Theft of perimeter signs from the south fence line that borders the railroad tracks is an ongoing challenge. Since the 2020 inspection, two signs have been cut out of the fence fabric and replaced. During the 2022 inspection, it was reported that perimeter sign P6 could not be located, but it was found again during the 2023 inspection. During the inspection, a new perimeter sign (P6A) was installed between perimeter signs P5 and P6 to improve coverage. Perimeter sign P5 is weathered but still legible (PL-2) and will continue to be monitored as it will need to be replaced soon. A few signs were discovered to have outdated emergency contact numbers. These were corrected by placing a sticker with the current number over the outdated number. No other maintenance needs were identified.

3.4.1.3 Site Markers

The site has two granite site markers. Site marker SMK-1 is just inside the main entrance gate (PL-3), and site marker SMK-2 is on the top slope of the disposal cell. No maintenance needs were identified.

3.4.1.4 Survey and Boundary Monuments

Before 2021, the site had three survey monuments and four boundary monuments. In 2021, a fifth boundary monument was installed at the southwest corner of the property (PL-4). All five boundary monuments were located during the inspection. Boundary monuments BM-1, BM-2, and BM-3 have all sunk approximately 6 inches below the present grade of the ground surface. A surveying crew located them in summer 2021 using GPS coordinates on file. Rather than raise the boundary monuments, their locations are marked with a section of PVC pipe filled with pea gravel. During the inspection, the PVC pipe marking the location of boundary monument BM-2 was restored (PL-5 and PL-6). No other maintenance needs were identified.

3.4.1.5 Aerial Survey Quality Control Monuments

Four aerial survey quality control monuments used for ground control for aerial surveys were located during the 2023 annual inspection (PL-7). No maintenance needs were identified.

3.4.1.6 Erosion Control Markers

The site has four pairs of erosion control markers along the bank of Chartiers Creek. All four pairs were located during the 2023 annual inspection (PL-8). No maintenance needs were identified.

3.4.1.7 Monitoring Wells

The site has five groundwater monitoring wells that are sampled every 5 years, and 2023 was a sampling year. Since sampling was taking place during the site inspection, NRC personnel took the time to observe the sampling process at one of the wells. All wells were locked. During sampling, the well locks were replaced. Two maintenance items were identified. There is a crack in the well pad of monitoring well 0424, but the pad remains serviceable. The well pad of monitoring well 0412 is leaning. The interior of the protective casing is encroaching on the actual well casing. DOE is planning to address both maintenance issues in 2024. No other maintenance needs were identified.

3.4.2 Inspection Areas

In accordance with the LTSP, the site is divided into five inspection areas (referred to as "transects" in the LTSP) to ensure a thorough and efficient inspection. The inspection areas are (1) the disposal cell, (2) the area adjacent to the disposal cell, (3) the diversion channels and perimeter ditches, (4) the site perimeter and security fence, and (5) the outlying areas. Inspectors examined specific site surveillance features within each area and looked for evidence of erosion, settling, slumping, or other modifying processes that might affect the site's conformance with LTSP requirements.

3.4.2.1 Disposal Cell

The disposal cell, completed in 1985, occupies 6.8 acres and is covered in grass (PL-9). There was no evidence of erosion, settling, slumping, or other modifying processes that might affect the integrity of the disposal cell. Animals burrow on the disposal cell cover, but the burrows should not pose a risk to disposal cell integrity or public health because the buried tailings are overlain by a 36-inch-thick clay layer (radon barrier), an 18-inch-thick biointrusion rock layer, and a 12-inch-thick topsoil layer. Biointrusion down to or through the radon barrier is unlikely. One new burrow was noted on the disposal cell near site marker SMK-2 during the inspection. It was noted on the inspection map and will be monitored for changes. Inspectors will continue to monitor the location and significance of burrows. No maintenance needs were identified.

3.4.2.2 Area Adjacent to the Disposal Cell

The site consists primarily of mowed grasses within the security fence and on the disposal cell cover. Seeded fescues and crown vetch (*Securigera varia*) are the most prevalent species. The spray-and-mow approach to vegetation management at the site continues to be effective. Noxious weeds within the security fence area are limited to resprouting seedlings that were observed in portions of mowed areas. A new animal burrow was identified west of the disposal cell. It was noted on the inspection map and will be monitored for changes. No maintenance needs were identified.

3.4.2.3 Diversion Channels and Perimeter Ditches

There was no evidence of rock deterioration or woody vegetation in the diversion channels and perimeter ditches (PL-10). Periodic physical removal and spot herbicide applications have been effective at reducing woody vegetation and will continue to be conducted as needed. No maintenance needs were identified.

3.4.2.4 Site Perimeter

In 2007, a radiological survey was conducted on a small parcel of land southwest of the security fence to evaluate its release for industrial reuse. The survey identified isolated radium-226 contamination in the soil in excess of the established average criterion for the site. As a result, the release criteria were not satisfied for the entire parcel, and the parcel was removed as a reuse candidate. Under current property usage, these radiological conditions do not pose a risk to personnel, and no corrective measures are required. LM controls land use through ownership. Inspectors will continue to check the area for evidence of trespassing.

During the 2017 annual inspection, an abandoned campsite was observed on the southwest corner of the site. The site and associated trash were removed in December 2017, and no-trespassing signs were posted. No evidence of recent trespassing was observed in this area during the 2023 annual inspection.

A local plastics company has cleared some of DOE’s property north of the railroad tracks and spread gravel to create a turnaround for its trucks. No-trespassing signs are now posted around this area to prevent unauthorized expansion of the turnaround. A 5-year access agreement was established in 2017 with the plastics company for continued use of the turnaround. The agreement was renewed for another 5 years in 2022. No changes to the size of the turnaround were observed in 2022. No-trespassing signs marking the edge of the turnaround were replaced in 2023 (PL-11).

A small, new pile of trash was west of the turnaround and north of the railroad tracks. The trash consisted of empty cans and some paper material. Arrangements will be made to remove this trash. No other maintenance needs were identified.

3.4.2.5 Outlying Area

Chartiers Creek Bank: Chartiers Creek is an active, meandering waterway west, north, and east of the disposal site. Bedrock outcrops and mature trees on the streambank west of the site indicate that the bank of that creek is stable.

Several riprap streambank stabilization projects have been conducted north and east of the site. From 2001 to 2008, riprap armoring was installed along the streambanks. Years of flow and heavy flow events in Chartiers Creek in late 2017 and early 2018 damaged those riprap installations. In late summer 2019, the entire length of the riprap embankment along Chartiers Creek north of the disposal cell (approximately 1200 linear feet) was repaired during low streamflow conditions. The work consisted of minor grading, replacing geotextile filter fabric, and importing and placing 2-foot-thick riprap slopes. No concerns with the current riprap embankment were noted during the inspection (PL-12).

As part of the 2019 repair project, a riparian forest buffer was planted above and along the embankment. Disturbed areas were seeded with a pollinator-friendly native grass and wildflower mix. This riparian forest buffer corridor will work with the engineered riprap embankment to further stabilize the bank against future stream flooding events and reduce erosion along the top edge of the riprap embankment. Plantings in the riparian forest buffer have experienced a 4-year survival rate of over 90%. The main challenge for the young plants is being damaged by deer. In 2022, the plastic sleeves (originally installed when the trees were planted) protecting the trees from deer rub were removed and replaced with larger wire cages. The cages, made from welded wire fencing mounted on metal T-posts, are more durable and offer better protection than plastic deer tubes and wooden stakes.

The riparian forest buffer is also recognized to improve stream quality. This effort is part of the commonwealth's goal to establish 95,000 acres of riparian forest buffer by 2025. The Pennsylvania Department of Conservation and Natural Resources was notified of the project. The general long-term health prospect is good for the young plants in the riparian buffer given the installation of the protective wire cages. A chain that limits vehicle access to the site near the riparian forest buffer and reuse prairie was down during the inspection. This continues to be a challenge at the site. The chain and sign were reinstalled in spring 2023. No signs of trespassing were noted during the 2023 inspection. LM believes the site subcontractor is removing the sign and chain for access and forgetting to set them back up when work is completed. Efforts will be made to better coordinate this issue with site subcontractors.

Area C and Tract 117: Area C and Tract 117 form a triangular parcel of property east of the site bounded by Strabane Avenue, Chartiers Creek, and the Pittsburgh and Ohio Central Railroad. Area C and Tract 117 are included in the annual inspection to ensure compliance with ICs that were put into place to address land-use and site access requirements. There was no evidence that any of the ICs in place for Area C and Tract 117 had been violated.

Additional control of invasive vegetation on Area C between Strabane Avenue and monitoring well 0424 began in 2021 to enhance the health of the riparian corridor being established along Chartiers Creek north of the disposal cell. Mowing and spraying in this area limits the spread of invasive vegetation from Area C to the recently planted riparian buffer area.

Strabane Avenue: The maintenance subcontractor, Lawn RX, periodically removes trash found on and adjacent to the site to maintain the site's appearance. Inspectors also pick up trash as necessary. Inspectors observed that Strabane Avenue, next to the site, was relatively clear of trash. No other maintenance needs were identified.

3.5 Follow-Up Inspections

LM will conduct follow-up inspections if (1) a condition is identified during the annual inspection or other site visit that requires a return to the site to evaluate the condition or (2) LM is notified by a citizen or outside agency that conditions at the site have substantially changed. No need for a follow-up inspection was identified.

3.6 Maintenance

The following minor maintenance items were identified during the 2023 inspection and will be scheduled to be completed before the next inspection:

- Repair of the well pad at monitoring well 0424
- Repair of the protective casing and well pad at monitoring well 0412
- Removal of the small pile of trash west of the turnaround area

3.7 Environmental Monitoring

3.7.1 Groundwater Monitoring

In accordance with the LTSP, LM conducts groundwater monitoring every 5 years to (1) evaluate downgradient contaminant trends in groundwater in the shallow, unconsolidated materials and in surface water; (2) demonstrate that concentrations of uranium at point of compliance (POC) wells are decreasing as predicted and that the system remains in compliance with the *Ground Water Compliance Action Plan and Alternate Concentration Limits for the Canonsburg, Pennsylvania, UMTRA Project Site* (DOE 2000); and (3) ensure that remedial actions at the disposal site and Area C continue to protect human health, safety, and the environment.

Sampling was conducted in 2023. Results from this year were not available to include in this report. They will be included in the 2024 report. In 2018, all sampling results were below the site-specific ACL for uranium in groundwater and the POE limit in surface water.

The groundwater monitoring network consists of five monitoring wells—three POC wells and two best management practice wells (Table 3-2 and Figure 3-2). All monitoring wells are completed in the uppermost aquifer (shallow, unconsolidated materials). Groundwater is sampled and analyzed for the one constituent of concern—uranium. The ACL is 1 milligram per liter (mg/L) for groundwater at the POC wells. Except for monitoring wells 0412 and 0413, uranium concentrations in 2018 were also below the UMTRCA maximum concentration limit (MCL) of 0.044 mg/L.

Table 3-2. Groundwater Monitoring Network for the Canonsburg, Pennsylvania, Disposal Site

Monitoring Well	Hydrologic Relationship	Groundwater Monitoring Purpose
0406A	Downgradient	Best management practice
0412	Downgradient	POC
0413	Downgradient	POC
0414B	Cross gradient	POC
0424	Downgradient	Best management practice

All groundwater monitoring results for the site are reported and published on the LM Geospatial Environmental Mapping System (GEMS) website (https://gems.lm.doe.gov/#site=CAN). Additionally, the *2018 Annual Site Inspection and Monitoring Report for Uranium Mill Tailings Radiation Control Act Title I Disposal Sites* (DOE 2019) presents the comprehensive monitoring results for 2018.

Figure 3-2. Groundwater and Surface Water Monitoring Network for the Canonsburg, Pennsylvania, Disposal Site

3.7.2 Surface Water Monitoring

In accordance with the LTSP, LM also conducts surface water monitoring every 5 years. Though 2023 was a sampling year, the results from this year were not available to include in this report. They will be included in the 2024 report. The most recent sampling event occurred in October 2018. Uranium concentrations in surface water sampled in 2018 were below the established ACL of 0.01 mg/L.

One surface water monitoring location, 0602, is the POE for Chartiers Creek and is sampled and analyzed for uranium. In 2018, the uranium concentration from surface water monitoring location 0602 had a concentration of 0.00096 mg/L, significantly below the MCL.

The *2018 Annual Site Inspection and Monitoring Report for Uranium Mill Tailings Radiation Control Act Title I Disposal Sites* (DOE 2019) presents the comprehensive monitoring results for 2018.

3.7.3 Vegetation Management

Vegetation management continues at the site in accordance with the LTSP. Activities include spot-treating invasive species, physically removing plants, using spot application of herbicides to target woody vegetation in diversion channels and perimeter ditches, and using the spray-and-mow approach. These activities remain successful. Noxious weeds observed within the fenced area during this year’s inspection included crown vetch. These areas are limited to resprouting seedlings that were observed in portions of mowed areas. No changes to the current vegetation management approach are recommended.

3.8 Emergency Response

Emergency responses are the actions LM will take in response to unusual damage or disruption that threatens or compromises site safety, security, or integrity in compliance with 10 CFR 40 Appendix A Criterion 12. No need for emergency response was identified.

3.9 References

10 CFR 40 Appendix A. U.S. Nuclear Regulatory Commission, “Criteria Relating to the Operation of Uranium Mills and the Disposition of Tailings or Wastes Produced by the Extraction or Concentration of Source Material from Ores Processed Primarily for Their Source Material Content,” *Code of Federal Regulations*.

10 CFR 40.27. U.S. Nuclear Regulatory Commission, “General License for Custody and Long-Term Care of Residual Radioactive Material Disposal Sites,” *Code of Federal Regulations*.

DOE (U.S. Department of Energy), 2000. *Ground Water Compliance Action Plan and Application for Alternate Concentration Limits for the Canonsburg, Pennsylvania, UMTRA Project Site*, LMS/U0035901, February.

DOE (U.S. Department of Energy), 2013. *Long-Term Surveillance Plan for the U.S. Department of Energy Canonsburg Uranium Mill Tailings Disposal Site, Canonsburg, Pennsylvania*, LMS/CAN/S00404, Office of Legacy Management, March.

DOE (U.S. Department of Energy), 2019. *2018 Annual Site Inspection and Monitoring Report for Uranium Mill Tailings Radiation Control Act Title I Disposal Sites*, LMS/S22053, Office of Legacy Management, March.

3.10 Photographs

Photograph Location Number	Azimuth	Photograph Description
PL-1	—	Base of Fence near Erosion Area
PL-2	90	Perimeter Sign P5, Weathered but Still Legible
PL-3	270	Site Marker SMK-1
PL-4	—	Boundary Monument BM-5
PL-5	—	Boundary Monument BM-2
PL-6	—	Boundary Monument BM-2, Restored with Pea Gravel
PL-7	—	Quality Control Monument QC-2
PL-8	—	Erosion Control Marker ECM-4
PL-9	0	Disposal Cell Behind Perimeter Sign P2
PL-10	20	Looking North Down Riprap-Armored Diversion Channel
PL-11	0	No-Trespassing Sign in Turnaround Area
PL-12	315	Riprap-Armored Streambank

Note:
— = Photograph taken vertically from above.

PL-1. Base of Fence near Erosion Area

PL-2. Perimeter Sign P5, Weathered but Still Legible

PL-3. Site Marker SMK-1

PL-4. Boundary Monument BM-5

PL-5. Boundary Monument BM-2

PL-6. Boundary Monument BM-2, Restored with Pea Gravel

PL-7. Quality Control Monument QC-2

PL-8. Erosion Control Marker ECM-4

PL-9. Disposal Cell Behind Perimeter Sign P2

PL-10. Looking North Down Riprap-Armored Diversion Channel

PL-11. No-Trespassing Sign in Turnaround Area

PL-12. Riprap-Armored Streambank

4.0 Durango, Colorado, Disposal Site

4.1 Compliance Summary

The U.S. Department of Energy (DOE) Office of Legacy Management (LM) conducted the Durango, Colorado, Uranium Mill Tailings Radiation Control Act (UMTRCA) Title I Disposal Site annual inspection on May 31, 2023, and the annual groundwater monitoring event in June 2023. No cause for a follow-up inspection was identified.

No changes were observed on top of the disposal cell or its associated drainage features. Inspectors identified minor maintenance items listed in Section 4.6.

The most recent annual sampling event occurred in June 2023. Concentrations of molybdenum, selenium, and uranium at the three point of compliance (POC) wells (wells 0607, 0612, and 0621) continue to be below site-specific thresholds. In addition to the annual sampling event and as a best management practice, LM samples monitoring wells 0608 and 0618 and POC well 0621 on a monthly basis (weather permitting) to monitor variable uranium concentrations in well 0618 that are typically above site-specific thresholds.

4.2 Compliance Requirements

Requirements for the long-term surveillance and maintenance of the site are specified in the site-specific *Long-Term Surveillance Plan for the Durango, Colorado, Disposal Site* (DOE 2019) (LTSP) in accordance with procedures established to comply with the requirements of the U.S. Nuclear Regulatory Commission (NRC) general license at Title 10 *Code of Federal Regulations* Section 40.27 (10 CFR 40.27). Table 4-1 lists these requirements.

Table 4-1. License Requirements for the Durango, Colorado, Disposal Site

Requirement	LTSP	This Report	10 CFR 40.27
Annual Inspection and Report	Section 3.3	Section 4.4	(b)(3)
Follow-Up Inspections	Section 3.4	Section 4.5	(b)(4)
Maintenance	Section 3.5	Section 4.6	(b)(5)
Emergency Measures	Section 3.5	Section 4.7	(b)(5)
Environmental Monitoring	Section 3.6	Section 4.8	(b)(2)
Corrective Action	Section 3.6	Section 4.9	--

4.3 Institutional Controls

The 121-acre site, identified by the property boundary shown in Figure 4-1, is owned by the United States and was accepted under the NRC general license in 1996. DOE is the licensee and, in accordance with the requirements for UMTRCA Title I sites, LM is responsible for the custody and long-term care of the site.

Institutional controls (ICs) at the site include federal ownership of the property, administrative controls, and the following physical ICs that are inspected annually: the disposal cell and associated drainage features, entrance gates, warning or no-trespassing signs (entrance and perimeter signs), site markers, survey and boundary monuments, and wellhead protectors.

4.4 Inspection Results

The site, 3.5 miles southwest of Durango, Colorado, was inspected on May 31, 2023. The inspection was conducted by D. Atkinson, E. Garcia, and N. Lind of the Legacy Management Support contractor. J. Dayvault (LM) and M. Cosby (Colorado Department of Public Health and Environment) also attended the inspection. The purposes of the inspection were to confirm the integrity of visible features at the site, identify changes in conditions that might affect conformance with the LTSP, and evaluate whether maintenance or a follow-up inspection and monitoring are needed.

4.4.1 Site Surveillance Features

Figure 4-1 shows the locations of site features, including site surveillance features and inspection areas, in black and gray font. Some site features that are present but not required to be inspected are shown in italic font. Observations from previous inspections that are currently monitored are shown in blue, and new observations identified during the 2023 annual inspection are shown in red. Inspection results and recommended maintenance activities associated with site surveillance features are described in the following subsections. Photographs to support specific observations are noted in the text and in Figure 4-1 by photograph location (PL) numbers. The photographs and photograph log are presented in Section 4.11.

4.4.1.1 Site Access, Entrance Gates, and Entrance Sign

Access to the site is via La Plata County Road 212, an improved dirt road that is accessed via a locked gate along La Plata County Road 210. Entrance to the site is through the locked steel entrance gate along La Plata County Road 212 and an older, original entrance gate. All gates were locked and functional. The entrance sign is at the older entrance gate inside the property boundary.

4.4.1.2 Perimeter Signs

There are 82 perimeter signs, attached to steel posts set in concrete, that delineate the property boundary. Perimeter signs are inspected for legibility and position to ensure that they are functioning as intended. Two additional perimeter signs (P83 and P84), also attached to steel posts, were installed in 2014 inside the property boundary along the east perimeter of Ditch No. 1. These additions act as surrogates for perimeter signs P40−P43, which are on a steep, densely wooded hillside. Perimeter signs P40–P43 are not routinely inspected because of their locations and the surrounding vegetation.

Inspectors noted that perimeter sign P5 (PL-1) was obscured by overgrown vegetation and was treated following the inspection. The concrete bases of several perimeter signs that continue to be undercut include perimeter signs P6, P8, P19, P25, P27, P28, P29, and P56 (PL-2). The undercutting at perimeter signs P57 and P58 was advanced enough that the signs were repaired following the inspection. Several perimeter signs, P17, P27, P34, P71, P74, P76, P79, P80, and P82, have bullet holes but are still legible. The sign number on perimeter sign P77 was faded but legible. No other maintenance needs were identified.

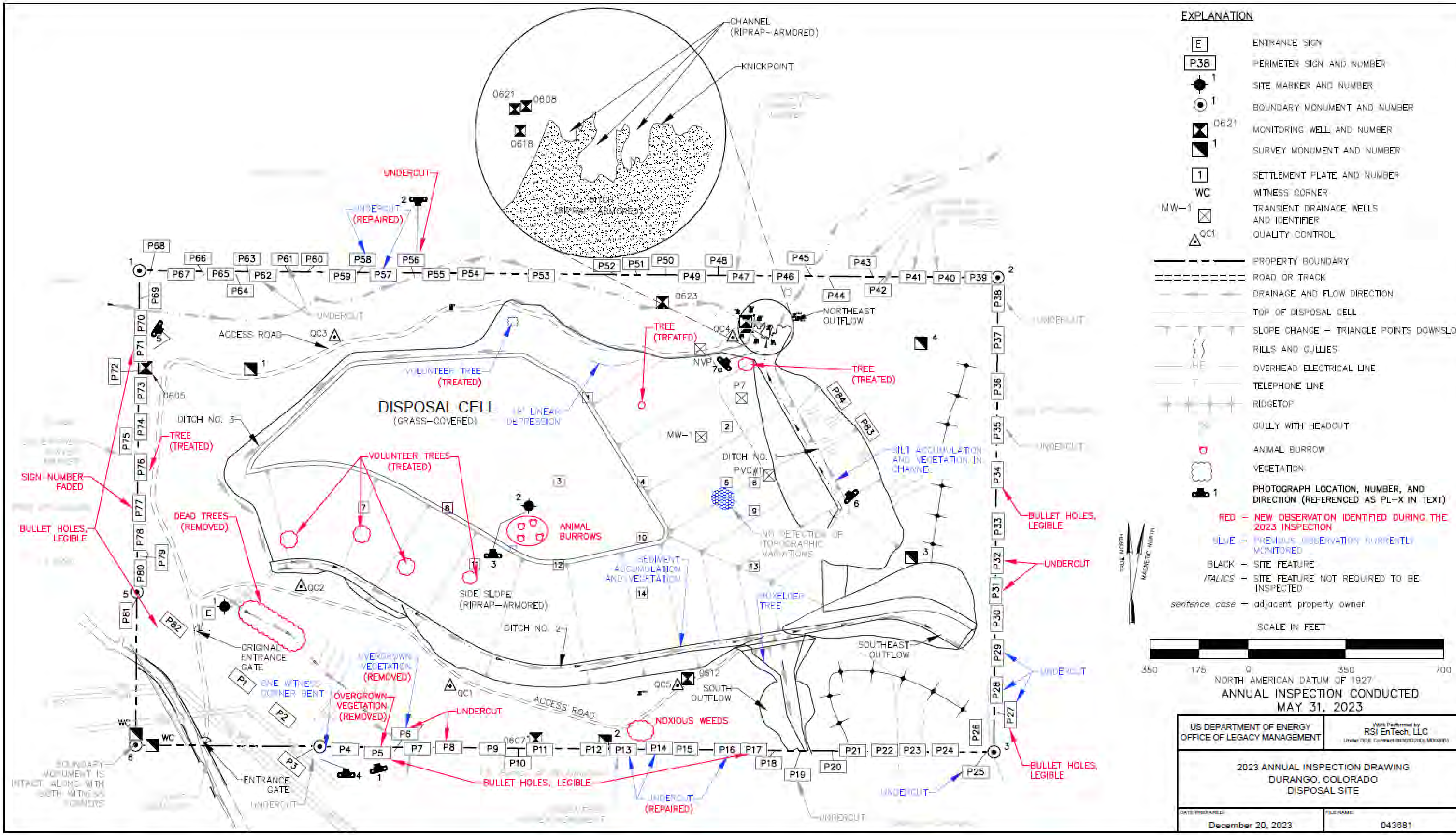


Figure 4-1. 2023 Annual Inspection Drawing for the Durango, Colorado, Disposal Site

4.4.1.3 Site Markers

The site has two site markers. Site marker SMK-1 is just inside the original entrance gate and was in good condition. Site marker SMK-2 (PL-3) is on the top slope of the disposal cell and was also in good condition. No maintenance needs were identified.

4.4.1.4 Survey and Boundary Monuments

Four survey monuments and six boundary monuments (each with two witness corners) delineate the property boundary. Boundary monument BM-6 was listed as missing in previous inspection reports but was observed intact and in place during the 2023 inspection, along with both adjacent witness corners. Boundary monument BM-4 was visible during the 2023 inspection (PL-4). No other maintenance needs were identified.

4.4.1.5 Aerial Survey Quality Control Monuments

Five aerial survey quality control monuments were inspected during the 2023 annual inspection. No maintenance needs were identified.

4.4.1.6 Monitoring Wells

The site has seven monitoring wells and two transient drainage wells. All wellhead protectors observed during the inspection were undamaged and locked. No maintenance needs were identified.

4.4.2 Inspection Areas

In accordance with the LTSP, the site is divided into six inspection areas (referred to as "transects" in the LTSP) to ensure a thorough and efficient inspection. The inspection areas are (1) the top of the disposal cell, (2) the side slopes of the disposal cell, (3) the drainage ditches, (4) the holding pond, (5) the site boundary, and (6) the outlying areas. Inspectors examined specific site surveillance features within each area and looked for evidence of erosion, settling, slumping, or other modifying processes that might affect the site's conformance with LTSP requirements.

4.4.2.1 Top of Disposal Cell

The disposal cell, completed in 1990, occupies 60 acres (PL-5). It has a vegetated cover consisting primarily of perennial grasses and broadleaf plants. There was no evidence of erosion, settling, slumping, or other modifying processes on top of the disposal cell. Inspectors observed several small animal burrows on the disposal cell top slope near site marker SMK-2. The burrows will be monitored but do not require mitigation at this time. No maintenance needs on the disposal cell top slope were identified.

4.4.2.2 Side Slopes of Disposal Cell

The side slopes of the disposal cell are armored with rock riprap. A linear depression approximately 18 feet long was first observed along the north toe of the disposal cell in 2015. The depression was repaired in October 2022, and inspectors were unable to detect any settling or other changes since the repair.

A subtle topographic variation in the surface of the northeast side slope, first observed during the 2018 annual inspection, was observed again in 2022. Inspectors were unable to discern the variations during the 2023 inspection. The variation does not warrant concern at this time, as no evidence of erosion or subsidence was found during the 2022 or 2023 inspection. Inspectors will continue to monitor the variation.

Inspectors found several young volunteer trees growing on the south side slope. The trees were treated following the inspection. No other maintenance needs were identified.

4.4.2.3 Drainage Ditches

Rock-armored drainage ditches are constructed at the toes of the side slopes on the east (Ditch No. 1), south (Ditch No. 2), and northwest and west (Ditch No. 3) sides of the disposal cell. Stormwater is directed into these ditches and conveyed away from the site into natural drainages. The ditches have sufficient depth and rock protection to carry stormwater runoff from a probable maximum precipitation event. Erosion occurs on some of the steep slopes above the ditches, depositing sediment in the riprap-armored channel. This sediment favors plant establishment but does not adversely affect the performance of the ditches, so maintenance is not needed at this time.

The riprap-covered outflows of the drainage ditches were designed to self-armor over time. The outflows and drainage channels below them are monitored annually. Inspectors observed increased vegetation growth along the east drainage channel (PL-6). A large boxelder tree is growing along the edge of the south outflow channel but does not affect the stability or effectiveness of the channel. A large arroyo has formed below the southeast outflow, which indicates that the drainage ditch is functioning properly. The uplands above the northeast outflow are steadily eroding (PL-7[a] and PL-7[b]), but this is not affecting the stability or effectiveness of the outflow area. No maintenance needs were identified.

4.4.2.4 Holding Pond

Inspectors noted that the former holding pond area, removed in 2017, is revegetating successfully and contains several species of native, pollinator-friendly wildflowers. No evidence of erosion or damage to the newly vegetated area was observed. No maintenance needs were identified.

4.4.2.5 Site Boundary

Boundary monuments and perimeter signs delineate the site boundary with one exception: the site boundary marked by boundary monument BM-6 is not delineated with perimeter signs because the signs cut across the corner of the site (perimeter signs P82, P1, P2, and P3). Inspectors noted no new activities or changes to the site boundary area. Gullies on the southeast and southwest portion of the site remain stable and do not threaten the integrity of the disposal cell or drainage ditches. No maintenance needs were identified.

4.4.2.6 Outlying Areas

The 0.25-mile area beyond the site boundary was visually observed for erosion, changes in land use, or other phenomena that might affect the long-term integrity of the site. No changes or new features were identified. Colorado Parks and Wildlife manages land to the north, west, and east of the site, and the U.S. Bureau of Reclamation manages land to the south. The primary land uses are wildlife habitat and recreation. Mountain bikers, hikers, and other recreational users commonly use La Plata County Road 212.

4.5 Follow-Up Inspections

LM will conduct follow-up inspections if (1) a condition is identified during the annual inspection or other site visit that requires a return to the site to evaluate the condition or (2) LM is notified by a citizen or outside agency that conditions at the site are substantially changed. No need for a follow-up inspection was identified.

4.6 Maintenance

Maintenance identified in the 2022 inspection was performed on the following areas before the 2023 inspection:

- Repair of undercut perimeter signs P13, P14, and P16
- Removal of vegetation around perimeter sign P6
- Treatment of volunteer tree on the north side of the disposal cell

Inspectors noted the following maintenance needs that were completed following the inspection:

- Removal of vegetation around perimeter sign P5
- Treatment of weeds and trees on the side and top slopes of the disposal cell
- Removal of dead trees around the disposal cell
- Repair of undercut perimeter signs P57 and P58

4.7 Emergency Measures

Emergency measures are the actions that LM will take in response to “unusual damage or disruption” that threatens or compromises site safety, security, or integrity in compliance with Criterion 12 of 10 CFR 40, Appendix A. No need for emergency measures was identified.

4.8 Environmental Monitoring

4.8.1 Groundwater Monitoring

LM conducts annual groundwater sampling and analysis to monitor disposal cell performance. The monitoring network consists of seven wells, including three POC wells, three wells monitored as a best management practice, and one background well (Figure 4-2). The most recent annual sampling event occurred at the site in June 2023.

The LTSP (DOE 2019) establishes three POC wells at the site: wells 0607, 0612, and 0621. These wells are completed in the uppermost aquifer (bedrock of the Cliff House Sandstone and the Menefee Formation) because of the limited extent of saturated alluvium underlying the site. A background well (well 0605) is also completed in the uppermost bedrock aquifer. Monitoring wells 0608, 0618, and 0623 are completed in the alluvium.

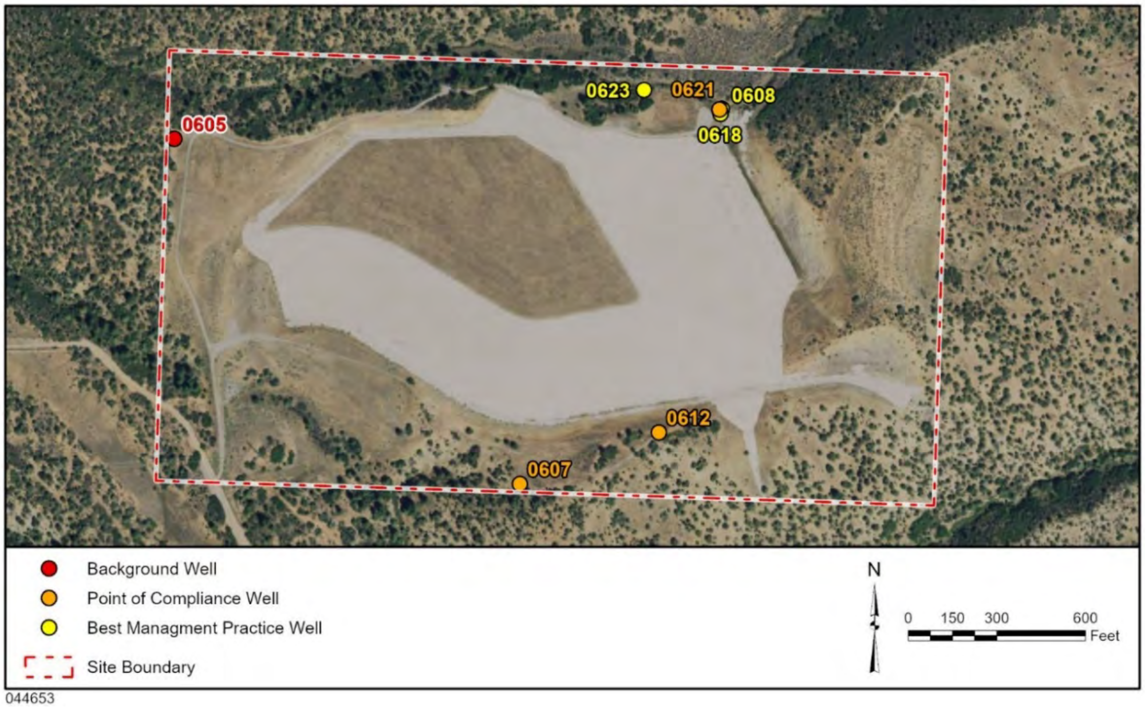


Figure 4-2. Groundwater Monitoring Network for the Durango, Colorado, Disposal Site

In addition to the annual sampling event and as a best management practice, LM samples monitoring wells 0608 and 0618 and POC well 0621 on a monthly basis (weather permitting) to monitor variable uranium concentrations in well 0618 that are typically above site-specific thresholds. Table 4-2 presents the current groundwater monitoring network.

Table 4-2. Groundwater Monitoring Network for the Durango, Colorado, Disposal Site

Monitoring Well	Well Compliance Type	Hydrologic Relationship (LTSP)
0605	Background	Upgradient (bedrock aquifer)
0607	POC	Downgradient (uppermost aquifer)
0608	N/A	Downgradient (alluvium)
0612	POC	Downgradient (bedrock aquifer)
0618	N/A	Downgradient (alluvium)
0621	POC	Downgradient (bedrock aquifer)
0623	N/A	Upgradient (alluvium)

Note:
Monitoring wells sampled as a best management practice have no compliance type and are indicated as N/A.

Abbreviation:
N/A = not applicable

Groundwater is sampled annually for three constituents: molybdenum, selenium, and uranium. The site-specific concentration thresholds or standards for the three constituents represent the respective maximum observed background concentrations reported in groundwater samples collected from wells completed in the bedrock aquifer, as identified in Table 4 of the LTSP (DOE 2019). Table 4-3 provides these site-specific standards.

Table 4-3. Site-Specific Groundwater Standards for the Durango, Colorado, Disposal Site Based on Background Concentrations

Constituent	Standard (mg/L)
Molybdenum	0.22
Selenium	0.042
Uranium	0.077

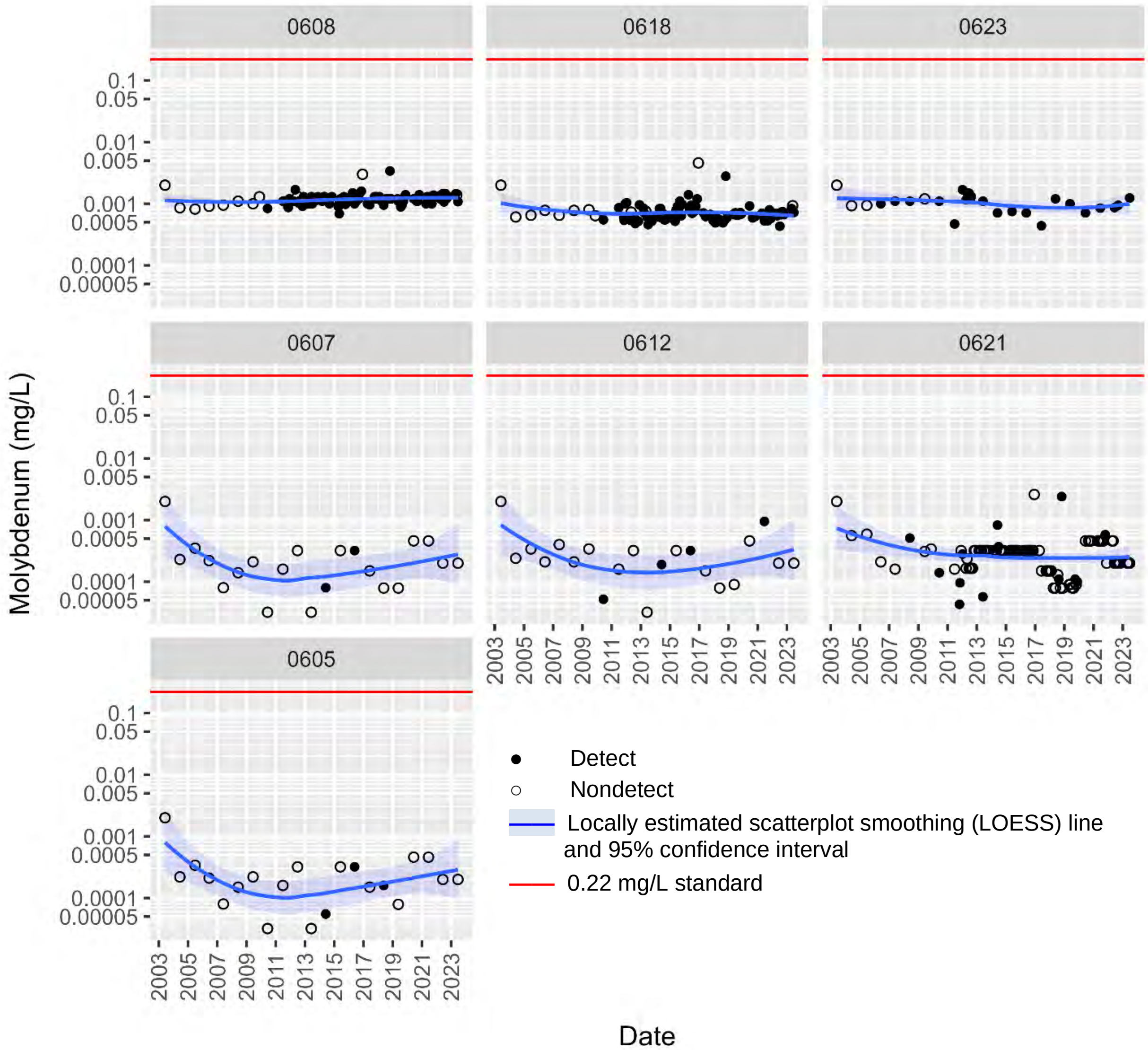
Abbreviation:
mg/L = milligrams per liter

Figure 4-3 through Figure 4-5 show the time-concentration plots for the three constituents, along with corresponding site-specific standards. These figures were developed using a faceting approach, whereby data are partitioned into a matrix of panels, with each panel plotting data for a single well. In each facet plot, a nonparametric smoothing method—locally estimated scatterplot smoothing (LOESS)—is used. The surrounding shaded area represents the 95% pointwise confidence interval. Because of the wide range in indicator parameter concentrations measured in site wells, a semilogarithmic scale is used. These figures were developed using R, version 4.3.1 (The R Foundation 2023), and the ggplot2 package, version 3.4.4 (Wickham 2016). All groundwater monitoring results plotted in the following figures are reported and published on the LM Geospatial Environmental Mapping System (GEMS) website (https://gems.lm.doe.gov/#site=DUD).

As shown in Figure 4-3 through Figure 4-5, concentrations of indicator parameters (molybdenum, selenium, and uranium) in POC wells 0607, 0612, and 0621 in the uppermost aquifer continue to be below respective standards. Uranium concentrations in well 0618 have consistently been variable and typically higher than concentrations in the other onsite wells.

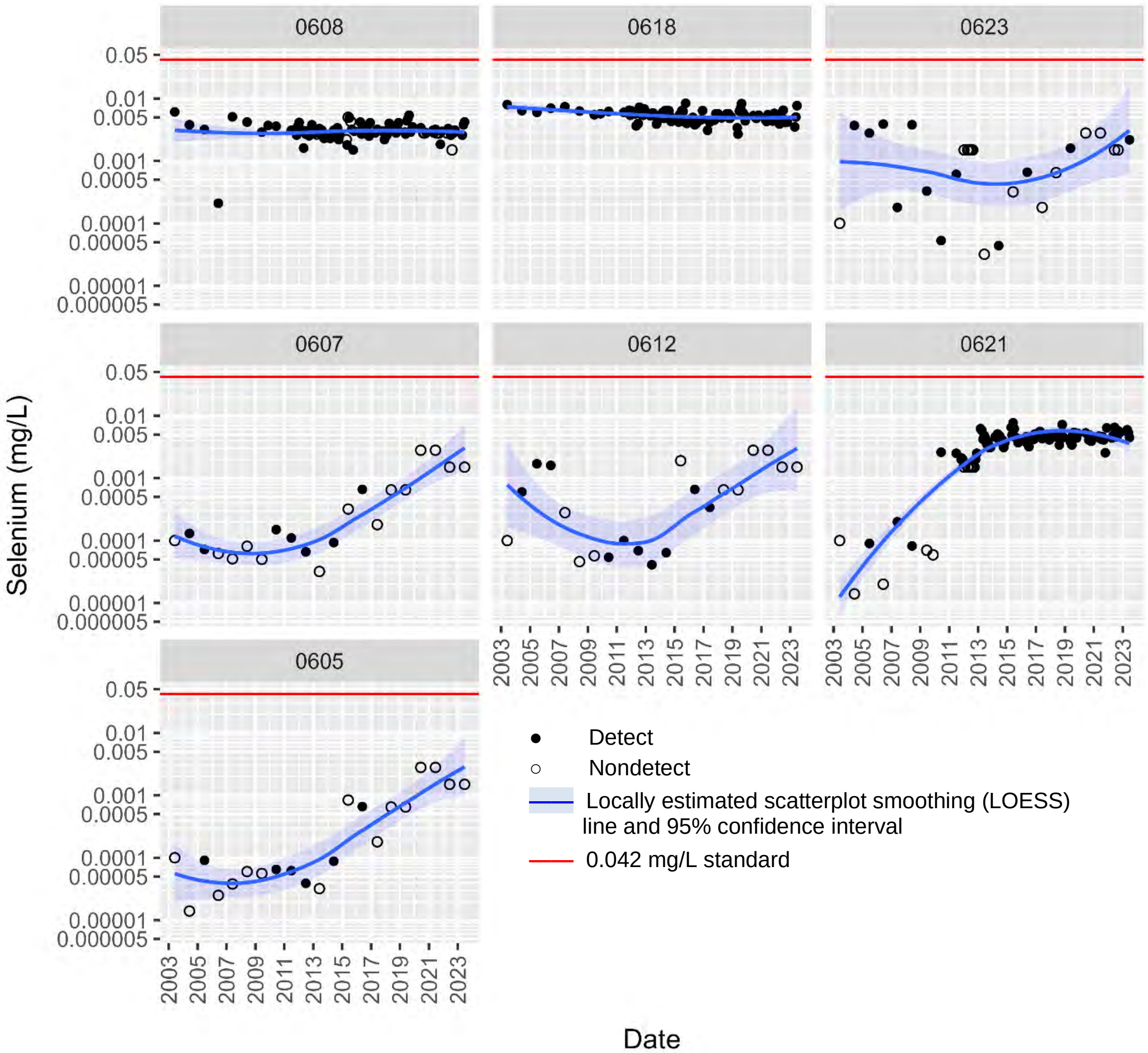
4.8.2 Vegetation Monitoring

Vegetation on top of the disposal cell remains healthy. The LTSP requires deep-rooted plants on the disposal cell cover and side slopes to be eliminated by either selective spraying or mechanical removal when their shoot height equals or exceeds 3.5 feet. Several noxious weeds identified at the time of the inspection were treated following the inspection.



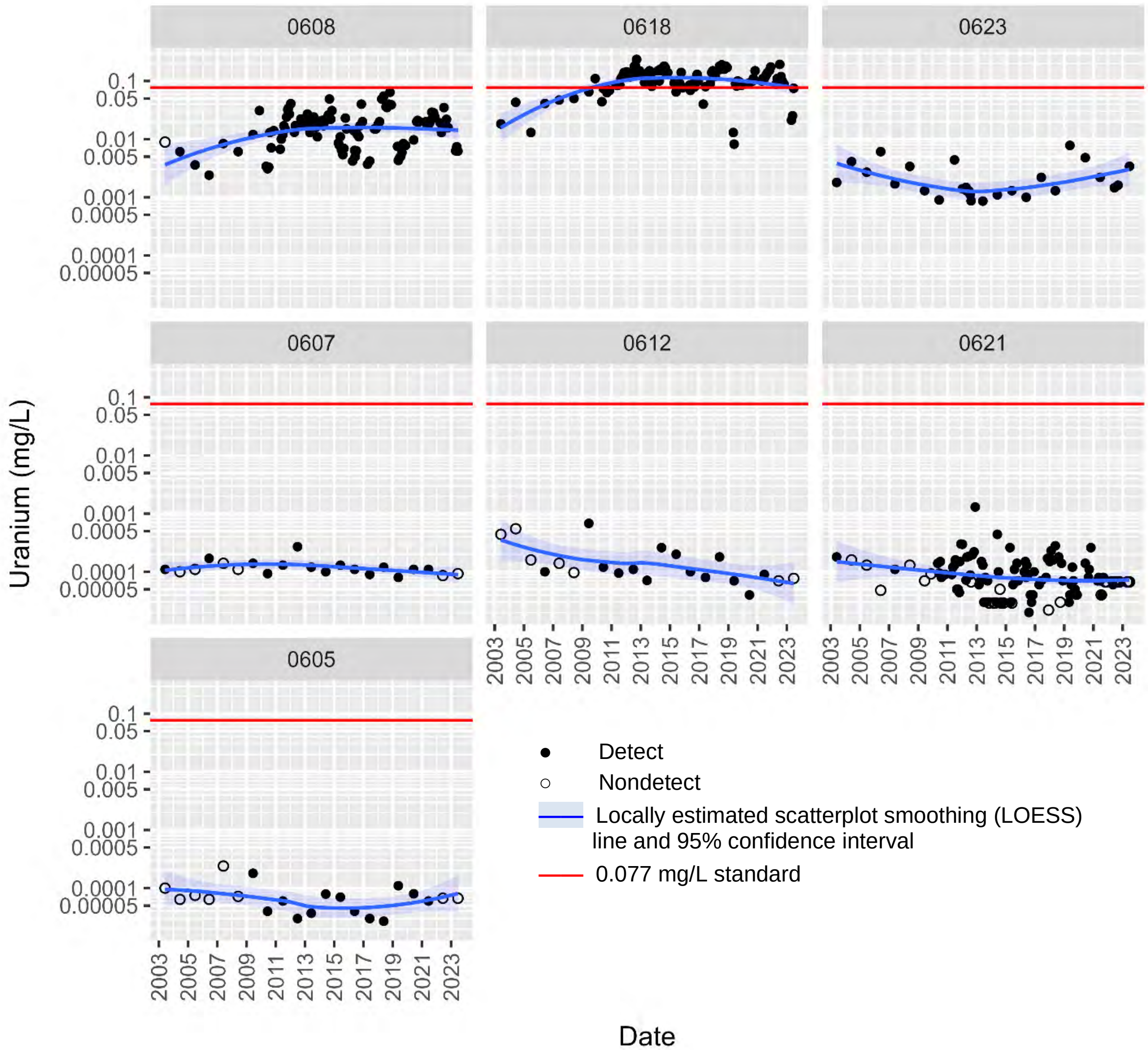
Notes: Wells are ordered by purpose: monitoring wells are listed in the top row, followed by POC wells (second row). Data for background well 0605 are plotted last.
Abbreviation: mg/L = milligrams per liter

Figure 4-3. Molybdenum Concentrations in Groundwater at the Durango, Colorado, Disposal Site, 2003–2023



Notes: Wells are ordered by purpose: monitoring wells are listed in the top row, followed by POC wells (second row). Data for background well 0605 are plotted last.
Abbreviation: mg/L = milligrams per liter

Figure 4-4. Selenium Concentrations in Groundwater at the Durango, Colorado, Disposal Site, 2003–2023



Notes: Wells are ordered by purpose: monitoring wells are listed in the top row, followed by POC wells (second row). Data for background well 0605 are plotted last.
Abbreviation: mg/L = milligrams per liter

Figure 4-5. Uranium Concentrations in Groundwater at the Durango, Colorado, Disposal Site, 2003–2023

4.9 Corrective Action

The LTSP, Section 3.6, describes the criteria for corrective action. No need for corrective action was identified.

4.10 References

10 CFR 40 Appendix A. U.S. Nuclear Regulatory Commission, "Criteria Relating to the Operation of Uranium Mills and the Disposition of Tailings or Wastes Produced by the Extraction or Concentration of Source Material from Ores Processed Primarily for Their Source Material Content," *Code of Federal Regulations*.

10 CFR 40.27. U.S. Nuclear Regulatory Commission, “General License for Custody and Long-Term Care of Residual Radioactive Material Disposal Sites,” *Code of Federal Regulations*.

DOE (U.S. Department of Energy) 2019. *Long-Term Surveillance Plan for the Durango, Colorado, Disposal Site*, LMS/DUD/S06297, Office of Legacy Management, May.

The R Foundation, 2023. “The R Project for Statistical Computing,” The R Foundation for Statistical Computing, version 4.3.1, https://www.r-project.org, accessed October 17, 2023.

Wickham, H., 2016. “ggplot2: Elegant Graphics for Data Analysis,” Springer-Verlag, New York, https://ggplot2.tidyverse.org, accessed October 17, 2023.

4.11 Photographs

Photograph Location Number	Azimuth	Photograph Description
PL-1	345	Heavy Vegetation Around Perimeter Sign P5
PL-2	180	Undercutting Around Base of Perimeter Sign P56
PL-3	—	Site Marker SMK-2
PL-4	—	Boundary Monument BM-4
PL-5	120	Disposal Cell Top Slope
PL-6	315	Grass in Drainage Channel near Perimeter Sign P83
PL-7	45	(a) Northeast Outflow Looking Away from Disposal Cell near Well 0618—2023 (b) Northeast Outflow Looking Away from Disposal Cell near Well 0618—2006 Photo for Comparison

Note:
— = Photograph taken vertically from above.

PL-1. Heavy Vegetation Around Perimeter Sign P5

PL-2. Undercutting Around Base of Perimeter Sign P56

PL-3. Site Marker SMK-2

PL-4. Boundary Monument BM-4

PL-5. Disposal Cell Top Slope

PL-6. Grass in Drainage Channel near Perimeter Sign P83

PL-7a. Northeast Outflow Looking Away from Disposal Cell near Well 0618—2023

PL-7b. Northeast Outflow Looking Away from Disposal Cell near Well 0618—2006 Photo for Comparison

5.0 Falls City, Texas, Disposal Site

5.1 Compliance Summary

The Falls City, Texas, Uranium Mill Tailings Radiation Control Act (UMTRCA) Title I Disposal Site was inspected on May 23, 2023. No changes were observed in the disposal cell or associated drainage features, and personnel found no cause for a follow-up inspection.

The U.S. Department of Energy (DOE) Office of Legacy Management (LM) conducts annual groundwater monitoring as a best management practice. LM conducts two types of groundwater monitoring at the Falls City site: disposal cell performance monitoring and groundwater compliance monitoring. In the original Long-Term Surveillance Plan (DOE 1997b) (1997 LTSP), DOE committed to 5 years of disposal cell performance monitoring for changes in groundwater quality over the initial ambient conditions. In the original Groundwater Compliance Action Plan (DOE 1998), DOE proposed a compliance strategy of no groundwater remediation and application of supplemental standards because site-related contamination in the uppermost aquifer poses no risk to human health as it is not used for human consumption and is classified as limited use. The limited use classification was due to widespread ambient contamination not due to milling and that could not be cleaned up with methods reasonably employed by public water systems. Therefore, no concentration limits or points of compliance have been established.

In 2008, DOE issued an updated LTSP, the *Long-Term Surveillance Plan for the U.S. Department of Energy Falls City Uranium Mill Tailings Disposal Site, Falls City, Texas* (DOE 2008) (2008 LTSP) that states that DOE has fulfilled the monitoring requirements for disposal cell performance and groundwater compliance. DOE committed to continue annual groundwater monitoring as a best management practice. DOE submitted the *Groundwater Monitoring Assessment*, *Falls City, Texas, Disposal Site* (DOE 2010) to the U.S. Nuclear Regulatory Commission (NRC) in 2010. In the 2010 report, DOE evaluated groundwater monitoring results from 2006 to 2010 and compared them to previous results. DOE recommended termination of the monitoring program based on the requirements specified in the 2008 LTSP and requested concurrence from NRC for groundwater monitoring activities to be discontinued at the site (Dayvault 2010). Because DOE has not received concurrence from NRC regarding the request, annual best management practice groundwater monitoring continues to be conducted. The most recent sampling event occurred in February 2023.

5.2 Compliance Requirements

Requirements for the long-term surveillance and maintenance of the site are specified in the site-specific 2008 LTSP in accordance with procedures established to comply with the requirements of the NRC general license at Title 10 *Code of Federal Regulations* Section 40.27 (10 CFR 40.27). Table 5-1 lists these requirements.

Table 5-1. License Requirements for the Falls City, Texas, Disposal Site

Requirement	LTSP	This Report	10 CFR 40.27
Annual Inspection and Report	Section 3.3	Section 5.4	(b)(3)
Follow-Up Inspections	Section 3.4	Section 5.5	(b)(4)
Maintenance	Section 3.5	Section 5.6	(b)(5)
Emergency Response	Section 3.6	Section 5.7	(b)(5)
Environmental Monitoring	Section 3.7	Section 5.8	(b)(2)

5.3 Institutional Controls

The 231-acre site, identified by the property boundary shown in Figure 5-1, is owned by the United States and was accepted under the NRC general license in 1997. DOE is the licensee and, in accordance with the requirements for UMTRCA Title I sites, LM is responsible for the custody and long-term care of the site. Institutional controls (ICs) at the site include federal ownership of the property, administrative controls, and the following physical ICs that are inspected annually: the disposal cell and associated drainage structures, entrance gate and sign, perimeter fence and signs, site markers, survey and boundary monuments, and wellhead protectors.

An adjacent 513-acre offsite property was sold by the State of Texas to Alamo Funding Group in 2005. The state initially acquired this land as part of the designated processing site, but this portion of the processing site was not incorporated into the final DOE-owned site. The warranty deed stipulates that the new owners agree not to use any groundwater underlying the property for commercial or industrial uses in accordance with requirements for parcel transfers stipulated in UMTRCA. No human habitation structures will be constructed on the property, and nothing may be done to affect groundwater quality or interfere with UMTRCA groundwater remediation activities. Permission must be obtained from the Texas Commission on Environmental Quality and LM before (1) constructing wells or otherwise exposing groundwater to the surface; (2) performing construction, excavation, or soil removal of any kind; or (3) selling the property. Alamo Funding Group subdivided the land and sold it to two parties in 2011 and 2012. LM confirmed that the deed restrictions remained in recorded real property documents. The two landowners will seek approval from LM and the state for any future construction.

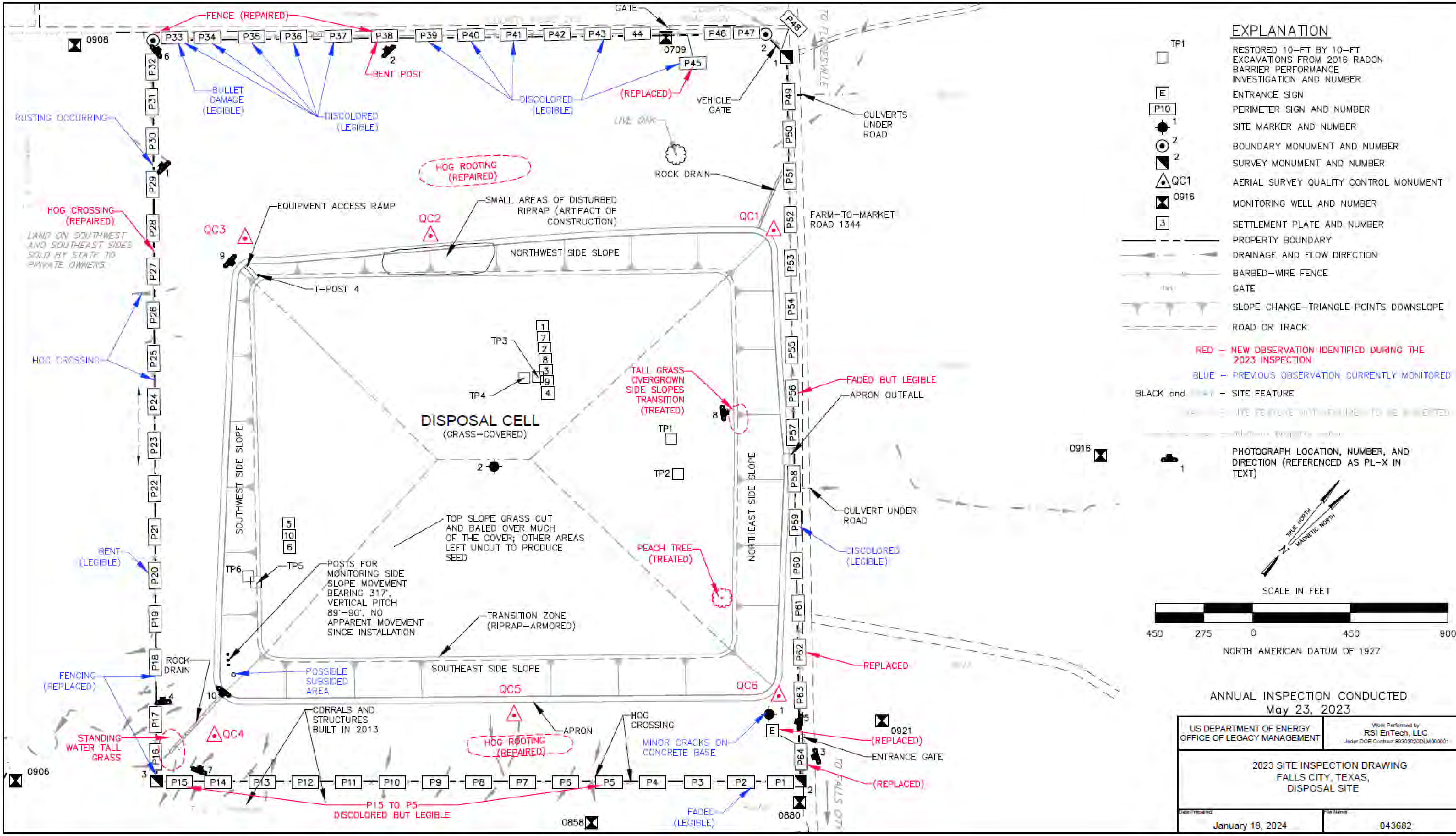


Figure 5-1. 2023 Annual Inspection Drawing for the Falls City, Texas, Disposal Site

5.4 Inspection Results

The site, 8 miles southwest of Falls City, Texas, was inspected on May 23, 2023, by D. Marshall, J. Graham, S. Daly, and L. Martin of the Legacy Management Support (LMS) contractor. C. Boger (LM site manager) and R. Lyssy (LMS maintenance subcontractor) attended the inspection. T. Johnson and S. Anderson (NRC) also attended the inspection. The purposes of the inspection were to confirm the integrity of visible features at the site, identify changes in conditions that might affect conformance with the 2008 LTSP, and evaluate whether maintenance or follow-up inspection and monitoring are needed.

5.4.1 Site Surveillance Features

Figure 5-1 shows the locations of site features, including site surveillance features and inspection areas, in black and gray font. Some site features that are present but not required to be inspected are shown in italic font. Observations from previous inspections that are currently monitored are shown in blue, and new observations identified during the 2023 annual inspection are shown in red. Inspection results and recommended maintenance activities associated with site surveillance features are described in the following subsections. Photographs to support specific observations are noted in the text and in Figure 5-1 by photograph location (PL) numbers. The photographs and photograph log are presented in Section 5.10.

5.4.1.1 Site Access, Entrance Gate, and Entrance Sign

Access to the site is from Farm-to-Market Road 1344. The entrance gate at the east corner of the site and the vehicle gate at the north corner were locked and functional. There are two entrance signs on each entrance gate. One sign is on the north entrance, and one sign is on the east entrance. The east entrance sign was illegible and was replaced following the inspection. No other maintenance needs were identified.

5.4.1.2 Perimeter Fence and Signs

A five-strand barbed-wire perimeter fence encloses the site. As noted in previous inspections, perimeter fence strands and posts are beginning to rust except along the northwest side where the fence was replaced in 2006. The fence on the southwest side, between perimeter signs P33 and P38, showed signs of rust and damage and was repaired following the inspection. The rusting occurring between perimeter signs P29 and P32 will continue to be monitored (PL-1). The post at perimeter sign P38 is bent but functional (PL-2).

Wild hogs dig under the perimeter fence line in some areas. Their crossings are filled in by the LMS maintenance subcontractor, as these crossings can potentially compromise the integrity of the perimeter fence or damage haying equipment.

There are 64 perimeter signs attached to steel posts set in concrete and positioned along the property boundary and set back 5 feet (ft). Perimeter sign P64 (PL-3) was brittle and was replaced following the inspection, along with perimeter sign P62. Perimeter sign P45 was illegible and was replaced following the inspection. Perimeter sign P33 has bullet damage but remains legible. Additional perimeter signs are fading but remain legible. Replacement of the perimeter fence between perimeter sign P18 and survey monument SM-3 was completed following the 2022 inspection (PL-4). No other maintenance needs were identified.

5.4.1.3 Site Markers

The site has two site markers. Site marker SMK-1 is just inside the entrance gate (PL-5). The corners of the concrete base around the marker are cracked. The cracks are unchanged since the last inspection, and repairs are not needed. Site marker SMK-2 is on the top slope of the disposal cell. No maintenance needs were identified.

5.4.1.4 Survey and Boundary Monuments

Three survey monuments and two boundary monuments delineate the corners of the property (PL-6).

5.4.1.5 Aerial Survey Quality Controls Monuments

Six aerial survey quality control monuments were installed in February 2023 (PL-7). All monuments were in good condition during the inspection. No maintenance needs were identified.

5.4.1.6 Monitoring Wells

There is one monitoring well onsite; 11 monitoring wells are offsite. All monitoring wells were inspected during the February 2023 sampling event, and wellhead protectors were undamaged and locked. No maintenance needs were identified.

5.4.2 Inspection Areas

In accordance with the 2008 LTSP, the site is divided into three inspection areas (referred to as "transects" in the LTSP) to ensure a thorough and efficient inspection. The inspection areas are (1) the top and side slopes of the disposal cell, apron outfall, and rock drains; (2) the region between the apron at the toe of the side slopes and the site perimeter; and (3) the outlying area. Inspectors examined specific site surveillance features within each area and looked for evidence of erosion, settling, slumping, or other modifying processes that might affect the site's conformance with LTSP requirements.

5.4.2.1 Top and Side Slopes of the Disposal Cell, Apron Outfall, and Rock Drains

The disposal cell, completed in 1994, occupies 127 acres. Its vegetated cover consists primarily of well-established coastal Bermudagrass and kleingrass, with other species interspersed. The site, including the disposal cell, is managed for hay production, which ensures that turf vitality is maintained. The LMS maintenance subcontractor can take as many as three cuttings of hay each year from the site. The LMS maintenance subcontractor spot-sprays woody vegetation distributed in the uncut grass. At the time of the May 2023 inspection, hay bales were present on the property.

The previously observed desiccation cracks were no longer present in the soil on the top of the disposal cell. There was no evidence of erosion, settling, slumping, or other modifying processes that might affect the integrity of the disposal cell. No areas of ponded water or areas of settlement were observed on top of the disposal cell during the 2023 inspection.

On the northwest side slope, there was tall grass overgrown at the transition point from the top of the side slope to the riprap side slope that was treated following the inspection (PL-8). LM has also monitored several small depressions on the northwest side slope of the disposal cell since 2010. These depressions do not compromise the protectiveness of the riprap side slope, and no changes have been observed since 2010. Inspectors will continue to monitor these areas.

Fractured riprap has been observed on the disposal cell side slopes since it was completed. Pieces of riprap are fractured in place, indicating that the fracturing occurred after placement. Fracturing is likely a consequence of mechanical placement or thermal expansion and contraction; the riprap condition appears stable.

An equipment access ramp to the top of the disposal cell is at the west corner of the side slope (PL-9). The ramp was installed in 2006 using clean, angular riprap of progressively smaller rock sizes to provide a free-draining and stable driving surface that does not encourage vegetation encroachment. Some displacement of smaller rock has occurred, as would be expected from use, but the ramp continues to provide a stable driving surface.

Vegetation management is conducted on the top of the disposal cell and on the side slopes. Much of the vegetation observed on the side slopes was dead or dormant grass. The grass does not affect disposal cell performance. Because deep roots of woody vegetation could penetrate the radon barrier, woody vegetation is controlled annually through cutting and applying herbicide. A peach tree was observed growing on top of the disposal cell and was treated following the inspection. No additional maintenance concerns were noted on the top and side slopes of the disposal cell.

LM participated in a project sponsored by NRC to investigate the effect of soil-forming processes on the performance of the radon barrier on UMTRCA disposal cells. In April 2016, researchers excavated through the cover materials (cover soil and underlying radon barrier) at six locations to measure radon flux and document soil structure (Figure 5-1). Although significant soil structure was developing, radon flux did not exceed the U.S. Environmental Protection Agency (EPA) standard. LM will continue to monitor these locations to confirm that positive drainage is preserved and vegetation continues to thrive at the grass-covered test pits.

There was water slowly flowing in the south rock drain during the inspection (PL-10) with water ponding on the south corner noted on the inspection map. Willows that grow along the south drain are periodically removed by the LMS maintenance subcontractor. No water was observed in the north rock drain. Vegetation is left uncut at the outlets of the rock drains to help dissipate the energy of stormwater runoff and reduce soil erosion. No maintenance needs were identified.

5.4.2.2 Region Between the Apron at the Toe of the Side Slopes and the Site Perimeter

The area between the perimeter fence and the apron at the toe of the disposal cell side slopes is covered with well-established grass, which is primarily kleingrass with some coastal Bermudagrass. The grass is cut and baled 1 to 3 times annually, depending on precipitation. It is usually left uncut along the fence, along rock drains, and around some surveillance features, such as survey monuments that cannot be accessed with conventional farming equipment. No maintenance needs were identified.

5.4.2.3 Outlying Area

The area 0.25 mile beyond the site boundary was visually observed for erosion, changes in land use, or other phenomena that might affect the long-term integrity of the site. No such impacts were observed.

A portion of the site has been sold to another owner who is using the area for occasional livestock grazing. The new owners have removed some of the brush on their property to facilitate grazing.

Karnes County Road 202 runs along the northwest side of the property boundary. Public access to the road was restricted by a locked gate before 2011. The road has been open since then, but this has not led to increased vandalism or trespassing at the site.

5.5 Follow-Up Inspections

LM will conduct follow-up inspections if (1) a condition is identified during the annual inspection or other site visit that requires a return to the site to evaluate the condition or (2) LM is notified by a citizen or outside agency that conditions at the site are substantially changed. No need for a follow-up inspection was observed.

5.6 Maintenance

Six aerial survey quality control monuments were installed before the site inspection. Inspectors noted the following minor maintenance items that were completed following the inspection:

- Replacement of perimeter signs P45, P62, and P64
- Replacement of the entrance sign on the northeast gate between perimeter signs P64 and P63
- Repair of the perimeter fence between perimeter signs P33 and P38
- Repair of the hog crossing between perimeter signs P27 and P28
- Repair of the hog rootings on the northwest and southeast outlying areas
- Removal of the tall grass and vegetation on the northeast side slope transition

No other maintenance needs were identified.

5.7 Emergency Response

An emergency response is action LM will take in response to unusual damage or disruption that threatens or compromises site safety, security, or integrity in compliance with 10 CFR 40 Appendix A Criterion 12. No need for an emergency response was found.

5.8 Environmental Monitoring

5.8.1 Groundwater Monitoring

In accordance with the 2008 LTSP, annual groundwater monitoring is conducted as a best management practice. The most recent sampling event occurred in February 2023. The compliance strategy for groundwater protection at the site is no further remediation and application of supplemental standards in accordance with 40 CFR 192.21(g). Because supplemental standards apply to the uppermost aquifer at the site, no concentration limits or point of compliance locations have been established. Groundwater in the uppermost aquifer beneath the site meets the EPA definition of limited use (Class III) because it is not currently or potentially a source of drinking water due to widespread ambient contamination that cannot be remediated using methods reasonably employed by public water supply systems (40 CFR 192.11[e]).

As prescribed in the LTSP, the site groundwater monitoring program has the following purposes:

- Disposal cell performance monitoring
- Groundwater compliance monitoring to demonstrate that potential users of groundwater downgradient of the site are not exposed to contamination related to the former processing site

Two hydraulically connected groundwater units comprise the uppermost aquifer beneath the site. The shallower of the two units consists of the Deweesville Sandstone, which is underlain by the Conquista Clay of the Whitsett Formation. Groundwater flow in the Conquista Clay occurs mainly in the middle sandstone subunit with clay subunits above and below, though continuously low permeability strata have not been identified (DOE 1997a). Thus, these two units together are often referred to as the Deweesville/Conquista aquifer. The Dilworth Sandstone of the Whitsett Formation is below the Conquista Clay. A downward hydraulic gradient occurs between the Deweesville/Conquista aquifer to the Dilworth aquifer, but the main communication between the two occurs through past mining company boreholes that were not abandoned properly (DOE 1997a). With this, the Dilworth is included as part of the uppermost aquifer. The 2008 LTSP states that the Dilworth Sandstone is underlain by the Manning Clay, a 300-foot-thick aquitard that isolates the uppermost aquifer from higher-quality groundwater in deeper aquifers. Samples are collected from the Deweesville/Conquista and the Dilworth groundwater units.

Table 5-2 and Figure 5-2 describe and illustrate the groundwater monitoring network at the site, which includes the groundwater compliance monitoring wells and the disposal cell performance monitoring wells. The disposal cell performance monitoring wells are near the disposal cell and are all completed in the Deweesville and Conquista units. The groundwater compliance monitoring wells are downgradient of the site and completed in the Deweesville and Conquista units and the Dilworth unit.

Table 5-2. Groundwater Monitoring Network for the Falls City, Texas, Disposal Site

Groundwater Monitoring Purpose	Monitoring Wells	Comments
Disposal cell performance monitoring	0709, 0858, 0880, 0906, 0908, 0916, and 0921	Well 0880 is completed in the Deweesville unit; remaining disposal cell performance wells are completed in the Conquista unit. Wells 0908 and 0916 have been dry since 1987.
Groundwater compliance monitoring	0862, 0886, 0891, 0924, and 0963	Well 0886 is completed in the Deweesville unit and is considered a sentinel well for groundwater flow toward the Conquista site. Wells 0924 and 0963 are completed in the Conquista unit, and wells 0862 and 0891 are completed in the underlying Dilworth unit. Wells 0924 and 0891 are considered sentinel wells for the Conquista and Dilworth units, respectively (DOE 1997a).

Groundwater is sampled annually for total uranium and field measurements of water level, temperature, pH, conductivity, turbidity, alkalinity, dissolved oxygen, and oxidation-reduction potential. Of particular interest are total uranium, pH, and water levels. The *Final Site Observational Work Plan for the UMTRA Project Site at Falls City, Texas* (DOE 1997a) identifies low pH in groundwater as an indicator of the extent and movement of the tailings-derived groundwater plumes. However, in the 2008 LTSP, subsequent monitoring results indicate that pH is not always an indicator of contaminant concentrations at the site. Therefore, increasing uranium concentrations at a monitoring well without an attendant drop in pH might still indicate movement of processing-related contamination.

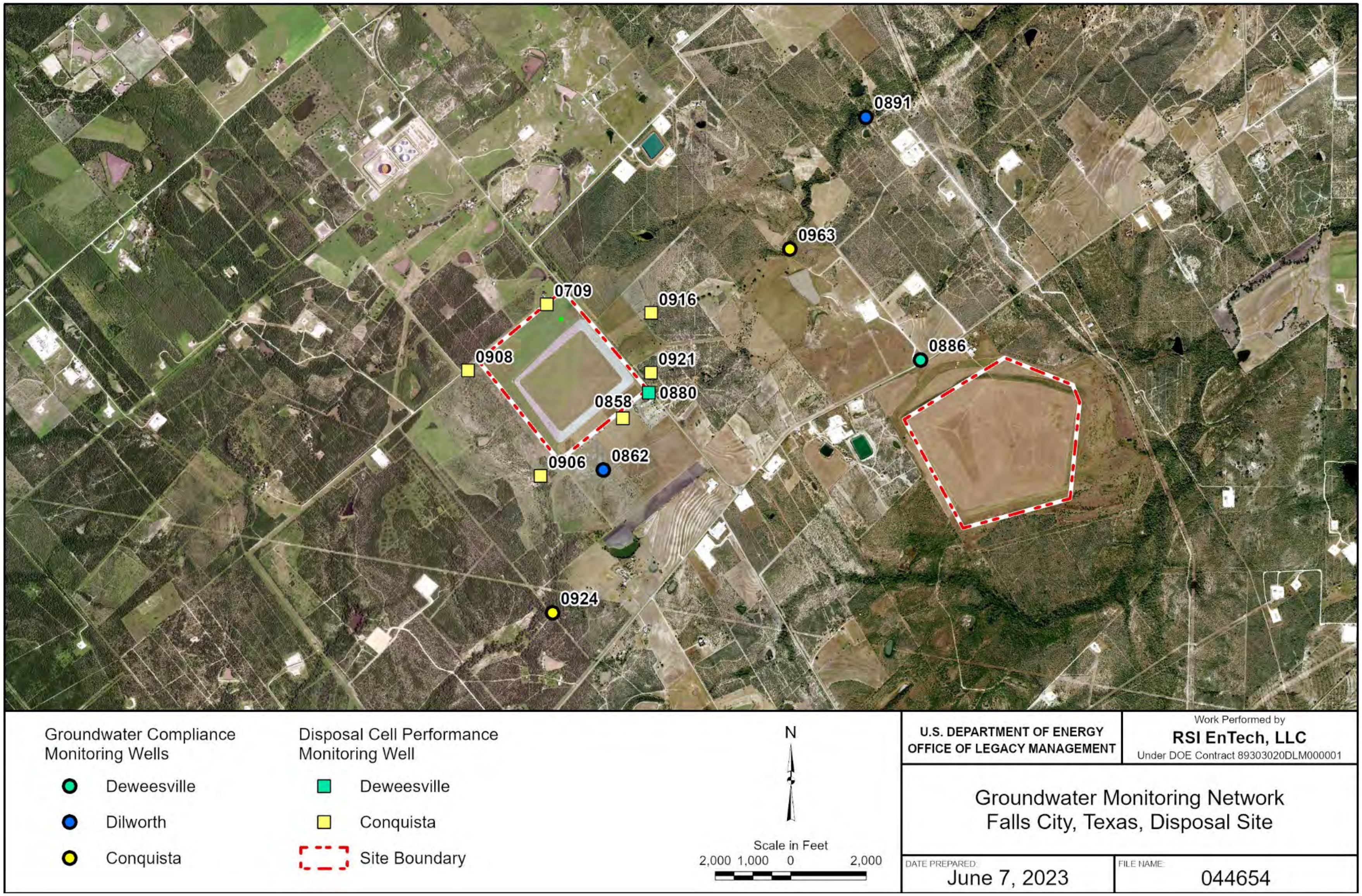


Figure 5-2. Groundwater Monitoring Well Network at the Falls City, Texas, Disposal Site

The following sections (Sections 5.8.2 and 5.8.3) present monitoring results for groundwater levels and groundwater quality (pH and uranium), respectively. To support these discussions, Figure 5-3 through Figure 5-8 use a faceting approach, whereby data are partitioned into a matrix of panels, with each panel plotting data for a single well. In each facet plot, a nonparametric smoothing method—locally estimated scatterplot smoothing (LOESS)—is used. The surrounding shaded area represents the 95% pointwise confidence interval. Using this approach, overall trends in the data are more apparent and not obscured by "noise" or random variation. Because of the wide range in uranium contaminant concentrations measured in site wells (0.0003–14 milligrams per liter [mg/L]), a semilogarithmic scale is used.

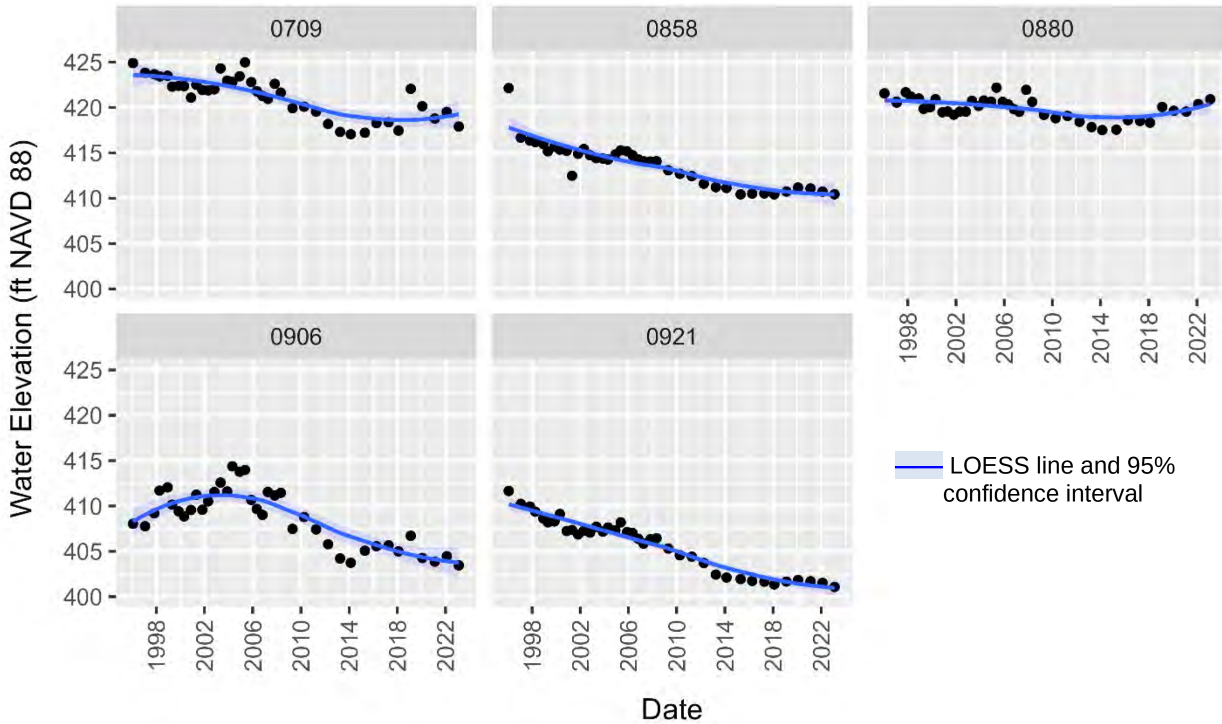
Figure 5-3 through Figure 5-8 were developed using R, version 4.3.0 (The R Foundation 2023), and the ggplot2 package, version 3.4.2 (Wickham 2016), one of a collection of packages included in the tidyverse (version 2.0.0) (Wickham et al. 2019). To support interpretation of these figures, Mann-Kendall trend analysis was performed for each well-parameter combination to assess whether trends in water levels, pH, or uranium are upward, stable (no trend), or declining. Detailed Mann-Kendall trend test results are documented at the end of this section (Table 5-3).

All groundwater monitoring results presented in the following sections are reported and published on the LM Geospatial Environmental Mapping System (GEMS) website (https://gems.lm.doe.gov/#site=FCT).

5.8.2 Groundwater Level Monitoring Results

Figure 5-3 and Figure 5-4 plot groundwater elevations measured between 1996 and 2023 in disposal cell performance and groundwater compliance monitoring wells, respectively. The data plotted in these figures are referenced to the North American Vertical Datum of 1988 (NAVD 88). Water levels in all disposal cell performance wells have statistically significant decreasing trends from 1996 to 2023 based on Mann-Kendall trend analyses (Table 5-3). The greatest water-level declines have occurred in wells 0709, 0921, and 0858, with decreases of 7.0, 10.6, and 11.7 ft, respectively.

Groundwater compliance wells 0862, 0886, and 0963 have statistically significant increasing water-level trends since 1996 (5–7 ft increases). Although water levels in well 0891 have increased 3.3 ft since 1996 (Figure 5-4), the trend is not significant (Table 5-3). In contrast, a statistically significant decreasing trend was identified for well 0924, where water levels have declined 1.6 ft since 1996.



Note: Disposal cell performance monitoring wells 0908 and 0916 have been dry since 1987.

Figure 5-3. Water-Level Measurements at Disposal Cell Performance Monitoring Wells at the Falls City, Texas, Disposal Site

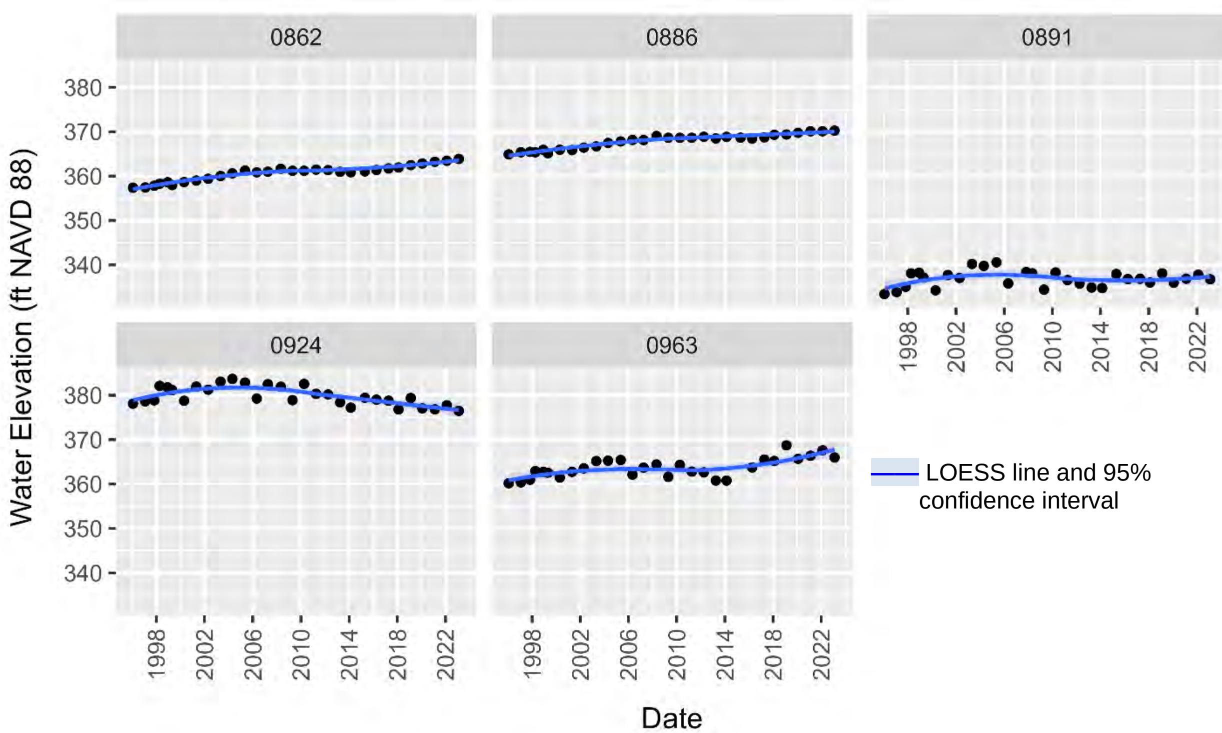
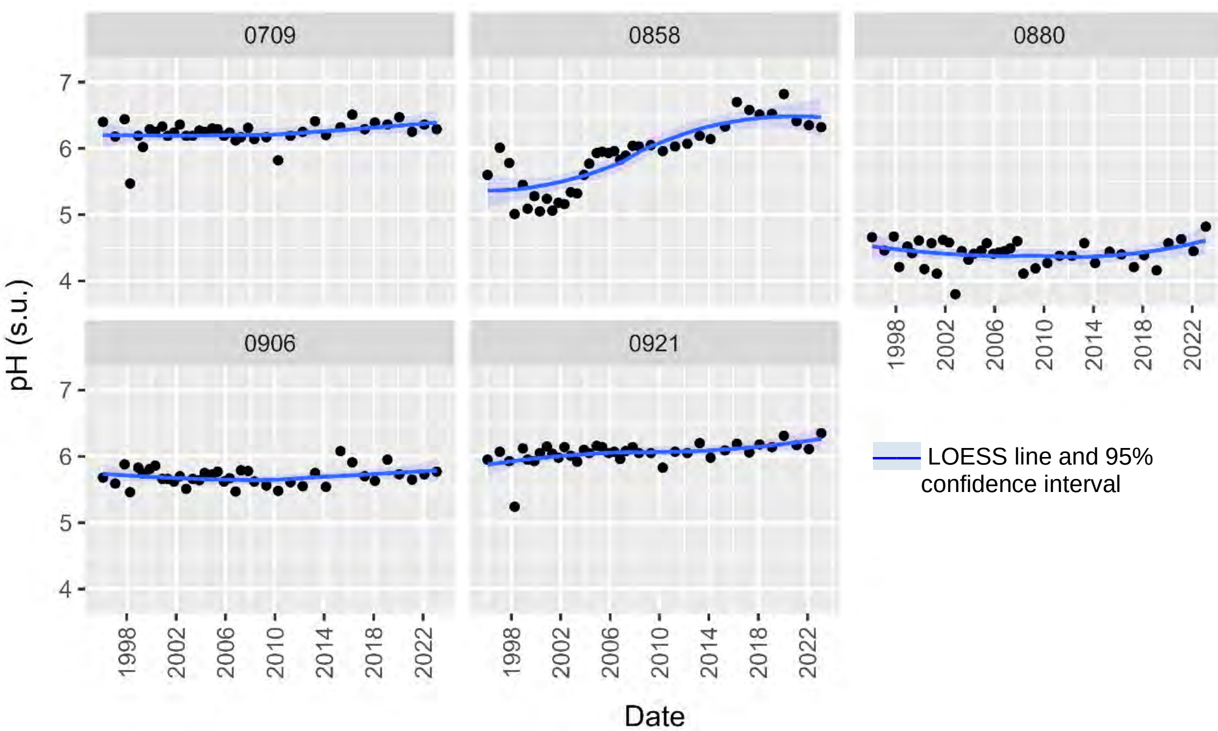


Figure 5-4. Water-Level Measurements at Groundwater Compliance Monitoring Wells at the Falls City, Texas, Disposal Site

5.8.3 Groundwater Quality Monitoring Results

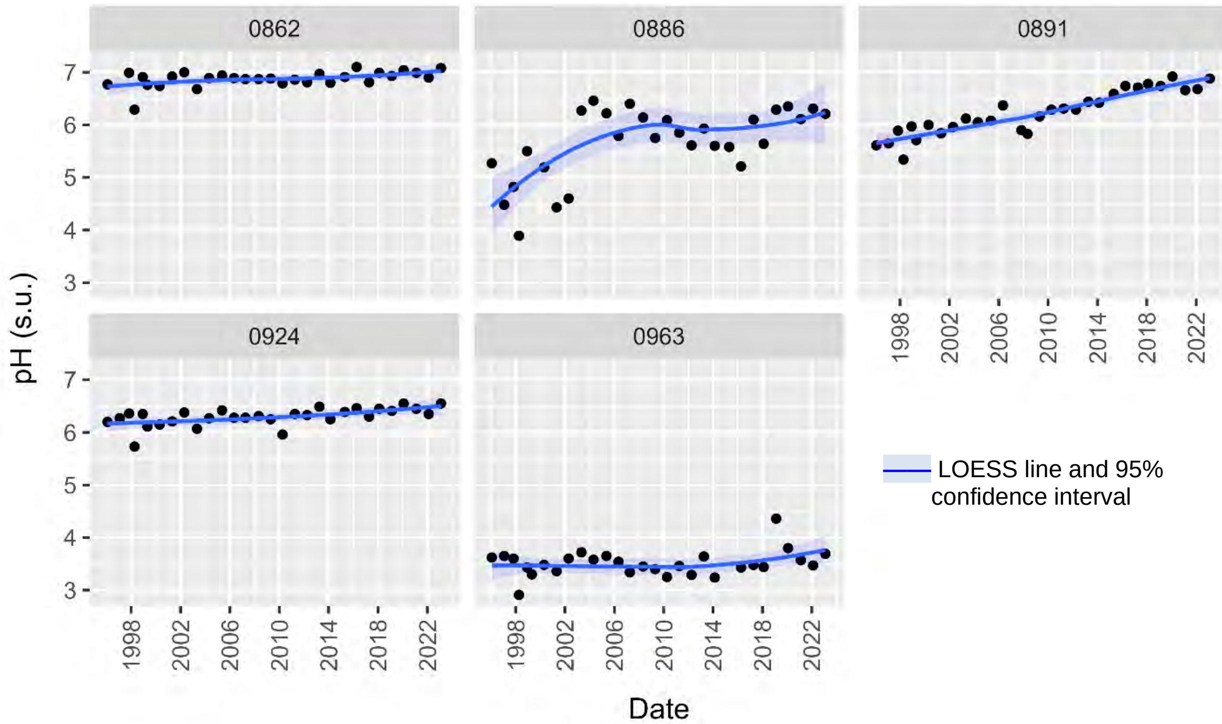
pH: Consistent with the findings in the previous annual report (DOE 2023), Mann-Kendall trend analysis indicates significant increasing trends in pH (since 1996) for wells 0858 and 0921 (Table 5-3). No significant trends were identified for the remaining disposal cell performance wells. Although pH values in all disposal cell performance wells have been greater than that measured in tailings pore fluids (pH of 2.9 [DOE 1997a]), pH levels in well 0880 remain relatively low, ranging from 3.4–5.2 historically and 3.8–4.8 for the 1996–2023 period shown in Figure 5-5. The pH values for all disposal cell performance monitoring wells do not show any recent significant changes (Figure 5-5).

For compliance monitoring wells, statistically significant increasing trends in pH have been identified in all wells except 0963 (Figure 5-6, Table 5-3). The pH values measured in 2023 were within the range of historical values for all groundwater compliance monitoring wells. The pH in monitoring well 0963 historically has been lower than at the other groundwater compliance wells (and the disposal cell performance monitoring wells), with a pH of 3.7 in 2023 compared to between 6.0–7.0 in the other wells.



Note: Disposal cell performance monitoring wells 0908 and 0916 have been dry since 1987.
Abbreviation: s.u. = standard unit

Figure 5-5. pH at Disposal Cell Performance Monitoring Wells at the Falls City, Texas, Disposal Site

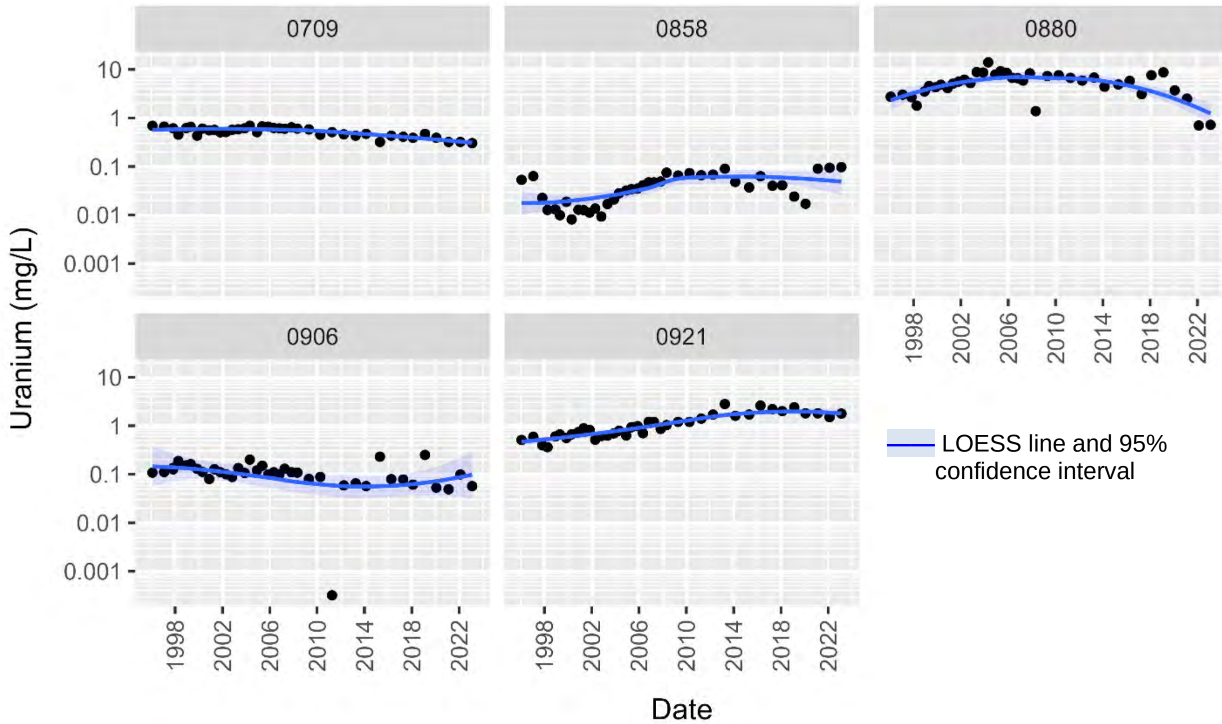


Abbreviation: s.u. = standard unit

Figure 5-6. pH at Groundwater Compliance Monitoring Wells at the Falls City, Texas, Disposal Site

Uranium: The 2023 uranium concentrations for disposal cell performance monitoring wells are similar to those reported in recent years (Figure 5-7). Using data since 1996, Mann-Kendall trend analysis identified statistically significant trends in uranium concentrations in all disposal cell performance monitoring wells except well 0880 (Table 5-3). Significant increasing trends were found for wells 0858 and 0921, while significant decreasing trends were identified for wells 0709 and 0906. Uranium concentrations in monitoring well 0880 are most variable, ranging from 0.7 mg/L (result from 2022 and 2023) to 14 mg/L in 2004, but with no significant trend.

In 2023, uranium concentrations in groundwater compliance monitoring wells were consistent with the findings reported in the previous annual report (Figure 5-8) (DOE 2023). Mann-Kendall trend analysis identified statistically significant uranium concentration trends in all wells, with increasing trends found for wells 0886, 0891, and 0924, and decreasing trends in wells 0862 (characterized by low uranium concentrations) and 0963 (Table 5-3). Although a significant increasing trend was identified for well 0924, uranium concentrations have been relatively stable since 2004, fluctuating between approximately 0.4 mg/L and 0.6 mg/L. Uranium concentrations in well 0886 have stabilized in recent years (most recent result of 0.0075 mg/L). The latter is also true for monitoring well 0891, where uranium concentrations have decreased since 2018 (Figure 5-8).



Note: Disposal cell performance monitoring wells 0908 and 0916 have been dry since 1987.

Figure 5-7. Uranium Concentrations at Disposal Cell Performance Monitoring Wells at the Falls City, Texas, Disposal Site

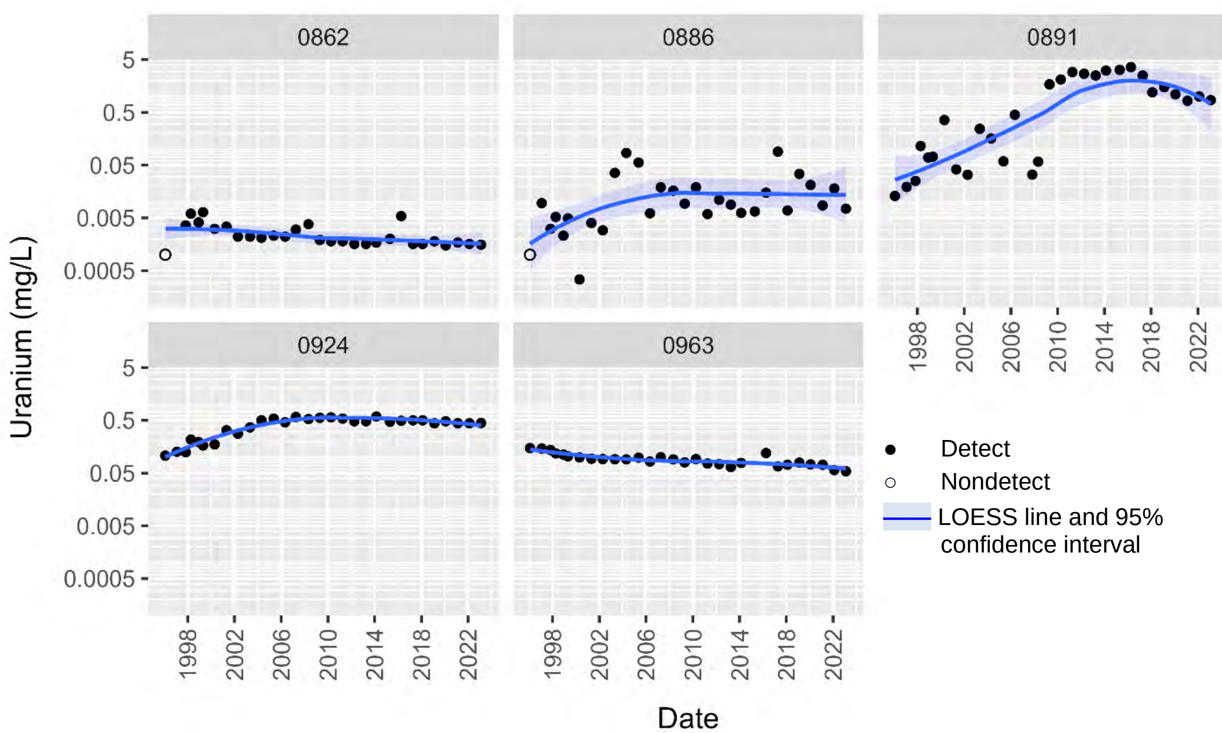


Figure 5-8. Uranium Concentrations in Groundwater Compliance Monitoring Wells at the Falls City, Texas, Disposal Site

Table 5-3. Mann-Kendall Trend Analysis Results for Falls City Site Monitoring Wells, 1996–2023

Parameter	Well	Monitoring Purpose	Initial Trend Analysis Date[a]	Number of Samples	Mann-Kendall Trend Analysis Results[b]		
					Kendall's tau[c]	p-value[d]	Trend
Water Level	0709	Disposal Cell Performance	1/24/1996	39	−0.587	<0.0001	Decreasing
Water Level	0858	Disposal Cell Performance	1/24/1996	39	−0.804	<0.0001	Decreasing
Water Level	0880	Disposal Cell Performance	1/24/1996	40	−0.36	0.001	Decreasing
Water Level	0906	Disposal Cell Performance	1/24/1996	39	−0.435	0.0001	Decreasing
Water Level	0921	Disposal Cell Performance	1/24/1996	39	−0.859	<0.0001	Decreasing
Water Level	0862	Groundwater Compliance	1/24/1996	30	0.842	0	Increasing
Water Level	0886	Groundwater Compliance	1/24/1996	30	0.838	0	Increasing
Water Level	0891	Groundwater Compliance	1/24/1996	30	0.025	0.86	No Trend
Water Level	0924	Groundwater Compliance	1/24/1996	30	−0.347	0.007	Decreasing
Water Level	0963	Groundwater Compliance	1/24/1996	29	0.483	0.0003	Increasing
pH	0709	Disposal Cell Performance	1/30/1996	39	0.195	0.089	No Trend
pH	0858	Disposal Cell Performance	1/28/1996	39	0.710	0	Increasing
pH	0880	Disposal Cell Performance	1/25/1996	39	−0.04	0.73	No Trend
pH	0906	Disposal Cell Performance	1/30/1996	39	0.018	0.88	No Trend
pH	0921	Disposal Cell Performance	1/27/1996	39	0.390	0.0006	Increasing
pH	0862	Groundwater Compliance	1/30/1996	29	0.296	0.027	Increasing
pH	0886	Groundwater Compliance	1/25/1996	29	0.345	0.009	Increasing
pH	0891	Groundwater Compliance	1/27/1996	30	0.776	0	Increasing
pH	0924	Groundwater Compliance	1/29/1996	30	0.462	0.0004	Increasing
pH	0963	Groundwater Compliance	1/26/1996	29	0.054	0.69	No Trend
Uranium	0709	Disposal Cell Performance	1/30/1996	39	−0.509	0	Decreasing
Uranium	0858	Disposal Cell Performance	1/28/1996	39	0.487	0	Increasing
Uranium	0880	Disposal Cell Performance	1/25/1996	39	0.036	0.76	No Trend
Uranium	0906	Disposal Cell Performance	1/30/1996	40	−0.411	0.0003	Decreasing[e]
Uranium	0921	Disposal Cell Performance	1/27/1996	39	0.753	0	Increasing
Uranium	0862	Groundwater Compliance	1/30/1996	29	−0.526	0.0001	Decreasing
Uranium	0886	Groundwater Compliance	1/25/1996	30	0.304	0.019	Increasing
Uranium	0891	Groundwater Compliance	1/27/1996	30	0.483	0.0002	Increasing
Uranium	0924	Groundwater Compliance	1/29/1996	31	0.356	0.007	Increasing
Uranium	0963	Groundwater Compliance	1/26/1996	29	−0.742	0	Decreasing

Notes:

[a] For most well-parameter combinations, the final trend analysis date for this period is February 8, 2023. The only exceptions are wells 0709 and 0921, sampled on February 9, 2023.

[b] Trend tests were performed using the Kendall package in R, version 2.2.1 (McLeod 2022). Trend analyses were conducted at the 0.05 significance level using a two-sided test.

[c] The test statistic, Kendall's tau, is a measure of the strength of the association between two variables, with values always falling between −1 and +1.

[d] A calculated p-value of <0.05 indicates that the null hypothesis is rejected and a significant trend in the time series exists.

[e] The decreasing trend for uranium in well 0906 is still statistically significant if the extreme low outlier (0.00032 mg/L in April 6, 2011, sample [Figure 5-7]) is removed from the analysis. The results were nearly equivalent to those cited above, with a Kendall's tau and p-value of −0.413 and 0.00029, respectively.

5.8.4 Evaluation of Groundwater Monitoring

No change in disposal cell performance is indicated by the following data from the disposal cell performance monitoring wells: (1) overall decreasing water-level trends (Table 5-3 and Figure 5-3), and (2) no declining pH trends (Table 5-3 and Figure 5-5). These results are consistent with declining drainage rates of low-pH tailings pore water into the underlying geology. However, water levels in well 0880 have been trending higher since 2014 (Figure 5-3). Disposal cell performance wells 0858 and 0921 have statistically significant increases in uranium (Table 5-3), though the uranium increase in well 0921 occurred before 2014 (Figure 5-7). The uranium increase in well 0858 was mainly in the last 3 years (Figure 5-7).

Site-related contamination in the uppermost aquifer poses no risk to human health because groundwater from this aquifer is not used for human consumption and is designated as limited use. Potable water is produced locally from the Carrizo Sandstone that lies 2000 ft beneath the surface near the site. Additionally, a 300-foot-thick aquitard isolates the uppermost aquifer from the higher-quality groundwater in deeper aquifers.

For the groundwater compliance monitoring wells, wells 0886, 0891, and 0924 have statistically significant increasing uranium concentrations (Table 5-3), though these increases occurred before 2010 (Figure 5-8). According to DOE (1997a) and the 2008 LTSP, these results are not unexpected, as these three wells were at the downgradient edge of low-pH groundwater plumes with mill processing-derived fluids and elevated uranium concentrations. Currently, the pH values in these three wells are increasing (Figure 5-6 and Table 5-3), thereby confirming that in the longer term, the low-pH areas do not necessarily define areas with uranium contamination. This correlation was true in the past (DOE 1997a) during the continued addition of low-pH fluids from uranium processing and low-pH fluids produced from the oxidation of the tailings. Currently, these processes are no longer occurring, and uranium can continue to be mobile with increasing pH values.

The higher uranium concentrations in groundwater compliance well 0891, which increased from 1996–2016 and subsequently declined, likely reflects the passage of groundwater with elevated uranium flowing from the direction of former mill tailings (specifically tailings pile No. 3) (DOE 1997a). To maintain the protection of human health and the environment, DOE is planning on evaluating the groundwater flow and potential uranium transport downgradient of wells 0886, 0891, and 0924 to confirm that (1) groundwater quality continues to meet the groundwater class of use and (2) groundwater discharge to surface water is not an issue. Best management practice groundwater monitoring of the current monitoring well network will be continued at least through, and possibly beyond, the conclusion of this additional evaluation until concurrence for cessation is provided by NRC.

5.9 References

10 CFR 40 Appendix A. U.S. Nuclear Regulatory Commission, "Criteria Relating to the Operation of Uranium Mills and the Disposition of Tailings or Wastes Produced by the Extraction or Concentration of Source Material from Ores Processed Primarily for Their Source Material Content," *Code of Federal Regulations*.

10 CFR 40.27. U.S. Nuclear Regulatory Commission, "General License for Custody and Long-Term Care of Residual Radioactive Material Disposal Sites," *Code of Federal Regulations*.

40 CFR 192. U.S. Environmental Protection Agency, "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings," *Code of Federal Regulations.*

Dayvault, 2010. Jalena Dayvault, Office of Legacy Management, U.S. Department of Energy, letter (transmittal of Groundwater Monitoring Assessment Report for the Falls City, Texas, Disposal Site, December 2010) to the deputy director, U.S. Nuclear Regulatory Commission, December 23.

DOE (U.S. Department of Energy), 1997a. *Final Site Observational Work Plan for the UMTRA Project Site at Falls City, Texas*, DOE/AL-62350-157, Rev. 1, Grand Junction Office, Grand Junction, Colorado, May.

DOE (U.S. Department of Energy), 1997b. *Long-Term Surveillance Plan for the Falls City Disposal Site, Falls City, Texas*, DOE/AL/625350-187, Rev. 3, Albuquerque Operations Office, Albuquerque, New Mexico, July.

DOE (U.S. Department of Energy), 1998. *Final Groundwater Compliance Action Plan, 40 CFR 192 (Subpart B) Groundwater Compliance Modification to the Remedial Action Plan and Site Design for Stabilization of the Inactive Uranium Mill Tailings Site at Falls City, Texas*, March 19.

DOE (U.S. Department of Energy), 2008. *Long-Term Surveillance Plan for the U.S. Department of Energy Falls City Uranium Mill Tailings Disposal Site, Falls City, Texas*, LMS/FCT/S01307, DOE-LM/1602-2008, Office of Legacy Management, March. https://lmpublicsearch.lm.doe.gov/lmsites/2494-fct_ltsp.pdf.

DOE (U.S. Department of Energy), 2010. *Groundwater Monitoring Assessment, Falls City, Texas, Disposal Site*, LMS/FCT/S07069, Office of Legacy Management, December.

DOE (U.S. Department of Energy), 2023. *2022 Annual Site Inspection and Monitoring Report for Uranium Mill Tailings Radiation Control Act Title I Disposal Sites*, LMS/S38159, Office of Legacy Management, March.

McLeod, A.I., 2022. "Kendall: Kendall Rank Correlation and Mann-Kendall Trend Test," R package version 2.2.1, https://cran.r-project.org/web/packages/Kendall/index.html, accessed May 2023.

The R Foundation, 2023. "The R Project for Statistical Computing," The R Foundation for Statistical Computing, version 4.3.0, https://www.r-project.org, accessed May 2023.

Wickham, H., 2016. "ggplot2: Elegant Graphics for Data Analysis," Springer-Verlag, New York, https://ggplot2.tidyverse.org.

Wickham, H., M. Averick, J. Bryan, W. Chang, L. D'Agostino McGowan, R. François, G. Grolemund, A. Hayes, L. Henry, J. Hester, M. Kuhn, T.L. Pedersen, E. Miller, S.M. Bache, K. Müller, J. Ooms, D. Robinson, D.P. Seidel, V. Spinu, K. Takahashi, D. Vaughan, C. Wilke, K. Woo, and H. Yutani, 2019. "Welcome to the Tidyverse," *Journal of Open Source Software* 4(43):1686. https://doi.org/10.21105/joss.01686.

5.10 Photographs

Photograph Location Number	Azimuth	Photograph Description
PL-1	276	Rusting Fence Line
PL-2	277	Perimeter Sign P38 with Bent Post
PL-3	215	Perimeter Sign P64
PL-4	316	Repaired Fence Line Between Survey Monument SM-3 and Perimeter Sign P18
PL-5	215	Site Marker SMK-1
PL-6	—	Boundary Monument BM-1
PL-7	341	Quality Control Monument QC-4
PL-8	43	Tall Grass Overgrown on Slide Slope Transition to Riprap
PL-9	93	Equipment Access Ramp
PL-10	175	South Rock Drain

Note:
— = Photograph taken vertically from above.

PL-1. Rusting Fence Line

PL-2. Perimeter Sign P38 with Bent Post

PL-3. Perimeter Sign P64

PL-4. Repaired Fence Line Between Survey Monument SM-3 and Perimeter Sign P18

PL-5. Site Marker SMK-1

PL-6. Boundary Monument BM-1

PL-7. Quality Control Monument QC-4

PL-8. Tall Grass Overgrown on Slide Slope Transition to Riprap

PL-9. Equipment Access Ramp

PL-10. South Rock Drain

6.0 Grand Junction, Colorado, Disposal Site

6.1 Compliance Summary

The Grand Junction, Colorado, Uranium Mill Tailings Radiation Control Act (UMTRCA) Title I Disposal Site was inspected on November 28 and December 12, 2023. No major changes were observed on the disposal cell or in the associated drainage features. Inspectors identified minor maintenance needs that will be handled during upcoming site maintenance, but no cause for a follow-up inspection was identified.

A portion of the disposal cell remains open to receive low-activity radioactive materials from specified sources. The open disposal cell and its supporting structures and facilities are not included in the annual inspection. Ongoing disposal cell cover study areas, which include cover studies on top of the disposal cell and on lysimeter facilities adjacent to the north and west sides of the disposal cell, are not inspected. This annual inspection includes the closed portion of the disposal cell and the remaining portions of the disposal site.

The U.S. Department of Energy (DOE) Office of Legacy Management (LM) conducts annual groundwater monitoring at the site as a best management practice. Two monitoring wells (0731 and 0732) are sampled to verify that groundwater in onsite paleochannels is not affected by potential seepage from the disposal cell. A third monitoring well (0733) is primarily used to measure water levels within the disposal cell. Groundwater monitoring of all three wells was completed on July 6, 2023.

6.2 Compliance Requirements

Requirements for the long-term surveillance and maintenance of the closed portion of the disposal cell and the remaining portions of the site are specified in the site-specific Interim Long-Term Surveillance Plan (DOE 1998) (LTSP) in accordance with procedures established to comply with the requirements of the U.S. Nuclear Regulatory Commission (NRC) general license at Title 10 *Code of Federal Regulations* Section 40.27 (10 CFR 40.27). Table 6-1 lists these requirements.

Table 6-1. Interim Requirements for the Grand Junction, Colorado, Disposal Site

Requirement	LTSP	This Report	10 CFR 40.27
Annual Inspection and Report	Sections 3.0 and 6.2	Section 6.4	(b)(3)
Follow-Up Inspections	Section 3.4	Section 6.5	(b)(4)
Maintenance and Repairs	Sections 2.7.3 and 4.0	Section 6.6	(b)(5)
Corrective Action	Section 5.0	Section 6.8	—
Groundwater Monitoring	Section 2.6	Section 6.7	(b)(2), (b)(3)

In December 2020, Congress passed legislation that extends the final disposal cell closure date from 2023 to 2031. Unless additional legislation is enacted by Congress further extending the final cell closure date, LM’s operations to receive radioactive waste at the site are planned to cease in September 2031. Following final closure of the disposal cell, the Interim LTSP

(DOE 1998) for the site will be revised and finalized; with NRC acceptance of the final LTSP, the site will be subject to the NRC general license.

6.3 Institutional Controls

The 360-acre site, identified by the property boundary shown in Figure 6-1, is owned by the United States. Low-activity radioactive waste will be received until the disposal cell's legally mandated closure date or until it is filled to capacity, whichever comes first. Institutional controls (ICs) at the site include federal ownership of the property, administrative controls, and the following physical ICs that are inspected annually: the closed portion of the disposal cell and associated drainage features, access and entrance gates and signs, perimeter fence and signs, boundary monuments, and wellhead protectors.

6.4 Inspection Results

The site, 18 miles southeast of Grand Junction, Colorado, was inspected on November 28 and December 12, 2023. The inspection was conducted by J. Lobato, P. Wetherstein, and H. Petrie of the Legacy Management Support contractor. S. Woods (LM) and M. Cosby (Colorado Department of Public Health and Environment) also attended the inspection. The purposes of the inspection were to confirm the integrity of visible features at the site, identify changes in conditions that might affect conformance with the Interim LTSP, and evaluate whether maintenance or a follow-up inspection and monitoring are needed.

6.4.1 Site Surveillance Features

Figure 6-1 shows the locations of site features, including site surveillance features and inspection areas, in black and gray font. Some site features that are present but not required to be inspected are shown in italic font. Observations from previous inspections that are currently monitored are shown in blue, and new observations identified during the 2023 annual inspection are shown in red. Inspection results and recommended maintenance activities associated with site surveillance features are described in the following subsections. Photographs to support specific observations are noted in the text and in Figure 6-1 by photograph location (PL) numbers. The photographs and photograph log are presented in Section 6.10.

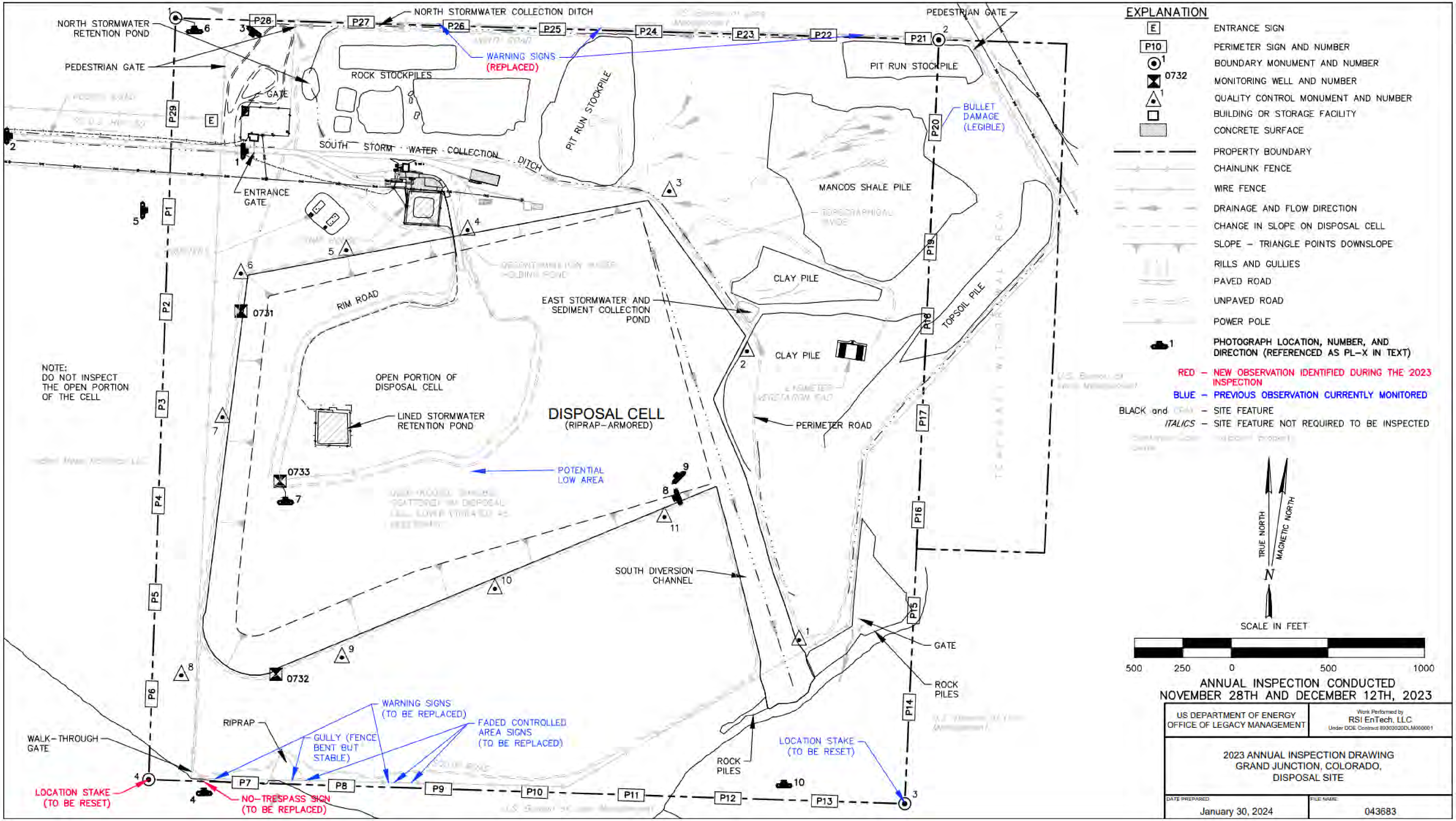


Figure 6-1. 2023 Annual Inspection Drawing for the Grand Junction, Colorado, Disposal Site

6.4.1.1 Access Road, Entrance Gates, and Entrance Signs

Access to the site is from U.S. Highway 50 by a right-of-way grant on federal land that is administered by the U.S. Bureau of Land Management (BLM). A steel double-swing gate along the highway right-of-way fence provides access to the BLM-administered right-of-way that leads to the site entrance gate. The access gate was secured at the time of the inspection (PL-1), and the lock was replaced during the inspection. Site access signs next to the gate were in good condition. No maintenance needs were identified.

Although it is not required by the Interim LTSP, LM maintains the site access road and associated right-of-way. The right-of-way is bounded by two barbed-wire fences that parallel the north and south sides of the site access road, with two stock gates included in each fence. Locks have been replaced on all access gates. No other maintenance needs were identified.

The solar-powered site entrance gate is secured by an electronic locking device that requires entry of a keypad code to open the gate. The entrance gate was functional at the time of the inspection (PL-2). Site entrance signs on and next to the entrance gate were in good condition.

The DOE contact number on the main entrance sign was updated with the new number. No maintenance needs were identified.

6.4.1.2 Perimeter Fence and Signs

A perimeter fence encloses the disposal cell features and operations areas (PL-3). It consists of a standard four-strand barbed-wire fence in some areas and a woven wire fence topped with barbed wire in others. The perimeter fence does not match the property boundary in several areas. The perimeter fence includes warning signs ("No-Trespassing" and "Controlled Area" signs) positioned at regular intervals. Multiple warning signs on the south perimeter fence are partially detached or illegible and (PL-4). The warning signs will be repaired or replaced before the next inspection.

There are 29 perimeter signs attached to steel posts set in concrete that are positioned at regular intervals along the property boundary (PL-5). Several perimeter signs along the south property boundary are faded or peeling but remain legible. Perimeter sign P20, replaced in 2021 because of bullet damage, has bullet damage again but remains legible. No other maintenance needs were identified.

6.4.1.3 Site Markers

Granite site markers similar to those at other UMTRCA sites will not be installed until final closure of the disposal cell in 2031.

6.4.1.4 Boundary Monuments

Four boundary monuments delineate the corners of the property boundary (PL-6). All were present and in good condition. The location stakes at boundary monuments BM-3 and BM-4 need to be reset. No other maintenance needs were identified.

6.4.1.5 Aerial Survey Quality Control Monuments

Eleven aerial survey quality control monuments were inspected. No maintenance needs were identified.

6.4.1.6 Monitoring Wells

The groundwater monitoring network consists of three monitoring wells: 0731, 0732, and 0733 (Figure 6-2) (well 0733 is shown in PL-7). All wellhead protectors were locked and undamaged. Root growth was observed in the well screens of monitoring wells 0731 and 0732 in 2021 (DOE 2022). The wells were redeveloped in 2022 (DOE 2023), and no root growth issues were observed during the 2023 sampling event. Weed spraying around each wellhead was completed in spring 2023 to keep out any deep-rooted plants. No other maintenance needs were identified.

6.4.2 Inspection Areas

In accordance with the Interim LTSP, the site is divided into four inspection areas to ensure a thorough and efficient inspection. The inspection areas are (1) the closed portion of the disposal cell, (2) diversion structures and drainage channels, (3) the area between the disposal cell and the property boundary or site perimeter fence, and (4) the outlying area. Inspectors examined specific site surveillance features within each area and looked for evidence of erosion, settling, slumping, or other modifying processes that might affect the integrity of the disposal cell and the site’s conformance with the Interim LTSP requirements.

6.4.2.1 Closed Portion of the Disposal Cell

The closed portion of the disposal cell is armored with basalt riprap to control erosion (PL-8). The rock showed no significant weathering. During the 2022 inspection, inspectors noted an area, approximately 23 × 12 feet (ft), east of monitoring well 0733 that appears to be a low area. In 2023, inspectors noted no change to this area. Inspectors will continue to monitor this area. There was no evidence of erosion, settling, slumping, rock degradation, or other modifying processes that might affect the integrity of the disposal cell (PL-9).

Grasses and weeds were growing on most of the disposal cell cover (PL-9). Historically, deep-rooted shrubs on top of the disposal cell have been treated with herbicide. Although treatment is not required by the Interim LTSP, LM plans to continue controlling the deep-rooted shrubs as needed. No maintenance needs were identified.

Figure 6-2. Groundwater Monitoring Network for the Grand Junction, Colorado, Disposal Site

6.4.2.2 Diversion Structures and Drainage Channels

The south diversion channel is a large, riprap-armored structure that intercepts run-on water from offsite and onsite, as well as stormwater runoff from the disposal cell, and conveys the water into a natural drainage that flows away from the site to the southwest (PL-10). Grasses, weeds, and shrubs growing within the diversion channel are not expected to affect the channel's performance. The discharge area of the channel is armored with large-diameter basalt riprap. No maintenance needs were identified.

Other drainage features at the site include north and south stormwater collection ditches, the north stormwater retention pond, and the east stormwater and sediment collection pond. No maintenance needs were identified.

6.4.2.3 Area Between the Disposal Cell and the Site Boundary or Perimeter Fence

There are 11 discrete stockpiles of rock and soil between the disposal cell and the perimeter fence on the north and west sides of the site. Most of these materials eventually will be used to cover and close the open portion of the disposal cell. Vegetation and surface rocks generally protect the stockpiles from significant erosion.

Most of the flat areas between the disposal cell and the property boundary are vegetated with native shrubs, scant perennial grasses, and annual weeds. This area includes roads adjacent to the inside of the site perimeter fence, the disposal cell, the south diversion channel, the site stormwater collection ditches, and a few other locations. Localized erosion was reported in 2021 at two locations on the perimeter road adjacent to the east side of the south diversion channel (Figure 6-1). Those erosion areas were partially repaired in 2022, and repairs will continue with the ongoing maintenance of site stormwater collection ditches. In addition, general maintenance of other parts of the perimeter road are planned to coincide with the next receive and place estimated to be sometime in 2025. No other maintenance needs were identified.

6.4.2.4 Outlying Area

The 0.25-mile area beyond the site boundary was visually observed for erosion, changes in land use, or other phenomena that might affect the long-term integrity of the site. No such changes were identified. Most of the land surrounding the site is rangeland administered by BLM, and private property on the west side is used primarily for cattle grazing. No land-use changes were evident in those areas. Outside the site's eastern boundary is a 40-acre temporary withdrawal area that was issued by BLM to DOE for stockpiled materials. Some of the withdrawal area is included within the site perimeter fence and contains stockpiled materials. This area is not included in the Interim LTSP. No maintenance needs were identified.

6.5 Follow-Up Inspections

LM will conduct follow-up inspections if (1) a condition is identified during the annual inspection or other site visit that requires a return to the site to evaluate the condition or (2) LM is notified by a citizen or outside agency that conditions at the site are substantially changed. No need for a follow-up inspection was identified.

6.6 Maintenance and Repairs

Before the inspection, the following maintenance items were completed or partially completed:

- Replacement of warning signs along the north fence line
- Partial repairs to the two eroded areas adjacent to the east side of the perimeter road

Inspectors identified the following maintenance items that will be completed before the next inspection:

- Replacement or repair of warning signs on the south perimeter fence
- Reset of the location stake at boundary monuments BM-3 and BM-4
- Continued repairs on the areas adjacent to the perimeter road

No other maintenance needs were identified.

6.7 Groundwater Monitoring

In accordance with the Interim LTSP, LM conducts annual groundwater monitoring as a best management practice. Groundwater at the site qualifies for supplemental standards because it is designated as limited use with no numerical concentration limits for hazardous constituents identified at the site (DOE 1998). This designation applies when groundwater in the upper aquifer is not a current or potential source of drinking water. The disposal cell is underlain by 5 to 40 ft of alluvium. Beneath the alluvium is approximately 700 ft of Mancos Shale, which overlies the uppermost aquifer at the site, the Dakota Sandstone. Groundwater in the site area occurs in thin paleochannels within lower portions of alluvium deposits and in the confined Dakota Sandstone unit. Groundwater in the Dakota Sandstone is designated as limited use because total dissolved solids (TDS) concentrations exceed 10,000 milligrams per liter (mg/L). LM monitors groundwater from three monitoring wells adjacent to and in the disposal cell to determine if groundwater in onsite paleochannels is, or is not, affected by seepage (i.e., transient drainage) from the disposal cell (Table 6-2 and Figure 6-2). The most recent sampling event occurred on July 6, 2023.

Table 6-2. Groundwater Monitoring Network at the Grand Junction, Colorado, Disposal Site

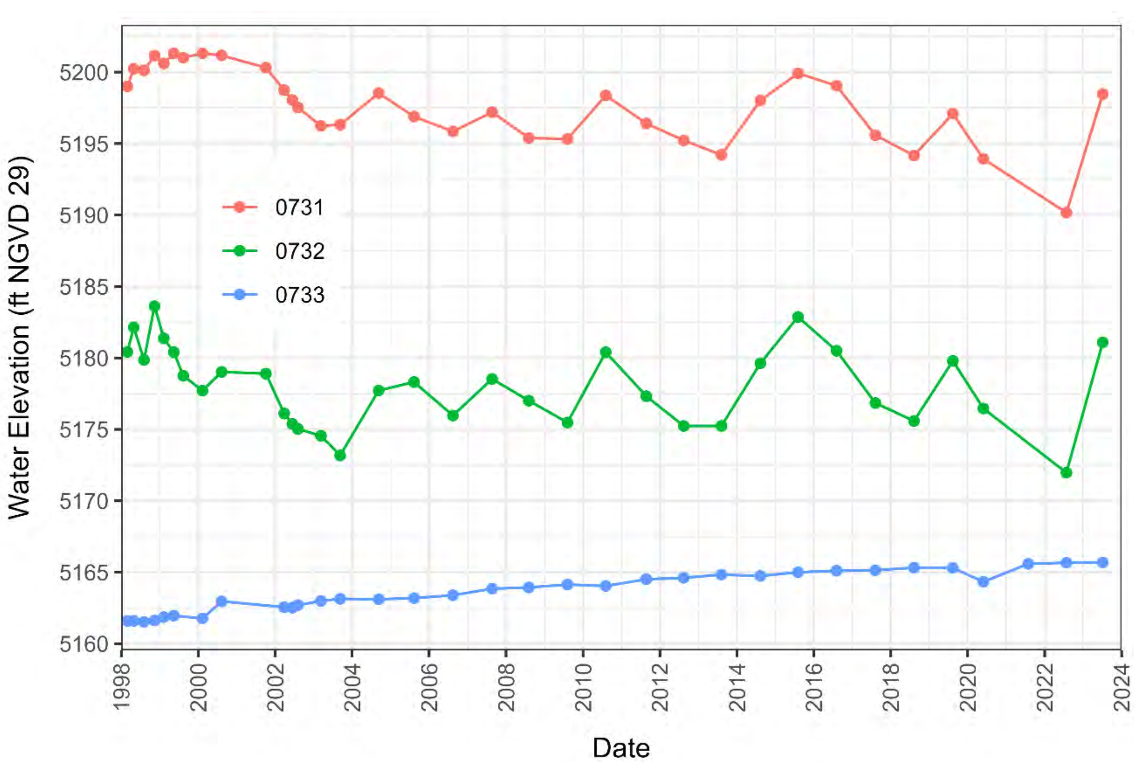
Monitoring Well	Hydrologic Relationship
0731	Paleochannel, downgradient, edge of disposal cell, north side
0732	Paleochannel, downgradient, edge of disposal cell, south side
0733	Disposal cell, deepest location, center

Monitoring wells 0731 and 0732 are screened within the alluvial paleochannels adjacent to the disposal cell and extend 5 to 7.5 ft into weathered Mancos Shale. These wells are in two separate paleochannel systems downgradient from the disposal cell (DOE 1998). Monitoring well 0733 is screened in the lower tailings within the disposal cell at an elevation that is below the paleochannel monitoring wells (Figure 6-2). Disposal cell construction was initiated by excavating Mancos Shale, which resulted in the base of the disposal cell being below the weathered Mancos Shale horizon. Monitoring well 0733 is primarily used to measure water levels within the disposal cell. All groundwater monitoring results for the site are reported and published on the LM Geospatial Environmental Mapping System (GEMS) website (https://gems.lm.doe.gov/#site=GRJ).

6.7.1 Groundwater-Level Monitoring

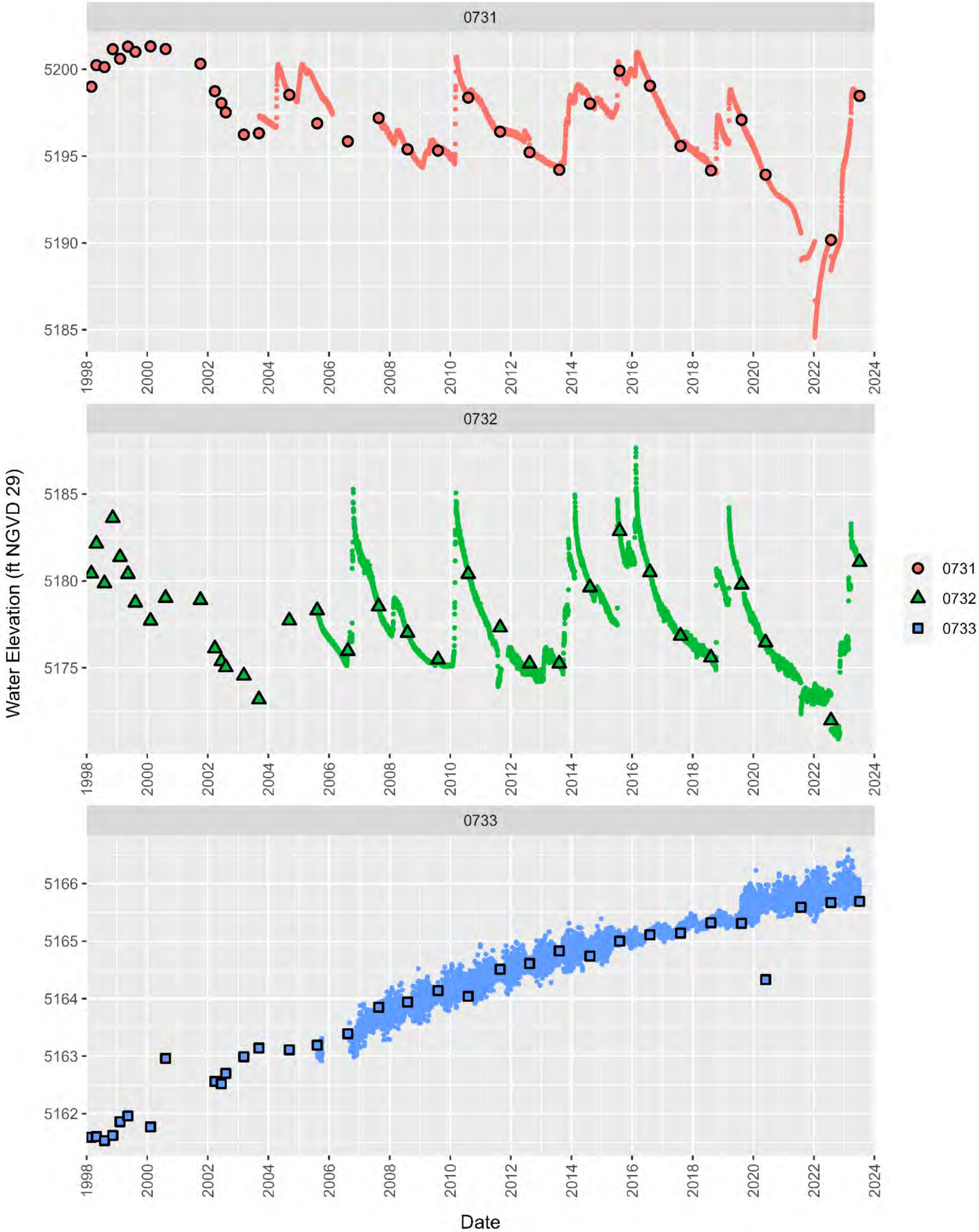
Static water-level measurements are obtained from each monitoring well before water quality samples are collected. These data are shown in Figure 6-3 for 1998–2023. The date for this and subsequent figures begins in 1998, coinciding with the issuance of the LTSP and installation of well 0733. As such, data from 1995 to 1997 for wells 0731 and 0732 are not shown. The timing of groundwater elevation fluctuations in wells 0731 and 0732 is similar (Figure 6-3), suggesting that the two paleochannel systems are influenced by the same upgradient recharge mechanisms. Water levels in disposal cell monitoring well 0733 have increased significantly (approximately 4 ft since 1998) but remain lower than water elevations in the two paleochannel monitoring wells (Figure 6-3).

Because the scale in Figure 6-3 spans approximately 40 ft, to provide greater resolution, Figure 6-4 plots the same data using unique scales to better show the magnitude of groundwater elevation fluctuations in each individual well. This figure also includes corresponding continuous water-level measurements obtained from pressure transducers installed in each of the wells in accordance with the LTSP (DOE 1998). Higher frequency water-level measurements from the pressure transducers enable better understanding of sources of recharge to the paleochannel systems and fluctuations in analyte concentrations.



Abbreviation: NGVD 29 = National Geodetic Vertical Datum of 1929

Figure 6-3. Manual Water-Level Measurements at the Grand Junction, Colorado, Disposal Site



Notes: The large symbols represent discrete water-level measurements from annual sampling events (shown in Figure 6-3). The small symbols are daily averages of corresponding transducer readings. The marked anomalous decline in water elevations shown for well 0731 datalogger data in early 2022 is likely due to a January 12, 2022, well redevelopment event.
Abbreviation: NGVD 29 = National Geodetic Vertical Datum of 1929

Figure 6-4. Water Elevations from Discrete Measurements and Corresponding Transducer Readings

6.7.2 Groundwater Quality Monitoring

In accordance with the LTSP, annual groundwater samples are analyzed for standard field parameters and the following indicator analytes: molybdenum, nitrate, polychlorinated biphenyls (PCBs), selenium, sulfate, TDS, uranium, and vanadium. The key indicator analytes are molybdenum, nitrate, selenium, and uranium. Results for these indicator parameters are compared to UMTRCA maximum concentration limits (MCLs) (40 CFR 192 Table 1 Subpart A), background concentrations from groundwater in alluvium, and background concentrations from groundwater in the Mancos Shale (Table 6-3). Background monitoring wells were installed, monitored, and abandoned before the disposal cell was constructed. Monitoring well concentration data are compared to the highest of the three values in Table 6-3 as a best management practice to determine if there is any potential seepage from the disposal cell. MCLs are listed for comparison evaluation only and not for compliance purposes.

Table 6-3. Maximum Concentration Limits and Maximum Background Concentrations for Groundwater in Alluvium and the Mancos Shale at the Grand Junction, Colorado, Disposal Site

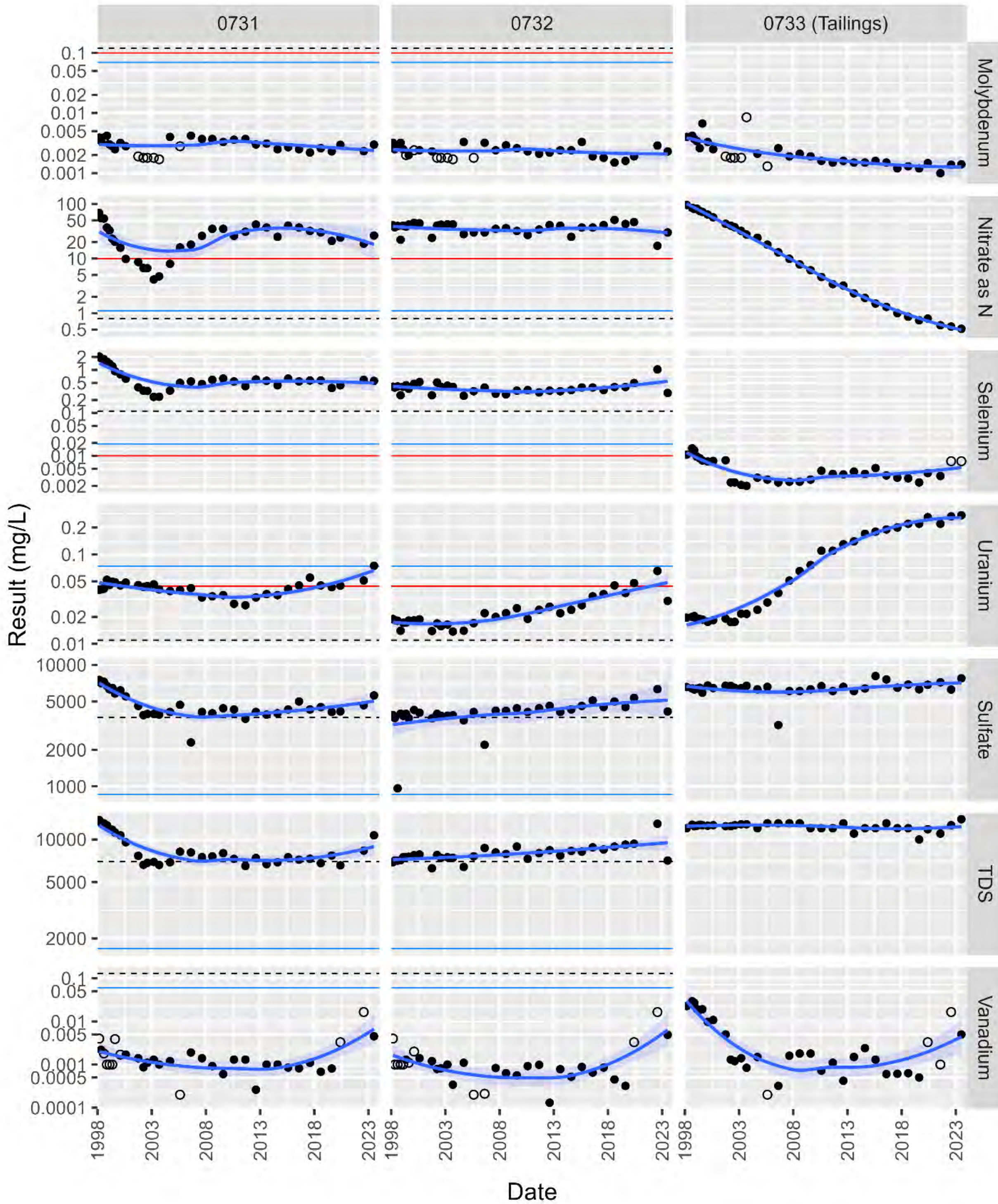
Constituent	MCL[a] (mg/L)	Maximum Concentration in Background Groundwater in Alluvium[b] (mg/L)	Maximum Concentration in Background Groundwater in the Mancos Shale[b] (mg/L)
Molybdenum	0.1	0.070	0.12
Nitrate (as nitrogen)	10	1.1	0.80
Selenium	0.01	0.019	0.11
Uranium	0.044	0.074	0.011
Sulfate	None	860	3700
TDS	None	1700	7000
Vanadium	None	0.060	0.13

Notes:

[a] MCLs as listed in 40 CFR 192 Table 1 Subpart A. U.S Environmental Protection Agency (EPA) secondary drinking water standards for sulfate and TDS are 250 and 500 mg/L, respectively. There are no EPA MCLs for vanadium.

[b] Maximum background concentrations listed for groundwater in alluvium and Mancos Shale are from Attachment 3 of DOE 1991, Table 3.34 and Table 3.37, respectively.

Figure 6-5 provides a matrix of time-concentration plots for each site monitoring well and analyte combination from 1998 to the present. Results for the key indicator analytes are shown first, followed by results for remaining analytes (sulfate, TDS, and vanadium). Data for the key indicator analytes are plotted relative to the MCLs and maximum background concentrations listed in Table 6-3. In accordance with LTSP requirements to evaluate analyte concentration trends in the monitoring wells (Section 2.6.2 of DOE 1998), Mann-Kendall trend analysis was conducted for all indicator analyte-well combinations to characterize the direction of concentration trends. Table 6-4 identifies analyte-well combinations with statistically significant increasing (or decreasing) trends based on the detailed Mann-Kendall trend test summary. The results referred to in the following discussion are presented to two significant figures.



● Detect ○ Nondetect
LOESS local regression line and 95% pointwise confidence interval
Limits or comparative maximum background concentrations from Table 6-3 (not appliable to tailings well 0733):
- MCL
- Maximum background concentration in alluvium
- - - - Maximum background concentration in Mancos Shale

Note: Wells 0731 and 0732 were sampled in 2021, but the analytical results were rejected and deemed nonreportable (DOE 2022).
Abbreviations: LOESS = locally estimated scatterplot smoothing**,** N = nitrogen

Figure 6-5. Time-Concentration Plots of All Analytes in Groundwater (1998–2023)

Table 6-4. Mann-Kendall Trend Analysis Results for Indicator Parameters in Grand Junction, Colorado, Disposal Site Monitoring Wells, 1998–2023

Parameter[a]	Well	Number of Samples[b]	Number of Nondetects	Kendall's tau[c,d]	p-value[c,d]	Trend[c,d]
Key Indicator Analytes						
Molybdenum	0731	33	7	−0.16	0.21	No Trend
Molybdenum	0732	33	7	−0.13	0.29	No Trend
Molybdenum	0733	33	6	−0.55	<0.001	Decreasing
Nitrate as N	0731	33	0	−0.01	0.95	No Trend
Nitrate as N	0732	33	0	−0.06	0.65	No Trend
Nitrate as N	0733	33	0	−0.99	<0.001	Decreasing
Selenium	0731	33	0	−0.29	0.019	Decreasing
Selenium	0732	33	0	−0.06	0.61	No Trend
Selenium	0733	33	2	−0.29	0.018	Decreasing
Uranium	0731	33	0	−0.08	0.54	No Trend
Uranium	0732	33	0	0.60	<0.001	Increasing
Uranium	0733	33	0	0.82	<0.001	Increasing
Remaining Analytes[e]						
Sulfate	0731	33	0	−0.28	0.025	Decreasing
Sulfate	0732	33	0	0.57	<0.001	Increasing
Sulfate	0733	33	0	0.15	0.23	No Trend
TDS	0731	33	0	−0.42	0.001	Decreasing
TDS	0732	33	0	0.54	<0.001	Increasing
TDS	0733	33	0	−0.14	0.26	No Trend
Vanadium	0731	33	10	−0.06	0.63	No Trend
Vanadium	0732	33	11	−0.04	0.75	No Trend
Vanadium	0733	33	4	−0.48	<0.001	Decreasing

Notes:

[a] For all well-parameter combinations, the initial trend analysis date is February 27, 1998, and the final trend analysis date is July 6, 2023.

[b] Duplicate sample results were excluded from the trend analysis.

[c] Trend tests were performed using the "NADA: Nondetects and Data Analysis for Environmental Data" package in R, version 1.6-1.1 (Lee 2020). The NADA trend test is similar to the traditional Mann-Kendall trend test except that it accounts for the presence of nondetects at multiple detection limits.

[d] Trend analyses were conducted at the 0.05 significance level using a two-sided test. A calculated p-value of less than 0.05 indicates that a significant trend in the time series exists. The test statistic, Kendall's tau, is a measure of the strength of the association between two variables, with values always falling between −1 and +1.

[e] PCBs are not addressed in this summary because results for all wells have been below detection limits.

Abbreviation:
N = nitrogen

Key Indicator Analytes

Molybdenum concentrations in all three monitoring wells have been consistently below both the MCL of 0.1 mg/L and corresponding background concentrations (by at least one order of magnitude), with results ranging from 0.0010–0.0067 mg/L overall and from 0.0014–0.0030 mg/L in 2023. A statistically significant decreasing trend was identified for well 0733, while concentrations in the two paleochannel wells have remained steady (no significant trend) since 1998 (Table 6-4).

With few exceptions, nitrate (as nitrogen) concentrations in paleochannel monitoring wells 0731 and 0732 have consistently exceeded the 10 mg/L MCL and corresponding background concentrations, generally ranging between about 20–40 mg/L (Figure 6-5). Exceptions apply to the 2000–2004 period, when nitrate concentrations in well 0731 decreased to as low as 4.6 mg/L, which is below the MCL. Results in 2023 were 26 mg/L and 30 mg/L, respectively. As noted in previous annual reports (e.g., DOE 2023), nitrate concentrations in disposal cell monitoring well 0733 have decreased significantly (Table 6-4), and this trend appears to be inversely correlated with the increasing trend in uranium concentrations (discussed below). Concentrations declined steadily from 96 mg/L in 1998 to 0.52 mg/L in 2023 (Figure 6-5). A possible explanation for this trend is increased reducing conditions (less oxygen) over time in this well, but this hypothesis has not been confirmed.

Selenium occurs naturally in the Mancos Shale deposits that underlie the disposal cell (DOE 1991), with concentrations ranging as high as 0.11 mg/L, exceeding the MCL of 0.01 mg/L (Table 6-3). Selenium concentrations in wells 0731 and 0732 have consistently exceeded background and the corresponding MCL of 0.01 mg/L, with most results ranging from 0.23 to 0.63 mg/L (Figure 6-5). The highest selenium concentrations have been measured in well 0731, where concentrations declined from 2.1 mg/L in 1998 to 0.30 mg/L in 2002, accounting for the statistically significant decreasing trend noted in Table 6-4. Concentrations in this well have remained fairly stable since then. No significant trend was found for selenium in well 0732, where concentrations have ranged from 0.24 to 1.0 mg/L. The most recent (2023) result in this well was 0.29 mg/L. The influence of the Mancos Shale is not evident in disposal cell monitoring well 0733 (screened in the lower tailings), where selenium concentrations have ranged from 0.0020 to 0.015 mg/L (Figure 6-5). The 2023 selenium result for well 0733 was below the detection limit (<0.0075 mg/L), equivalent to the 2022 result (DOE 2023).

Before 2023, uranium concentrations in well 0731 ranged from 0.027 to 0.055 mg/L, periodically exceeding the 0.044 mg/L MCL but consistently below the maximum concentration in background alluvial groundwater (0.074 mg/L) (Figure 6-5). The most recent (2023) result was 0.075 mg/L, a historical maximum essentially equaling the background value. Uranium concentrations in wells 0732 and 0733 continue to exhibit statistically significant increasing trends (Table 6-3). The maximum concentration in well 0732 (0.065 mg/L) was measured in 2022; the concentration declined in 2023 to 0.030 mg/L, which is below the MCL. The most recent (2023) uranium result for well 0733, 0.27 mg/L, is the historical maximum. Relatively high concentrations of uranium and other constituents are expected for a well screened in the disposal cell tailings. Concentrations of constituents of concern in well 0733 are not subject to compliance goals and are monitored solely for information gathering purposes.

Remaining Analytes

As there are no comparative concentration limits for the non-key indicator analytes, this discussion is limited to a brief summary of overall trends for sulfate, TDS, vanadium, and PCBs. Statistically significant trends in sulfate and TDS concentrations continue to be found for both paleochannel wells, with trends decreasing in well 0731 and increasing in well 0732 (Table 6-3). Sulfate concentrations in wells 0731 and 0732 have averaged between approximately

4000–5000 mg/L, while those in well 0733 have been slightly higher (6000–7000 mg/L). TDS concentrations are also highest in tailings well 0733 (generally 12,000–13,000 mg/L), relative to those in wells 0731 and 0732 (with most results ranging between 7000 and 9000 mg/L). The most recent TDS concentration in well 0733, 14,000 mg/L, is a historical maximum. Sulfate and TDS concentrations in wells 0731 and 0732 have been near or above the Mancos Shale background values of 3700 and 7000 mg/L, respectively. Sulfate and TDS concentrations in wells 0731 and 0732 have been much greater than the alluvial groundwater background values of 860 and 1700 mg/L, respectively (Figure 6-5).

Vanadium concentrations in paleochannel wells 0731 and 0732 have typically ranged from 0.0010 to 0.0020 mg/L, with about 30% of results below detection limits (Figure 6-5, Table 6-4). A statistically significant decreasing trend was found for vanadium in well 0733 (Table 6-4), stemming largely from the early sharp decrease in concentrations between 1998 and 2002, from 0.029 to 0.0012 mg/L. Since 2002, vanadium concentrations in this well have been generally stable, with most results ranging from 0.0010–0.0030 mg/L. In 2023, vanadium concentrations in wells 0731, 0732, and 0733 were 0.0045, 0.0049, and 0.0050 mg/L, respectively. Vanadium concentrations in wells 0731 and 0732 have been well below Mancos Shale and alluvial groundwater background values of 0.013 and 0.060 mg/L, respectively (Figure 6-5).

PCBs (Aroclors) continue to be monitored but have never been detected in site monitoring wells.

6.8 Corrective Action

Corrective action is taken to correct out-of-compliance or hazardous conditions that create a potential health and safety problem or that may affect the integrity of the disposal cell or compliance with 40 CFR 192. No need for corrective action was identified. However, monitoring wells 0731 and 0732 are sampled as a best management practice to verify that groundwater in onsite paleochannels is not affected by potential seepage from the disposal cell. There are no set compliance standards for this best management practice monitoring, but NRC and state notification is required if any constituents have increasing trends above respective MCLs as specified in the Interim LTSP (DOE 1998). Based on the exceedance of background concentrations for nitrate, selenium, uranium, sulfate, and TDS from groundwater in the alluvium or the Mancos Shale, current data indicate that these two wells may be affected by disposal cell seepage. LM has initiated an alluvial aquifer characterization effort to further evaluate the data from wells 0731 and 0732 and follow the requirements of the Interim LTSP (DOE 1998) for past, current, and future constituent concentrations (including uranium).

6.9 References

10 CFR 40.27. U.S. Nuclear Regulatory Commission, “General License for Custody and Long-Term Care of Residual Radioactive Material Disposal Sites,” *Code of Federal Regulations*.

40 CFR 192. U.S. Environmental Protection Agency, “Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings,” *Code of Federal Regulations*.

40 CFR 192 Table 1 Subpart A. U.S. Environmental Protection Agency, “Maximum Concentration of Constituents for Groundwater Protection,” *Code of Federal Regulations*.

DOE (U.S. Department of Energy), 1991. *Remedial Action Plan and Site Design for Stabilization of the Inactive Uranium Mill Tailings Site at Grand Junction, Colorado*, DOE/AL/050505.0000, UMTRA Project Team, September.

DOE (U.S. Department of Energy), 1998. *Interim Long-Term Surveillance Plan for the Cheney Disposal Site Near Grand Junction, Colorado*, DOE/AL/62350–243, Rev. 1, Environmental Restoration Division, UMTRA Project Team, April.

DOE (U.S. Department of Energy), 2022. *2021 Annual Site Inspection and Monitoring Report for Uranium Mill Tailings Radiation Control Act Title I Disposal Sites*, LMS/S33843, Office of Legacy Management, March.

DOE (U.S. Department of Energy), 2023. *2022 Annual Site Inspection and Monitoring Report for Uranium Mill Tailings Radiation Control Act Title I Disposal Sites*, LMS/S38159, Office of Legacy Management, March.

Lee, L., 2020. "NADA: Nondetects and Data Analysis for Environmental Data," R package, version 1.6-1.1, https://CRAN.R-project.org/package=NADA, accessed December 29, 2023.

6.10 Photographs

Photograph Location Number	Azimuth	Photograph Description
PL–1	90	Site Access Gate and Signs
PL–2	90	Solar Entrance Gate and Signs
PL–3	215	West Perimeter Fence Line
PL–4	0	Faded Sign, South Perimeter Fence Line
PL–5	90	Perimeter Sign P1
PL–6	—	Boundary Monument BM-1
PL–7	—	Monitoring Well 0733
PL–8	250	Disposal Cell, South Side Slope
PL–9	315	Disposal Cell Top
PL–10	0	South Diversion Channel

Note:
— = Photograph taken vertically from above.

PL–1. Site Access Gate and Signs

PL–2. Solar Entrance Gate and Signs

PL–3. West Perimeter Fence Line

PL–4. Faded Sign, South Perimeter Fence Line

PL–5. Perimeter Sign P1

PL–6. Boundary Monument BM-1

PL–7. Monitoring Well 0733

PL–8. Disposal Cell, South Side Slope

PL–9. Disposal Cell Top

PL–10. South Diversion Channel

7.0 Green River, Utah, Disposal Site

7.1 Compliance Summary

The Green River, Utah, Uranium Mill Tailings Radiation Control Act (UMTRCA) Title I Disposal Site was inspected on May 3, 2023. No changes were observed on the disposal cell or in the associated drainage features. Inspectors identified several minor maintenance issues at the site but did not identify concerns that required a follow-up or contingency inspection.

The U.S. Department of Energy (DOE) Office of Legacy Management (LM) conducts annual groundwater monitoring to track disposal cell performance in accordance with the site-specific Long-Term Surveillance Plan (DOE 1998) (LTSP). In 2011, LM developed a Draft Groundwater Compliance Action Plan (DOE 2011) (Draft GCAP) to update the groundwater monitoring requirements as specified in the LTSP. The Draft GCAP has been approved by the State of Utah but had not been accepted by the U.S. Nuclear Regulatory Commission (NRC) at the time of this report's publication. Groundwater analytical results presented in this report are evaluated with respect to requirements and concentration limits specified in the LTSP. Groundwater monitoring was conducted in June 2023. Concentrations of routinely monitored analytes exceeded corresponding concentration limits in several point of compliance (POC) wells: nitrate and sulfate in wells 0171 and 0173 and uranium in well 0171.

7.2 Compliance Requirements

Requirements for the long-term surveillance and maintenance of the site are specified in the site-specific LTSP (DOE 1998) in accordance with procedures established to comply with the requirements of the NRC general license at Title 10 *Code of Federal Regulations* Section 40.27 (10 CFR 40.27). Table 7-1 lists these requirements.

Table 7-1. License Requirements for the Green River, Utah, Disposal Site

Requirement	LTSP	This Report	10 CFR 40.27
Annual Inspection and Report	Section 6.0	Section 7.4	(b)(3)
Follow-Up or Contingency Inspections	Section 7.0	Section 7.5	(b)(4)
Maintenance and Repairs	Section 8.0	Section 7.6	(b)(5)
Groundwater Monitoring	Section 5.2	Section 7.7	(b)(2)
Corrective Action	Section 9.0	Section 7.8	--

7.3 Institutional Controls

The 25-acre site, identified by the property boundary shown in Figure 7-1, is owned by the United States and was accepted under the NRC general license in 1998. DOE is the licensee and, in accordance with the requirements for UMTRCA Title I sites, LM is responsible for the custody and long-term care of the site. Institutional controls (ICs) at the site include federal ownership of the property, administrative controls, and the following physical ICs that are inspected annually: the disposal cell and associated drainage features; entrance gate and sign; security fence around the disposal cell; perimeter signs; unmanned aircraft system (UAS) signs; site markers; survey, boundary, and aerial survey quality control monuments; and wellhead protectors.

7.4 Inspection Results

The site, 1 mile southeast of Green River, Utah, was inspected on May 3, 2023. The inspection was conducted by A. Farinacci and D. Atkinson of the Legacy Management Support (LMS) contractor. M. Young (LM site manager), W. Frazier (LM), P. Robinson (LM Realty Services), H. Mickelson (State of Utah representative), and M. De Lurdes Dinis (guest of DOE), as well as E. Garcia, K. MacDougall, and S. Herrera (LMS contractor) also attended the inspection. The purposes of the inspection were to confirm the integrity of visible features at the site, identify changes in conditions that might affect conformance with the LTSP, and evaluate whether maintenance or follow-up inspection and monitoring are needed.

7.4.1 Site Surveillance Features

Figure 7-1 shows the locations of site features, including site surveillance features and inspection areas, in black and gray font. Some site features that are present but not required to be inspected are shown in italic font. Observations from previous inspections that are currently monitored are shown in blue, and new observations identified during the 2023 annual inspection are shown in red. Inspection results and recommended maintenance activities associated with site surveillance features are described in the following subsections. Photographs to support specific observations are noted in the text and in Figure 7-1 by photograph location (PL) numbers. The photographs and photograph log are presented in Section 7.10.

7.4.1.1 Access Road, Entrance Gate, and Entrance Sign

Access to the site is either from U.S. Highway 6 and 50 heading east from the town of Green River or from U.S. Interstate 70 via S 1600 E Street. The paved access road crosses property owned by the state and the U.S. Army. Access was granted to LM through right-of-way agreements with both entities. Entrance to the site is through an open gate in the paved road right-of-way fence; LM does not own the gate or the right-of-way fence and access via the gate is not controlled. Past this gate, a dirt road leads across state land to the site. The access road divides near the entrance to the disposal cell, with one branch leading to a locked gate in the security fence that encloses the disposal cell and the other providing access around the outside of the security fence. The entrance sign is next to the access road where it enters the site. The sign is heavily faded and will be replaced before the next annual inspection (PL-1). The lock on the steel site access gate in the right-of-way fence was replaced during the 2022 inspection with a new lock that uses a different key. No other maintenance needs were identified.

7.4.1.2 Security Fence, Perimeter Signs, and Warning Signs

A chainlink security fence encloses the portion of the site that contains the disposal cell. Vehicle gates are at the south and east corners of the security fence, and a personnel gate is at the north corner of the security fence. The security fence was intact, but inspectors observed vegetation growth along the fence line. The vegetation will be treated before the next annual inspection to ensure that no damage to the fence occurs. A minor erosional rill was observed under the fence near perimeter sign P16 (PL-2). This rill has been observed previously and poses little risk at this time because it remains small and is not adjacent to a fence post. Inspectors will continue to monitor this area. The gates were operable and locked at the time of the inspection.

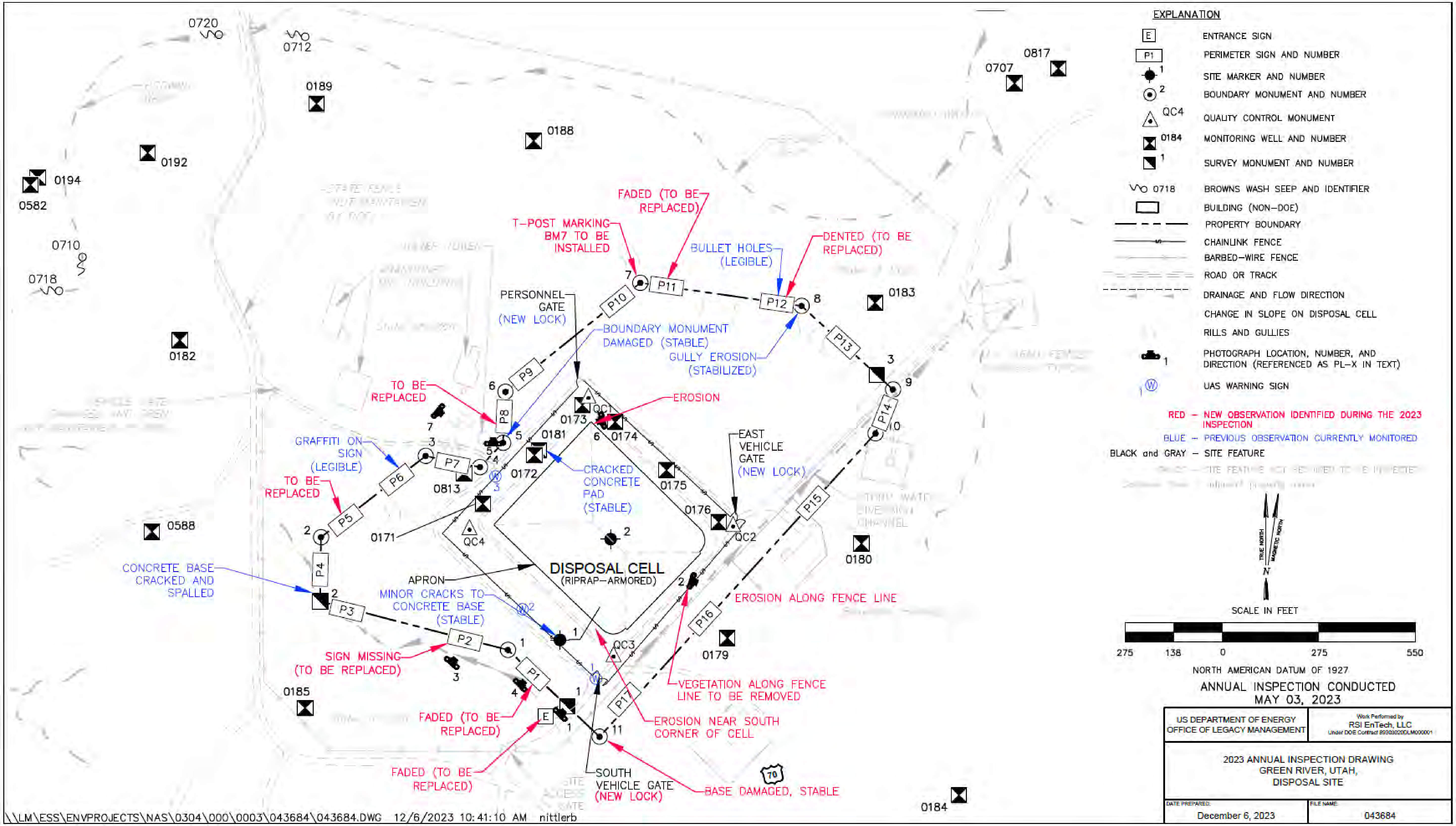


Figure 7-1. 2023 Annual Inspection Drawing for the Green River, Utah, Disposal Site

Seventeen perimeter signs, attached to steel posts set in concrete, are positioned along the unfenced property boundary. Perimeter sign P2 was missing (PL-3) and will be replaced before the next annual inspection. All other perimeter signs were present with several exhibiting bullet hole and sun damage (faded) (PL-4). Perimeter signs P1, P2, P5, P8, P11, and P12 will be replaced before the next annual inspection, along with any other perimeter signs exhibiting damage. Three new UAS signs were installed along the security fence before the 2022 inspection. No maintenance needs were identified.

7.4.1.3 Site Markers

The site has two granite markers. Site marker SMK-1 is inside the security fence near the southwest corner of the site, and SMK-2 is on the crest of the disposal cell. The concrete base of SMK-1 has several minor cracks, but they do not compromise the integrity of the base, and repairs are not necessary at this time. No maintenance needs were identified.

7.4.1.4 Survey and Boundary Monuments

Eleven boundary monuments and three survey monuments delineate the property boundary. As reported in 2021, boundary monument BM-5 (PL-5) is bent from being hit by a vehicle, and the concrete base around survey monument SM-2 is cracked and spalled. Both boundary monument BM-5 and survey monument SM-2 are fully functional, and repairs of these monuments are not needed at this time. The base of boundary monument BM-11 is damaged but stable, and no repairs are needed at this time. Boundary monument BM-7 is difficult to find and will be marked with a T-post before the next annual inspection.

7.4.1.5 Aerial Survey Quality Control Monuments

Four aerial survey quality control monuments were inspected. No maintenance needs were identified.

7.4.1.6 Monitoring Wells

Twenty-two monitoring wells are on or near the site. The LTSP establishes four POC wells at the site for postclosure groundwater monitoring. All wellhead protectors observed during the inspection were undamaged. The wellhead protector at location 0173 was found unlocked and was relocked by the inspectors. Some of the concrete monitoring well collars were cracked, but the wellhead protectors at those wells are stable, and repairs are not necessary at this time. No other maintenance needs were identified.

7.4.2 Inspection Areas

In accordance with the LTSP, the site is divided into three inspection areas to ensure a thorough and efficient inspection. The inspection areas are (1) the disposal cell and adjacent area inside the security fence, (2) the site perimeter between the security fence and the site boundary, and (3) the outlying area. Inspectors examined specific site surveillance features within each area and looked for evidence of settlement, erosion, or other modifying processes that might affect the site's conformance with LTSP requirements.

7.4.2.1 Disposal Cell and Adjacent Area Inside the Security Fence

The disposal cell, completed in 1989, occupies 6 acres. The slopes of the disposal cell cover are armored with riprap, consisting primarily of competent basalt with a small fraction of sedimentary rocks, to control erosion. A small percentage of the rock, mainly sedimentary rock, has degraded, but the riprap cover is functioning as designed. Inspectors found no evidence of settling, slumping, erosion, or other modifying processes that might affect the integrity of the disposal cell.

A boulder-filled trench, known as an apron, surrounds the disposal cell. The apron was intact and stable. Inspectors noted small (less than 8 square feet) instances of erosion and possible soil piping features along the base of the side slopes (PL-6) that have been observed during previous inspections. The rills and piping features form as stormwater runoff along the perimeter road drains into the disposal cell apron. This occurrence is not a concern because the erosion is minor and the sediment has not filled the apron or become visible in the apron, indicating that the apron's performance is not adversely affected. Inspectors will continue to monitor the area.

The area between the disposal cell and the security fence contains the perimeter dirt road, several monitoring wells, and sparsely vegetated open space. The road was passable, and there was no indication of trespassing in the open space. No maintenance needs were identified at this time.

7.4.2.2 Perimeter Area Between the Security Fence and the Site Boundary

The area between the security fence and the site boundary is primarily open space but includes access roads, a stormwater diversion channel, and monitoring wells. The site property boundary is not fenced, and trespassing occurs on the site from several access points through state- and privately owned land. Unauthorized access to the site is primarily from the west through a former mill access gate that has been broken off its hinges; LM is not responsible for the gate or associated fence. The site is also accessible through remote, unfenced, open-access points to the north and east. The site will continue to be monitored for adverse public use typically indicated by trash, tire ruts, fire rings, and vandalism. Inspectors did not find new trash dumps or indications of vandalism (except for missing perimeter sign P2) during the inspection.

Signs of erosion noted during previous inspections appear in multiple areas in the site perimeter. Erosional rills are present on the west side of the site near perimeter sign P7 and the water tower (PL-7) but are currently not affecting site surveillance features. Rills and gullies are also present along the escarpment northeast of the disposal cell between boundary monument BM-7 and survey monument SM-3 (approximately 400 feet [ft] from the base of the disposal cell). The maximum gully depth in this area is approximately 3 ft, but the erosion appears to be stabilizing as larger rocks drop to the bottom of the gullies and provide armoring. A portion of the stormwater diversion channel along the southeast side of the site continues to erode slowly. These erosional features could eventually damage site surveillance features (i.e., perimeter signs, boundary monuments, and the security fence). The closest erosional features are approximately 300 ft from the disposal cell and do not pose a risk to its integrity at this time. Inspectors will continue to monitor these features. No immediate maintenance needs were identified.

7.4.2.3 Outlying Area

The 0.25-mile area beyond the site boundary was visually observed for erosion, changes in land use, or other phenomena that might affect the long-term integrity of the site. No such impacts were observed. Abandoned buildings and a water tower associated with the former milling activities are northwest of the site. The buildings are not maintained and are in disrepair, and debris tends to blow onto the site from surrounding buildings (e.g., shingles, siding, plastic). Accumulation of windblown debris is minor and will continue to be monitored. Trash will also be removed.

Areas of erosion noted during previous inspections include the natural drainage near the southwest side of the site and rills and gullies northwest of the water tower. Evidence of continued erosion in these areas was apparent but does not threaten the integrity of the disposal cell or site surveillance features. Inspectors will continue to monitor these erosional features. No maintenance needs were identified.

Inspectors noted activity at a gravel pit to the west-northwest of the site, and potential changes to land use near the site will be monitored by LM and LMS personnel.

7.5 Follow-Up or Contingency Inspections

LM will conduct follow-up or contingency inspections if (1) a condition is identified during the annual inspection or other site visit that requires a return to the site to evaluate the condition or (2) LM is notified by a citizen or outside agency that conditions at the site are substantially changed. No need for a follow-up or contingency inspection was identified.

7.6 Maintenance and Repairs

Maintenance and repairs to be performed before the next annual inspection include:

- Replacement of perimeter signs P1, P2, P5, P8, P11, and P12
- Replacement of the entrance sign
- Installation of a T-post as a marker near boundary monument BM-7
- Treatment of vegetation along the security fence

No other maintenance needs were identified.

7.7 Groundwater Monitoring

In accordance with the LTSP, annual groundwater monitoring is conducted to evaluate the performance of the disposal cell. In 2011, LM developed a Draft GCAP (DOE 2011) that was approved by the State of Utah but has yet to receive NRC’s concurrence. The most recent sampling event occurred on June 5, 2023. Because the Draft GCAP has not been accepted, this section addresses only those wells designated in the LTSP for postclosure groundwater monitoring (DOE 1998). Locations of the four POC wells are shown in Figure 7-2.

Note: Well 0181 was installed in June 2002 to replace former POC well 0172 (refer to discussion in text).

Figure 7-2. Groundwater Monitoring Network at the Green River, Utah, Disposal Site

The POC wells represent the intersection of a vertical plane with the uppermost aquifer (the middle sandstone unit of the Cedar Mountain Formation) underlying the site. The LTSP included monitoring well 0172, but its construction integrity was suspect, and the well was replaced with monitoring well 0181 in June 2002. Well 0181 has been monitored as the replacement POC well since July 2002. Table 7-2 lists the wells included in the current site groundwater monitoring network; the corresponding locations are shown in Figure 7-2.

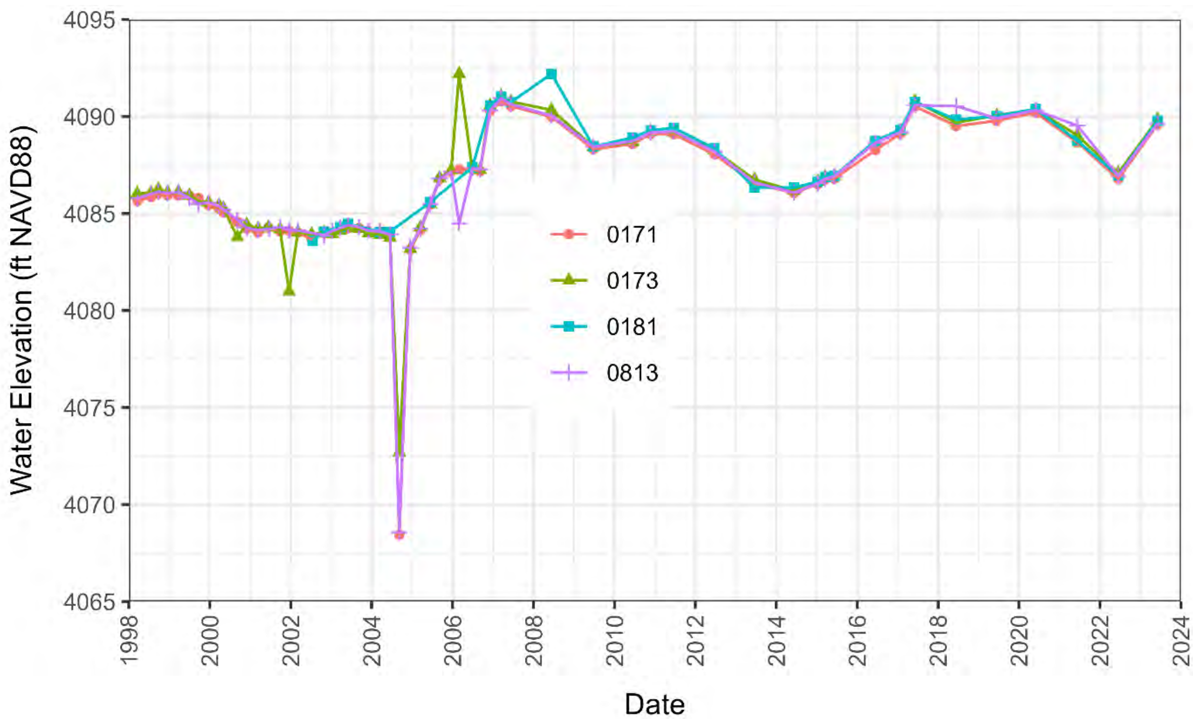
Table 7-2. Groundwater Monitoring Network for the Green River, Utah, Disposal Site

Groundwater Monitoring Purpose	Monitoring Wells
POC well	0171, 0173, 0181, 0813

POC wells are sampled for nitrate (nitrate + nitrite as nitrogen [N]), sulfate, and uranium. Groundwater monitoring results are reported and published on the LM Geospatial Environmental Mapping System (GEMS) website at https://gems.lm.doe.gov/#site=GRN.

7.7.1 Water Level Monitoring

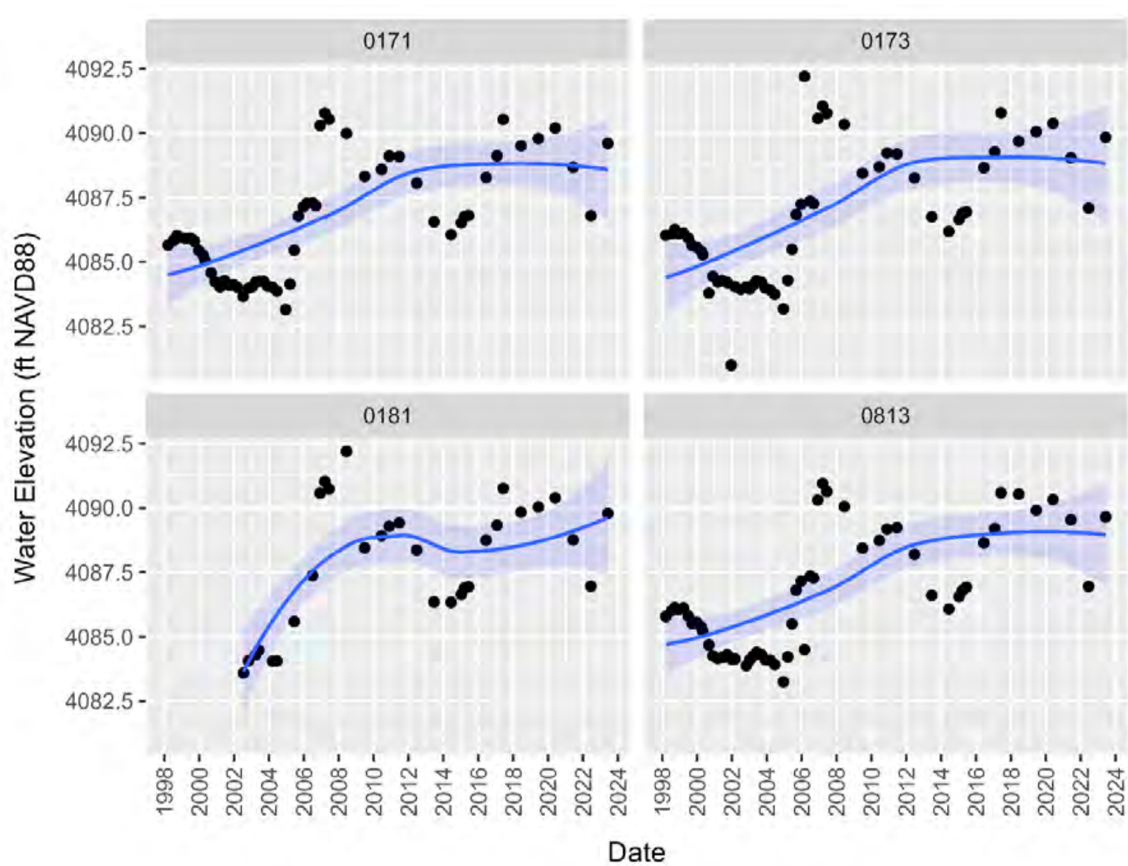
Water levels in the POC wells have been measured manually every year since 1991. As shown in Figure 7-3, groundwater elevations measured from 1998 through 2023 have been generally consistent across the four POC wells, generally ranging from 4085 to 4090 ft in the past 12 years.



Abbreviation: NAVD88 = North American Vertical Datum of 1988

Figure 7-3. Groundwater Elevations at the Green River, Utah, Disposal Site, 1998–2023

The sharp (11–15 ft) drop in water levels in wells 0171, 0173, and 0813 recorded in September 2004 (Figure 7-3) may have been due to instrument error or human error in recording the original field record. However, there is no definitive evidence of error and the data as shown are consistent with available documentation. The three other water level measurements taken in these wells in 2004 (in March, June, and December) are consistent with previous and subsequent nonoutlier water elevations. To provide greater resolution on the historical groundwater elevation data, Figure 7-4 plots the same results as those shown in Figure 7-3 but excludes the three outliers discussed above. In contrast with the initial line plot, Figure 7-4 was developed using a faceting approach, whereby data are partitioned into a matrix of panels, with each panel plotting data for a single well. In each facet plot, a nonparametric smoothing method—locally estimated scatterplot smoothing (LOESS)—is used. The surrounding shaded area represents the 95% pointwise confidence interval. Using this approach, overall trends in the data are more apparent and not obscured by "noise" or random variation.



Note: This figure excludes the following three low outlier water level measurements recorded on September 7, 2004: 4068.46 ft (well 0171), 4072.69 ft (well 0173), and 4068.58 ft (well 0813). These outlier measurements are plotted in Figure 7-3.
Abbreviation: NAVD88 = North American Vertical Datum of 1988

Figure 7-4. 1998–2023 Groundwater Elevations at Green River, Utah, Disposal Site, POC Wells Excluding September 2004 Outlier Measurements

Groundwater elevations in all four POC wells increased about 5 ft between 2004 and 2008 and have fluctuated since then (Figure 7-4). For the 1998–2023 time frame, Mann-Kendall trend analysis indicates statistically significant increasing trends in all four wells. No significant trend is indicated if the dataset is limited to 2010–2023.

7.7.2 Disposal Cell Performance Monitoring

Table 7-3 lists the concentration limits in milligrams per liter (mg/L) for POC wells established in the LTSP. The concentration limits determined for uranium and nitrate were the higher value from either the U.S. Environmental Protection Agency maximum concentration limits (MCLs) (40 CFR 192 Table 1 Subpart A) or the background concentration levels present before construction of the disposal cell (DOE 1998). The background water quality in the Cedar Mountain Formation is characterized by high total dissolved solids and concentrations of sulfate that exceed national primary and secondary drinking water standards (DOE 1998). In accordance with the LTSP, sulfate results are compared to well-specific background concentration limits (Table 7-3). Table 7-4 lists the most recent (June 2023) analytical results for the four POC wells.

Table 7-3. LTSP Concentration Limits for POC Wells at the Green River, Utah, Disposal Site

Monitoring Well	Nitrate[a] (mg/L)	Sulfate (mg/L)	Uranium (mg/L)
0171	10[b]	3334	0.044[b]
0173	10[b]	4000	0.044[b]
0181[c]	102	4985	0.067
0813	10[b]	4440	0.069

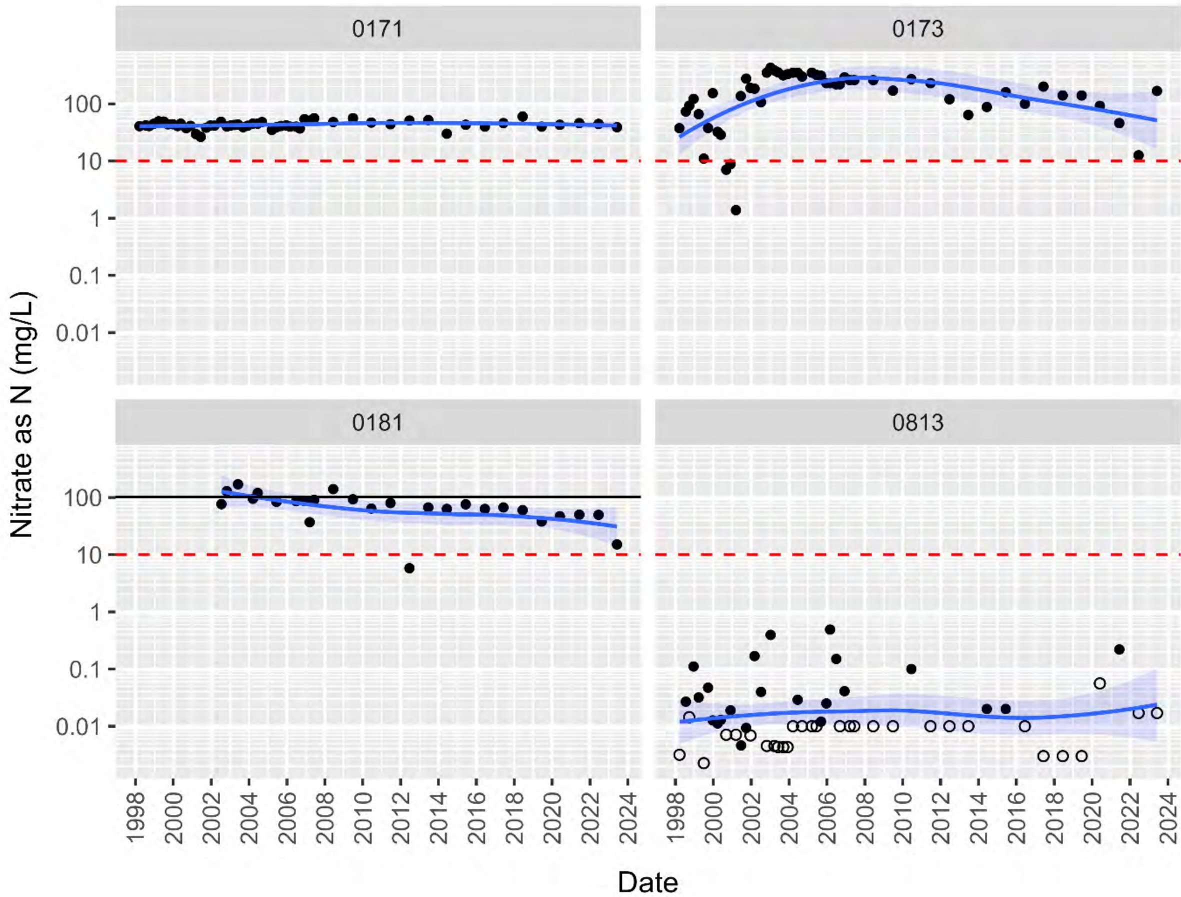
Notes:
[a] Nitrate = nitrate plus nitrite as N.
[b] MCL (40 CFR 192 Table 1 Subpart A).
[c] Concentration limits for well 0181 correspond to those derived initially for well 0172 (Table 5.1 of DOE 1998).

Table 7-4. 2023 Analytical Results for POC Wells at the Green River, Utah, Disposal Site

Monitoring Well	Nitrate[a] (mg/L)	Sulfate (mg/L)	Uranium (mg/L)
0171	39.0	3810	0.084
0173	168.0	9980	0.039
0181	15.1	4840	0.012
0813	<0.017	3360	0.026

Notes:
Results in red font denote concentrations equal to or exceeding the LTSP-driven concentration limit.
[a] Nitrate = nitrate plus nitrite as N.

Figure 7-5 shows the time-concentration plots for nitrate in the four POC wells along with corresponding concentration limits. Nitrate concentrations continue to exceed the 10 mg/L MCL in wells 0171 and 0173 (Table 7-4; Figure 7-5). Nitrate concentrations have been stable in well 0171, averaging about 40 mg/L, but highly variable in well 0173. Between 1998 and 2023, nitrate concentrations in this well ranged from 1.4–427 mg/L, with a mean and standard deviation of 183 ± 119 mg/L. Nitrate concentrations in well 0173 decreased from 200 mg/L in 2017 to 12.6 mg/L in 2022 (approaching the MCL) but rebounded to 168 mg/L in 2023.



● Detect ○ Nondetect

Locally estimated scatterplot smoothing (LOESS) line and 95% confidence interval

- - - - 10 mg/L 40 CFR 192 MCL (the concentration limit for all POC wells except well 0181)

–––– 102 mg/L background concentration from Table 7-3 (applies to well 0181 only)

Notes: Nitrate expressed as nitrate plus nitrite as N; results before 2004 were converted from nitrate as NO_3. Results below the detection limit are presented at the laboratory reported value.

Figure 7-5. Nitrate Concentrations at POC Wells at the Green River, Utah, Disposal Site

Nitrate concentrations in well 0181 (15.1 mg/L in 2023) have been below the concentration limit (background value of 102 mg/L) since 2009 but (with one exception) still above the 10 mg/L MCL. Nitrate concentrations in well 0813 have ranged from 0.005–0.5 mg/L; most results (57%) have been below detection limits. Mann-Kendall trend analysis (Table 7-5) identified a significant decreasing trend in nitrate concentrations for well 0181 but no significant trend in the remaining POC wells.

Table 7-5. Mann-Kendall Trend Analysis Results for Nitrate, Sulfate, and Uranium in Green River, Utah, Disposal Site POC Wells, 1998–2023

Parameter[a]	POC Well	Initial Trend Analysis Date[b]	Number of Samples[c]	Kendall's tau[d]	p-value[d]	Trend[d,e]
Nitrate	0171	3/20/1998	53	0.125	0.19	No Trend
Nitrate	0173	3/17/1998	53	0.02	0.84	No Trend
Nitrate	0181	7/17/2002	26	−0.579	0	Decreasing
Nitrate	0813	3/20/1998	53[d]	−0.101	0.28	No Trend
Sulfate	0171	3/20/1998	48	−0.107	0.30	No Trend
Sulfate	0173	3/17/1998	48	0.297	0.003	Increasing[e]
Sulfate	0181	7/17/2002	21	0.365	0.023	Increasing
Sulfate	0813	3/20/1998	48	−0.103	0.31	No Trend
Uranium	0171	3/20/1998	54	0.649	0	Increasing
Uranium	0173	3/17/1998	54	0.708	0	Increasing
Uranium	0181	7/17/2002	26	0.031	0.84	No Trend
Uranium	0813	3/20/1998	54	0.756	0	Increasing

Notes:

[a] Nitrate expressed as nitrate plus nitrite as N. Results before 2004 were converted from nitrate as NO_3.

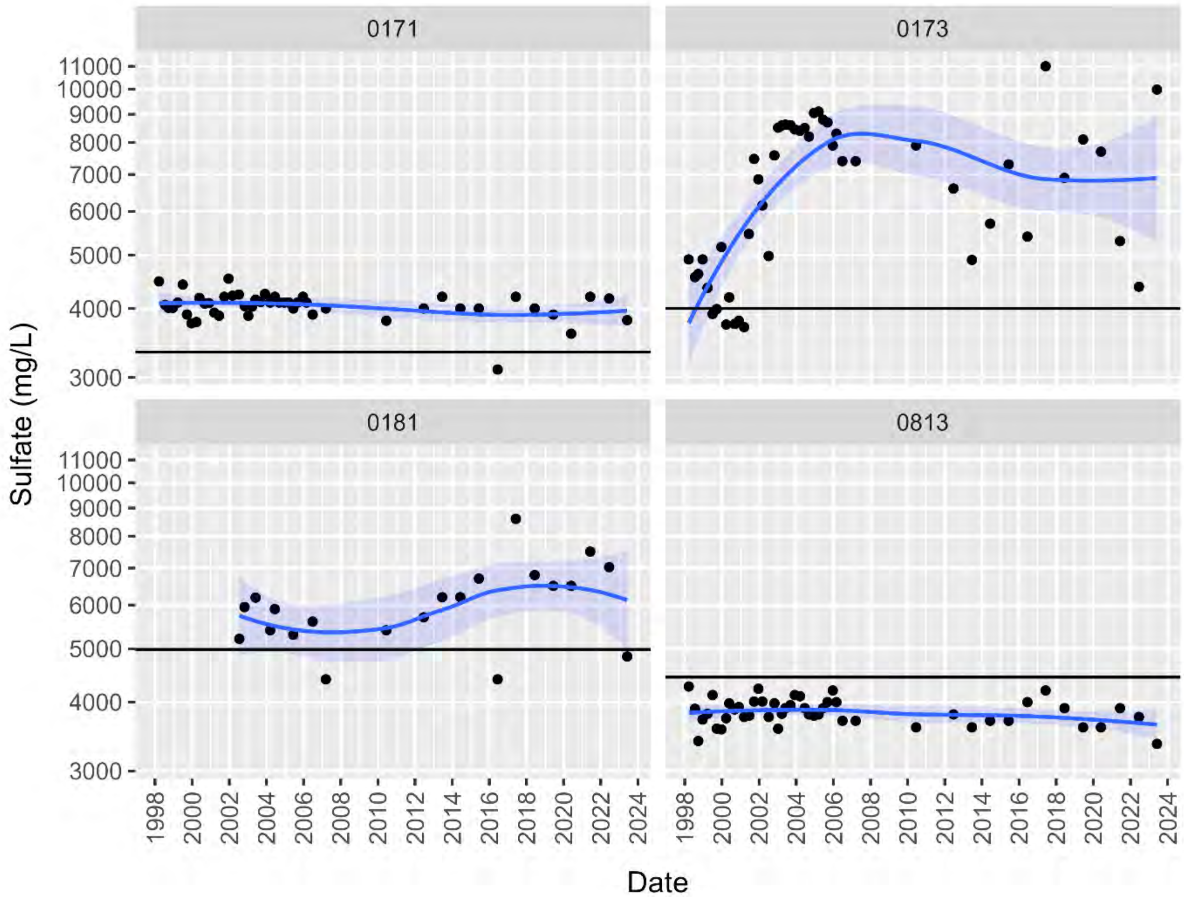
[b] Initial trend analysis dates vary as indicated above. For all well-parameter combinations, the final trend analysis date is June 5, 2023.

[c] Duplicate sample results were excluded from the analysis. As shown in Figure 7-5 through Figure 7-7, POC wells were sampled more frequently between 1998 and 2008 (about four times per year). After 2007, samples were collected on an annual basis, usually in June.

[d] For most well-parameter combinations, trend tests were performed using the Kendall package in R, version 2.2-1 (McLeod 2022). Because of the low detection frequency for nitrate in well 0813 (only 23 of the 53 results were above the detection limit), the NADA (Nondetects and Data Analysis for Environmental Data) package (version 1.6-1.1 [Lee 2020]) was used for that analysis. The NADA trend test is similar to the traditional Mann-Kendall trend test except that it accounts for the presence of nondetects at multiple detection limits. Trend analyses were conducted at the 0.05 significance level using a two-sided test. The test statistic, Kendall's tau, is a measure of the strength of the association between two variables, with values always falling between −1 and +1.

[e] To account for the inconsistent sampling frequencies acknowledged in note "c," Mann-Kendall trend analyses were rerun whereby data from 1998–2007 were limited to results for May, June, or July. Although tau and p-values differed as expected, the overall trends were the same for all well-analyte combinations except for sulfate in well 0173, for which no significant trend was identified using the culled dataset.

Figure 7-6 shows the time-concentration plots for sulfate in POC wells relative to the corresponding well-specific background concentration limits listed in Table 7-3. As has been the case historically, sulfate concentrations continue to exceed the LTSP background concentrations in POC wells 0171 and 0173 (Figure 7-6). Similar to observations made for nitrate, while sulfate concentrations in well 0171 have been stable (averaging about 4000 mg/L), concentrations have been the highest and most variable in well 0173, ranging from 3700 to 11,000 mg/L. Sulfate concentrations in this well increased from 4380 mg/L in 2022 to 9980 mg/L in 2023. Sulfate concentrations in well 0181 (4840 mg/L in 2023) were below the corresponding concentration limit (4985 mg/L) for the first time since 2016, while those in well 0813 remain below the corresponding concentration limit of 4440 mg/L (Figure 7-6).



—— Locally estimated scatterplot smoothing (LOESS) line and 95% confidence interval

---- LTSP background concentration from Table 7-3: 3334 mg/L, 4000 mg/L, 4985 mg/L, and 4440 mg/L, respectively, for wells 0171, 0173, 0181, and 0813

Figure 7-6. Sulfate Concentrations at POC Wells at the Green River, Utah, Disposal Site

For the 1998–2023 time frame and using the full dataset, Mann-Kendall trend analysis identified a significant increasing trend in sulfate concentrations for wells 0173 and 0181 (Table 7-5). For well 0173, this finding stems largely from the marked increase in sulfate concentrations between 1998 and approximately 2006, when samples were collected 4–5 times each year (versus annually). As indicated in Table 7-5 (note “e”), the trend analysis that was conducted using a culled dataset yielded no significant trend. This is also the case if only the highly variable data since 2010 are used in the analysis. Although a statistically significant increasing trend was found for well 0181, as mentioned previously, the most recent (2023) result was below the LTSP concentration limit.

Figure 7-7 shows the time-concentration plots for uranium in POC wells relative to the LTSP concentration limits listed in Table 7-3. In 2023, uranium concentrations exceeded the corresponding LTSP concentration limit only in well 0171 (Table 7-4), where results have been above the 0.044 mg/L MCL since late 2022 (with one exception). As observed for nitrate and sulfate, uranium concentrations in well 0173 also increased, from 0.007 mg/L in 2022 to 0.039 mg/L (just below the MCL) in 2023. Uranium concentrations in well 0181 remain below both the corresponding concentration limit and the MCL, and the trend is stable. Except for

2020–2022, uranium concentrations in well 0813 have been below both the MCL and the 0.069 mg/L concentration limit.

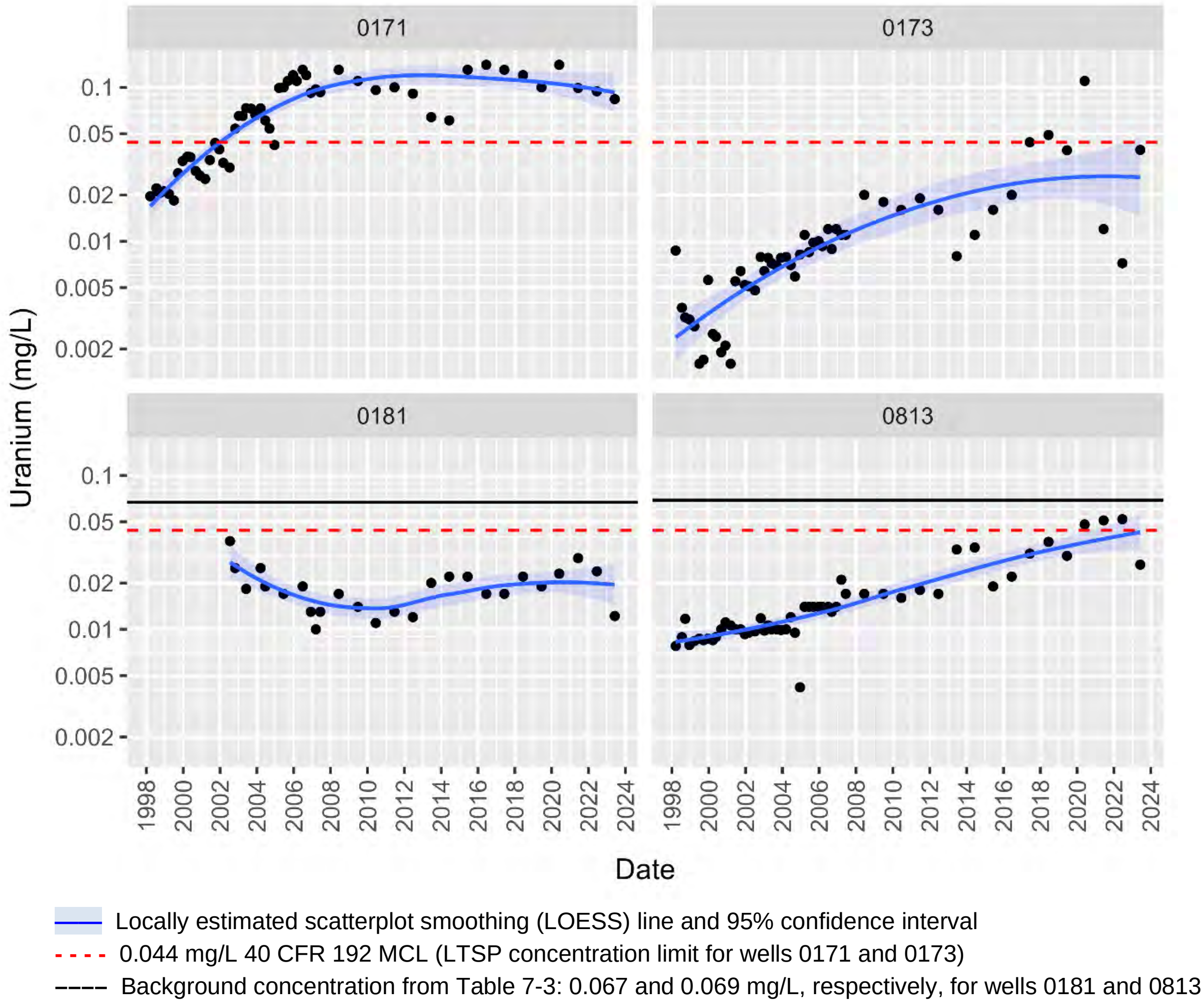


Figure 7-7. Uranium Concentrations at POC Wells at the Green River, Utah, Disposal Site

Mann-Kendall trend analysis applied to the full (1998–2023) time frame indicates significant increasing trends in uranium concentrations for all POC wells except well 0181 (Table 7-5). Since about 2010, uranium concentrations have stabilized in well 0171 and (like nitrate and sulfate) have been highly variable in well 0173. Mann-Kendall trend analysis rerun using only data since 2010 yielded statistically significant increasing uranium concentration trends for wells 0181 and 0183, but no trend was found for wells 0171 and 0173.

In summary, in 2023, concentrations of the routinely monitored analytes exceeded corresponding concentration limits in several POC wells: nitrate and sulfate in wells 0171 and 0173 and uranium in well 0171. Based on data collected since 1998, Mann-Kendall trend analysis indicates statistically significant increasing trends for several well-parameter combinations: sulfate in wells 0173 and 0181 and uranium in wells 0171, 1073, and 0183. When the trend analysis was limited to data since 2010, significant increasing trends were found only for uranium, in wells 0181 and 0183. Groundwater monitoring and disposal cell performance evaluation will continue at the site in accordance with the requirements set forth in the LTSP until the Draft GCAP has been finalized.

7.8 Corrective Action

Corrective action is taken to correct out-of-compliance or hazardous conditions that create a potential health and safety problem or that may affect the integrity of the disposal cell or compliance with 40 CFR 192. No need for corrective action was identified.

7.9 References

10 CFR 40.27. U.S. Nuclear Regulatory Commission, "General License for Custody and Long-Term Care of Residual Radioactive Material Disposal Sites," *Code of Federal Regulations*.

40 CFR 192. U.S. Environmental Protection Agency, "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings," *Code of Federal Regulations.*

40 CFR 192 Table 1 Subpart A. U.S. Environmental Protection Agency, "Maximum Concentration of Constituents for Groundwater Protection," *Code of Federal Regulations*.

DOE (U.S. Department of Energy), 1998. *Long-Term Surveillance Plan for the Green River, Utah, Disposal Site*, DOE/AL/62350-89, Rev. 2, July.

DOE (U.S. Department of Energy), 2011. *Draft Groundwater Compliance Action Plan for the Green River, Utah, Disposal Site*, LMS/GRN/S07892, Office of Legacy Management, December.

Lee, L., 2020. "NADA: Nondetects and Data Analysis for Environmental Data," R package, version 1.6-1.1, https://CRAN.R-project.org/package=NADA, accessed November 16, 2023.

McLeod, A.I., 2022. "Kendall: Kendall Rank Correlation and Mann-Kendall Trend Test," R package, version 2.2.1, https://cran.r-project.org/web/packages/Kendall/index.html, accessed November 16, 2023.

7.10 Photographs

Photograph Location Number	Azimuth	Photograph Description
PL-1	10	Faded Entrance Sign
PL-2	110	Erosional Rill near Perimeter Sign P16
PL-3	40	Perimeter Sign P2 Missing
PL-4	45	Faded Perimeter Sign P1
PL-5	—	Boundary Monument BM-5 is Damaged but Stable
PL-6	255	Rill Running into Toe Drain near North Corner of Disposal Cell
PL-7	130	Rills and Erosion near Water Tower

Note:
— = Photograph taken vertically from above.

PL-1. Faded Entrance Sign

PL-2. Erosional Rill near Perimeter Sign P16

PL-3. Perimeter Sign P2 Missing

PL-4. Faded Perimeter Sign P1

PL-5. Boundary Monument BM-5 is Damaged but Stable

PL-6. Rill Running into Toe Drain near North Corner of Disposal Cell

PL-7. Rills and Erosion near Water Tower

8.0 Gunnison, Colorado, Disposal Site

8.1 Compliance Summary

The U.S. Department of Energy (DOE) Office of Legacy Management (LM) conducted the Gunnison, Colorado, Uranium Mill Tailings Radiation Control Act (UMTRCA) Title I Disposal Site inspection on August 31, 2023. No cause for a follow-up inspection was identified.

No changes were observed on the disposal cell or in the associated diversion channels. Inspectors identified several minor maintenance items that were addressed following the annual inspection.

The most recent groundwater sampling event occurred in July 2021. The next scheduled monitoring event will occur in 2026. Groundwater monitoring results were below the site-specific uranium action level in the six point of compliance (POC) wells.

8.2 Compliance Requirements

Requirements for the long-term surveillance and maintenance of the site are specified in the site-specific Long-Term Surveillance Plan (DOE 1997) (LTSP) in accordance with procedures established to comply with the requirements of the U.S. Nuclear Regulatory Commission (NRC) general license at Title 10 *Code of Federal Regulations* Section 40.27 (10 CFR 40.27). Table 8-1 lists these requirements.

Table 8-1. License Requirements for the Gunnison, Colorado, Disposal Site

Requirement	LTSP	This Report	10 CFR 40.27
Annual Inspection and Report	Section 3.0	Section 8.4	(b)(3)
Follow-Up Inspections	Section 3.5	Section 8.5	(b)(4)
Maintenance and Repairs	Section 5.0	Section 8.6	(b)(5)
Groundwater Monitoring	Section 4.0	Section 8.7	(b)(2)
Corrective Action	Section 6.0	Section 8.8	--

8.3 Institutional Controls

The 92-acre site, identified by the property boundary shown in Figure 8-1, is owned by the United States and was accepted under the NRC general license in 1997. DOE is the licensee and, in accordance with the requirements for UMTRCA Title I sites, LM is responsible for the custody and long-term care of the site. Institutional controls (ICs) at the site include federal ownership of the property, administrative controls, and the following physical ICs that are inspected annually: the disposal cell and associated diversion channels, entrance gate, and sign; perimeter fence and signs; site markers; survey and boundary monuments; quality control monuments; and wellhead protectors.

8.4 Inspection Results

The site, 6 miles southeast of Gunnison, Colorado, was inspected on August 31, 2023. The inspection was conducted by J. Lobato and M. Guziak of the Legacy Management Support contractor. M. Hurt (LM site manager), M. Cosby (Colorado Department of Public Health and Environment), and M. Schmidt and S. Casebolt (Gunnison County Public Works) also attended the inspection. The purposes of the inspection were to confirm the integrity of visible features at the site, identify changes in conditions that might affect conformance with the LTSP, and evaluate whether maintenance or follow-up inspection and monitoring are needed.

8.4.1 Site Surveillance Features

Figure 8-1 shows the locations of site features, including site surveillance features and inspection areas, in black and gray font. Some site features that are present but not required to be inspected are shown in italic font. Observations from previous inspections that are currently monitored are shown in blue, and new observations identified during the 2023 annual inspection are shown in red. Inspection results and recommended maintenance activities associated with site surveillance features are described in the following subsections. Photographs to support specific observations are noted in the text and in Figure 8-1 by photograph location (PL) numbers. The photographs and photograph log are presented in Section 8.10.

8.4.1.1 Site Access, Entrance Gate, and Entrance Sign

Access to the site is from Gunnison County Road 42 onto U.S. Bureau of Land Management (BLM) Route 3068, a gravel road maintained by BLM. Entrance to the site is through a locked gate that is part of the perimeter fence. The entrance gate was locked and functional, and the entrance sign was intact and legible. The site has two additional access gates, one on the east fence line and the other on the north fence line, that provide access to several offsite monitoring wells. Although not part of the inspection results, all three barbed-wire gates were replaced with metal gates following the inspection. Gates were locked at the time of the inspection. No maintenance needs were identified.

8.4.1.2 Perimeter Fence and Signs

A three-strand barbed-wire perimeter fence encloses the site, which is set along or within the property boundary. In 2019, fence flagging was added to help protect sage-grouse and antelope from becoming entangled. The perimeter fence was intact.

There are 45 perimeter signs bolted to the perimeter fence posts. Perimeter signs P2, P3, P35, P40, P44, and P45 (PL-1) have bullet damage but remain legible. No other maintenance needs were identified.

8.4.1.3 Site Markers

The site has two granite site markers. Site marker SMK-1 (PL-2) is just inside the entrance gate, and site marker SMK-2 is on the top slope of the disposal cell. The concrete base of site marker SMK-2 has cracks lining up with each of the four monument corners but remains stable. No maintenance needs were identified.

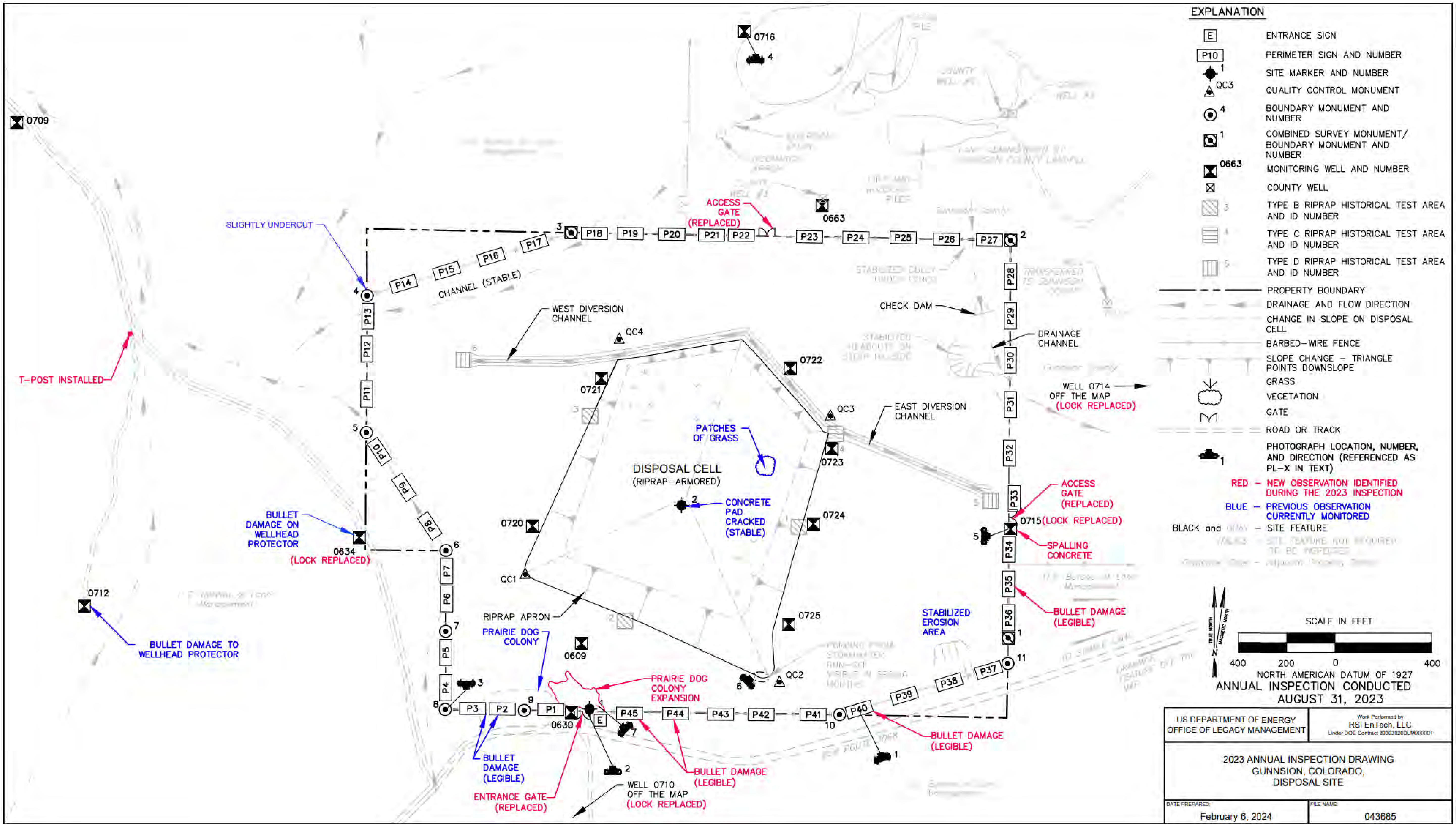


Figure 8-1. 2023 Annual Inspection Drawing for the Gunnison, Colorado, Disposal Site

8.4.1.4 Survey and Boundary Monuments

Three combined survey and boundary monuments and eight additional boundary monuments delineate the property boundary (PL-3). Inspectors noted that boundary monument BM-4 is slightly undercut but remains stable. No maintenance needs were identified.

8.4.1.5 Aerial Survey Quality Control Monuments

In October 2022, four permanent aerial survey quality control monuments were installed at the site for an aerial survey of the disposal cell. The quality control monument locations are shown in Figure 8-1. No maintenance needs were identified.

8.4.1.6 Monitoring Wells

The site has 16 groundwater monitoring wells. The wellhead protectors were locked and properly labeled. Bullet damage is on the wellhead protector of monitoring wells 0634 and 0712, but the well casings are not impacted and remain functional. Monitoring well 0716 is on landfill property. Gunnison County landfill operators have placed concrete barriers to protect monitoring well 0716 (PL-4) from landfill activities. The concrete around monitoring well 0715 is beginning to spall (PL-5). Four monitoring well locks (monitoring wells 0634, 0710, 0714, and 0715) were replaced before the inspection as part of a programmatic effort. No maintenance needs were identified.

8.4.2 Inspection Areas

In accordance with the LTSP, the site is divided into four inspection areas to ensure a thorough and efficient inspection. The inspection areas are (1) the top of the disposal cell; (2) the disposal cell side slopes, apron, and diversion channels; (3) the area between the disposal cell and the site boundary; and (4) the outlying area. Inspectors examined specific site surveillance features within each area and looked for evidence of erosion, settling, slumping, or other modifying processes that might affect the site’s conformance with LTSP requirements.

8.4.2.1 Top of the Disposal Cell

There was no evidence of settling, slumping, erosion, or any other modifying process that might affect the integrity of the top slope of the disposal cell. Several isolated patches of grass have established on the top slope; however, these shallow-rooted plants do not degrade the performance of the radon barrier component of the disposal cell’s engineered cover. No maintenance needs were identified.

8.4.2.2 Disposal Cell Side Slopes, Apron, and Diversion Channels

The disposal cell, completed in 1995, occupies 29 acres and is armored with basalt riprap to control erosion. Basalt riprap armors the disposal cell side slopes, the apron that collects and diverts stormwater runoff from the disposal cell, and the two diversion channels that protect the disposal cell from precipitation run-on. There was no evidence of settling, slumping, erosion, or any other modifying process that might affect the integrity of the disposal cell side slopes, apron, or diversion channels. Six historical test areas that were armored with riprap were last inspected during the 2017 annual inspection; in accordance with the LTSP (DOE 1997), monitoring is no longer required because no rock degradation has been observed.

Stormwater runoff from the disposal cell occasionally accumulates in a low-lying area at the southeast corner of the disposal cell apron (PL-6). The riparian-type vegetation that has become established there indicates that the area retains moisture. Water collection in this area does not pose a problem because the disposal cell surfaces are designed to drain to the southeast, and any water that ponds there is below the elevation of tailings placed under the engineered cover. No maintenance needs were identified.

8.4.2.3 Area Between the Disposal Cell and the Site Boundary

Reclaimed and undisturbed areas comprise the area between the disposal cell and the site boundary. In general, the vegetation in the reseeded, reclaimed areas consists of well-established grass; native plants are much less abundant and less diverse in reclaimed areas than they are in undisturbed areas. Former erosion areas are stable and naturally revegetating with native plant species. Inspectors observed several new prairie dog burrows inside the perimeter fence near perimeter signs P1, P2, and P3 (PL-7). Inspectors noted that the prairie dog colony appears to be expanding and will be monitored to ensure that the holes do not damage any DOE assets or become a nuisance. The closest burrow to the southern riprap apron is approximately 280 feet away. No maintenance needs were identified.

8.4.2.4 Outlying Area

In accordance with the LTSP, a drainage feature from the southeast corner of the site and along BLM Route 3068 was checked for indications of seepage from the vadose zone. The feature, which follows the borrow ditch along the road, was dry and showed no signs of seepage.

The 0.25-mile area beyond the site boundary was visually observed for erosion, changes in land use, or other phenomena that might affect the long-term integrity of the site. A prairie dog colony that has been observed along the southwestern boundary of the site has moved inside the perimeter fence, as noted in Section 8.4.2.3. Inspectors will continue to monitor and track the extent of the prairie dog colony in this area.

Gunnison County owns the land adjacent to the site boundary to the north and east and uses the land for a municipal landfill. The nearest landfill operations continue to be approximately 400 feet north of the property boundary. Although landfill activities do not affect the site, inspectors will continue to monitor the level of activity occurring near the site boundary and surveillance features (e.g., fences and monitoring wells). There is a spoil pile near monitoring well 0716 (Figure 8-1) that inspectors will continue to monitor. No maintenance needs were identified.

8.5 Follow-Up or Contingency Inspections

LM will conduct follow-up inspections if (1) a condition is identified during the annual inspection or other site visit that requires a return to the site to evaluate the condition or (2) LM is notified by a citizen or outside agency that conditions at the site are substantially changed. No need for a follow-up inspection was identified.

8.6 Maintenance and Repairs

Monitoring well locks were replaced at four locations (monitoring wells 0634, 0710, 0714, and 0715) before the inspection. The wood stake marking the two-track road leading to monitoring well 0712 was missing and has been replaced with a metal T-post. The barbed-wire entrance gates were replaced with metal gates following the inspection. No other maintenance needs were identified.

8.7 Environmental Monitoring

8.7.1 Groundwater Monitoring

In accordance with the LTSP (DOE 1997), LM conducts groundwater monitoring every 5 years to demonstrate that the site-specific uranium action level has not been exceeded. Groundwater was sampled and groundwater levels were measured annually from 1998 to 2001. Following the 2001 sampling event, the monitoring frequency changed to once every 5 years. The most recent sampling event occurred in July 2021. Groundwater monitoring results for the site are reported and published on the LM Geospatial Environmental Mapping System (GEMS) website https://gems.lm.doe.gov/#site=GUD. The next sampling event is planned for 2026.

The groundwater monitoring network consists of 16 monitoring wells. This total includes six POC wells, two monitoring wells to monitor background groundwater quality, and eight wells to monitor groundwater levels.

The indicator analyte for disposal cell performance is uranium, which was selected because of its presence in tailings pore fluid, relatively high mobility in groundwater, and low concentration in background groundwater samples, as stated in Section 2.5 in the LTSP (DOE 1997).

The site-specific screening monitoring action level (action level) concentration for uranium is 0.013 milligram per liter (mg/L). The basis for this action level is the maximum observed concentration of uranium in background samples before long-term surveillance and maintenance activities began. The U.S. Environmental Protection Agency established a maximum concentration limit for uranium of 0.044 mg/L in groundwater (40 CFR 192 Subpart A Table 1). Water levels are measured at each monitoring well during groundwater monitoring events. A rising water level trend in monitoring wells 0663, 0715, 0716, and 0721 through 0725 was noted in the 2021 monitoring report results. In 2022, DOE initiated a new project to investigate the rising water level. Data for the rising water level project have been collected, and DOE is reviewing the results.

The concentrations of uranium in samples collected and analyzed from the POC wells in 2021 ranged from 0.001 mg/L to 0.005 mg/L. In 2021, uranium concentrations were consistent with historical results in five of the POC wells; however, they slightly exceeded the historical maximum in POC well 0721. Uranium results from the POC wells in 2021 were below the action level of 0.013 mg/L.

Figure 8-2 presents the locations of the groundwater monitoring network and Table 8-2 lists the site’s groundwater monitoring network.

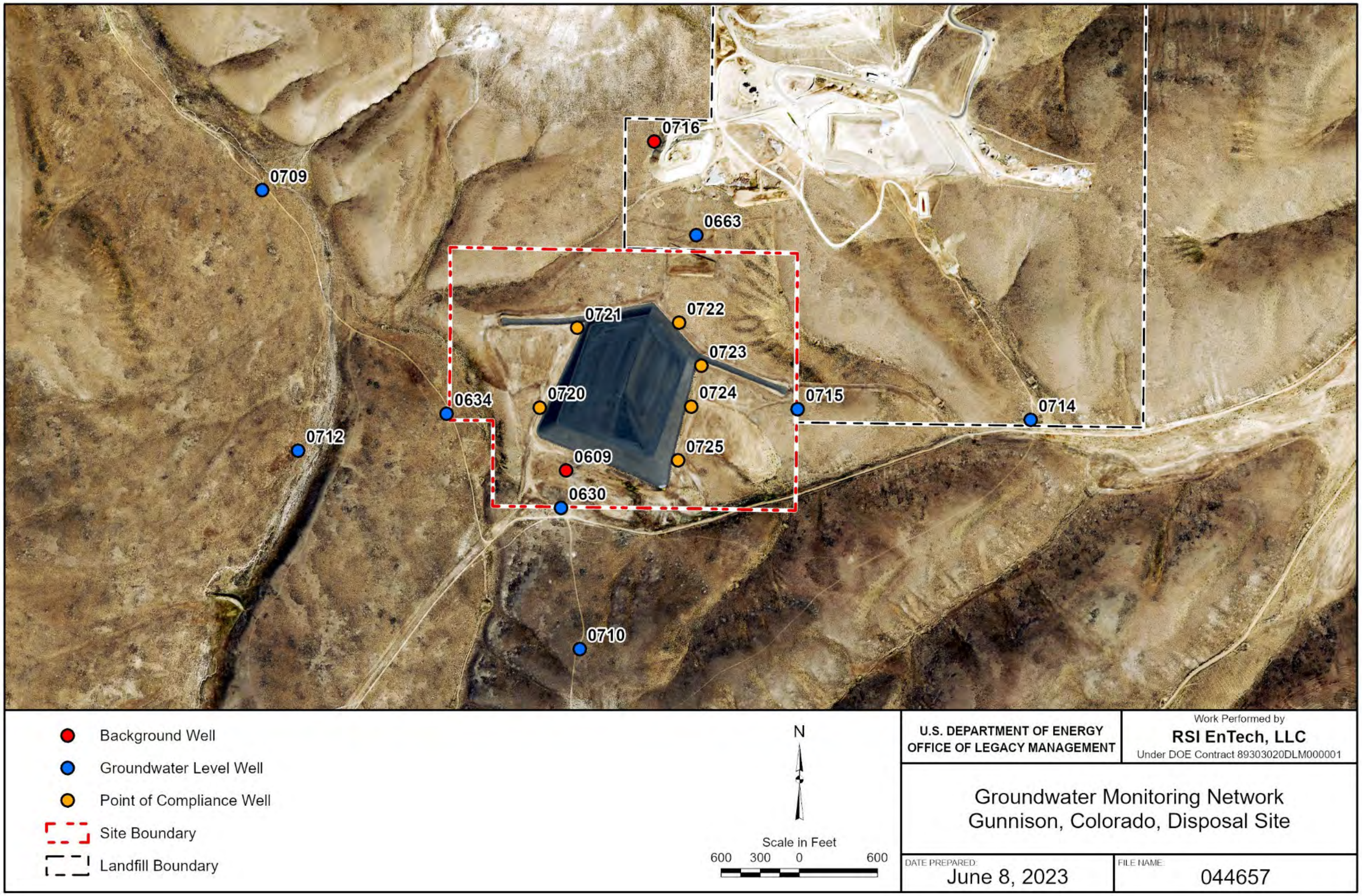


Figure 8-2. Groundwater Monitoring Network at the Gunnison, Colorado, Disposal Site

Table 8-2. Groundwater Monitoring Network for the Gunnison, Colorado, Disposal Site

POC and Background Wells	Groundwater Level Wells
0720 (POC)	0630
0721 (POC)	0634
0722 (POC)	0663
0723 (POC)	0709
0724 (POC)	0710
0725 (POC)	0712
0609 (background)	0714
0716 (background)	0715

8.8 Corrective Action

Corrective actions may be warranted to address hazardous conditions that create a potential health and safety problem or conditions that may affect the integrity of the disposal cell or compliance with 40 CFR 192.04. No need for corrective action was identified as part of this inspection.

8.9 References

10 CFR 40.27. U.S. Nuclear Regulatory Commission, "General License for Custody and Long-Term Care of Residual Radioactive Material Disposal Sites," *Code of Federal Regulations*.

40 CFR 192 Subpart A Table 1. U.S. Environmental Protection Agency, "Maximum Concentration of Constituents for Groundwater Protection," *Code of Federal Regulations.*

40 CFR 192.04. U.S. Environmental Protection Agency, "Corrective Action," *Code of Federal Regulations*.

DOE (U.S. Department of Energy), 1997. *Long-Term Surveillance Plan for the Gunnison, Colorado, Disposal Site*, DOE/AL/62350-222, Rev. 2, April.

8.10 Photographs

Photograph Location Number	Azimuth	Photograph Description
PL-1	340	Perimeter Sign P40 with Bullet Holes
PL-2	0	Site Marker SMK-1
PL-3	180	Boundary Monument BM-8
PL-4	0	Monitoring Well 0716 with Concrete Barriers
PL-5	90	Monitoring Well 0715 with Concrete Spalling at Base
PL-6	45	Evidence of Water Accumulation on Southeast Toe of Disposal Cell
PL-7	315	Prairie Dog Colony Area

PL-1. Perimeter Sign P40 with Bullet Holes

PL-2. Site Marker SMK-1

PL-3. Boundary Monument BM-8

PL-4. Monitoring Well 0716 with Concrete Barriers

PL-5. Monitoring Well 0715 with Concrete Spalling at Base

PL-6. Evidence of Water Accumulation on Southeast Toe of Disposal Cell

PL-7. Prairie Dog Colony Area

9.0 Lakeview, Oregon, Disposal Site

9.1 Compliance Summary

The Lakeview, Oregon, Uranium Mill Tailings Radiation Control Act (UMTRCA) Title I Disposal Site was inspected June 21, 2023. No changes were observed on the disposal cell or in the drainage features. Inspectors identified minor maintenance needs but found no cause for a follow-up or contingency inspection.

Disposal cell riprap gradation monitoring has been performed annually since 1997 at random locations on the west side slope due to concerns over premature rock degradation. With the approval of the U.S. Nuclear Regulatory Commission (NRC) in 2019 to discontinue rock gradation monitoring at the site (Mandeville 2019), rock gradation monitoring was not performed in 2023 but photos were taken as a best practice. No evidence of settling, slumping, erosion, or any other modifying process on the disposal cell side slopes was observed that might affect the integrity of the cell.

The U.S. Department of Energy (DOE) Office of Legacy Management (LM) conducts groundwater monitoring every 5 years to demonstrate compliance with established groundwater quality protection standards. The most recent sampling event occurred in June 2019. Groundwater monitoring results were below the U.S. Environmental Protection Agency (EPA) designated maximum concentration limits (MCLs) in all monitoring wells.

9.2 Compliance Requirements

Requirements for the long-term surveillance and maintenance of the site are specified in the site-specific Long-Term Surveillance Plan (DOE 1994) (LTSP) in accordance with procedures established to comply with the requirements of the NRC general license at Title 10 *Code of Federal Regulations* Section 40.27 (10 CFR 40.27). Table 9-1 lists these requirements.

Table 9-1. License Requirements for the Lakeview, Oregon, Disposal Site

Requirement	LTSP	This Report	10 CFR 40.27
Annual Inspection and Report	Section 6.0	Section 9.4	(b)(3)
Follow-Up or Contingency Inspections	Section 7.0	Section 9.5	(b)(4)
Maintenance and Repairs	Section 8.0	Section 9.6	(b)(5)
Groundwater Monitoring	Section 5.3	Section 9.7	(b)(2)
Corrective Action	Section 9.0	Section 9.8	—

9.3 Institutional Controls

The 40-acre site, identified by the property boundary shown in Figure 9-1, is owned by the United States and was accepted under the NRC general license in 1995. DOE is the licensee and, in accordance with the requirements for UMTRCA Title I sites, LM is responsible for the custody and long-term care of the site.

Institutional controls (ICs) at the site include federal ownership of the property, administrative controls, and the following physical ICs that are inspected annually: the disposal cell and associated drainage features, entrance gate and sign, perimeter fence and signs, site markers, survey and boundary monuments, and wellhead protectors.

9.4 Inspection Results

The site, approximately 7 miles northwest of Lakeview, Oregon, was inspected on June 21, 2023. The inspection was conducted by Z. Aldous and T. Santonastaso of the Legacy Management Support contractor. T. Sicilia and M. Woods (Oregon Department of Energy) and A. Denny (LM) participated in the inspection. The purposes of the inspection were to confirm the integrity of visible features at the site, identify changes in conditions that might affect conformance with the LTSP, and evaluate whether maintenance or follow-up inspection and monitoring are needed.

9.4.1 Site Surveillance Features

Figure 9-1 shows the locations of site features, including site surveillance features and inspection areas, in black and gray font. Some site features that are present but not required to be inspected are shown in italic font. Observations from previous inspections that are currently monitored are shown in blue, and new observations identified during the 2023 annual inspection are shown in red. Inspection results and recommended maintenance activities associated with site surveillance features are described in the following subsections. Photographs to support specific observations are noted in the text and in Figure 9-1 by photograph location (PL) numbers. The photographs and photograph log are presented in Section 9.10.

9.4.1.1 Access Road, Entrance Gate, and Entrance Sign

Access to the site is from a gravel road that heads west from Lake County Road 2-16B. DOE was granted a perpetual easement on the approximately 1.2-mile access road between the county road and property boundary. A lockable gate across the access road on the adjacent privately owned land limits access to the site. The entrance gate to the site is in the southeast corner of the perimeter fence. The entrance gate was locked and undamaged. The entrance sign is attached to a steel post set in concrete along the access road and was undamaged (PL-1). A pedestrian gate in the northwest corner of the site was locked and undamaged. No maintenance needs were identified.

9.4.1.2 Perimeter Fence and Signs

A four-strand barbed-wire perimeter fence (five-strand along much of the western boundary) encloses the site. Sheep fencing is on the southeastern and southern boundaries of the site. Some vegetation is growing near, and entangled in, the perimeter fence line, but the fence appeared stable and remains functional. A bent fence post observed during the 2021 inspection near the southeast corner of the site will be repaired in the future. An empty post was found near the south fence that will be removed in the future. A small hole in the sheep fence was observed in the southern fence line (PL-2). The hole appears to be man-made, possibly to help small animals escape through the fence. Evidence of minor erosion from animals digging under the fence was identified near the southeast corner of the fence line during the 2022 inspection (PL-3) and several new locations along the northern fence line were identified during the 2023 inspection (PL-4), but this is not a concern to the site security or the integrity of the fence.

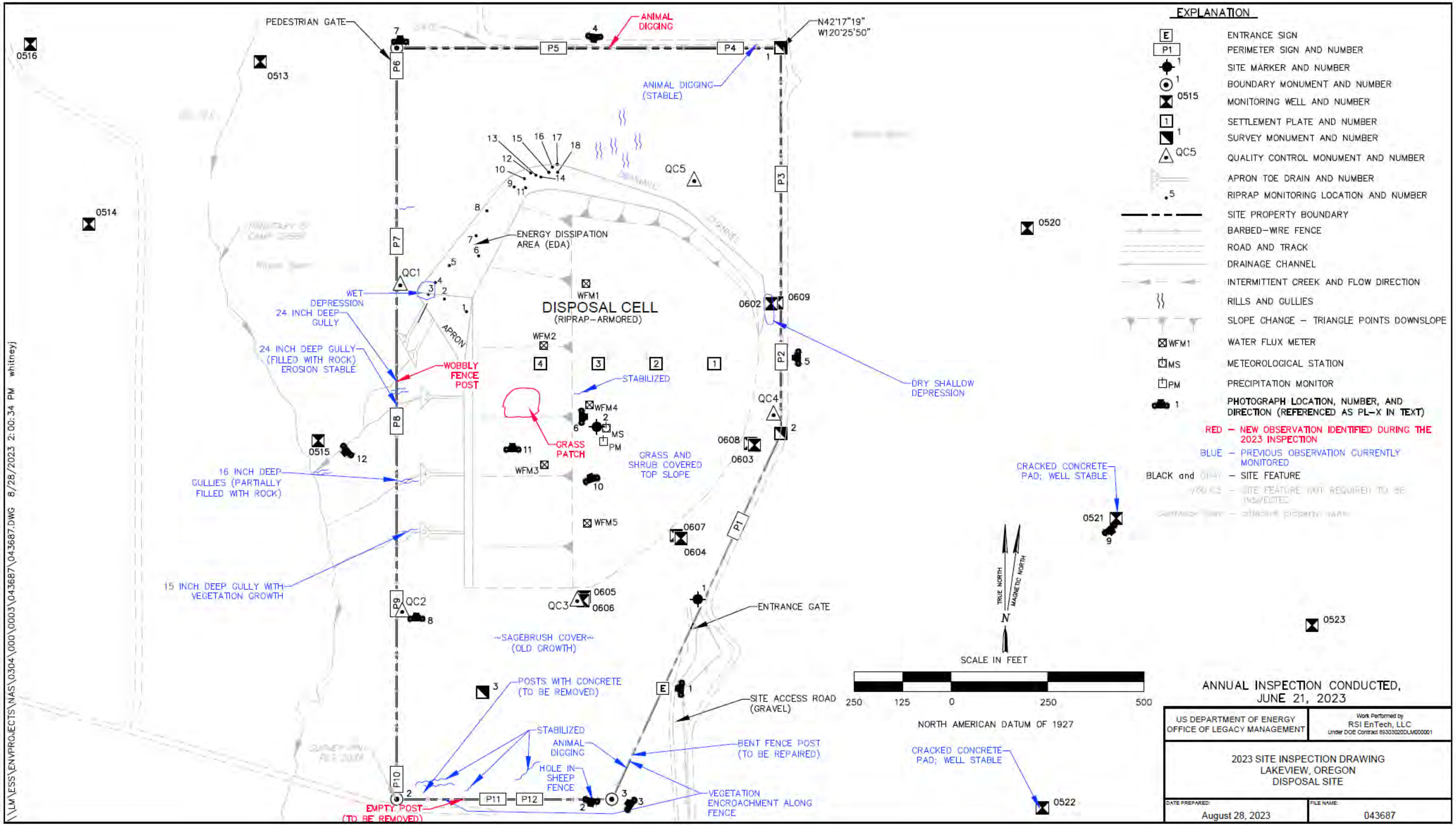


Figure 9-1. 2023 Annual Inspection Drawing for the Lakeview, Oregon, Disposal Site

There are 12 perimeter signs, attached to steel posts set in concrete and positioned along the property boundary (PL-5). No other maintenance needs were identified.

9.4.1.3 Site Markers

The site has two granite site markers. Site marker SMK-1 is just inside the entrance gate, and site marker SMK-2 (PL-6) is on the top slope of the disposal cell. No maintenance needs were identified.

9.4.1.4 Survey and Boundary Monuments

Three survey monuments and three boundary monuments (PL-7) delineate the property boundary. No maintenance needs were identified.

9.4.1.5 Aerial Survey Quality Control Monuments

There are five permanent aerial survey quality control monuments installed at the site to provide control during aerial surveys of the disposal cell. A baseline aerial survey was performed in October 2021. The quality control monuments were inspected in 2023 (PL-8). No maintenance needs were identified.

9.4.1.6 Monitoring Wells

The site has 12 downgradient groundwater monitoring wells with four wells offsite to the east. Four upgradient wells are offsite to the west. Wells 0522 and 0521 (PL-9) have concrete bases that are cracked, but the wellhead protectors remain stable. A dry, shallow depression remains near well 0602, as noted in previous inspections. The wellhead protectors were locked and undamaged. No maintenance needs were identified.

9.4.2 Inspection Areas

In accordance with the LTSP, the site is divided into three inspection areas to ensure a thorough and efficient inspection. The inspection areas are (1) the top of the disposal cell; (2) the side slopes of the disposal cell, adjacent drainage channel, and aprons; and (3) the site perimeter and outlying area. The inspectors examined specific site surveillance features within each area and looked for evidence of erosion, settling, slumping, or other modifying processes that might affect the site’s conformance with LTSP requirements.

9.4.2.1 Top of Disposal Cell

The disposal cell, completed in 1988, occupies 16 acres. At the time of disposal cell construction, the entire top slope of the disposal cell was covered in 12 inches of type B-sized riprap. In 1989, at the request of the State of Oregon, 4 inches of soil was added over the riprap to allow a vegetative cover to be established and help minimize the visual impact of the disposal cell. The design for the top of the disposal cell has created conditions that favor the growth of deep-rooted plants. The growth of shrubs on the disposal cell top slope is favored by movement of precipitation through the topsoil, riprap, and bedding layers; the compacted soil (radon barrier) inhibits root growth from reaching the tailings. Grasses and forbs growing on the top slope have gradually increased over the years, but some areas, such as near the System Operation and Analysis at Remote Sites (SOARS) station, remain sparsely vegetated (PL-10). This plant growth pattern is consistent with surrounding offsite areas. Riprap was observed through the soil on the top slope in several small areas during the inspection. These areas are sporadic across the top slope and are likely caused by the soil infilling the riprap-void spaces. No structural or disposal cell performance concerns are associated with the riprap becoming visible on the top slope.

The incipient development of checkerboard soil erosion patterns was observed in some of the more sparsely vegetated areas on the top slope (consistent with similar areas offsite). A previously identified shallow rill on the top slope could not be found and was assumed to have stabilized from natural weathering processes. No additional changes were noted during the inspection. No structural or disposal cell performance concerns are associated with this condition because the riprap rock cover is continuous beneath the top slope soil cover, slope crests, and side slopes. Inspectors will continue to monitor this condition.

The contact boundary between the disposal cell top and side slopes was inspected and generally appears stable and uniform. No erosion was observed during the inspection at the crest of the west side slope and the disposal cell top slope, and both appear to be stable. Inspectors will continue to monitor the transition zone between the disposal cell top slope and the west side slope for erosion development. There was no evidence of settling, slumping, erosion, or any other modifying process on the top of the disposal cell that might affect the integrity of the disposal cell.

LM is participating in an NRC-sponsored project to investigate the effect of soil-forming processes on the performance of the radon barrier on UMTRCA disposal cells. In October 2017, researchers excavated through the cover materials (soil, riprap, bedding material, and underlying radon barrier) at six locations on the disposal cell (five on the top slope and one on the west side slope) to support the study. Areas restored and reseeded in 2017 as part of the study were observed to have vegetation growth. The restored locations were inspected to confirm that no settlement is occurring, positive drainage is preserved, and vegetation is reestablishing. No maintenance needs were identified.

9.4.2.2 Disposal Cell Side Slopes and Adjacent Drainage Channel, Apron, and Toe Drains

Deterioration of the basalt riprap that armors the disposal cell side slopes is a result of physical and chemical weathering processes. In accordance with the LTSP, deterioration monitoring at the site consists of rock gradation monitoring on the west side slope and photographic monitoring in the energy dissipation area (EDA). Addendums to the LTSP commit LM to annually assess the mean diameter value of the riprap on the west side slope through gradation monitoring to ensure the riprap remains large enough to protect the disposal cell from erosion during a major precipitation event, as designed. The thickness of the riprap on the west side slope was doubled during construction due to concerns over rock quality.

In 2015, LM proposed to replace annual gradation monitoring with rill inspections. The rills may form along the interface between the vegetated soil and rock top slope and the rock-covered west side slope (Dayvault 2015). Focusing on these areas allows LM to assess conditions that may indicate the development of potential failure points along the side slope. In 2019, NRC concurred with the discontinuation of rock gradation monitoring (Mandeville 2019); therefore, it was not performed in 2023. DOE is updating the LTSP to reflect this change. No rills or erosional features were observed along the side slope and the interface between the vegetated soil and rock top slope during the inspection.

Annual photographic monitoring of the 18 locations for long-term rock monitoring was conducted during the 2023 inspection. Minor rock degradation has been observed in the EDA since monitoring began at the original 10 photograph locations established in 1997 and at the eight additional locations established in 2000. No significant degradation of the EDA rock has been observed since monitoring began.

In the past, water has been observed in the large depression in the EDA at the lower end of the drainage channel. Water is a potential concern because inundation may accelerate deterioration of the large riprap by the freeze-thaw process. Wet conditions were observed in the EDA depression during the 2023 inspection (a high precipitation year).

Small amounts of vegetation (primarily grass) have encroached on the riprap on the side slopes, on the upper (eastern) portion of the stormwater drainage channel (i.e., diversion channel), and on the west side slope’s apron. During the 2023 annual inspection, a patch of grass approximately 2.5-feet × 2.5-feet was observed on the west side slope toward the bottom between water flux monitors WFM2 and WFM3 (PL-11). The relatively sparse plant growth in these features will not affect their performance (i.e., channels were designed to control stormwater runoff from affecting encapsulated materials within the disposal cell). There are a few small shrubs in the upper (eastern) portion of the drainage channel, but they will not obstruct water flow. An area of dense, tall grass near Toe Drains 1 and 3 suggests that conditions are periodically wetter in this area because stormwater runoff is channeled there by control features. During the 2023 inspection, there was flowing water in these toe drains. No ponded water was observed during the inspection. Minor erosion was observed near the fence line near Toe Drain 3 but appears to be stable. There was no evidence of settling, slumping, erosion, or any other modifying process on the disposal cell side slopes that might affect the integrity of the disposal cell. No other maintenance needs were identified.

9.4.2.3 Site Perimeter and Outlying Area

The area beyond the site boundary for a distance of 0.25 mile was visually observed for erosion, changes in land use, or other phenomena that might affect the long-term integrity of the site. This includes the seeded grass area extending from the disposal cell to the site boundary and perimeter fence. No such impacts were observed. An active animal burrow was observed in 2022 in the northwest corner of the site near the pedestrian gate but could not be located during the 2023 inspection.

In September and October 2021, the Cougar Peak Wildfire burned approximately 91,000 acres to the west of the site mostly within the Fremont-Winema National Forest. The fire perimeter was within 2 miles of the site and the burn scar can be clearly seen from the site.

Gullies that formed in seeded areas extending west of Toe Drains 1 through 5 were filled with rock in 2000. Although the rock has generally arrested the headcutting that was advancing eastward from the adjacent private property onto DOE property, some minor headcutting is still evident. Several small gullies have been observed on the private property directly west of the site in the heavily grazed areas downslope of the perimeter fence line near monitoring well 0515 (PL-12). Several rills and shallow gullies were also observed onsite on the slope north of the disposal cell where grass reestablishment has been limited, in a drainage area on the site north of perimeter sign P7, north of perimeter sign P8, and in the southwest corner of the site. These gullies and rills were identified during previous annual inspections but appear to have stabilized, as no significant changes were observed in 2023. The gullies do not pose a threat to disposal cell integrity, and inspectors will continue to monitor these areas. In previous years, inspectors have observed a pile of cut telephone poles and signposts with concrete bases in the southwest corner of the site. The cut telephone poles were removed in June 2019; however, the fence posts with cement bases were too heavy to remove by hand. Though this remaining debris does not affect site integrity, it will be removed in the future. No other maintenance needs were identified.

9.5 Follow-Up or Contingency Inspections

LM will conduct follow-up or contingency inspections if (1) a condition is identified during the annual inspection or other site visit that requires a return to the site to evaluate the condition or (2) LM is notified by a citizen or outside agency that conditions at the site are substantially changed. No need for a follow-up or contingency inspection was identified.

9.6 Maintenance and Repairs

No maintenance was performed in 2023.

Inspectors documented the following minor maintenance to be addressed in the future:

- Replacement of a bent fence post near the southeast corner of the site
- Removal of the signposts with concrete bases from the southwest corner of the site
- Fence repairs on the south side
- Raise fence posts that have been pushed into the ground by the snow
- Removal of empty post found on the south fence

No other maintenance needs were identified.

9.7 Groundwater Monitoring

In accordance with the LTSP, LM conducts groundwater monitoring every 5 years to demonstrate compliance with established groundwater quality protections standards. The most recent sampling event occurred on June 13, 2019, and the next event will occur in 2024.

The groundwater monitoring network consists of nine monitoring wells, including eight downgradient point of compliance (POC) wells and one upgradient background monitoring well (Table 9-2 and Figure 9-2). Four of the nine monitoring wells were observed to be dry on June 13, 2019, and could not be sampled.

Seven additional LM-owned monitoring wells (wells 0513, 0514, 0516, 0520, 0521, 0522, and 0523) are on private property adjacent to the site but are no longer required to be sampled as identified in the LTSP (Figure 9-1). The constituents monitored in site groundwater are arsenic, cadmium, and uranium. EPA established MCLs for these analytes in groundwater in 40 CFR 192 Table 1 Subpart A (Table 9-3).

Table 9-2. Groundwater Monitoring Network for the Lakeview, Oregon, Disposal Site

Groundwater Monitoring Purpose	Monitoring Wells
Paired POC wells	0602/0609
Paired POC wells	0603/0608
Paired POC wells	0604/0607
Paired POC wells	0605/0606
Upgradient	0515

Table 9-3. Maximum Concentration Limits for Groundwater at the Lakeview, Oregon, Disposal Site

Constituent	MCL[a] (mg/L)
Arsenic	0.05
Cadmium	0.01
Uranium	0.044

Note:
[a] MCL (40 CFR 192 Table 1 Subpart A)

Abbreviation:
mg/L = milligrams per liter

Concentrations of these constituents continued to remain significantly below their respective MCLs in 2019. Arsenic concentrations were similar to the 2014 results, all cadmium concentration results were below the laboratory detection limit of 0.000083 milligrams per liter, and uranium concentrations remained stable or have slightly increased (DOE 2020).

All groundwater monitoring results for the site are reported and published on the LM Geospatial Environmental Mapping System (GEMS) website (https://gems.lm.doe.gov/#site=LKD). The *2019 Annual Site Inspection and Monitoring Report for Uranium Mill Tailings Radiation Control Act Title I Disposal Sites* (DOE 2020) shows the most recent monitoring results. All monitoring results were within the range of historical monitoring results, with the exception of the uranium concentration at monitoring well 0606, which showed a slight increase but remains below the MCL. Based on the monitoring results to date, there is no indication of any degradation of groundwater quality near the site. The next disposal cell groundwater monitoring event is scheduled for 2024.

9.8 Corrective Action

In accordance with the LTSP, corrective action is taken to correct out-of-compliance or hazardous conditions that create a potential health and safety problem or that may affect the integrity of the disposal cell or compliance with 40 CFR 192. No need for corrective action was identified.

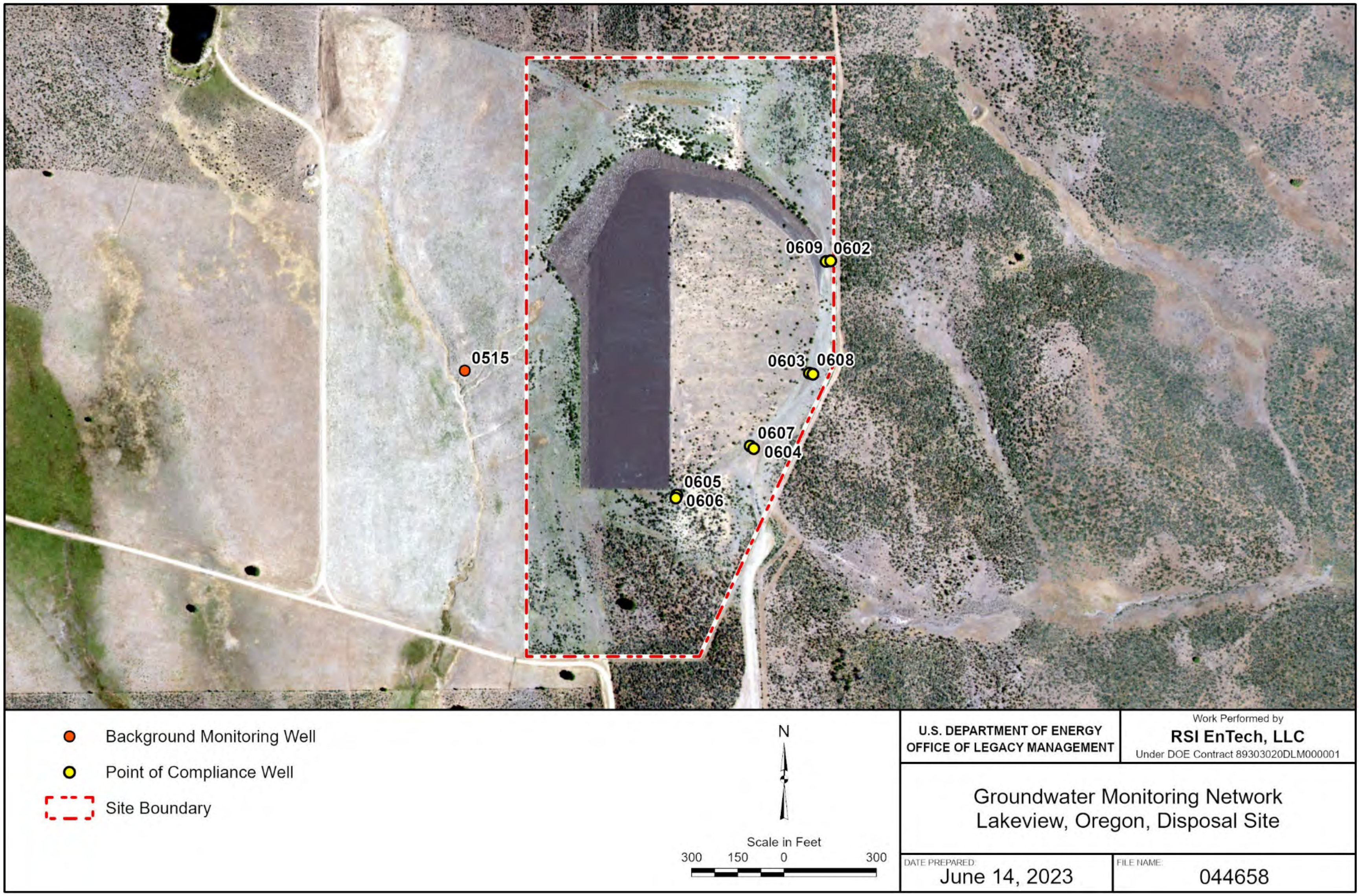


Figure 9-2. Groundwater Monitoring Network, Lakeview, Oregon, Disposal Site

9.9 References

10 CFR 40.27. U.S. Nuclear Regulatory Commission, “General License for Custody and Long-Term Care of Residual Radioactive Material Disposal Sites,” *Code of Federal Regulations*.

40 CFR 192. U.S. Environmental Protection Agency, “Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings,” *Code of Federal Regulations*.

40 CFR 192 Table 1 Subpart A. U.S. Environmental Protection Agency, “Maximum Concentration of Constituents for Groundwater Protection,” *Code of Federal Regulations*.

Dayvault, 2015. Jalena Dayvault, UMTRCA site manager, Office of Legacy Management, U.S. Department of Energy, letter (about Lakeview, Oregon, Uranium Mill Tailings Radiation Control Act [UMTRCA] Title I Disposal Site’s West Side Slope Rock Degradation Assessment) to U.S. Nuclear Regulatory Commission, March 2.

DOE (U.S. Department of Energy), 1994. *Long-Term Surveillance Plan for the Collins Ranch Disposal Site, Lakeview, Oregon*, DOE/AL/62350-19F, Rev. 3, August.

DOE (U.S. Department of Energy), 2020. *2019 Annual Site Inspection and Monitoring Report for Uranium Mill Tailings Radiation Control Act Title I Disposal Sites*, LMS/S26685, Office of Legacy Management, March.

Mandeville, 2019. Doug Mandeville, project manager, U.S. Nuclear Regulatory Commission, letter (about Lakeview Rock Degradation Monitoring Program) to Jason Nguyen, UMTRCA site manager, Office of Legacy Management, U.S. Department of Energy, October 11.

9.10 Photographs

Photograph Location Number	Azimuth	Photograph Description
PL-1	275	Entrance Sign
PL-2	190	Hole in Sheep Fence
PL-3	305	Animal Burrow Under Fence
PL-4	185	New Animal Burrow
PL-5	270	Perimeter Sign P2
PL-6	90	Site Marker SMK-2
PL-7	—	Boundary Monument BM1
PL-8	—	Quality Control Monument QC2
PL-9	140	Well 0521 with Cracked Concrete Base
PL-10	340	Sparse Vegetation near SOARS Station on Top of Cell
PL-11	355	Grass Patch on Riprap Between Water Flux Meters WFM2 and WFM3
PL-12	230	Gully near Monitoring Well 0515

Note:
— = Photograph taken vertically from above.

PL-1. Entrance Sign

PL-2. Hole in Sheep Fence

PL-3. Animal Burrow Under Fence

PL-4. New Animal Burrow

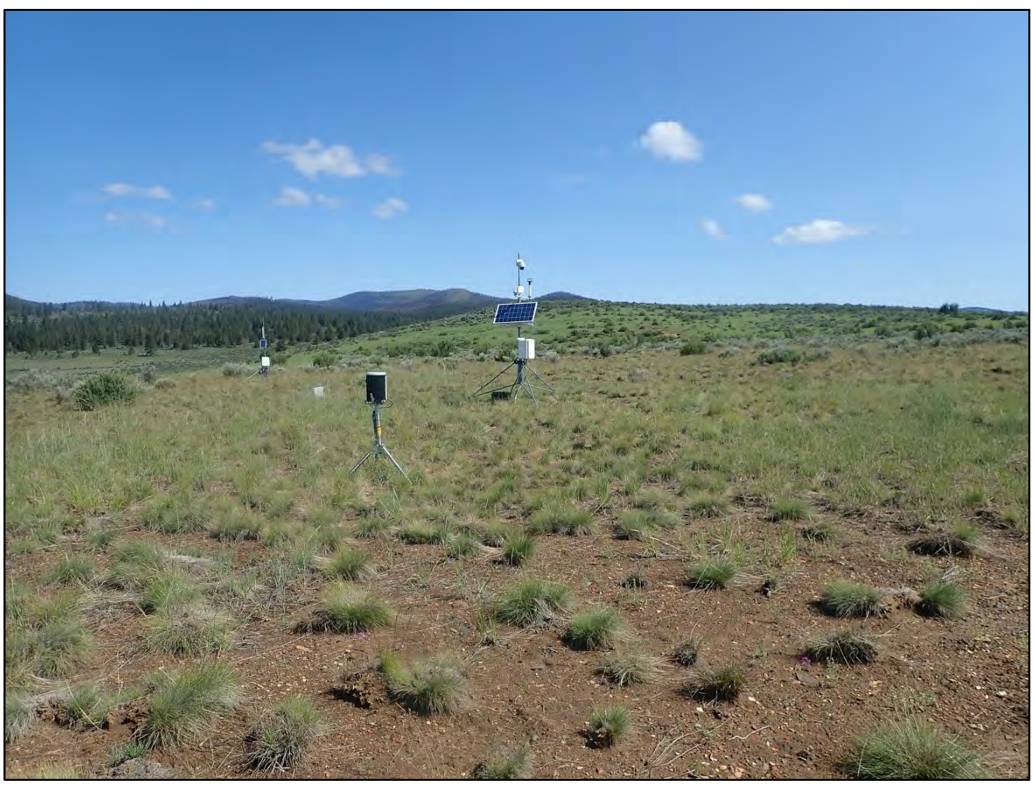
PL-5. Perimeter Sign P2

PL-6. Site Marker SMK-2

PL-7. Boundary Monument BM1

PL-8. Quality Control Monument QC2

PL-9. Well 0521 with Cracked Concrete Base



PL-10. Sparse Vegetation near SOARS Station on Top of Cell

PL-11. Grass Patch on Riprap Between Water Flux Meters WFM2 and WFM3

PL-12. Gully near Monitoring Well 0515

10.0 Lowman, Idaho, Disposal Site

10.1 Compliance Summary

The Lowman, Idaho, Uranium Mill Tailings Radiation Control Act (UMTRCA) Title I Disposal Site was inspected on June 6, 2023. No significant changes were observed on the disposal cell or in the associated drainage features. Inspectors identified minor maintenance needs that were completed following the inspection but found no cause for a follow-up inspection. Groundwater monitoring is not required and was discontinued in 2004.

10.2 Compliance Requirements

Requirements for the long-term surveillance and maintenance of the site are specified in the site-specific *Long-Term Surveillance Plan for the U.S. Department of Energy Lowman, Idaho, (UMTRCA Title I) Disposal Site* (DOE 2005) (LTSP) in accordance with procedures established to comply with the requirements of the U.S. Nuclear Regulatory Commission (NRC) general license at Title 10 *Code of Federal Regulations* Section 40.27 (10 CFR 40.27). Table 10-1 lists these requirements.

Table 10-1. License Requirements for the Lowman, Idaho, Disposal Site

Requirement	LTSP	This Report	10 CFR 40.27
Annual Inspection and Report	Section 3.3	Section 10.4	(b)(3)
Follow-Up Inspections	Section 3.4	Section 10.5	(b)(4)
Site Maintenance	Section 3.5	Section 10.6	(b)(5)
Emergency Response	Section 3.6	Section 10.7	(b)(5)
Environmental Monitoring	Section 3.7	Section 10.8	(b)(2)

10.3 Institutional Controls

The 18-acre site, identified by the property boundary shown in Figure 10-1, is owned by the United States and was accepted under the NRC general license in 1994. The U.S. Department of Energy (DOE) is the licensee and, in accordance with the requirements for UMTRCA Title I sites, the Office of Legacy Management (LM) is responsible for the custody and long-term care of the site. Institutional controls (ICs) at the site include federal ownership of the property, administrative controls, and the following physical ICs that are inspected annually: the disposal cell and associated drainage features; entrance gate, sign, perimeter signs, and site markers; and survey and boundary monuments.

10.4 Inspection Results

The site, 0.5 mile east of Lowman, Idaho, was inspected on June 6, 2023. The inspection was conducted by Z. Aldous and M. Guziak of the Legacy Management Support contractor. K. Kreie and P. Kerl of LM, along with P. Rekow, D. Nygard, and T. Richardson from the State of Idaho attended the inspection. The purposes of the inspection were to confirm the integrity of visible features at the site, identify changes in conditions that might affect conformance with the LTSP, and evaluate whether maintenance or follow-up inspection and monitoring are needed.

10.4.1 Site Surveillance Features

Figure 10-1 shows the locations of site features, including site surveillance features and inspection areas, in black and gray font. Some site features that are present but not required to be inspected are shown in italic font. Observations from previous inspections that are currently monitored are shown in blue, and new observations identified during the 2023 annual inspection are shown in red. Inspection results and recommended maintenance activities associated with site surveillance features are described in the following subsections. Photographs to support specific observations are noted in the text and in Figure 10-1 by photograph location (PL) numbers. The photographs and photograph log are presented in Section 10.10.

10.4.1.1 Access Road, Entrance Gate, and Entrance Sign

The site is about 650 feet (ft) north of Idaho Highway 21 and is accessed by a gravel road. A locked steel gate on the site access road is about 150 ft from the highway. The site is not fenced, but the topography and mature forests prevent vehicle access around the entrance gate and along the property boundary. The entrance gate was locked and functional. The access road was passable, and the entrance sign was present and legible. No maintenance needs were identified.

10.4.1.2 Perimeter Signs

There are 18 perimeter signs attached to steel posts set in concrete and positioned along the unfenced property boundary. Several perimeter signs (P3, P4, P13, and P15) have bullet damage but remain legible. Perimeter sign P7 is slightly bent from treefall but remains legible (PL-1). No maintenance needs were identified.

10.4.1.3 Site Markers

The site has two granite site markers. Site marker SMK-1 is just inside the southwest property boundary, and site marker SMK-2 (PL-2) is on the top slope of the disposal cell. No maintenance needs were identified.

10.4.1.4 Survey and Boundary Monuments

Three combined survey and boundary monuments (PL-3) and four boundary monuments delineate the property boundary. Steel T-posts are installed next to the survey and boundary monuments to help inspectors locate them. Several years ago, the U.S. Department of Agriculture (USDA) surveyed its lands managed by the U.S. Forest Service and placed boundary monuments along the shared DOE-USDA border. Inspectors noted that the survey monuments were about 5 to 15 ft outside DOE survey monuments. No maintenance needs were identified.

10.4.1.5 Aerial Survey Quality Control Monuments

Three aerial survey quality control monuments were inspected during the 2023 annual inspection. No maintenance needs were identified.

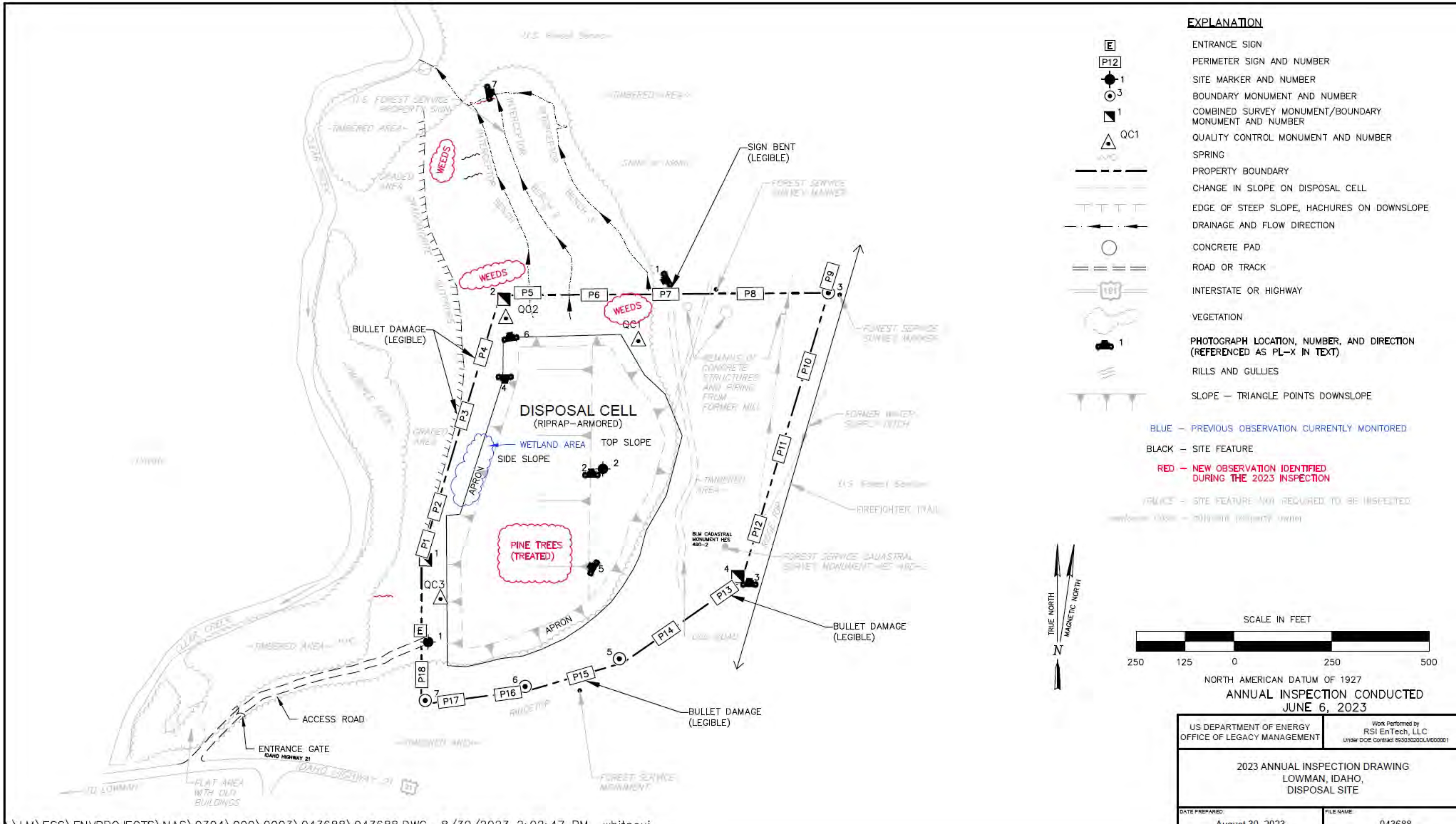


Figure 10-1. 2023 Annual Inspection Drawing for the Lowman, Idaho, Disposal Site

10.4.2 Inspection Areas

In accordance with the LTSP, the site is divided into three inspection areas (referred to as "transects") to ensure a thorough and efficient inspection. The inspection areas are (1) the top and side slopes of the disposal cell, (2) the area between the disposal cell and the site boundary, and (3) the outlying area. Inspectors examined the specific site surveillance features within each area and looked for evidence of erosion, settling, slumping, or other modifying processes that might affect the site's conformance with LTSP requirements.

10.4.2.1 Top and Side Slopes of the Disposal Cell

The disposal cell, completed in 1991, occupies 8.29 acres. The disposal cell top and side slopes are armored with basalt riprap to control erosion. An apron of larger riprap surrounds the disposal cell on all sides (PL-4). There was no evidence of erosion, settling, slumping, rock degradation, or other modifying processes that might affect the integrity of the disposal cell. A saturated soil area was observed on the northwest side of the cell, confirming that the disposal cell is shedding precipitation appropriately.

Natural vegetation continues to encroach on the top and side slopes of the disposal cell. Although the LTSP states that control of vegetation growth on the cell is not needed, LM concluded that controlling the growth of conifers—primarily ponderosa pine, but also Douglas fir—would be a best management practice. Mature conifers could potentially become uprooted during windstorms and damage the surface of the disposal cell. Numerous ponderosa pine trees were cut down in 2018. Additional ponderosa pine and Douglas fir trees have established since then and were removed following the inspection (PL-5). Other plants growing on the disposal cell do not threaten the integrity of the disposal cell and are not controlled. Inspectors will continue to monitor this area. No other maintenance needs were identified.

10.4.2.2 Area Between the Disposal Cell and the Site Boundary

The steep slopes east and south of the disposal cell are stable and vegetated with well-established conifers, shrubs, and grasses. Several features from historical milling operations remain on the steep hillside east of the disposal cell, including a water-supply ditch and the remains of a water piping system from former milling operations. The slopes north and west of the disposal cell were highly disturbed during site remediation, but they are now stable and vegetated (PL-6). No maintenance needs were identified.

10.4.2.3 Outlying Area

The area within 0.25 mile of the site boundary was inspected for evidence of construction, development, logging, or changes in land use that might affect the site. No evidence of change was observed in 2023. Several wildfires have occurred in the area during the last decade, and some have come near the site. A wildland firefighter trail was identified during the 2020 inspection outside the site boundary along the ridgeline east of the site, but the trail does not affect the site. LM will evaluate the need for a fire mitigation plan at the site.

The reclaimed area north of the disposal cell and outside the site boundary is a steep area, owned by the state, that was disturbed during site remediation. LM installed three interceptor benches across the steep slope in this area in 1998 to intercept stormwater runoff and route it offsite into

Clear Creek. Over time, minor erosion has breached the benches in several locations, and LM repaired this erosion in 2016. Rock armoring has been very successful in preventing further erosion, and vegetation has become well established. Minor erosion was noted within and around the geocell grid on the north end of the interceptor benches where they are routed into Clear Creek (PL-7). This will continue to be monitored. No maintenance needs were identified.

10.5 Follow-Up Inspections

LM will conduct follow-up inspections if (1) a condition is identified during the annual inspection or other site visit that requires a return to the site to evaluate the condition or (2) LM is notified by a citizen or outside agency that conditions at the site have substantially changed. No need for a follow-up inspection was identified.

10.6 Maintenance

Inspectors noted that treatment of the coniferous ponderosa pine and Douglas fir trees on the disposal cell cover was needed. The trees were treated following the inspection. No other maintenance needs were identified.

10.7 Emergency Response

Emergency response is action LM will take in response to unusual damage or disruption that threatens or compromises site safety, security, or integrity in compliance with 10 CFR 40 Appendix A. No need for an emergency response was identified.

10.8 Environmental Monitoring

In accordance with the LTSP, groundwater monitoring is not required and was discontinued in 2004. Groundwater monitoring is not required because (1) the disposal cell is performing as designed and (2) the groundwater monitoring program demonstrated that the site complies with groundwater protection standards and no site-related contamination exists in groundwater near the site. All monitoring wells at the site were decommissioned in 2006.

10.9 References

10 CFR 40 Appendix A. U.S. Nuclear Regulatory Commission, “Criteria Relating to the Operation of Uranium Mills and the Disposition of Tailings or Wastes Produced by the Extraction or Concentration of Source Material from Ores Processed Primarily for Their Source Material Content,” *Code of Federal Regulations.*

10 CFR 40.27. U.S. Nuclear Regulatory Commission, “General License for Custody and Long-Term Care of Residual Radioactive Material Disposal Sites,” *Code of Federal Regulations.*

DOE (U.S. Department of Energy), 2005. *Long-Term Surveillance Plan for the U.S. Department of Energy Lowman, Idaho, (UMTRCA Title I) Disposal Site*, LMS/S00583, DOE-LM/GJ771-2005, Office of Legacy Management, January.

10.10 Photographs

Photograph Location Number	Azimuth	Photograph Description
PL-1	240	Bent Perimeter Sign P7
PL-2	—	Site Marker SMK-2
PL-3	—	Combined Survey Monument and Boundary Monument 4
PL-4	180	Disposal Cell Apron
PL-5	300	Trees on Disposal Cell
PL-6	350	Vegetated Area North of Disposal Cell
PL-7	80	Erosion on North Side of Interceptor Benches

Note:
— = Photograph taken vertically from above.

PL-1. Bent Perimeter Sign P7

PL-2. Site Marker SMK-2

PL-3. Combined Survey Monument and Boundary Monument 4

PL-4. Disposal Cell Apron

PL-5. Trees on Disposal Cell

PL-6. Vegetated Area North of Disposal Cell

PL-7. Erosion on North Side of Interceptor Benches

11.0 Maybell, Colorado, Disposal Site

11.1 Compliance Summary

The Maybell, Colorado, Uranium Mill Tailings Radiation Control Act (UMTRCA) Title I Disposal Site was inspected on September 6, 2023. Inspectors identified several minor maintenance needs but found no cause for a follow-up inspection. Groundwater monitoring is not required.

11.2 Compliance Requirements

Requirements for the long-term surveillance and maintenance of the site are specified in the site-specific *Long-Term Surveillance Plan for the Maybell, Colorado (UMTRCA Title I) Disposal Site, Moffat County, Colorado* (DOE 2008) (LTSP) in accordance with procedures established to comply with the requirements of the U.S. Nuclear Regulatory Commission (NRC) general license at Title 10 *Code of Federal Regulations* Section 40.27 (10 CFR 40.27). Table 11-1 lists these requirements.

Table 11-1. License Requirements for the Maybell, Colorado, Disposal Site

Requirement	LTSP	This Report	10 CFR 40.27
Annual Inspection and Report	Sections 3.3 and 3.4	Section 11.4	(b)(3)
Follow-Up Inspections	Section 3.5	Section 11.5	(b)(4)
Maintenance	Section 3.6	Section 11.6	(b)(5)
Emergency Measures	Section 3.6	Section 11.7	(b)(5)
Environmental Monitoring	Section 3.7	Section 11.8	(b)(2)

11.3 Institutional Controls

The 251-acre site, identified by the property boundary shown in Figure 11-1, is owned by the United States and was accepted under the NRC general license in 1999. The U.S. Department of Energy (DOE) is the licensee and, in accordance with the requirements for UMTRCA Title I sites, the Office of Legacy Management (LM) is responsible for the custody and long-term care of the site. Institutional controls (ICs) at the site include federal ownership of the property, administrative controls, and the following physical ICs that are inspected annually: the disposal cell and associated drainage features, entrance gate and sign, perimeter fence and perimeter (warning) signs, site markers, and survey and boundary monuments.

11.4 Inspection Results

The site, 25 miles west of Craig, Colorado, was inspected on September 6, 2023. The inspection was conducted by Z. Aldous and C. Murphy of the Legacy Management Support contractor. W. Frazier (LM) and M. Cosby from the Colorado Department of Public Health and Environment also attended the inspection. The purposes of the inspection were to confirm the integrity of visible features at the site, identify changes in conditions that might affect conformance with the LTSP, and evaluate whether maintenance or follow-up inspection and monitoring are needed.

11.4.1 Site Surveillance Features

Figure 11-1 shows the locations of site features, including site surveillance features and inspection areas, in black and gray font. Some site features that are present but not required to be inspected are shown in italic font. Observations from previous inspections that are currently monitored are shown in blue, and new observations identified during the 2023 annual inspection are shown in red. Inspection results and recommended maintenance activities associated with site surveillance features are described in the following subsections. Photographs to support specific observations are noted in the text and in Figure 11-1 by photograph location (PL) numbers. The photographs and photograph log are presented in Section 11.10.

11.4.1.1 Access Road, Entrance Gate, and Entrance Sign

Access to the site is from the gravel-surfaced Moffat County Road 53, which runs north from U.S. Highway 40, approximately 8 miles east of Maybell, Colorado. County Road 53 ends at an unlocked gate near the northeast corner of the site (approximately 3 miles from the highway). The road continues west as a dirt two-track road directly north of the site from the end of County Road 53 to the site entrance gate (the road continues to the UMTRCA Title II Maybell West, Colorado, Disposal Site). LM is responsible for road maintenance under a U.S. Bureau of Land Management right-of-way permit. Entrance to the site is through two locked, metal stock gates in the perimeter fence. One is the entrance gate, which is adjacent to site marker SMK-1 and the entrance sign. The second gate is between perimeter signs P3 and P4 in the northwest corner of the property. Both gates were locked and functional. The entrance sign is near the entrance gate and is mounted on a T-post in the perimeter fence (PL-1). The entrance sign has bullet damage but remains legible. No maintenance needs were identified.

11.4.1.2 Perimeter Fence and Signs

To facilitate LM's land management, a four-strand barbed-wire perimeter fence encloses the disposal cell, drainage structures, and much of the site. The site is in wintering grounds frequented by big-game animals (primarily pronghorn, deer, and elk) and is also surrounded by open range used to graze cattle. Periodically, animals cause minor damage to the perimeter fence. In 2021, plastic fence flags were attached to the top strand of the perimeter fence to alert wildlife and reduce animal entanglements or strikes against fence lines. The fence had been cut or damaged in several locations, primarily on the northern side of the property (PL-2) and was repaired following the inspection.

There are 26 perimeter signs. On the northern, western, and southern sides of the site, perimeter signs are attached to T-posts in the perimeter fence. On the eastern side of the site, perimeter signs are attached to steel posts set in concrete and are inside the property boundary approximately midway between the disposal cell and the perimeter fence. Several of the perimeter signs along the dirt road to the north and west of the site (P5, P6, P8, and P11) have bullet damage but remain legible. Additional warning signs were added to the entrance gate on the north side. No other maintenance needs were identified.

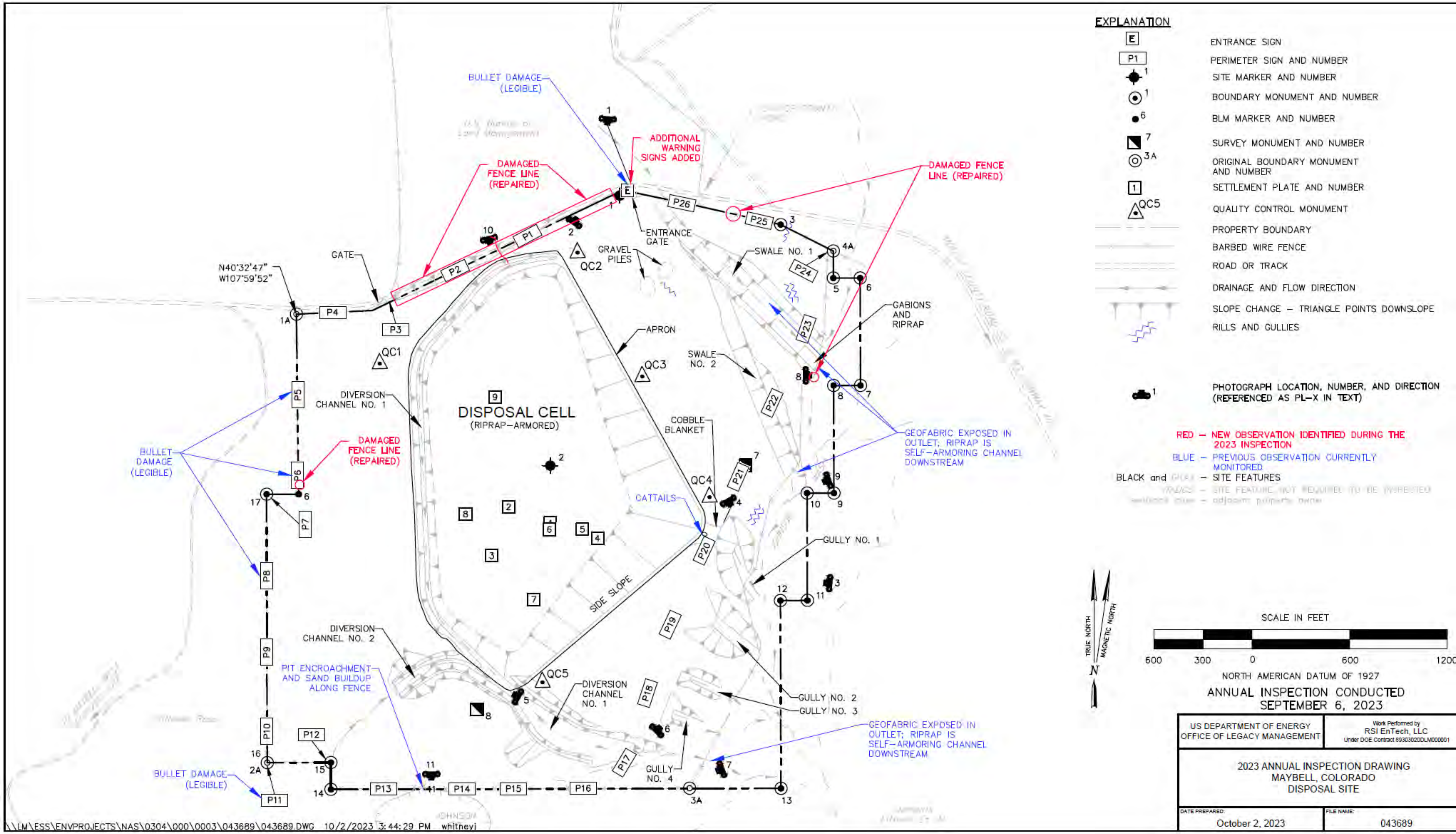


Figure 11-1. 2023 Annual Inspection Drawing for the Maybell, Colorado, Disposal Site

11.4.1.3 Site Markers

The site has two granite site markers. Site marker SMK-1 is just inside the entrance gate, and site marker SMK-2 is on the top slope of the disposal cell. No maintenance needs were identified.

11.4.1.4 Survey and Boundary Monuments

The site has two survey monuments. Survey monument SM-7 is on the bench above Johnson Wash just north of perimeter sign P21, and survey monument SM-8 is south of the disposal cell on the bench above Diversion Channel No. 2. The two survey monuments are historical site features that are difficult to locate. Seventeen boundary monuments delineate the property boundary. No maintenance needs were identified.

11.4.1.5 Aerial Survey Quality Control Monuments

Five aerial survey quality control monuments were inspected during the 2023 inspection. No maintenance needs were identified.

11.4.2 Inspection Areas

In accordance with the LTSP, the site is divided into three inspection areas (referred to as "transects" in the LTSP) to ensure a thorough and efficient inspection. The inspection areas are (1) the disposal cell, (2) other areas inside the site boundary, and (3) the outlying area. Inspectors examined the specific site surveillance features within each area and looked for evidence of erosion, settling, slumping, or other modifying processes that might affect the site's conformance with LTSP requirements.

11.4.2.1 Disposal Cell

The disposal cell, completed in 1998, occupies 66 acres; it is armored with riprap to control erosion and deter animal and human intrusion (PL-3). There was no evidence of erosion, settling, slumping, rock degradation, or other modifying processes that might affect the integrity of the disposal cell. Scattered plants continue to establish on the disposal cell top slope, but they are not affecting the integrity of the disposal cell.

In accordance with the LTSP, inspectors looked for seeps on the east and southeast side slopes of the disposal cell because slimes were encapsulated in this portion of the cell. No seeps were observed at the toe of the disposal cell in these areas. A 2003 laboratory analysis of evaporite minerals from this location confirmed that no constituents attributable to the disposal cell contents were present.

Stormwater runoff from the disposal cell discharges into the cobble blanket and continues into Gully No. 1 (PL-4). Cattails are present in this area indicating regular pooling of water. During the 2021 inspection, standing water was observed in the easternmost portion of the disposal cell toe slope apron upgradient of the cobble blanket. This area was dry during the 2023 inspection. No maintenance needs were identified.

11.4.2.2 Other Areas Inside the Site Boundary

Surface conditions at the site are a combination of rock-armored drainage and diversion channels, along with contouring of soil surfaces to achieve the necessary surface water drainage control to protect the disposal cell from erosion. The rock-armored diversion channels (PL-5), swales, and gullies (PL-6) are performing as designed.

Erosion directly downgradient of the outlets of Diversion Channel No. 1 (PL-7) and Swale No. 1 (PL-8) has exposed the underlying geofabric, but that exposure has not changed significantly since the 2020 inspection. During the 2022 inspection, it was discovered that Swale No. 2 (PL-9) had erosion exposing the underlying geofabric. Riprap placed in the outlets continues to protect against headcutting. Minor rills adjacent to Swale No. 1 and Gully No. 1 continue to stabilize as a result of natural armoring and increased vegetation growth. Minor erosion on the northern portion of the site directly downslope of the perimeter fence between perimeter signs P1 and P2 continues to stabilize (PL-10). Minor erosion perpendicular to the perimeter fence near boundary monument BM-3 continues to be monitored, with no significant changes observed during the annual inspection. Documented erosion does not threaten the disposal cell, and there was no evidence of sediment moving offsite into Johnson Wash. No maintenance needs were identified.

11.4.2.3 Outlying Area

The area 0.25 mile beyond the site boundary was visually observed for erosion, changes in land use, or other phenomena that might affect the long-term integrity of the site. No such impacts were observed.

Directly south of the site is a former open-pit uranium mine known as the Johnson Pit. Over time, slumping of the pit wall caused the pit to encroach several feet onto property now owned by DOE. This encroachment presents no threat to the integrity of the disposal cell at this time. This encroachment is visually monitored annually; it is periodically documented with photographs to assess whether the pit wall has slumped further and to verify the integrity and functionality of the perimeter fence. At the time of the inspection, there was no evidence of any additional encroachment of the pit onto the site. However, windblown sand continues to accumulate along the northern crest of the pit wall along the perimeter fence line (PL-11). The perimeter fence remains functional, but continued accumulation of sand will require vertically extending the fence or removing the sand. Inspectors will continue to monitor this area. No immediate maintenance needs were identified.

11.5 Follow-Up Inspections

LM will conduct follow-up inspections if (1) a condition is identified during the annual inspection or other site visit that requires a return to the site to evaluate the condition or (2) LM is notified by a citizen or outside agency that conditions at the site are substantially changed. No need for a follow-up inspection was identified.

11.6 Maintenance

Maintenance conducted after the 2023 inspection included the following:

- Installation of additional warning signs to the entrance gate
- The damaged fence line was repaired

11.7 Emergency Measures

In compliance with the LTSP, emergency measures are the actions that LM will take in response to unusual damage or disruption that threatens or compromises site safety, security, or integrity. No need for emergency measures was identified.

11.8 Environmental Monitoring

11.8.1 Groundwater Monitoring

In accordance with the LTSP, groundwater monitoring is not required. Supplemental standards have been applied to site groundwater because it is designated as limited use—a designation given to groundwater that is not a current or potential source of drinking water. Groundwater in the uppermost aquifer is designated as limited use because it contains widespread ambient contamination that cannot be cleaned up by treatment methods employed in public water systems (40 CFR 192.11[e]). There are no current or future uses of the uppermost aquifer in the area. Water-level monitoring, conducted from 1995 to 2004, did not detect disposal cell-related impacts to the groundwater system, such as transient drainage downgradient of the cell. NRC concurred that stipulated groundwater-level monitoring requirements had been satisfied (Janosko 2005). Therefore, no further groundwater monitoring was required.

11.8.2 Vegetation Monitoring

In accordance with the LTSP, visual inspections are conducted annually to verify the continued health of onsite vegetation and to ensure that undesirable plant species (e.g., deep-rooted plants on the disposal cell cover and noxious weeds) do not proliferate onsite. No noxious weeds or deep-rooted vegetation were noted on the disposal cell, drainages, or diversion channels during the inspection. Following reclamation, the disturbed soil surfaces on the site were revegetated with a mix of native and adaptive grasses to provide soil stability. These revegetated areas appeared to be healthy, with similar diversity and density as the surrounding non-disturbed areas.

11.9 References

10 CFR 40.27. U.S. Nuclear Regulatory Commission, “General License for Custody and Long-Term Care of Residual Radioactive Material Disposal Sites,” *Code of Federal Regulations*.

40 CFR 192. U.S. Environmental Protection Agency, “Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings,” *Code of Federal Regulations*.

DOE (U.S. Department of Energy) 2008. *Long-Term Surveillance Plan for the Maybell, Colorado (UMTRCA Title I) Disposal Site, Moffat County, Colorado*, LMS/MAY/S03649, DOE-LM/1605-2008, Office of Legacy Management, April.

Janosko, 2005. Gary S. Janosko, chief of Fuel Cycle Facilities Branch, U.S. Nuclear Regulatory Commission, letter (about Decommissioning of Monitor Wells at the Maybell, Colorado, Uranium Mill Tailings Radiation Control Act [UMTRCA] Title I Disposal Site) to Michael Tucker, site manager, Office of Legacy Management, U.S. Department of Energy, January 5.

11.10 Photographs

Photograph Location Number	Azimuth	Photograph Description
PL-1	185	Entrance Sign
PL-2	35	Fence Damage near Entrance Sign
PL-3	275	Disposal Cell Overview
PL-4	150	Cobble Blanket and Gully No. 1
PL-5	300	Diversion Channel No. 1
PL-6	45	Gully No. 4 Overview
PL-7	250	Exposed Geofabric Below Diversion Channel No. 1
PL-8	90	Exposed Geofabric in Outlet of Swale No. 1
PL-9	250	Exposed Geofabric in Swale No. 2
PL-10	165	Minor Rilling Under Fence
PL-11	180	Sand Encroachment near Pit

PL-1. Entrance Sign

PL-2. Fence Damage near Entrance Sign

PL-3. Disposal Cell Overview

PL-4. Cobble Blanket and Gully No. 1

PL-5. Diversion Channel No. 1

PL-6. Gully No. 4 Overview

PL-7. Exposed Geofabric Below Diversion Channel No. 1

PL-8. Exposed Geofabric in Outlet of Swale No. 1

PL-9. Exposed Geofabric in Swale No. 2

PL-10. Minor Rilling Under Fence

PL-11. Sand Encroachment near Pit

12.0 Mexican Hat, Utah, Disposal Site

12.1 Compliance Summary

The Mexican Hat, Utah, Uranium Mill Tailings Radiation Control Act (UMTRCA) Title I Disposal Site was inspected on August 8, 2023.

In response to the cell depressions identified in 2016, the U.S. Department of Energy (DOE) Office of Legacy Management (LM) continued investigations and performed geotechnical sampling and materials testing (GSMT) on the disposal cell side slope cover components in April 2019 (DOE 2019a). Data obtained through the GSMT were used to identify causes for cover degradation features observed at the site, and these causes are highlighted in the *Erosional Piping Characterization and Data Report, Mexican Hat, Utah, Disposal Cell* (DOE 2020).

The interim cover protection (ICP) project was conducted in 2019 as a temporary measure to replace and restore the cover to the original design specifications until a long-term solution can be assessed. The ICP project focused on the degradation associated with the lower portions of the northeast side slope.

Changes in the cover have since been observed in other locations on the northeast side slope, but no new major erosion, settling, slumping, rock degradation, or other modifying processes that might affect the integrity of the disposal cell were evident during the 2023 inspection. Minor surface rilling was observed in the riprap cover on the north side slope earlier in 2023. During the 2023 inspection, no evidence of sediment discharge was observed in this localized area or within the drainage apron, so no evidence of breach through the radon barrier was or has been identified. No other modifying processes that might affect the integrity of the disposal cell were evident on the cover during the 2023 inspection, and the site remains protective of human health and the environment. Collaborative efforts continue to improve understanding of internal erosion processes and impacts and are focused on developing corrective action concepts for mitigating continued erosion and establishing the long-term performance design for the disposal cell cover.

During the annual inspection, LM also conducted annual observational seep monitoring. The results are described in Section 12.8.2. Groundwater monitoring is not required.

12.2 Compliance Requirements

Requirements for the long-term surveillance and maintenance of the site are specified in the site-specific Long-Term Surveillance Plan (DOE 2007) (LTSP) in accordance with procedures established to comply with the requirements of the U.S. Nuclear Regulatory Commission (NRC) general license at Title 10 *Code of Federal Regulations* Section 40.27 (10 CFR 40.27). Table 12-1 lists these requirements.

Table 12-1. License Requirements for the Mexican Hat, Utah, Disposal Site

Requirement	LTSP	This Report	10 CFR 40.27
Annual Inspection and Report	Sections 3.3 and 3.4	Section 12.4	(b)(3)
Follow-Up Inspections	Section 3.5	Section 12.5	(b)(4)
Maintenance	Section 3.6	Section 12.6	(b)(5)
Emergency Measures	Section 3.6	Section 12.7	(b)(5)
Environmental Monitoring	Section 3.7	Section 12.8	(b)(2)

12.3 Institutional Controls

The 119-acre disposal site, identified by the property boundary shown in Figure 12-1, is held in trust by the U.S. Bureau of Indian Affairs. The Navajo Nation retains title to the land. UMTRCA authorized DOE to enter into a Cooperative Agreement (DE-FC04-85AL26731) with the Navajo Nation to perform remedial actions at former uranium processing sites. DOE and the Navajo Nation executed a Custodial Access Agreement that provides perpetual access to DOE for custody and long-term care at the site.

The site was accepted under the NRC general license in 1997. DOE is the licensee and, in accordance with the requirements for UMTRCA Title I sites, LM is responsible for the custody and long-term care of the site. Institutional controls (ICs) at the site include federal custody of the disposal cell and its engineered features, administrative controls, and the following physical ICs that are inspected annually: the disposal cell and associated drainage features, entrance gate and sign, fence, perimeter signs, site markers, and survey and boundary monuments.

12.4 Inspection Results

The site was inspected on August 8, 2023. The inspection was conducted by E. Garcia, K. Lott, C. Mueller, and N. Lind of the Legacy Management Support contractor. The purposes of the inspection were to confirm the integrity of visible features at the site, identify changes in conditions that might affect conformance with the LTSP, and evaluate whether maintenance or follow-up inspection and monitoring are needed.

12.4.1 Site Surveillance Features

Figure 12-1 shows the locations of site features, including site surveillance features and inspection areas, in black and gray font. Some site features that are present but not required to be inspected are shown in italic font. Observations from previous inspections that are currently monitored are shown in blue, and new observations identified during the 2023 annual inspection are shown in red. Inspection results and recommended maintenance activities associated with site surveillance features are described in the following subsections. Photographs to support specific observations are noted in the text and in Figure 12-1 by photograph location (PL) numbers. The photographs and photograph log are presented in Section 12.10.

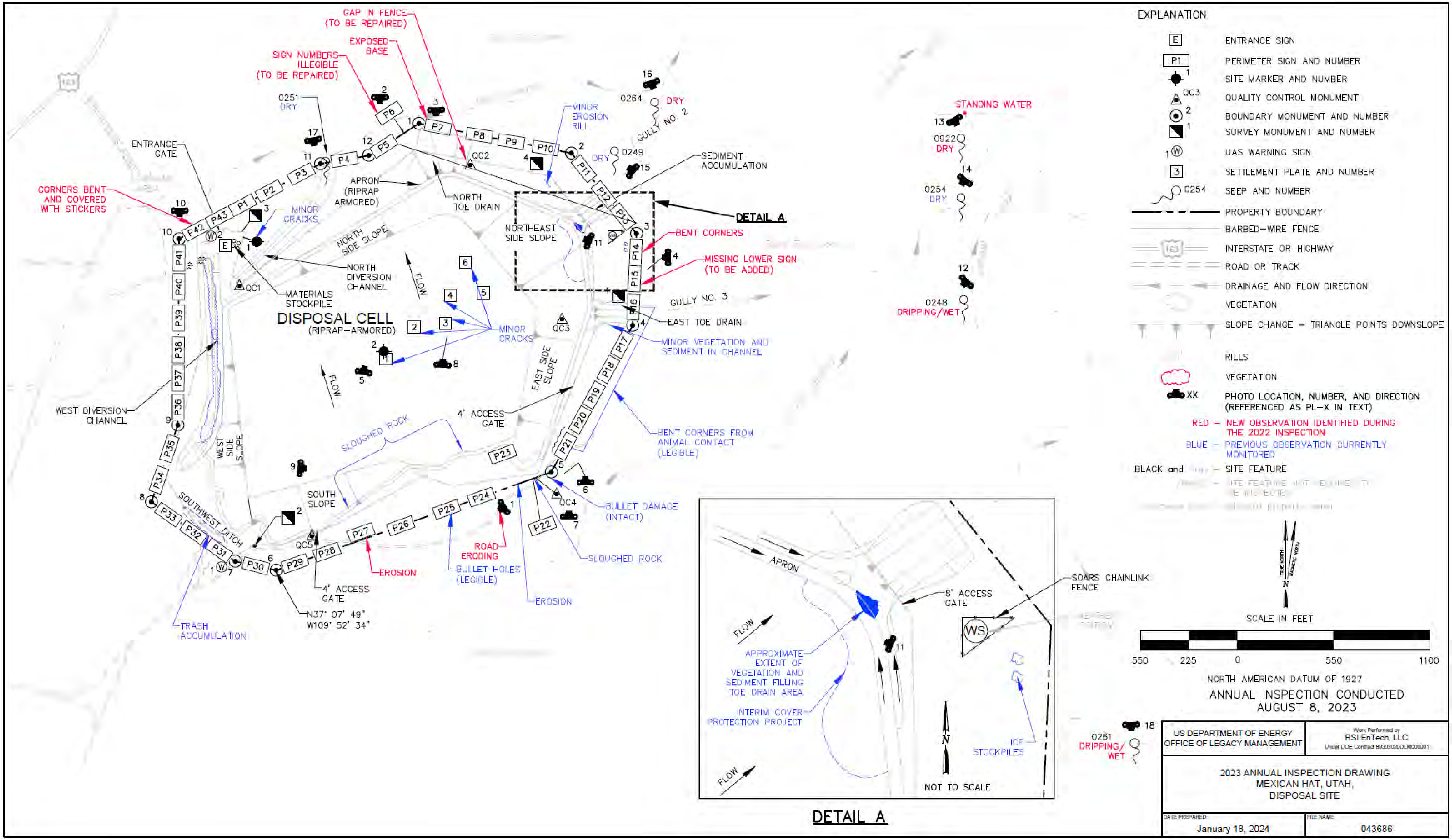


Figure 12-1. 2023 Annual Inspection Drawing for the Mexican Hat, Utah, Disposal Site

12.4.1.1 Site Access, Entrance Gate, and Entrance Sign

Access to the site is from a short, unmarked dirt road off U.S. Highway 163 that ends at a graded parking area. Minor erosion continues along the dirt access road, but the site remains accessible (PL-1). The steel entrance gate at the northwest corner of the site was locked and functional. The entrance sign is affixed to a steel post immediately behind the entrance gate. No maintenance needs were identified.

12.4.1.2 Fence and Perimeter Signs

A barbed-wire fence encloses the disposal cell. One gap that could be large enough for a person or wildlife to move under was identified under the fence at the north toe drain. Improvements to this section of fence are planned in the next year. Minor erosion is occurring under the south fence line in two different areas and will continue to be monitored. Two 4-foot access gates and one 8-foot access gate were permanently installed in 2018 to the perimeter barbed-wire fence to support past disposal cell cover evaluations and maintenance activities. These gates were all locked and functional.

A perimeter chainlink fence was installed in 2019 around the existing System Operation and Analysis at Remote Sites (SOARS) weather monitoring station. Approximately 260 linear feet of 6-foot-tall chainlink fence and a lockable double-swing gate were installed on existing dirt and rock surfaces around the SOARS station. The fence, equipment, and gates were all in good condition.

There are 43 pairs of perimeter signs, designated P1 through P43 (each pair consisting of an upper sign indicating property ownership and barring trespassing and a lower sign identifying the site as a radioactive materials disposal site), positioned along the property boundary. Each paired perimeter sign is attached to a single steel post set in concrete. Perimeter signs are typically outside the fence that encloses the disposal cell, but some are affixed directly to the fence or immediately inside the fence. The lower perimeter sign on P6 was pushed up and covering the phone numbers on the upper sign and will be repaired following the inspection (PL-2). The base of perimeter sign P7 is more exposed than on previous inspections (PL-3). The corners of the lower perimeter sign on P14 are bent, possibly from burro contact. The signpost at perimeter sign P15 had been repaired following the 2022 inspection but is missing the lower sign (PL-4). The lower sign will be added before the next inspection. The corners of the lower southeastern perimeter signs (perimeter signs P16 through P21) are bent, possibly from burro contact. Perimeter sign P25 has bullet holes but is legible. Perimeter sign P42 has bent corners and is covered in stickers but is legible. These signs will be repaired before the next inspection. All remaining perimeter signs are in good condition.

Two signs prohibiting unauthorized unmanned aircraft system flights are in good condition. One sign was installed by the entrance gate at the northwest corner of the site, and one sign was installed on the southwest corner between perimeter sign P31 and boundary monument BM-5. No other maintenance needs were identified.

12.4.1.3 Site Markers

The site has two granite site markers. Site marker SMK-1 is just inside the fence near the entrance gate; the concrete base has several minor cracks, which have been noted during previous inspections. This does not compromise the integrity of the base, and repairs are unnecessary. Site marker SMK-2 is on the top slope of the disposal cell (PL-5) and is in good condition. No maintenance needs were identified.

12.4.1.4 Survey and Boundary Monuments

During construction of the disposal cell, four survey monuments were installed. Twelve boundary monuments delineate the property boundary. As noted previously, vandalism has resulted in bullet damage to boundary monument BM-5, but the monument remains legible and intact (PL-6). No maintenance needs were identified.

12.4.1.5 Aerial Survey Quality Control Monuments

Five aerial survey quality control monuments were inspected during the 2023 annual inspection (PL-7). No maintenance needs were identified.

12.4.1.6 Settlement Plates

Six settlement plates were inspected during the 2023 annual inspection. All settlement plates have minor cracking in the concrete bases, but the integrity of the bases is not compromised (PL-8). No maintenance needs were identified.

12.4.2 Inspection Areas

In accordance with the LTSP, the site is divided into four inspection areas (referred to as "transects" in the LTSP) to ensure a thorough and efficient inspection. The inspection areas are (1) the disposal cell, (2) the toe drains and diversion channels, (3) the balance of the site and the site perimeter, and (4) the outlying area. Inspectors examined specific site surveillance features within each area and looked for evidence of settlement, erosion, or other modifying processes that might affect the site's conformance with LTSP requirements.

12.4.2.1 Disposal Cell

The disposal cell, completed in 1994, occupies 68 acres and is armored with riprap to control erosion. Depressions in the riprap cover along the toe and lower portions of the northeast side slope of the disposal cell were identified during the 2016 annual inspection and a follow-up inspection on April 8, 2016 (DOE 2017). Additional site visits to further characterize the depression features have been completed every year since 2016 and are detailed in the *Mexican Hat UMTRCA Disposal Cell Side Slope Cover Depressions Evaluation Report, Mexican Hat, Utah* (DOE 2019b). The ICP project was conducted in 2019 as a temporary measure to replace and restore the cover to the original design specifications until a long-term solution to the degradation associated with the lower portions of the northeast side slope can be assessed.

Changes in the cover have since been observed in other locations on the northeast side slope, but no new major erosion, settling, slumping, rock degradation, or other modifying processes that might affect the integrity of the disposal cell were evident during the 2023 inspection. Minor surface rilling was observed in the riprap cover on the north side slope earlier in 2023. During the 2023 inspection, no sediment discharge could be observed in this localized area or within the drainage apron. No other modifying processes that might affect the integrity of the disposal cell were evident on the rest of the cover during the 2023 inspection, and the site remains protective of human health and the environment.

There was no noticeable increase of sloughed rock or soil along the south apron of the disposal cell (PL-9). Because the apron is adjacent to the base of a steep exposure of Halgaito Shale, it is expected that occasional sloughing of rock and soil associated with this exposure will continue. The accumulated material is not affecting the function of the apron, and this area will continue to be monitored. No maintenance needs were identified.

12.4.2.2 Toe Drains and Diversion Channels

Erosion continues in upgradient offsite areas resulting in sediment being transported onto the site and into the west diversion channel. Sediment accumulation has promoted the growth of vegetation in the west diversion channel, although no more than in previous inspections (PL-10).

Sediment accumulation has also been observed along the transition zone from the apron to the northeast toe drain. The origin of this material is being evaluated as part of the ongoing cover degradation assessment. Possible sources of this material include a windblown material that originates offsite or radon barrier material associated with the depression features on the northeast side slope of the disposal cell, or both. Visual observations during the inspection did not identify any apparent increases in the sediment accumulation or vegetation growth in this area compared to previous visual observations (PL-11). No maintenance needs were identified.

12.4.2.3 Balance of the Site and Site Perimeter

Minor erosion continues in upgradient areas along the southwest portions of the site. This is an expected natural process, as the exposed geology at the site is composed of interbedded silty sandstone, siltstone, and shale with varying degrees of cementation and susceptibility to erosion. Inspectors will continue to monitor erosion in these areas.

Sloughed rock from an overhanging exposure of Halgaito Shale continues to be observed along the southern perimeter of the site. Although no visual changes were evident and this material appears to be stable, the sloughed rock is approaching the barbed-wire fence between perimeter signs P22 and P23 and will likely need to be removed or secured in the future to protect the fence from damage or a potential breach.

Scattered trash (broken glass, bottles, cans, cardboard, and paper containers) was picked up from the site and surrounding areas before the inspection, but trash continues to accumulate in areas of the site that are accessible to vehicles (e.g., outside the perimeter of the barbed-wire fence). The most noticeable accumulation of trash is in the southwest ditch, inside the barbed-wire fence; however, this trash is likely transported onto the site by wind.

As part of the 2019 ICP project, road repairs were performed along the dirt access road to provide site access to haul trucks, delivery trucks, and other vehicles. Road repairs included grading the entire access road. Two incised areas were stabilized by installing geocell with standard U.S. Department of Transportation-specific rock types that allow proper drainage. The repaired areas were examined during the inspection and appeared to be performing as designed, except for minimal degradation of the access road and minor erosion to one of the drainages armored with geocell. Inspectors will continue to monitor the area.

The revegetated material and equipment storage areas used during the ICP project were inspected in 2023. Vegetation growth has increased since 2022. The straw wattles installed to provide stormwater run-on and runoff protection were intact and performing as designed.

Old bedding material removed during the ICP project and excess new bedding material were stockpiled near the SOARS perimeter chainlink fence. Straw wattles were installed around this material for stormwater runoff protection. This area was evaluated during the inspection and is performing as designed. No maintenance needs were identified.

12.4.2.4 Outlying Area

The area 0.25 mile beyond the site boundary was visually observed for erosion, changes in land use, or other phenomena that might affect the long-term integrity of the site. Headcutting at a northwest arroyo has been observed to be growing closer to the access road, but no action is needed at this time. No other impacts were identified.

12.5 Follow-Up Inspections

LM will conduct follow-up inspections if (1) a condition is identified during the annual inspection or other site visit that requires a return to the site to evaluate the condition or (2) LM is notified by a citizen or outside agency that conditions at the site have substantially changed. No other follow-up inspections or evaluations are needed based on the inspection results.

12.6 Maintenance

Inspectors noted the following maintenance items that will be completed before the next inspection:

- Repair the gap in the fence near perimeter sign P8
- Replace the lower sign on perimeter sign P15
- Replace the illegible sign numbers on perimeter sign P6

Improvements to the fence and perimeter signs are planned before the next inspection. No other maintenance needs were identified.

12.7 Emergency Measures

Emergency measures are the actions that LM will take in response to unusual damage or disruption that threatens or compromises site safety, security, or integrity in compliance with

10 CFR 40 Appendix A Criterion 12. The depression features identified in 2016 along the disposal cell's northeast side slope, and any other erosional features observed since, do not meet the criteria for implementing an emergency action; therefore, no need for emergency measures was identified.

12.8 Environmental Monitoring

12.8.1 Groundwater Monitoring

In accordance with the LTSP, groundwater monitoring is not required because the uppermost aquifer is hydrogeologically isolated from contamination in the overlying formation.

12.8.2 Seep Monitoring

In accordance with Section 3.7.2 of the LTSP, LM conducts observational monitoring of seven designated seeps during annual inspections as specified in an approved monitoring plan (DOE 2019c). Observational monitoring consists of visual observations and photographic documentation of the seven seep locations specified in the LTSP. The observed seep locations, shown in Figure 12-2, are primarily the result of the infiltration of precipitation into the surrounding formation or perched water that leaked from the former processing site tailings pond. Most seeps have exhibited dry conditions during the previous years of observational monitoring.

The LTSP required annual visual monitoring of the seven designated seeps through 2016, when an evaluation was to be conducted and a decision was to be made about whether to continue or discontinue visual seep monitoring. The evaluation has been completed and, as described in the *Seep Monitoring Evaluation Report, Mexican Hat, Utah, UMTRCA Title I Disposal Site* (DOE 2019c), visual monitoring will continue to be performed during the annual site inspections.

Observational documentation consists of photographing seeps (PL-12 through PL-18) and providing descriptions of the conditions observed at the seven designated seeps. Since 2010, groundwater discharge has been observed at cross-gradient seep 0248, which typically exhibits dripping conditions; during the 2023 inspection, seep 0248 was dripping and showed thick, flowering vegetation growth (PL-12). Seeps 0922 (PL-13) and 0254 (PL-14) were dry, but the ephemeral drainage nearby had standing water. Seeps 0249 (PL-15), 0264 (PL-16), and 0251 (PL-17) were dry, and ephemeral drainages near these seeps were dry.

Upgradient (background) seep 0261 (PL-18), approximately 0.5 mile upstream of seep 0248 in Gypsum Creek, was observed to be dripping during the inspection.

Table 12-2 documents the conditions of each monitored seep observed during the inspection with the respective drainage in which each seep occurs and a reference to photographic documentation.

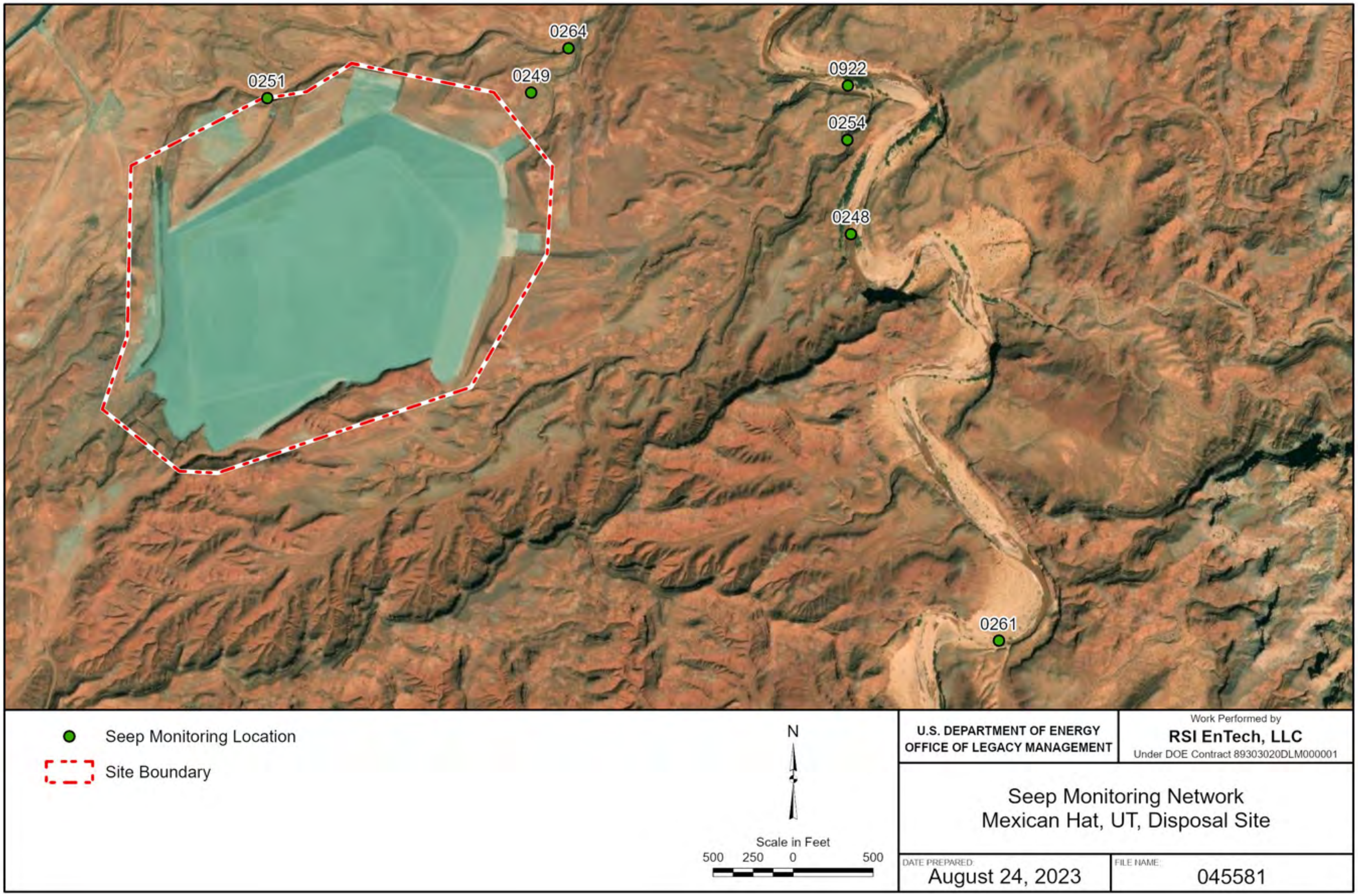


Figure 12-2. Seep Monitoring Locations at the Mexican Hat, Utah, Disposal Site

Table 12-2. Observations of Seeps near the Mexican Hat, Utah, Disposal Site

Seep Location Number	Drainage	Location Relative to Disposal Cell	Photograph Location Number	Observed Seep Conditions
0248	Gypsum Creek	Cross gradient	PL-12	Dripping (no flow rate measured). Thick, flowering vegetation growth was noted.
0249	Gully No. 2	Downgradient	PL-15	Dry conditions (no evaporites present); seep area is covered with gray limestone that presumably is extra riprap apron material from disposal cell construction. Warning sign not posted at this location since this seep has never been documented to be discharging water.
0251	North Arroyo	Downgradient	PL-17	Dry conditions (no evaporites present).
0254	South Arroyo	Downgradient	PL-14	Dry conditions (no evaporites present). Warning sign not posted at this location due to seasonal flash flood conditions in the ephemeral drainage.
0261	Gypsum Creek	Upgradient (background)	PL-18	Seep was dripping. This seep discharges directly into Gypsum Creek, which has standing water outside the immediate seep discharge area. Warning sign not posted since this seep is a background location.
0264	North Arroyo	Downgradient	PL-16	Dry (no evaporites present in immediate area).
0922	Gypsum Creek	Downgradient	PL-13	Dry conditions (no evaporites present). Seep is along the south side of Gypsum Creek, which was noted to have standing water present.

12.8.3 Vegetation Monitoring

In accordance with the LTSP, vegetation conditions are observed during annual inspections to ensure that undesirable plant species, including deep-rooted plants on the disposal cell cover and noxious weeds, do not proliferate at the site. Except for deep-rooted vegetation, natural plant community succession is expected and will not adversely impact the performance of the disposal cell. During the 2023 inspection, three shallow-rooted plants were pulled from the top slope of the disposal cell. Vegetation is continuing to grow in the west diversion channel and will be monitored during annual inspections to ensure that it does not negatively affect the performance of this surface water diversion structure (PL-10). No other maintenance needs were identified.

12.9 References

10 CFR 40 Appendix A. U.S. Nuclear Regulatory Commission, “Criteria Relating to the Operation of Uranium Mills and the Disposition of Tailings or Wastes Produced by the Extraction or Concentration of Source Material from Ores Processed Primarily for Their Source Material Content,” *Code of Federal Regulations.*

10 CFR 40.27. U.S. Nuclear Regulatory Commission, “General License for Custody and Long-Term Care of Residual Radioactive Material Disposal Sites,” *Code of Federal Regulations*.

DOE (U.S. Department of Energy), 2007. *Long-Term Surveillance Plan for the Mexican Hat, Utah (UMTRCA Title I), Disposal Site, San Juan County, Utah*, DOE-LM/1530-2007, Rev. 3, October.

DOE (U.S. Department of Energy), 2017. *2016 Annual Site Inspection and Monitoring Report for Uranium Mill Tailings Radiation Control Act Title I Disposal Sites*, LMS/S15036, Office of Legacy Management, March.

DOE (U.S. Department of Energy), 2019a. *Geotechnical Sampling and Materials Testing Work Plan for the Mexican Hat, Utah, UMTRCA Title I Disposal Site*, LMS/HAT/S20483, Rev. 1, Office of Legacy Management, January.

DOE (U.S. Department of Energy), 2019b. *Mexican Hat UMTRCA Disposal Cell Side Slope Cover Depressions Evaluation Report, Mexican Hat, Utah*, LMS/HAT/S14765, Office of Legacy Management, January.

DOE (U.S. Department of Energy), 2019c. *Seep Monitoring Evaluation Report, Mexican Hat, Utah, UMTRCA Title I Disposal Site*, LMS/HAT/S15190, Office of Legacy Management, December.

DOE (U.S. Department of Energy), 2020. *Erosional Piping Characterization and Data Report, Mexican Hat, Utah, Disposal Cell*, LMS/HAT/S29391, Office of Legacy Management, December.

12.10 Photographs

Photograph Location Number	Azimuth	Photograph Description
PL-1	236	Exposed Geocell on Access Road
PL-2	180	Perimeter Sign P6 with Blocked Numbers
PL-3	178	Perimeter Sign P7 with Exposed Base
PL-4	270	Perimeter Sign P15 Missing Lower Sign
PL-5	11	Site Marker SMK-2
PL-6	—	Boundary Monument BM-5
PL-7	—	Quality Control Monument QC-4
PL-8	3	Settlement Plate SP-3
PL-9	95	Sloughing Rock Along South Apron
PL-10	180	Vegetation in West Diversion Channel
PL-11	293	Vegetation in Northeast Toe Drain
PL-12	223	Seep 0248 (Dripping/Wet)
PL-13	150	Seep 0922 (Dry)
PL-14	219	Seep 0254 (Dry)
PL-15	309	Seep 0249 (Dry)
PL-16	160	Seep 0264 (Dry)
PL-17	171	Seep 0251 (Dry)
PL-18	178	Seep 0261 (Background—Dripping/Wet)

Note:
— = Photograph taken vertically from above.

PL-1. Exposed Geocell on Access Road

PL-2. Perimeter Sign P6 with Blocked Numbers

PL-3. Perimeter Sign P7 with Exposed Base

PL-4. Perimeter Sign P15 Missing Lower Sign

PL-5. Site Marker SMK-2

PL-6. Boundary Monument BM-5

PL-7. Quality Control Monument QC-4

PL-8. Settlement Plate SP-3

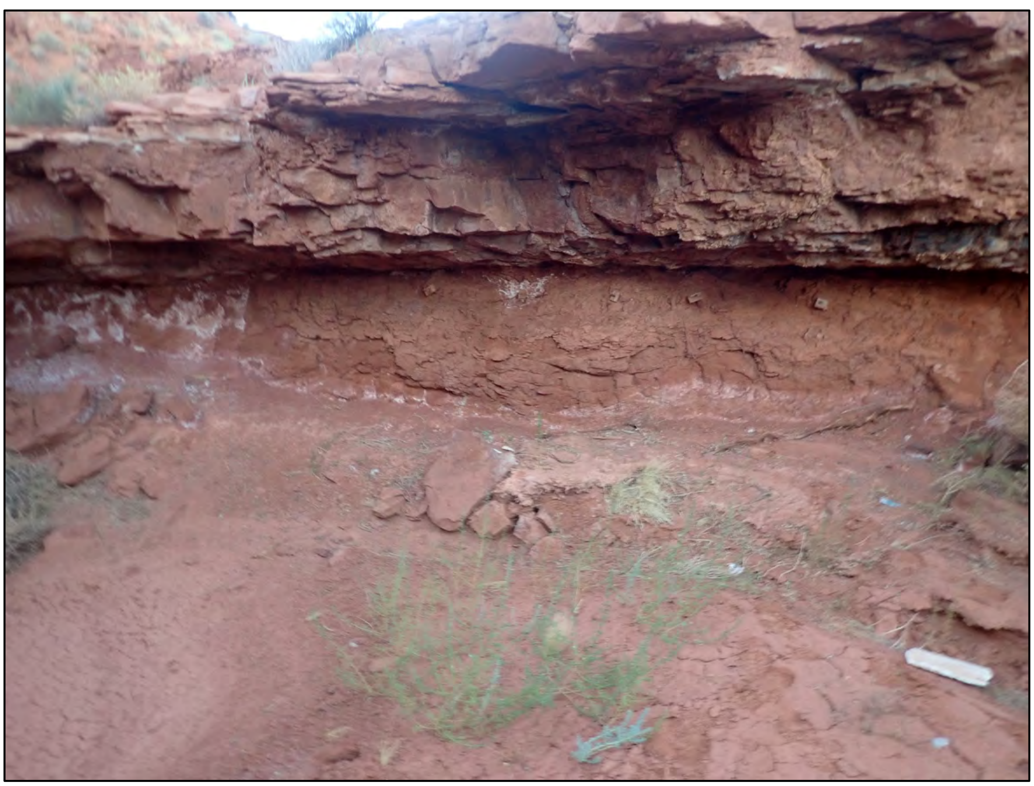
PL-9. Sloughing Rock Along South Apron

PL-10. Vegetation in West Diversion Channel

PL-11. Vegetation in Northeast Toe Drain

PL-12. Seep 0248 (Dripping/Wet)

PL-13. Seep 0922 (Dry)



PL-14. Seep 0254 (Dry)

PL-15. Seep 0249 (Dry)

PL-16. Seep 0264 (Dry)

PL-17. Seep 0251 (Dry)

PL-18. Seep 0261 (Background—Dripping/Wet)

13.0 Naturita, Colorado, Disposal Site

13.1 Compliance Summary

The Naturita, Colorado, Uranium Mill Tailings Radiation Control Act (UMTRCA) Title I Disposal Site was inspected on May 3, 2023. No changes were observed on the disposal cell or in the associated drainage features. Inspectors identified several minor maintenance needs but found no cause for a follow-up inspection.

Groundwater monitoring is not required and was discontinued in 2014. The site-specific *Long-Term Surveillance Plan for the Naturita, Colorado, Disposal Site* (DOE 2019) (LTSP) was revised in 2019 to remove the groundwater monitoring requirement.

13.2 Compliance Requirements

Requirements for the long-term surveillance and maintenance of the site are specified in the site-specific LTSP (DOE 2019) in accordance with procedures established to comply with the requirements of the U.S. Nuclear Regulatory Commission (NRC) general license at Title 10 *Code of Federal Regulations* Section 40.27 (10 CFR 40.27). Table 13-1 lists these requirements.

Table 13-1. License Requirements for the Naturita, Colorado, Disposal Site

Requirement	LTSP	This Report	10 CFR 40.27
Annual Inspection and Report	Sections 3.2, 3.3	Section 13.4	(b)(3)
Follow-Up Inspections	Section 3.4	Section 13.5	(b)(4)
Site Maintenance	Section 3.5.1	Section 13.6	(b)(5)
Environmental Monitoring	Section 3.6	Section 13.7	(b)(2)
Emergency Measures	Section 3.5.2	Section 13.8	—

13.3 Institutional Controls

The 26.65-acre site, identified by the property boundary shown in Figure 13-1, is owned by the United States and was accepted under the NRC general license in 1999. The U.S. Department of Energy (DOE) is the licensee and, in accordance with the requirements for UMTRCA Title I sites, the Office of Legacy Management (LM) is responsible for the custody and long-term care of the site. Institutional controls (ICs) at the site include federal ownership of the property, administrative controls, and the following physical ICs that are inspected annually: the disposal cell and associated drainage features, entrance gate and sign, perimeter fence and signs, site markers, survey and boundary monuments, and aerial survey quality control monuments.

13.4 Inspection Results

The site, 13 miles northwest of Naturita, Colorado, was inspected on May 3, 2023. The inspection was conducted by K. Meadows and L. Sheader of the Legacy Management Support (LMS) contractor. M. Hurt, LM site manager, and M. Cosby from the Colorado Department of Public Health and Environment also attended the inspection. The purposes of the inspection were to confirm the integrity of visible features at the site, identify changes in conditions that might affect conformance with the LTSP, and evaluate whether maintenance or follow-up inspection and monitoring are needed.

13.4.1 Site Surveillance Features

Figure 13-1 shows the locations of site features, including site surveillance features and inspection areas, in black and gray font. Some site features that are present but not required to be inspected are shown in italic font. Observations from previous inspections that are currently monitored are shown in blue, and new observations identified during the 2023 annual inspection are shown in red. Inspection results and recommended maintenance activities associated with site surveillance features are described in the following subsections. Photographs to support specific observations are noted in the text and in Figure 13-1 by photograph location (PL) numbers. The photographs and photograph log are presented in Section 13.10.

13.4.1.1 Site Access, Entrance Gate, and Entrance Sign

Access to the site is from Colorado Highway 141 to Montrose County Road EE22, which borders the northeast side of the site. The main entrance to the site is through a locked steel gate directly off County Road EE22. The entrance sign next to the entrance gate was intact at the inspection (PL-1). No other maintenance needs were identified.

13.4.1.2 Perimeter Fence and Signs

A barbed-wire perimeter fence encloses the site. At two locations identified in Figure 13-1, the top fence strand was broken (PL-2) but was repaired following the inspection. There are 25 perimeter signs positioned along the perimeter fence attached to steel posts set in concrete and set back 5 feet from the property boundary. Inspectors noticed that perimeter sign P5 was missing, which was replaced following the inspection. Erosion around the concrete base of perimeter sign P22 is continually present and will be monitored (PL-3). No other maintenance needs were identified.

13.4.1.3 Site Markers

The site has two granite site markers. Site marker SMK-1 is just inside the entrance gate, and site marker SMK-2 is on the top slope of the disposal cell (PL-4). No maintenance needs were identified.

13.4.1.4 Survey and Boundary Monuments

Three survey monuments and 14 boundary monuments delineate the property boundary (PL-5). Boundary monuments BM-3, BM-4, and BM-11 are dual-purpose monuments that represent survey monuments SM-3, SM-4, and SM-11, respectively. No maintenance needs were identified.

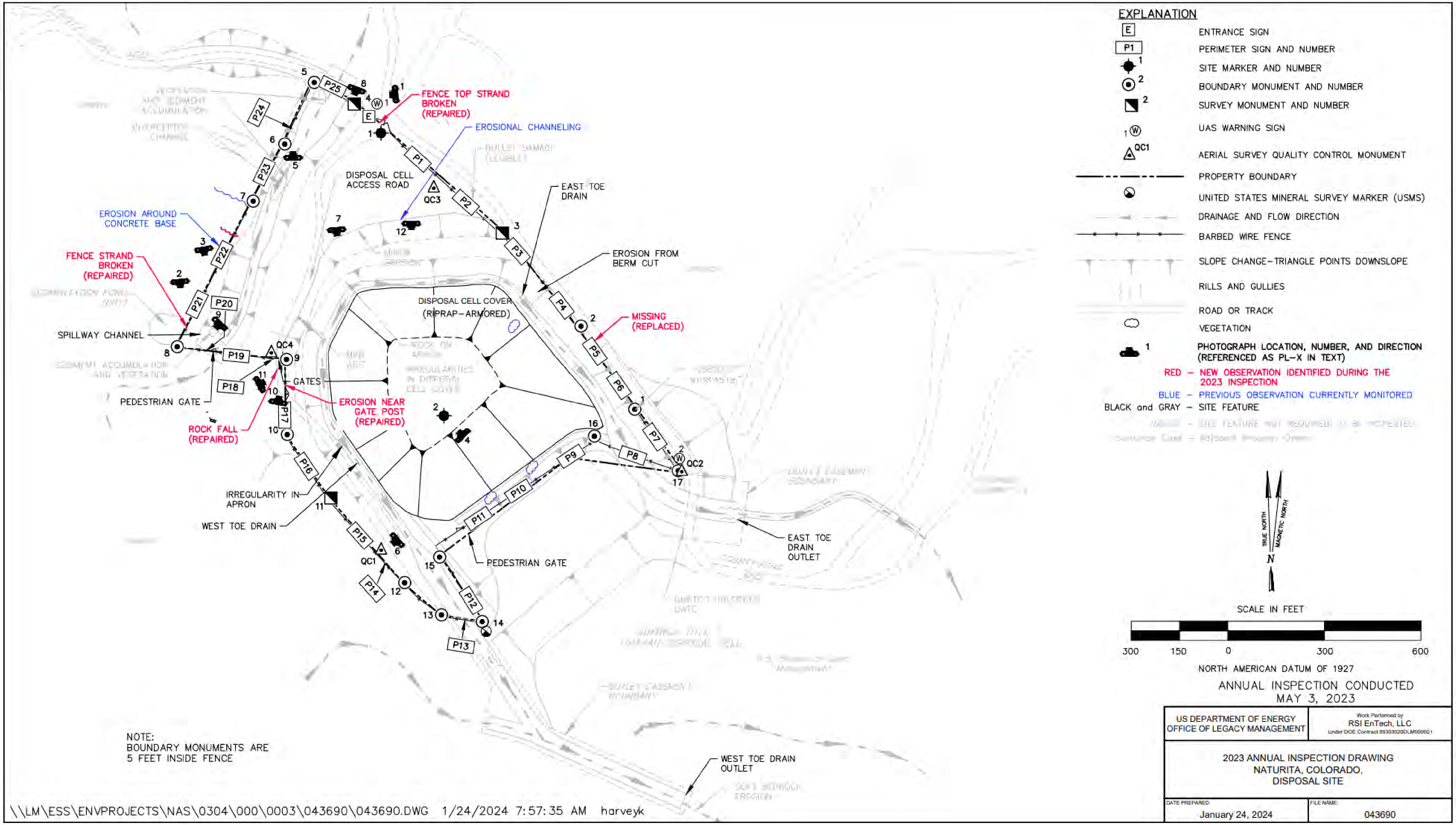


Figure 13-1. 2023 Annual Inspection Drawing for the Naturita, Colorado, Disposal Site

13.4.1.5 Aerial Survey Quality Control Monuments

Four aerial survey quality control monuments utilized during aerial surveys for ground control were inspected (PL-6). No maintenance needs were identified.

13.4.2 Inspection Areas

In accordance with the LTSP, the site is divided into three inspection areas to ensure a thorough and efficient inspection. The inspection areas are (1) the disposal cell, (2) the remainder of the site, and (3) the outlying area. Inspectors examined specific site surveillance features within each area and looked for evidence of erosion, settling, slumping, or other modifying processes that might affect the site's conformance with LTSP requirements.

13.4.2.1 Disposal Cell

The disposal cell, completed in 1998, occupies 10 acres (PL-7). The disposal cell is armored with riprap to control erosion. The riprap is rounded, with larger diameter rock on the side slopes versus on the top slope. There was no evidence of settling, slumping, erosion, rock degradation, or other modifying processes that might affect the integrity of the disposal cell.

The top slope of the disposal cell appears to have slightly darker rock than the surrounding areas but seems to have not changed over time.

Vehicle tracks present in the apron area on the west side of the disposal cell continue to be observed. Inspectors will continue to monitor these areas for potential impacts.

Sediment is accumulating in the apron on the northeast side of the disposal cell from erosion caused by the culvert break along County Road EE22. Vegetation is becoming established in this area. No maintenance needs were identified.

13.4.2.2 Remainder of the Site

Two riprap-armored toe drains (the west and east toe drains) collect water from the disposal cell side slopes and divert it to the southeast. The west toe drain outlet is south of the site in an easement. Soft bedrock is being eroded near the west toe drain outlet, but that erosion does not threaten the performance of the toe drain, and repairs are not necessary. The east toe drain outlet is southeast of the site in an easement. Water is conveyed to the east toe drain outlet through the east toe drain and five culverts under County Road EE22. Erosion has exposed resistant bedrock near the east toe drain outlet but does not threaten the performance of the toe drain, and repairs are not necessary. Some sediment has accumulated in the upper end of the east and west toe drains, allowing scattered vegetation to grow, but this has not adversely affected the performance of the toe drains.

A riprap-armored interceptor channel, upgradient and northwest of the disposal cell, diverts stormwater and snowmelt runoff to the northeast under County Road EE22. Some sediment has eroded from the offsite area upslope from the channel and is being deposited in the channel. Sediment accumulation and associated vegetation have not adversely affected the performance of the interceptor channel (PL-8). Herbicide treatment of rabbitbrush plants is ongoing.

Headcutting erosion has been observed within the spillway channel below the sedimentation pond on the outlying area northwest of the site. Inspectors noted minor increases in rock slumping in this area during the 2023 inspection and will continue to monitor this area (PL-9).

The disposal cell access road along the northwest side of the site descends through shale and sandstone units of the Salt Wash Member of the Morrison Formation. The road provides access to the disposal cell on the west side of the site. A rockfall sent many boulders and small debris onto the access road along the northwestern side of the disposal cell (PL-10). The rocks were removed following the inspection. Erosion along the access road has caused an erosional rill to develop along the gate post (PL-11). This area was repaired following the inspection.

Erosion in the steep cliff below the previous berm cut alongside County Road EE22 does not threaten the integrity of the disposal cell or site features. The berm cut was repaired in 2020. Inspectors continue to monitor this area.

Inspectors confirmed the small erosional channeling reported in 2022 occurring along the cliff north of the disposal cell that was flagged for safety reasons (PL-12). Inspectors will continue to monitor the area for further signs of erosion. No maintenance needs were identified.

13.4.2.3 Outlying Area

The 0.25-mile area beyond the site boundary was visually observed for erosion, changes in land use, or other phenomena that might affect the long-term integrity of the site. The area has been highly disturbed by mining, quarrying, reclamation, and road building.

The gully that has formed on the outlying area along the northern site boundary near perimeter signs P22 and P23 is still present but does not appear to have grown since the last inspection. The gully originates on the hillside beyond the northern perimeter fence and is slowly extending toward the fence line. Inspectors will continue to monitor this area for ongoing erosion and resulting impacts. No maintenance needs were identified.

13.5 Follow-Up Inspections

LM will conduct follow-up inspections if (1) a condition is identified during the annual inspection or other site visit that requires a return to the site to evaluate the condition or (2) LM is notified by a citizen or outside agency that conditions at the site are substantially changed. No need for a follow-up inspection was identified.

13.6 Maintenance and Repair

Inspectors noted the following maintenance items that were repaired after the inspection:

- Repaired the broken fence strands near the site entrance and perimeter sign P21
- Replaced perimeter sign P5
- Moved the rockfall off the access road
- Repaired the erosion near the gate post between boundary monuments BM-9 and BM-10

No other maintenance needs were identified.

13.7 Environmental Monitoring

In accordance with the LTSP, LM ensures that a plant specialist or other qualified person conducts vegetation monitoring.

If volunteer plant growth or sedimentation becomes extreme enough to potentially degrade the function of engineered structures, LM will evaluate the potential impact and select appropriate responses. The vegetation growing in the southern fence area does not require maintenance. No maintenance needs were identified.

13.8 Emergency Measures

Emergency measures are actions DOE will take in response to “unusual damage or disruption” that threatens or compromises site safety, security, or integrity (10 CFR 40 Appendix A Criterion 12). No need for emergency measures was identified.

13.9 References

10 CFR 40 Appendix A. U.S. Nuclear Regulatory Commission, “Criteria Relating to the Operation of Uranium Mills and the Disposition of Tailings or Wastes Produced by the Extraction or Concentration of Source Material from Ores Processed Primarily for Their Source Material Content,” *Code of Federal Regulations*.

10 CFR 40.27. U.S. Nuclear Regulatory Commission, “General License for Custody and Long-Term Care of Residual Radioactive Material Disposal Sites,” *Code of Federal Regulations*.

DOE (U.S. Department of Energy), 2019. *Long-Term Surveillance Plan for the Naturita, Colorado, Disposal Site*, LMS/NAD/S13227, Office of Legacy Management, December.

13.10 Photographs

Photograph Location Number	Azimuth	Photograph Description
PL-1	265	Entrance Sign
PL-2	175	Broken Fence Strand at Northwest Corner of Site near Perimeter Sign P21
PL-3	170	Erosion Around Concrete Base of Perimeter Sign P22
PL-4	310	Site Marker SMK-2
PL-5	—	Boundary Marker BM-6
PL-6	230	Aerial Survey Quality Control Monument QC-1
PL-7	175	Disposal Cell
PL-8	200	Interceptor Trench on Northern Side of Disposal Site
PL-9	223	Rocks in Spillway
PL-10	10	Boulders in Access Road
PL-11	125	Erosion Forming near Gate Post Along Access Road
PL-12	180	Erosional Channeling Along North Cliff Above Disposal Cell

Note:
— = Photograph taken vertically from above.

PL-1. Entrance Sign

PL-2. Broken Fence Strand at Northwest Corner of Site near Perimeter Sign P21

PL-3. Erosion Around Concrete Base of Perimeter Sign P22

PL-4. Site Marker SMK-2

PL-5. Boundary Marker BM-6

PL-6. Aerial Survey Quality Control Monument QC-1

PL-7. Disposal Cell

PL-8. Interceptor Trench on Northern Side of Disposal Site

PL-9. Rocks in Spillway

PL-10. Boulders in Access Road

PL-11. Erosion Forming near Gate Post Along Access Road

PL-12. Erosional Channeling Along North Cliff Above Disposal Cell

14.0 Rifle, Colorado, Disposal Site

14.1 Compliance Summary

The Rifle, Colorado, Uranium Mill Tailings Radiation Control Act (UMTRCA) Title I Disposal Site was inspected on August 29, 2023. Minor depressions or undulations were noted on the disposal cell cover, particularly on the southeastern edge of the cell. These features will be verified with the light detection and ranging (lidar) data from the baseline aerial survey. No other changes were observed on the disposal cell. No changes were observed in the associated drainage features. Inspectors identified minor maintenance items that are listed in Section 14.6 but found no cause for a follow-up inspection.

Since 2001, the U.S. Department of Energy (DOE) has actively pumped pore water from the disposal cell into an evaporation pond to facilitate reduction of pore-water levels within the cell. Despite these efforts, pore water continues to accumulate, and water levels in the disposal cell are increasing. Three unplanned system shutdowns occurred since the 2022 annual site inspection that caused the elevation of the pore water within the disposal cell to rise above the elevation of the top of the disposal cell liner for short durations. To address these issues, DOE has initiated accelerated planning and associated actions to increase the extraction and management of pore water building up within the disposal cell.

14.2 Compliance Requirements

Requirements for the long-term surveillance and maintenance of the site are specified in the site-specific Long-Term Surveillance Plan (DOE 1997) (LTSP) in accordance with procedures established to comply with the requirements of the U.S. Nuclear Regulatory Commission (NRC) general license at Title 10 *Code of Federal Regulations* Section 40.27 (10 CFR 40.27). Table 14-1 lists these requirements.

Table 14-1. License Requirements for the Rifle, Colorado, Disposal Site

Requirement	LTSP	This Report	10 CFR 40.27
Annual Inspection and Report	Section 3.0	Section 14.4	(b)(3)
Follow-Up Inspections	Section 3.4	Section 14.5	(b)(4)
Maintenance and Repairs	Section 4.0	Section 14.6	(b)(5)
Groundwater Monitoring	Section 2.6	Section 14.7	(b)(2)
Disposal Cell Pore-Water Level Monitoring	Appendix	Section 14.8	—
Corrective Action	Section 5.0	Section 14.9	—

14.3 Institutional Controls

The 205-acre site, identified by the property boundary shown in Figure 14-1, is owned by the United States and was accepted under the NRC general license in 1998. DOE is the licensee and, in accordance with the requirements for UMTRCA Title I sites, the Office of Legacy Management (LM) is responsible for the custody and long-term care of the site. Institutional controls (ICs) at the site include federal ownership of the property, administrative controls, and the following physical ICs that are inspected annually: the disposal cell and associated drainage features, entrance gates and sign, stock fence, perimeter signs, site markers, survey and boundary monuments, standpipes, and evaporation pond.

14.4 Inspection Results

The site, 6 miles north of Rifle, Colorado, was inspected on August 29, 2023. The inspection was conducted by M. Franke, C. Mueller, K. MacDougall, N. Lind, and E. Gaasche of the Legacy Management Support (LMS) contractor. M. Young (LM), and A. Lawrence and M. Cosby (Colorado Department of Public Health and Environment) also attended the inspection. The purposes of the inspection were to confirm the integrity of visible features at the site, identify changes in conditions that might affect conformance with the LTSP, and evaluate whether maintenance or follow-up inspection and monitoring are needed.

14.4.1 Site Surveillance Features

Figure 14-1 shows the locations of site features, including site surveillance features and inspection areas, in black and gray font. Some site features that are present but not required to be inspected are shown in italic font. Observations from previous inspections that are currently monitored are shown in blue, and new observations identified during the 2023 annual inspection are shown in red. Inspection results and recommended maintenance activities associated with site surveillance features are described in the following subsections. Photographs to support specific observations are noted in the text and in Figure 14-1 by photograph location (PL) numbers. The photographs and photograph log are presented in Section 14.11.

14.4.1.1 Access Road, Entrance Gates, and Entrance Sign

Access to the site is from an improved gravel road northeast of Colorado Highway 13. A perpetual right-of-way across U.S. Bureau of Land Management (BLM) property provides access to the site. Entrance to the site is through two locked gates on the access road: an outer reinforced metal gate about 1700 feet (ft) south of the site and an inner metal gate at the stock fence. The entrance sign, which is next to the inner gate, was faded and had minor cracks but remained legible (PL-1). The BLM section of the access road had several gullies approximately 6 to 12 inches deep, across and along the access road, from a precipitation event 5 days before the inspection that produced more than 1 inch of rain (PL-2). The access road was repaired following the inspection. No other maintenance needs were identified.

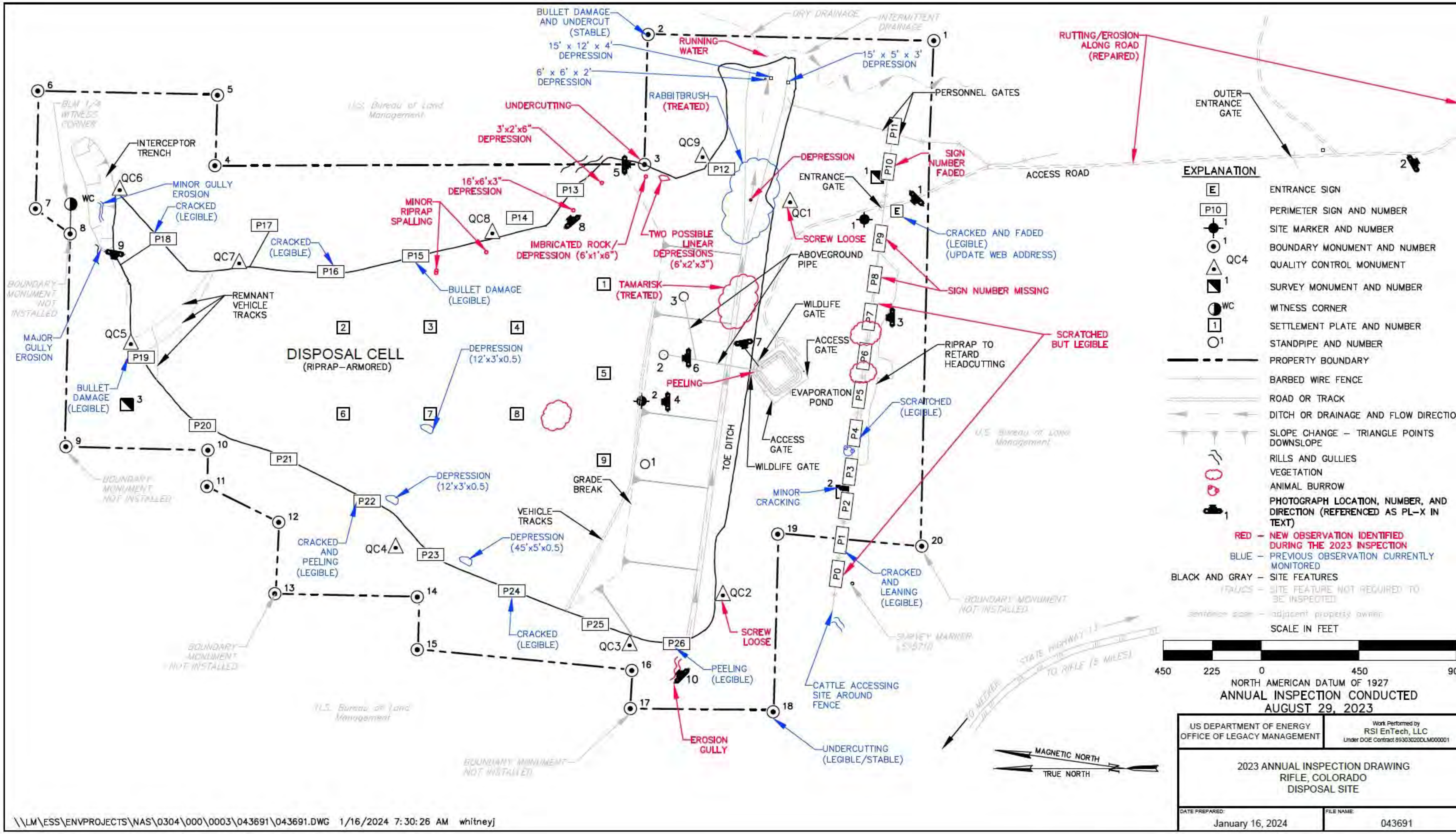


Figure 14-1. 2023 Annual Inspection Drawing for the Rifle, Colorado, Disposal Site

14.4.1.1 Stock Fence and Perimeter Signs

A four-strand barbed-wire stock fence at the southern end of the site extends to the edge of steep-sided arroyos that bound the site on the east and west. In previous years, livestock associated with an adjacent BLM grazing allotment would go around the fence to graze on the site vegetation. Inspectors noticed little to no evidence of continued livestock grazing during the 2023 inspection. This is discussed further in Section 14.4.2.3. Two barbed-wire personnel gates are at the southeast corner of the site. No maintenance needs were identified.

There are 27 perimeter signs positioned along the site perimeter. Perimeter signs P0 through P11 are attached to the stock fence, and perimeter signs P12 through P26 are attached to steel posts set in concrete and set back 5 ft from the boundary. Perimeter signs P15 and P19 have bullet damage but remain legible. Perimeter signs P1, P16, P18, P22, P24, and P26 have minor cracks and are peeling but remain legible. The sign number on perimeter sign P10 is faded, and the sign numbers on perimeter signs P8 and P9 are missing. Perimeter signs P0 through P7 are scratched but legible (PL-3). No maintenance needs were identified.

14.4.1.2 Site Markers

The site has two granite site markers. Site marker SMK-1 is just inside the inner entrance gate, and site marker SMK-2 is on the top slope of the disposal cell (PL-4). No maintenance needs were identified.

14.4.1.3 Survey and Boundary Monuments

Three survey monuments and 15 boundary monuments delineate the property boundary. The boundary monuments are set at the corners of the irregular site boundary. Although the site boundary has 20 corners, only 15 are marked by boundary monuments because five of the corners are on extremely steep terrain that is not safely accessible. Consequently, boundary monuments BM-8, BM-9, BM-13, BM-17, and BM-20 were never installed. GPS is used to identify and inspect existing boundary monuments that are in hard-to-access areas. Boundary monument BM-2 has several bullet holes but remains intact. Boundary monuments BM-2 and BM-3 have undercutting at the ground surface but remain stable (PL-5). Boundary monument BM-18 was previously reported to have undercutting, but it was not inspected during the 2023 inspection because it was too difficult to access. Survey monument SM-2 has slight cracking in the concrete, but the cracking does not affect the integrity of the survey monument. No maintenance needs were identified.

14.4.1.4 Aerial Survey Quality Control Monuments

Nine aerial survey quality control monuments were inspected during the 2023 annual inspection. No maintenance needs were identified.

14.4.1.5 Standpipes

Three 18-inch diameter standpipes (referred to here as MW01, MW02, and MW03) on the south side slope of the disposal cell are used to monitor pore-water levels in the disposal cell.[1] At the time of the inspection, disposal cell pore water was being pumped from standpipes MW02 (PL-6) and MW03 into the evaporation pond. A third standpipe, MW01, is currently dry and not part of the leachate removal system.

No routine maintenance needs were identified for the standpipes. However, in conjunction with the disposal cell pore-water level monitoring efforts (Section 14.8), the surface components for standpipes MW02 and MW03 were modified following the inspection by installing protective vaults over the standpipes and burial of the pipeline that transmits water to the evaporation pond.

14.4.1.6 Evaporation Pond

A lined evaporation pond was constructed adjacent to the disposal cell in 2001 to receive water pumped from standpipes MW02 and MW03. The pond contained water at the time of the inspection. Evaluation of the pond liner's integrity was completed in fall 2020 by a professional geosynthetic liner installation and inspection company. Two minor holes, approximately 2 inches in diameter, were identified at the top slope of the liner and repaired in May 2021. Inspectors noted that one of the patches placed on the top 1 foot of the pond liner in May 2021 was peeling on the top 1 foot of the liner near the northern corner of the evaporation pond (PL-7). LM plans to replace the pond liner in fiscal year (FY) 2025, barring further damage that would necessitate earlier replacement.

At the time of the 2023 inspection, the security fence around the pond was intact and effectively preventing livestock from entering the area. The vehicular access gates on the northern and western corners of the fence were closed and locked at the time of the inspection. A meteorological station alongside the pond was functioning normally. No other maintenance needs were identified.

14.4.2 Inspection Areas

In accordance with the LTSP, the site is divided into four areas to ensure a thorough and efficient inspection. The inspection areas are (1) the disposal cell and interceptor trench, (2) the toe ditch and toe ditch outlet, (3) onsite reclaimed areas, and (4) the outlying area. Inspectors examined specific site surveillance features within each area and looked for evidence of settlement, erosion, or other modifying processes that might affect the site's conformance with LTSP requirements.

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[1] Previous annual reports (e.g., DOE 2023a) referred to the standpipes using an "SP-" prefix (e.g., SP-01, SP-02, and SP-03). Because these locations are designated as MW01, MW02, and MW03 in LM's authoritative database (https://gems.lm.doe.gov/#site=RFLhttps://gems.lm.doe.gov/#site=RFL), they are referred to as such in the remainder of this report.

14.4.2.1 Disposal Cell and Interceptor Trench

The disposal cell, completed in 1996, occupies 71 acres and is armored with riprap consisting of river cobbles and boulders to control erosion and deter animal and human intrusion. During the 2023 inspection, inspectors noted four depressions on the southeast side of the top of the cell. The largest was approximately 16 ft × 6 ft × 3 inches (PL-8). There was no other evidence of erosion, settling, slumping, or other modifying processes that might affect the integrity of the disposal cell. As in the past several inspections, inspectors noticed minor rock degradation on the disposal cell top slope, primarily in the form of cracking and spalling. Rock degradation is not currently a concern.

Remnant vehicle tracks, which formed on the cover during well decommissioning activities in 2002, remain evident in the northern portion of the disposal cell. Additional vehicle tracks continue to be visible in the southern portion of the disposal cell, which are attributable to the installation of solar panels and pumps at standpipes MW02 and MW03.

Tamarisk was noted in the toe ditch and was treated following the inspection. Small, isolated patches of other grasses also were present on the disposal cell cover and side slope, but they do not present a concern and do not require treatment.

A vegetated interceptor trench was constructed at the top of the disposal cell to protect it from stormwater and snowmelt runoff (PL-9). The trench appeared to be functioning as designed, although minor gully erosion has been occurring in the lower portion of the trench. The gully did not appear to be increasing significantly in depth or width. In the outfall area below the trench (down the steep-sided natural slope), stormwater runoff has formed a major gully to the north of the armoring riprap. The gully did not appear to be increasing in depth or width during the 2023 inspection. The outfall area will continue to be monitored to assess if additional riprap is needed on the slope to prevent upstream gully migration. No maintenance needs were identified.

14.4.2.2 Toe Ditch and Toe Ditch Outlet

A toe ditch runs along the downslope (southern) edge of the disposal cell and is armored with the same rock that protects the disposal cell. The toe ditch diverts stormwater runoff from the disposal cell offsite to the east. The ditch was stable and functioning as designed. At the time of the inspection, water was running from the toe ditch.

Minor erosion, anticipated in the design, remains evident in the channel at the toe ditch outlet. Rock previously placed in the outlet to stabilize the erosion has dropped into and armored the eroded areas. Inspectors found two depressions in the rock during the 2017 annual inspection (one about 15 × 12 ft in area and 4 ft deep and one about 6 × 6 ft in area and 2 ft deep) and another depression during the 2018 annual inspection (about 15 × 5 ft in area and 3 ft deep). These depressions were formed near the outlet of the toe ditch on the east end after the underlying soil eroded away. A fourth depression was noted in the toe ditch near quality control monument QC-1 during the 2023 annual site inspection. They are not a concern at this time but will continue to be monitored. No maintenance needs were identified.

14.4.2.3 Onsite Reclaimed Areas

Disturbed areas around the edges and south of the disposal cell were reseeded in 1996 and, overall, have been successfully reclaimed. Before 2012, there was little evidence of grazing within the site boundaries. Since 2012, however, cattle grazing has been regularly observed, and cattle trails have been identified meandering up the steep arroyos on the unfenced, southwest side of the site. There was little to no evidence of cattle grazing observed during the 2023 inspection. LM is evaluating additional fencing installation options on the southwest side of the site to prevent cattle access. Animals are burrowing under the fence between perimeter signs P3 and P4. Inspectors will continue to monitor this area and conduct repairs when necessary.

Three arroyos are present in the reclaimed area south of the disposal cell and outside the stock fence. A rock apron was placed between the stock fence and the headcuts in these arroyos to prevent headward migration toward the disposal cell. As erosion has migrated into the rock apron, the rock has naturally armored the arroyos and effectively stabilized them from further erosion. Inspectors will continue to monitor this area. No maintenance needs were identified.

A small gully has formed adjacent to the disposal cell near perimeter sign P26 (PL-10). It will continue to be monitored.

14.4.2.4 Outlying Area

The 0.25-mile area beyond the site boundary was visually observed for erosion, changes in land use, or other phenomena that might affect the long-term integrity of the site. The primary land uses in the area are grazing, hunting, recreation, and wildlife habitat. The Rifle Arch Trailhead is approximately 0.25 mile southwest of the site along Highway 13. The City of Rifle constructed two additional mountain biking trails in spring 2021 that follow the Rifle Arch Trail. Historically, trash has been dumped along the access road between Highway 13 and the outer entrance gate, and BLM has periodically removed it. No other changes to the outlying area were observed.

14.5 Follow-Up Inspections

LM will conduct follow-up inspections if (1) a condition is identified during the annual inspection or other site visit that requires a return to the site to evaluate the condition or (2) LM is notified by a citizen or outside agency that conditions at the site are substantially changed. No need for a follow-up inspection was identified.

14.6 Maintenance and Repairs

Treatment of rabbitbrush growing on the top of the disposal cell was completed before the 2023 inspection.

Inspectors noted the following maintenance items that were completed following the 2023 inspection:

- Treating the tamarisk growing in the toe drain
- Repairing the access road

Inspectors identified the following maintenance items that will be completed before the next inspection:

- Updating the website address on the entrance sign

14.7 Groundwater Monitoring

Groundwater quality monitoring is not required by the LTSP (DOE 1997). Transient drainage from the disposal cell enters the Wasatch Formation, a 3800-foot-thick sequence of shales, siltstones, and fine-grained sandstones (DOE 1997). The Wasatch Formation separates the disposal cell from the uppermost useable aquifer (the Mesaverde Group). Groundwater in the Wasatch Formation is classified as limited use due to naturally occurring concentrations of total dissolved solids that exceed 10,000 milligrams per liter (DOE 1997). Additionally, this unit produces very little water and is not considered to be an aquifer. Based on data from 1998–1992, background levels of barium, cadmium, chromium, molybdenum, and selenium exceed corresponding U.S. Environmental Protection Agency maximum concentration limits. The LTSP concluded that no further groundwater monitoring is required at the site because (1) the Wasatch Formation does not represent a useable source of water and (2) no exposure pathways to site-related groundwater exist at the site (DOE 1997). Therefore, all monitoring wells at the site were decommissioned by 2002.

14.8 Disposal Cell Pore-Water Level Monitoring

In accordance with the LTSP, LM monitors pore-water levels in the disposal cell at standpipes MW02 and MW03, which are installed at the downgradient end of the disposal cell on the south side slope (Figure 14-1). This monitoring is conducted in conjunction with extraction to maintain water levels below the high-density polyethylene (HDPE) liner that was installed in the toe of the disposal cell at an elevation of 6022.50 ft during original construction.[2] The bottom of standpipe MW01 is at an elevation of 6023.95 ft; as such, it continues to be dry and does not require continuous monitoring.

A contingency plan for control of pore-water levels at the toe of the disposal cell was included as an attachment to the LTSP (DOE 1997). The plan included the installation of a dewatering system and a retention pond to use when water levels reach an elevation of 6016.5 ft and the solar-powered dewatering pump is initiated at a water level elevation of 6018.5 ft. Both the dewatering system and the evaporation pond were constructed in 2001. Water pumped from the standpipes was discharged through an aboveground polyethylene pipe to the evaporation pond. In November 2023, new discharge pipelines were installed and buried in the disposal cell frost barrier to protect against freezing. The disposal cell dewatering system (pump) is activated when the interior pore-water elevation reaches 6018.5 ft.

[2] All elevation data presented in this section are referenced to the North American Vertical Datum of 1988 (NAVD 88). In January 2021, the site's vertical datum was transformed from National Geodetic Vertical Datum of 1929 (NGVD 29) to NAVD 88. The transformation resulted in an approximate increase of 2.53 ft in elevation measurements across the site relative to the original NGVD 29 datum.

Unplanned system shutdowns of the pumping system have occurred for various reasons, including: (1) periods when solar-powered pumps are nonoperational (for recovery tests or maintenance) or (2) when temperatures are below freezing, preventing the pump from operating. Recent unplanned system shutdowns (occurring since the 2022 annual site inspection) are addressed later in this section.

Table 14-2 lists the total annual dewatering volumes based on the flow meter at the evaporation pond for 2008–2023. Figure 14-2 plots the same data along with corresponding cumulative volumes, accounting for previous (1993–2008) leachate extraction volumes (DOE 2009). The current cumulative dewatering volume (through early November 2023) is approximately 7.2 million gallons.

Figure 14-3 plots historical pore-water elevations in standpipes MW02 and MW03 and corresponding dewatering rates. The 6018.5 ft pump action level was first exceeded between 2001 and 2003, after which elevations declined. Starting in approximately 2012, water elevations in both standpipes began steadily increasing and the pump action level was again exceeded in 2016 (Figure 14-3). After an approximate 12-year shutdown, pumping at MW02 resumed in 2018. In response to the increasing water elevations, in 2019, LM began nearly continuous dewatering, a shift from the previous seasonal pumping regime evident in Figure 14-3.

Before spring 2021, the pore-water levels were monitored during monthly pump shutdown periods, which allowed the water levels to equilibrate between the standpipes and the surrounding media. In 2022, the monthly recovery tests ceased due to concerns that the liner would be overtopped during the recurring shutdown periods. Since then, pumps have been operating continuously with few exceptions. Because of the fairly continuous drawdown, measured water levels only represent the bottom of each well's cone of depression, and the ambient water level within the tailings is unknown.

In March 2021, the solar-powered pumping system was upgraded to provide additional operation of the pumps by increasing electrical storage ability. By adding batteries to store solar-generated electricity, the pumps can operate throughout the night and on overcast days. To allow the pumping system to function at colder temperatures in the winter, in July 2022, the leachate discharge pipes were replaced with 2-inch-diameter pipes and insulated where the pipe crosses the toe ditch to protect against freezing and pipe bursting. These upgrades resulted in an increase in annual dewatering volumes (Table 14-2) but do not appear to have decreased the pore-water level in the disposal cell. In fact, despite increased pumping, the maximum water level in both standpipes continues to rise (Figure 14-3).

Table 14-2. Total Dewatering Volumes at the Rifle, Colorado, Disposal Site, 2008–2023

Reporting Year[a]	Annual Dewatering Volumes (gal)[b]	Daily Average Dewatering Rate (gal per day)[c]	Days Pumping[d]	Cumulative Dewatering Volumes (gal)[e]
2008	143,078	708	139	143,078
2009	389,601	1070	159	532,680
2010	215,345	590	134	748,025
2011	61,331	169	66	809,355
2012	155,189	424	128	964,544
2013	106,266	291	107	1,070,810
2014	138,571	380	139	1,209,381
2015	154,621	424	149	1,364,002
2016	168,515	460	183	1,532,516
2017	87,741	240	101	1,620,258
2018	121,538	340	155	1,741,796
2019[f]	246,970	684	336	1,988,766
2020	194,711	532	332	2,183,477
2021	296,836	813	339	2,480,313
2022	255,209	699	322	2,735,522
2023	225,430	723	309	2,960,952

Notes:

[a] Data from June 13, 2008, (start of continuous flow measurements) through November 8, 2023, when the pond flow meter malfunctioned and other maintenance needs were identified (Young 2023b).

[b] Annual dewatering volumes based on flow readings registered at the evaporation pond flow meter. As acknowledged in the previous annual report (DOE 2023a), these readings are considered more accurate than those measured at standpipes MW02 and MW03. For some years, annual and cumulative volumes reported here differ from those documented in previous annual reports because of retroactive corrections to data retrieved from the System Operation and Analysis at Remote Sites (SOARS)/AQUARIUS database. In most cases, these differences are negligible (≤±1%), except for volumes reported for 2009 (−4.4%), 2014 (+2.6%), and 2017 (+1.9%).

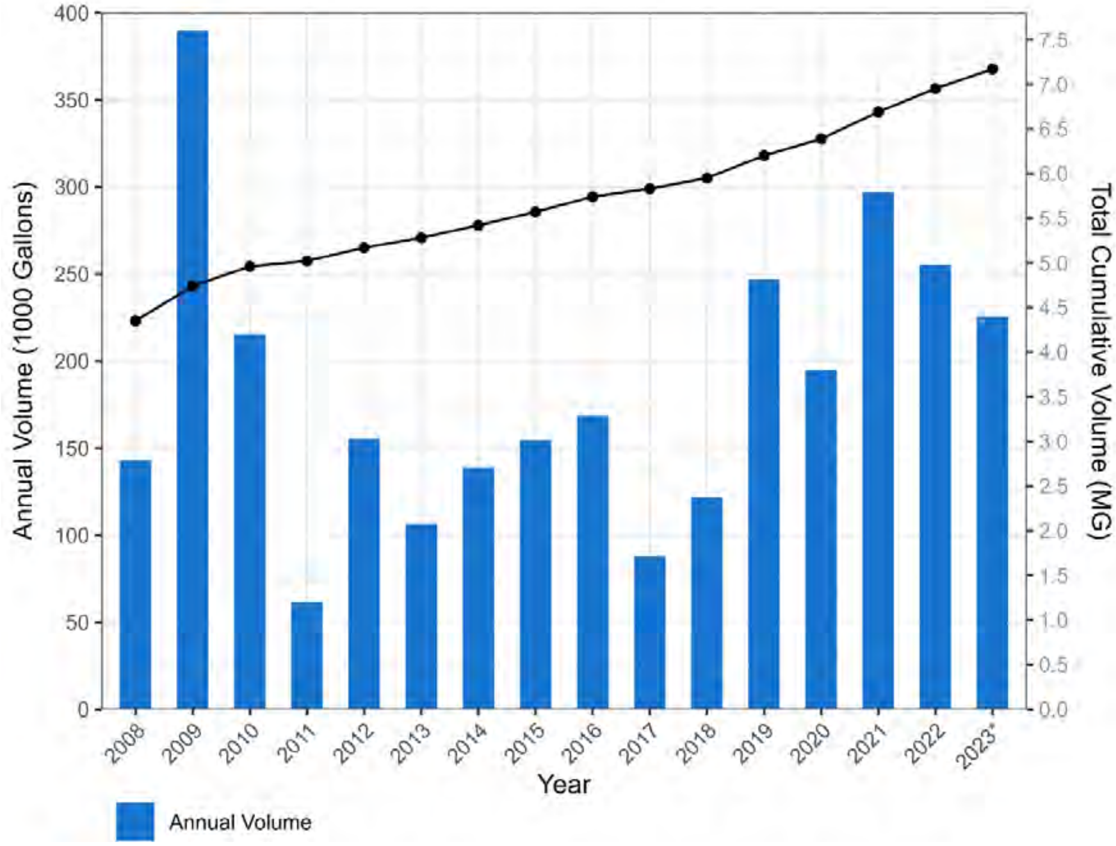
[c] Daily average dewatering rates were calculated by dividing annual dewatering volumes by the corresponding number of records (357–366 depending on year). Exceptions apply to 2008 (divisor of 202 given start date of June 13, 2008) and 2023 (divisor of 312 given end date of November 8, 2023).

[d] Entries in this column (days pumping) correspond to the number of days with daily flow volumes greater than zero.

[e] Cumulative volumes correspond to the 2008–2023 time frame and do not account for historical volumes. The total measured volume of leachate extracted from the standpipes through 2008 was approximately 4.35 million gallons (DOE 2009).

[f] Continuous pumping began in 2019, a shift from the previous seasonal pumping regime.

Abbreviation:
gal = gallons

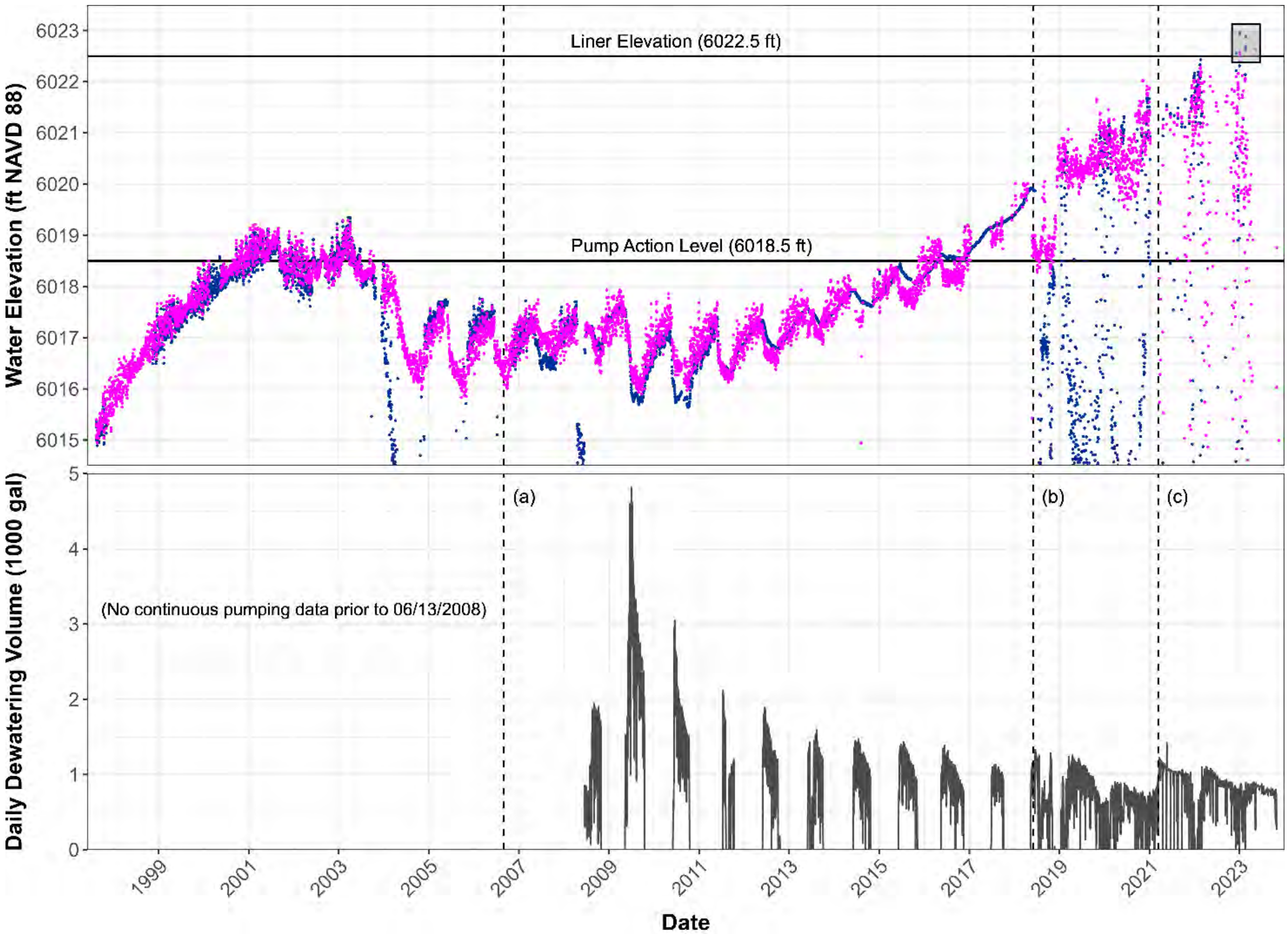


–●– Cumulative Volume (MG)

Notes: Annual volumes from Table 14-2; data from June 13, 2008, through November 8, 2023. Cumulative volumes based on the 2008 annual inspection report (DOE 2009), which stated that the total measured volume of leachate extracted from the standpipes through 2008 was approximately 4.35 million gallons.

Abbreviation: MG = million gallons

Figure 14-2. Annual and Cumulative Volumes of Leachate Removed from the Rifle Disposal Cell, 2008–2023



- MW02 daily maximum water elevation
- MW03 daily maximum water elevation

\- - - Denotes changes in system operations:
(a) MW02 pumping stopped – 9/1/2006
(b) MW02 pumping resumed – 6/15/2018
(c) Collection system upgrades – 3/12/2021

—— Daily dewatering volume (from evaporation pond flow meter)

Period when pore-water elevations exceeded the top of liner elevation (zoom view shown in Figure 14-4)

Notes: Water elevations shown in the upper portion of this figure are referenced to vertical datum NAVD 88 and represent daily maximum elevations filtered from 5-minute data. The upper surface of all data points is the closest representation of static pore-water level conditions, with drawdown associated with pumping periods. Pumping has been continuous since mid-2018, resulting in sustained drawdown in MW02 and MW03.

The *y*-axis lower limit in the uppermost plot is clipped at 6014.5 ft to focus on the data trend most representative of static (nonpumping) conditions. Therefore, the full extent of the daily maximum data subset (accounting for drawdown) is not reflected here. Examples include the following periods:

- December 2003 through June 15, 2008, when daily maximum elevations in standpipe MW02 ranged from 6008–6009 ft (NAVD 88)
- 2021–2023, when daily maximum elevations in standpipes MW02 and MW03 were as low as 6001–6002 ft in MW02 and 6006 ft in MW03 due to continued drawdown.

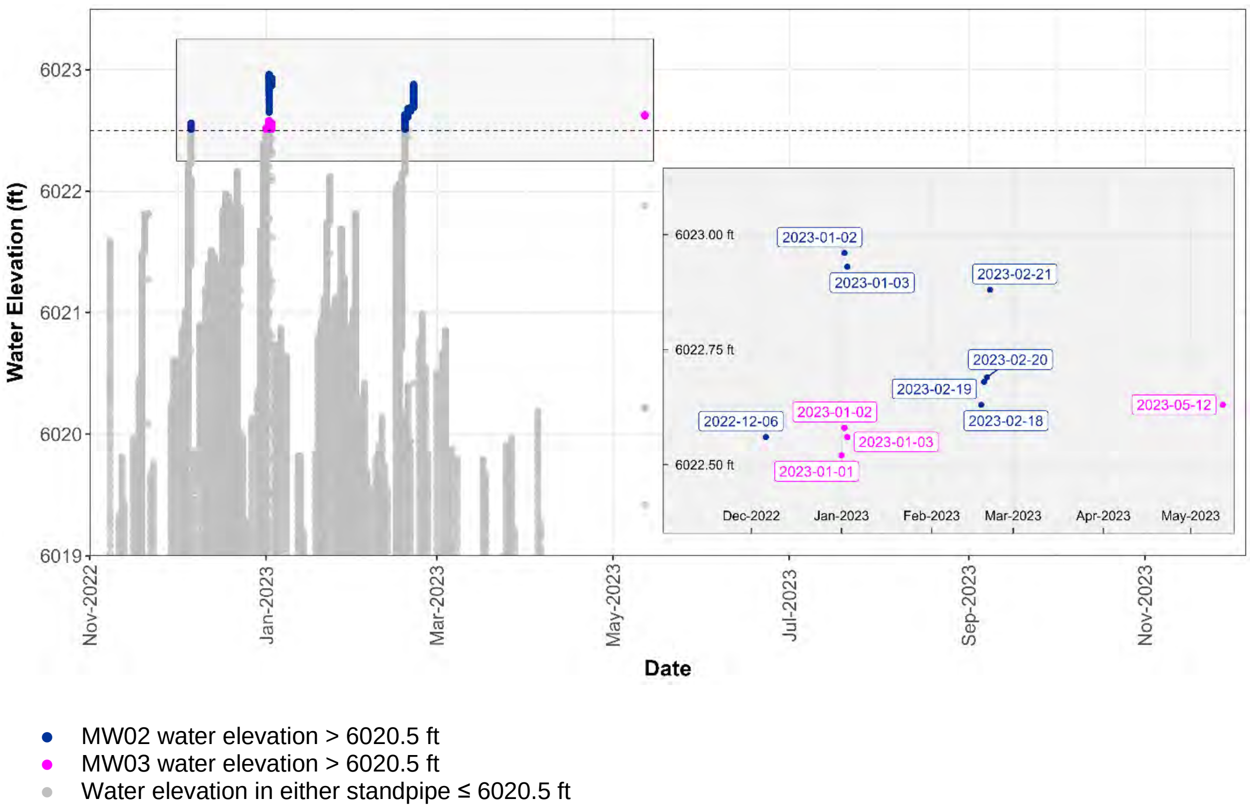
Abbreviation: gal = gallons

Figure 14-3. Disposal Cell Pore-Water Elevations in Standpipes MW02 and MW03 and Corresponding Dewatering Rates at the Rifle, Colorado, Disposal Site, 1997–2023

Three unplanned system shutdowns occurred since the 2022 annual site inspection that caused the elevation of the pore water within the disposal cell to rise above the elevation of the top of the HDPE liner for short durations. A zoom view of these exceedances, showing only pore-water elevation measurements exceeding 6020.5 ft, is provided in Figure 14-4. These shutdowns are documented in the *Preliminary Assessment Report for Unplanned Pumping System Shutdown and Subsequent Pore-Water Level Rise Within the Rifle, Colorado, Disposal Site* (Young 2023a) and summarized below.

- December 6, 2022: The pore-water level in standpipe MW02 rose to an elevation of 6022.56 ft, the first documented exceedance of the top of liner elevation.
- January 1–3, 2023: Pore-water levels in standpipes MW02 and MW03 rose to maximum elevations of 6022.96 (maximum recorded elevation) and 6022.58 ft, respectively.
- May 12, 2023: The pore-water elevation in MW02 rose to 6022.63 ft.

In addition to the unplanned system shutdowns noted above, exceedances of the top of liner elevation also occurred for a brief period in February 2023 (February 18–21), associated with apparent malfunctions of the MW02 pump and flowmeter. During this period, water elevations in MW02 rose temporarily to levels ranging from 6022.63 to 6022.88 ft (Figure 14-4).



Notes: Water elevations are referenced to vertical datum NAVD 88. Unlike the presentation in Figure 14-3, which shows only the daily maximum recorded elevation, this figure shows all exceedances of the 6020.5 ft top of liner elevation recorded in standpipes MW02 and MW03.

Figure 14-4. Zoom View of Pore-Water Elevations Exceeding the Top of Liner Elevation, December 2022 Through May 2023

In March 2022, LM completed a collaborative initiative with the National Laboratory Network (NLN) to identify innovative approaches to perform pore-water source investigation and accumulation mitigation strategies for the site. LM included NRC in the LM and NLN collaborative process. These efforts culminated in the development of the *Work Plan Disposal Cell Pore-Water Sources Investigation for the Rifle, Colorado, Disposal Site* (DOE 2023b). This work plan documents LM's approach for addressing the following three data quality objectives:

1. Update the disposal cell conceptual site model
2. Evaluate potential impacts associated with rising fluid levels within the disposal cell
3. Identify potential short-term, mid-term, and long-term solutions for pore-water source mitigation and accumulation within the disposal cell

14.9 Corrective Action

Corrective action is taken to correct out-of-compliance or hazardous conditions that create a potential health and safety problem or that may affect the integrity of the disposal cell or compliance with 40 CFR 192.

To address the continued rise in pore-water levels, DOE has initiated planning to increase the extraction and pore-water handling capacity to dewater the disposal cell. This will include optimization of the existing pumping infrastructure and installation of additional extraction wells, power, and evaporation capacity. DOE plans to complete the work in FY 2024.

14.10 References

10 CFR 40.27. U.S. Nuclear Regulatory Commission, "General License for Custody and Long-Term Care of Residual Radioactive Material Disposal Sites," *Code of Federal Regulations*.

40 CFR 192. U.S. Environmental Protection Agency, "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings," *Code of Federal Regulations*.

DOE (U.S. Department of Energy), 1997. *Long-Term Surveillance Plan for the Estes Gulch Disposal Site Near Rifle, Colorado*, DOE/AL/62350-235, Rev. 1, November.

DOE (U.S. Department of Energy), 2023a. *2022 Annual Inspection and Monitoring Report for Uranium Mill Tailings Radiation Control Act Title I Disposal Sites*, LMS/S38159, Office of Legacy Management, March.

DOE (U.S. Department of Energy), 2023b. *Work Plan Disposal Cell Pore-Water Sources Investigation for the Rifle, Colorado, Disposal Site*, LMS/RFL/S32856, Office of Legacy Management, June.

Young, M., 2023a. M. Young, Office of Legacy Management, U.S. Department of Energy, letter (about the *Preliminary Assessment Report for Unplanned Pumping System Shutdown and Subsequent Pore-Water Level Rise Within the Rifle, Colorado, Disposal Site*) to K. Hayes, U.S. Nuclear Regulatory Commission, June 27.

Young, M., 2023b. M. Young, Office of Legacy Management, U.S. Department of Energy, letter (about the *Preliminary Assessment Report for Pore Water Discharge onto the Rifle, Colorado, Disposal Site*) to K. Hayes, U.S. Nuclear Regulatory Commission, November 8.

14.11 Photographs

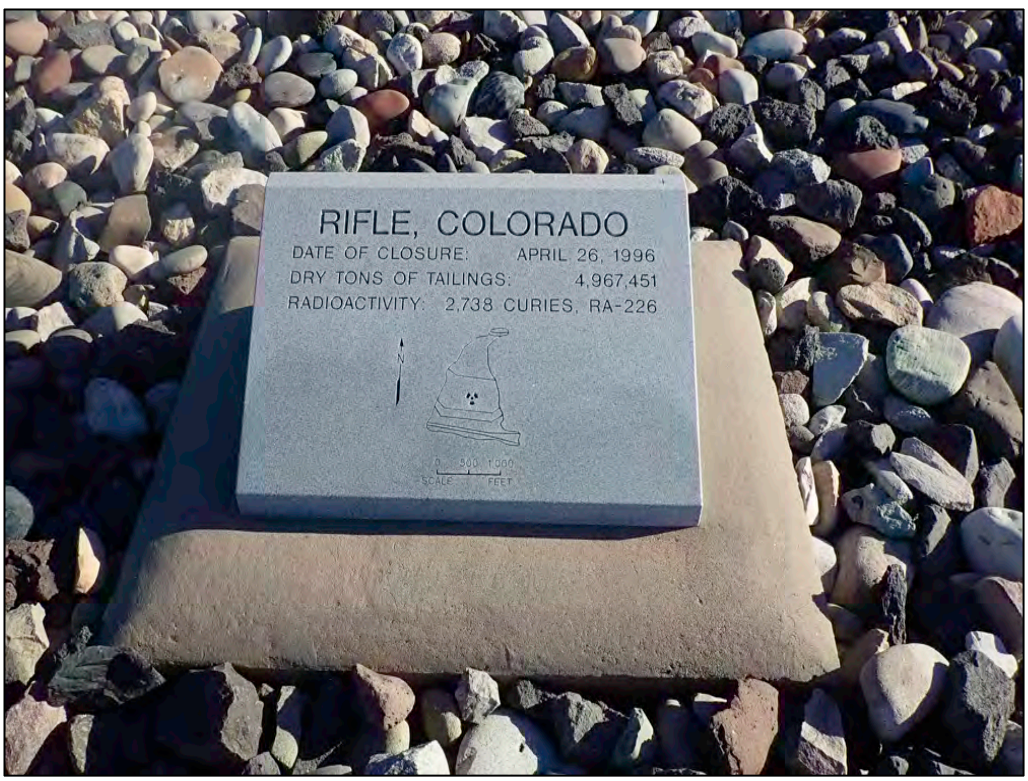
Photograph Location Number	Azimuth	Photograph Description
PL-1	315	Entrance Sign, Cracked and Faded but Legible
PL-2	150	Rutting and Erosion Along Access Road
PL-3	0	Perimeter Sign P7, Scratched but Legible
PL-4	—	Site Marker SMK-2
PL-5	180	Boundary Monument BM-3 with Concrete Base Undercutting
PL-6	0	Standpipe MW02
PL-7	260	Evaporation Pond Liner with Repair Patch on Northern Corner
PL-8	50	Depression on Top Slope in Southeast Area of Disposal Cell
PL-9	280	Gully at Toe of Interceptor Trench
PL-10	44	Erosion near Perimeter Sign P26

Note:
— = Photograph taken vertically from above.

PL-1. Entrance Sign, Cracked and Faded but Legible

PL-2. Rutting and Erosion Along Access Road

PL-3. Perimeter Sign P7, Scratched but Legible



PL-4. Site Marker SMK-2

PL-5. Boundary Monument BM-3 with Concrete Base Undercutting

PL-6. Standpipe MW02

PL-7. Evaporation Pond Liner with Repair Patch on Northern Corner

PL-8. Depression on Top Slope in Southeast Area of Disposal Cell

PL-9. Gully at Toe of Interceptor Trench

PL-10. Erosion near Perimeter Sign P26

15.0 Salt Lake City, Utah, Disposal Site

15.1 Compliance Summary

The Salt Lake City, Utah, Uranium Mill Tailings Radiation Control Act (UMTRCA) Title I Disposal Site was inspected on June 22, 2023. Due to an abnormally wet spring in the region around the site, inspectors observed ponded water in drainage channels and increased vegetation around the disposal cell. Observations of rock-quality monitoring plots indicated no significant change from the previous year. Inspectors did not find any routine maintenance needs and found no cause for a follow-up inspection. Maintenance needs that could be addressed during the inspection were completed by inspectors. Groundwater monitoring is not required.

15.2 Compliance Requirements

Requirements for the long-term surveillance and maintenance of the site are specified in the site-specific Long-Term Surveillance Plan (DOE 1997) (LTSP) in accordance with procedures established to comply with the requirements of the U.S. Nuclear Regulatory Commission (NRC) general license at Title 10 *Code of Federal Regulations* Section 40.27 (10 CFR 40.27). Table 15-1 lists these requirements.

Table 15-1. License Requirements for the Salt Lake City, Utah, Disposal Site

Requirement	LTSP	This Report	10 CFR 40.27
Annual Inspection and Report	Section 3.0	Section 15.4	(b)(3)
Follow-Up Inspections	Section 3.4	Section 15.5	(b)(4)
Maintenance and Repairs	Section 5.0	Section 15.6	(b)(5)
Groundwater Monitoring	Section 4.0	Section 15.7	(b)(2)
Corrective Action	Section 6.0	Section 15.8	--

15.3 Institutional Controls

The 100-acre site, identified by the property boundary shown in Figure 15-1, is owned by the United States and was accepted under the NRC general license in 1997. The U.S. Department of Energy (DOE) is the licensee and, in accordance with the requirements for UMTRCA Title I sites, the Office of Legacy Management (LM) is responsible for the custody and long-term care of the site. Institutional controls (ICs) at the site include federal ownership of the property, administrative controls, and the following physical ICs that are inspected annually: the disposal cell and associated drainage features, entrance gates and sign, fences, perimeter (warning) signs, site markers, and boundary monuments.

15.4 Inspection Results

The site, 81 miles west of Salt Lake City, Utah, was inspected on June 22, 2023. The inspection was conducted by D. Atkinson and N. Lind of the Legacy Management Support (LMS) contractor. M. Kautsky and M. Young (LM) and H. Mickelson, C. Bishop, and B. Anderson (Utah Department of Environmental Quality) attended the inspection. S. Gurr and N. Clarke of EnergySolutions (the private operator of the surrounding radioactive waste disposal facility) escorted the inspection group. The purposes of the inspection were to confirm the integrity of visible features at the site, identify changes in conditions that might affect conformance with the LTSP, and evaluate whether maintenance or follow-up inspection and monitoring are needed.

15.4.1 Site Surveillance Features

Figure 15-1 shows the locations of site features, including site surveillance features and inspection areas, in black and gray font. Some site features that are present but not required to be inspected are shown in italic font. Observations from previous inspections that are currently monitored are shown in blue, and new observations identified during the 2023 annual inspection are shown in red. Inspection results and recommended maintenance activities associated with site surveillance features are described in the following subsections. Photographs to support specific observations are noted in the text and in Figure 15-1 by photograph location (PL) numbers. The photographs and photograph log are presented in Section 15.10.

15.4.1.1 Site Access, Entrance Gates, and Entrance Sign

The site is surrounded by the EnergySolutions radioactive waste facility. A perpetual right-of-way easement ensures that LM and its representatives have continued access across the EnergySolutions property to the site. LM also provides EnergySolutions access to the site to perform periodic maintenance activities, as needed, through a signed access agreement. In accordance with the agreement, EnergySolutions is required to provide a minimum 48-hour notice to LM before accessing or conducting maintenance activities at the site.

All personnel entering the EnergySolutions facility must sign in at the security building. Because of the surrounding radioactive waste disposal facility, posted radiological control areas must be crossed to access the site. Therefore, EnergySolutions requires that inspectors and other site visitors receive a radiological hazard awareness briefing, sign the EnergySolutions Radiological Work Permit, wear a dosimeter, and be escorted to and from the site. Hard hats, safety glasses, high-visibility vests, and steel-toed boots are also required on the EnergySolutions property. Following the inspection and before exiting the radiological control area, personnel and equipment are scanned for radiological contamination using a calibrated Ludlum model 2360 alpha-beta ratemeter.

A route across the EnergySolutions property provides access to the southwest corner of the site. Six locked gates around the site limit access to the site and disposal cell. Two gates (Gates 61 and 64) are in the southwest corner of the property, and one gate (Gate 87) is in the northwest corner of the property; these property boundary gates are maintained by EnergySolutions. The remaining three gates (Gate 65 in the northwest corner and Gates 60 and 62 in the southwest corner) are along the interior chainlink security fence that surrounds the disposal cell; these interior gates are maintained by LM. Gates 60, 61, and 64 are considered site entrance gates. The gates were locked and functional. The entrance sign is at Gate 61. No maintenance needs were identified.

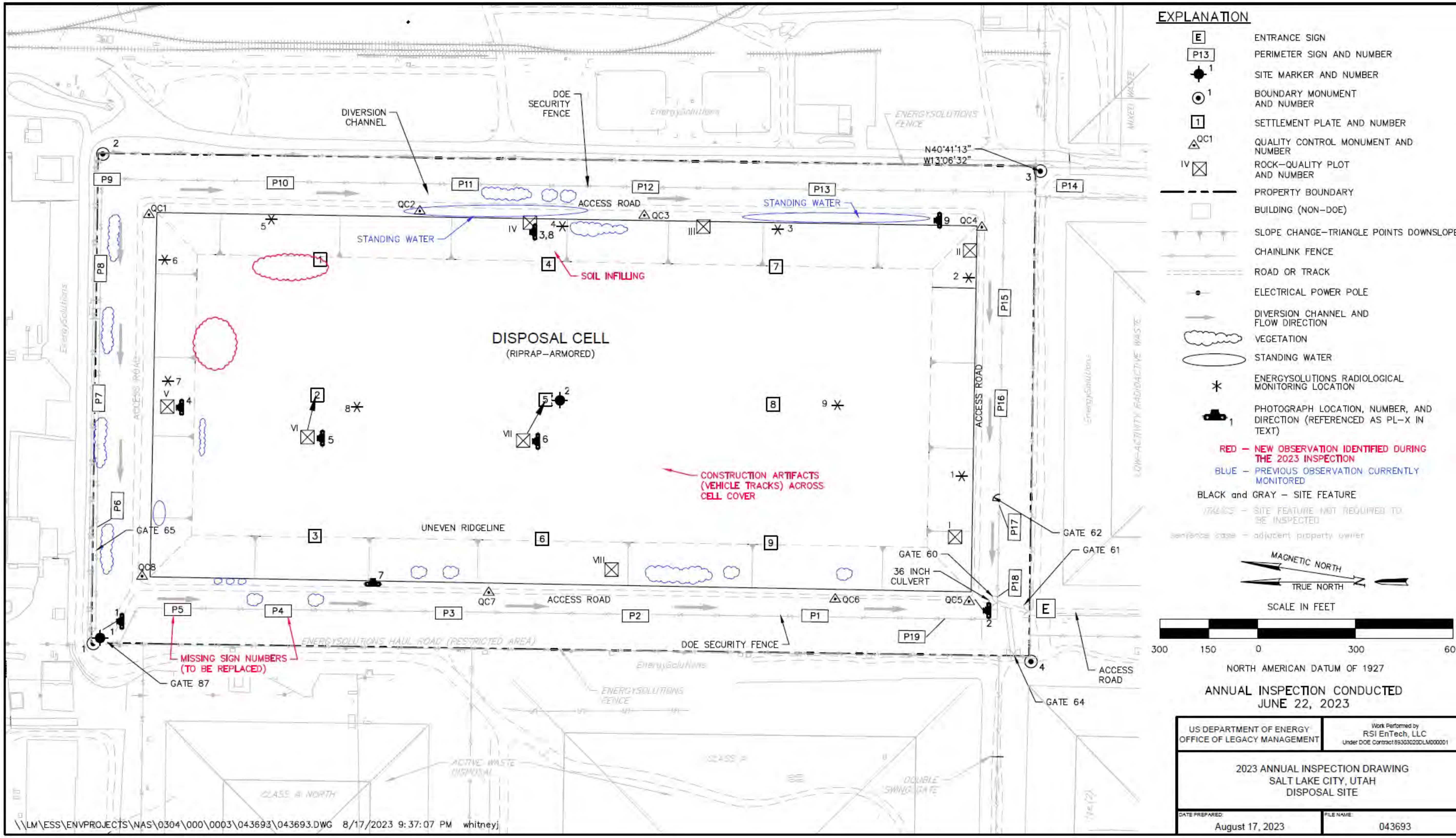


Figure 15-1. 2023 Annual Inspection Drawing for the Salt Lake City, Utah, Disposal Site

15.4.1.2 Fences and Perimeter Signs

The site has two chainlink fences: the exterior EnergySolutions perimeter fence along the property boundary and the interior LM security fence that encloses the disposal cell and surface water diversion channels. There are 19 perimeter signs attached to the LM security fence; all 19 perimeter signs were present and in good condition. Perimeter signs P4 and P5 are missing their number identifiers. Numbers will be replaced during the next annual site inspection. Inspectors noted continued growth of vegetation along the east fence line; treating and removing this vegetation is not required at this time. No other maintenance needs were identified.

15.4.1.3 Site Markers

The site has two granite site markers. Site marker SMK-1 (PL-1) is just inside Gate 87 in the northwest corner of the site. Site marker SMK-2 is on the top slope of the disposal cell. No maintenance needs were identified.

15.4.1.4 Boundary Monuments

Four boundary monuments delineate the corners of the property boundary (boundary monuments BM-1 to BM-4). Protective casings that EnergySolutions installed over each boundary monument continue to protect the boundary monuments from damage by surrounding earthmoving activities. No maintenance needs were identified.

15.4.1.5 Aerial Survey Quality Control Monuments

Eight aerial survey quality control monuments (PL-2) were in good condition and no maintenance needs were identified.

15.4.2 Inspection Areas

In accordance with the LTSP, the site is divided into three inspection areas to ensure a thorough and efficient inspection. The inspection areas are (1) the disposal cell, (2) the area between the disposal cell and the site perimeter, and (3) the outlying area. Inspectors examined specific site surveillance features within each area and looked for evidence of erosion, settling, slumping, or other modifying processes that might affect the site’s conformance with LTSP requirements.

15.4.2.1 Disposal Cell

The disposal cell, completed in 1988, occupies 54 acres. The disposal cell is armored with riprap to control erosion. Inspectors noted the presence of vehicle tracks on the top slope and east side slope of the disposal cell, but there was no evidence of erosion, settling, slumping, or other modifying processes that might affect the integrity of the disposal cell. Vehicle use on disposal cells is prohibited without consent from DOE. No maintenance needs were identified.

One of several types of rock found within the mix used for the disposal cell erosion-protection riprap layer has exhibited minor degradation since the disposal cell was constructed. Eight rock-quality monitoring plots, each measuring 1 square meter (indicated by Roman numerals I–VIII in Figure 15-1), were established in 2010 to monitor for continued rock degradation.

The type of rock exhibiting degradation constitutes approximately 1%–10% of the riprap material; observed rock degradation is thought to result from freeze-thaw weathering. Rock-quality monitoring plots are visually monitored and documented annually with photographs. Photographs of plots IV, V, VI, and VII (PL-3 through PL-6) have been included in the report as representative of the rock-quality monitoring plots. Based on visual monitoring of the rock in the plots, there have been no significant changes from the 2022 annual inspection. Comparisons to the initial 2010 rock-quality plot photographs indicate very little (if any) additional rock degradation since monitoring began (PL-3 through PL-6). The extent of rock degradation observed to date has not reduced the effectiveness of the riprap cover, and, at this time, there is no concern that cover integrity will be affected in the future. Rock-quality monitoring plots will continue to be visually monitored and documented annually with photographs to ensure that the riprap continues to protect the integrity of the disposal cell.

Nine settlement plates are on the top slope of the disposal cell; several outer casings associated with the settlement plates were visually inspected. Surveying of the settlement plates is not required unless settlement appears to be occurring. Every year, EnergySolutions performs light detection and ranging (lidar) surveys of the area that includes the disposal cell. The lidar survey results are available upon request. The LMS contractor completed a baseline aerial survey of the site in 2022 using lidar and photogrammetry. The results of this survey will be used in future assessments of erosion or other modifying processes to help ensure that the disposal cell remains structurally sound and protective of human health and the environment.

Although areas of the disposal cell have continued to have minor perennial grass growth, no deep-rooted plants were present on the disposal cell. Two small weedy plants were found growing on the west side slope (PL-7), and two areas near the northeast corner of the top slope had minor vegetation growth. Soil infilling and some minor settling was observed along the east side slope (PL-8). No immediate maintenance is required, but this area will be monitored in the future for further settling, slumping, and infilling. No other maintenance needs were identified.

15.4.2.2 Area Between Disposal Cell and Site Perimeter

Inspectors examined the area between the toe of the disposal cell and the EnergySolutions security fence on the property boundary. No evidence of erosion was observed. Vegetation encroaching along the access road was removed after the 2021 inspection and the road is in good condition. EnergySolutions will continue to remove vegetation along the road as needed.

The surface water diversion channels were functioning as designed. Ponded water and vegetation growth were observed in and along these diversion channels (PL-9) but are not impeding stormwater runoff.

Radiological surveys are performed at least every 2 years on the site by EnergySolutions personnel to confirm there is no spillover or windblown radioactive contamination from surrounding radioactive waste disposal operations. The previous survey occurred in 2022, and informal spot-check radiological measurements were collected by EnergySolutions in 2023.

Dose rate measurements and wipe samples were collected at random locations around the base of the disposal cell, including on the disposal cell top slope during the 2023 annual inspection.

Results from all radiological surveys conducted at the site have been below applicable exposure limits established in the *Radiological Control Manual* (LMS/POL/S04322). All results from the 2023 wipe samples collected by EnergySolutions were below the minimum detectable activities (i.e., nondetect) for removable alpha and beta radiation contamination. Therefore, both spillover and windblown radiological contamination from the surrounding radioactive waste disposal operation are not evident. The next radiological survey will occur during the 2024 annual site inspection.

EnergySolutions conducts periodic walkthroughs of the site to remove any windblown debris. The company reported no debris on the site in 2023. No maintenance needs were identified.

15.4.2.3 Outlying Area

The area beyond the site boundary for 0.25 mile was visually observed for erosion, changes in land use, or other phenomena that might affect the long-term integrity of the site. No such impacts were observed.

A variety of features and ongoing waste disposal activities that are managed by EnergySolutions surround the site. The most obvious waste disposal activities are occurring directly west of the site where a Class A (i.e., low-level radioactive waste) disposal cell is being capped. On the northeast and east sides of the site, incoming wastes are unloaded from railcars and transferred to haul trucks; decontamination facilities are also present. Directly to the south is a completed low-level (activity) radioactive waste disposal cell; to the southwest is a waste disposal cell containing Atomic Energy Act Section 11e.(2) byproduct material, as described in Title 42 *United States Code* Section 2011 et seq. (42 USC 2011 et seq.); and to the southeast is an operating mixed-waste treatment and disposal facility. Administration, security, and maintenance buildings lie directly north-northwest of the site. A shredding facility, rotary dump, and railroad spur delivery loop are northwest of the site. These adjacent operations and facilities are not affecting the site.

15.5 Follow-Up Inspections

LM will conduct follow-up inspections if (1) a condition is identified during the annual inspection or other site visit that requires a return to the site to evaluate the condition or (2) LM is notified by a citizen or outside agency that conditions at the site have substantially changed. No need for a follow-up inspection was identified.

15.6 Maintenance and Repairs

Maintenance was performed to remove the vegetation on the east perimeter fence before the inspection.

Inspectors noted that the contact information stickers on perimeter signs P4 and P5 were missing and will be replaced during the next inspection. No other maintenance needs were identified.

15.7 Groundwater Monitoring

In accordance with the LTSP, groundwater monitoring is not required. Supplemental standards have been applied as site standards because (1) the uppermost aquifer is classified as limited use due to naturally occurring concentrations of total dissolved solids that exceed 10,000 milligrams per liter and (2) the site is not contributing to the contamination of any current or potentially useful aquifer. EnergySolutions owns and maintains several groundwater monitoring wells throughout its licensed radioactive waste facility.

15.8 Corrective Action

Corrective action is taken to correct out-of-compliance or hazardous conditions that create a potential health and safety problem or that may affect the integrity of the disposal cell or compliance with 40 CFR 192. No need for corrective action was identified.

15.9 References

10 CFR 40.27. U.S. Nuclear Regulatory Commission, "General License for Custody and Long-Term Care of Residual Radioactive Material Disposal Sites," *Code of Federal Regulations*.

40 CFR 192. U.S. Environmental Protection Agency, "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings," *Code of Federal Regulations.*

42 USC 2011 et seq. "Atomic Energy Act of 1954," *United States Code*.

DOE (U.S. Department of Energy), 1997. *Long-Term Surveillance Plan for the South Clive Disposal Site, Clive, Utah*, DOE/AL/62350-228, Rev. 2, September.

Radiological Control Manual, LMS/POL/S04322, continually updated, prepared by the LMS contractor for the U.S. Department of Energy Office of Legacy Management.

15.10 Photographs

Photograph Location Number	Azimuth	Photograph Description
PL-1	—	Site Marker SMK-1
PL-2	—	Aerial Survey Quality Control Monument QC-5
PL-3	—	(a) Rock-Quality Monitoring Plot IV—2023 (b) Rock-Quality Monitoring Plot IV—2010 Photo for Comparison
PL-4	—	(a) Rock-Quality Monitoring Plot V—2023 (b) Rock-Quality Monitoring Plot V—2010 Photo for Comparison
PL-5	—	(a) Rock-Quality Monitoring Plot VI—2023 (b) Rock-Quality Monitoring Plot VI—2010 Photo for Comparison
PL-6	—	(a) Rock-Quality Monitoring Plot VII—2023 (b) Rock-Quality Monitoring Plot VII—2010 Photo for Comparison
PL-7	90	Vegetation on West Side Slope
PL-8	—	Infilled Soil in Rock-Quality Monitoring Plot IV
PL-9	0	Ponded Water in Toe Drain near Southeast Corner of Disposal Cell

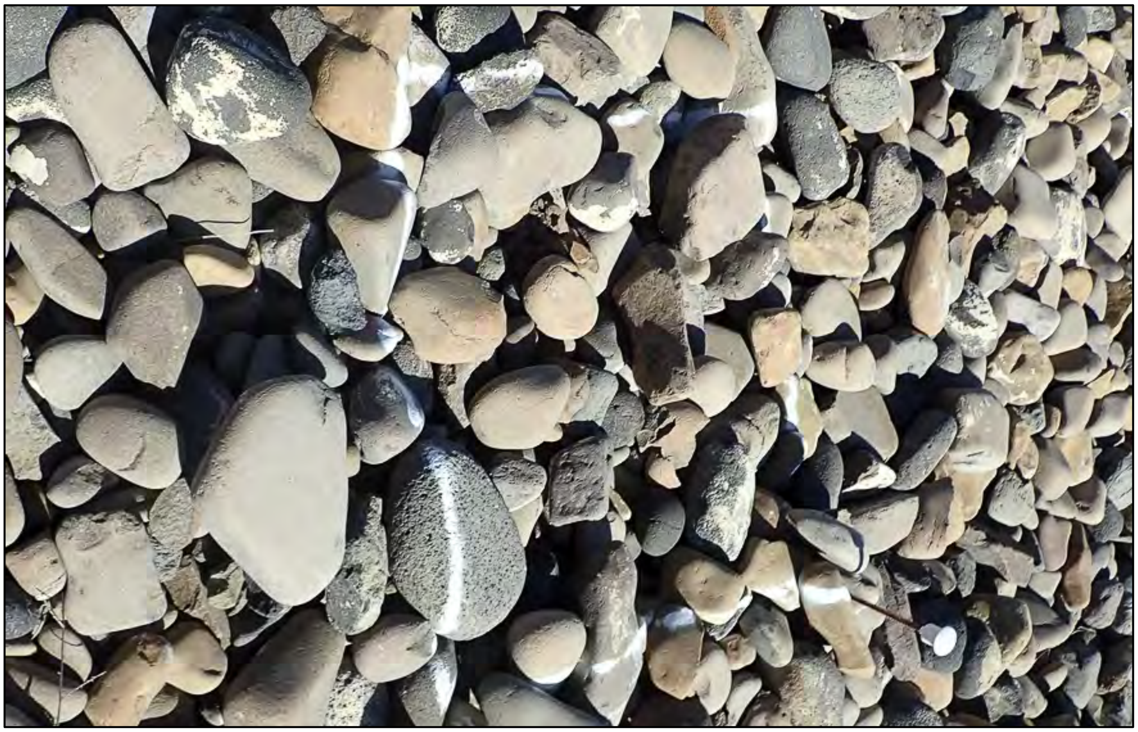
Note:
— = Photograph taken vertically from above.

PL-1. Site Marker SMK-1

PL-2. Aerial Survey Quality Control Monument QC-5

PL-3a. Rock-Quality Monitoring Plot IV—2023

PL-3b. Rock-Quality Monitoring Plot IV—2010 Photo for Comparison



PL-4a. Rock-Quality Monitoring Plot V—2023

PL-4b. Rock-Quality Monitoring Plot V—2010 Photo for Comparison

PL-5a. Rock-Quality Monitoring Plot VI—2023

PL-5b. Rock-Quality Monitoring Plot VI—2010 Photo for Comparison

PL-6a. Rock-Quality Monitoring Plot VII—2023

PL-6b. Rock-Quality Monitoring Plot VII—2010 Photo for Comparison

PL-7. Vegetation on West Side Slope

PL-8. Infilled Soil in Rock-Quality Monitoring Plot IV

PL-9. Ponded Water in Toe Drain near Southeast Corner of Disposal Cell

16.0 Shiprock, New Mexico, Disposal Site

16.1 Compliance Summary

The Shiprock, New Mexico, Uranium Mill Tailings Radiation Control Act (UMTRCA) Title I Disposal Site was inspected on June 21, 2023. No changes were observed on the disposal cell or in the associated diversion channels. Inspectors identified several minor maintenance needs but found no cause for a follow-up inspection. Groundwater monitoring to evaluate disposal cell performance is not required.

16.2 Compliance Requirements

Requirements for the long-term surveillance and maintenance of the site are specified in the site-specific Long-Term Surveillance Plan (DOE 1994) (LTSP) in accordance with procedures established to comply with the requirements of the U.S. Nuclear Regulatory Commission (NRC) general license at Title 10 *Code of Federal Regulations* Section 40.27 (10 CFR 40.27). Table 16-1 lists these requirements.

Table 16-1. License Requirements for the Shiprock, New Mexico, Disposal Site

Requirement	LTSP	This Report	10 CFR 40.27
Annual Inspection and Report	Section 6.0	Section 16.4	(b)(3)
Follow-Up or Contingency Inspections	Section 7.0	Section 16.5	(b)(4)
Maintenance and Repairs	Section 8.0	Section 16.6	(b)(5)
Environmental Monitoring	Sections 5.0 and 6.4	Section 16.7	(b)(2)
Corrective Action	Section 9.0	Section 16.8	–

16.3 Institutional Controls

The 105-acre site, identified by the property boundary shown in Figure 16-1, is held in trust by the U.S. Bureau of Indian Affairs. The Navajo Nation retains title to the land. UMTRCA authorized the U.S. Department of Energy (DOE) to enter into a Cooperative Agreement (DE-FC04-85AL26731) with the Navajo Nation and required it to be in place before bringing the site under the NRC general license. DOE and the Navajo Nation executed a Custodial Access Agreement that conveys the federal government title to the residual radioactive materials stabilized at the repository site and ensures that DOE has perpetual access to the site.

The site was accepted under the NRC general license in 1996. DOE is the licensee and, in accordance with the requirements for UMTRCA Title I sites, the Office of Legacy Management (LM) is responsible for the custody and long-term care of the site. Institutional controls (ICs) at the site include federal custody of the disposal cell and its engineered features, administrative controls, and the following physical ICs that are inspected annually: the disposal cell and associated drainage features, entrance gates and signs, perimeter fence and signs, site markers, survey and boundary monuments, and erosion control markers.

16.4 Inspection Results

The site, 1 mile south of Shiprock, New Mexico, was inspected on June 21, 2023. The inspection was conducted by J. Sullivan and E. Garcia of the Legacy Management Support (LMS) contractor. J. Tallbull (LM) and G. Jay (LMS) attended the inspection. The purposes of the inspection were to confirm the integrity of visible features at the site, identify changes in conditions that might affect conformance with the LTSP, and evaluate whether maintenance or follow-up inspection and monitoring are needed.

16.4.1 Site Surveillance Features

Figure 16-1 shows the locations of site features, including site surveillance features and inspection areas, in black and gray font. Some site features that are present but not required to be inspected are shown in italic font. Observations from previous inspections that are currently monitored are shown in blue, and new observations identified during the 2023 annual inspection are shown in red. Inspection results and recommended maintenance activities associated with site surveillance features are described in the following subsections. Photographs to support specific observations are noted in the text and in Figure 16-1 by photograph location (PL) numbers. The photographs and photograph log are presented in Section 16.10.

16.4.1.1 Access Roads, Entrance Gates, and Entrance Signs

Access to the site is from a gravel road off U.S. Highway 491. Three gates allow access to the site through the perimeter fence: the east gate (the current main entrance gate near the terrace escarpment), the north gate (an auxiliary access gate), and the west gate (the former main entrance gate). Access to the main entrance gate is on the road to the gravel pit. The three gates were locked and functional. Pairs of entrance signs—one pictorial and one textual—are present near each gate. One pair is present at the east and north gates, and two pairs are present at the west gate. Contact information on the evaporation pond entrance sign was updated. No other maintenance needs were identified.

16.4.1.2 Perimeter Fence and Signs

A chainlink perimeter fence encloses the disposal cell and drainage features. Regular maintenance to keep the perimeter fence free of trash, tumbleweeds, and other debris is ongoing. Seventeen pairs of perimeter signs, designated P1 through P17 (each pair consisting of one pictorial and one textual sign), are positioned along the perimeter fence[1] (PL-1). Perimeter sign P10 was replaced after the inspection. The radiation symbol on perimeter sign P14 needs to be replaced. Cracked signs and signs with faded symbols will be replaced before the next inspection. No other maintenance needs were identified.

[1] Plate 1 of the LTSP shows six sets of perimeter signs on fence fabric along the terrace escarpment. These were not installed because a fence was never installed in this area. Because the escarpment prohibits access to the site, a fence was not needed.

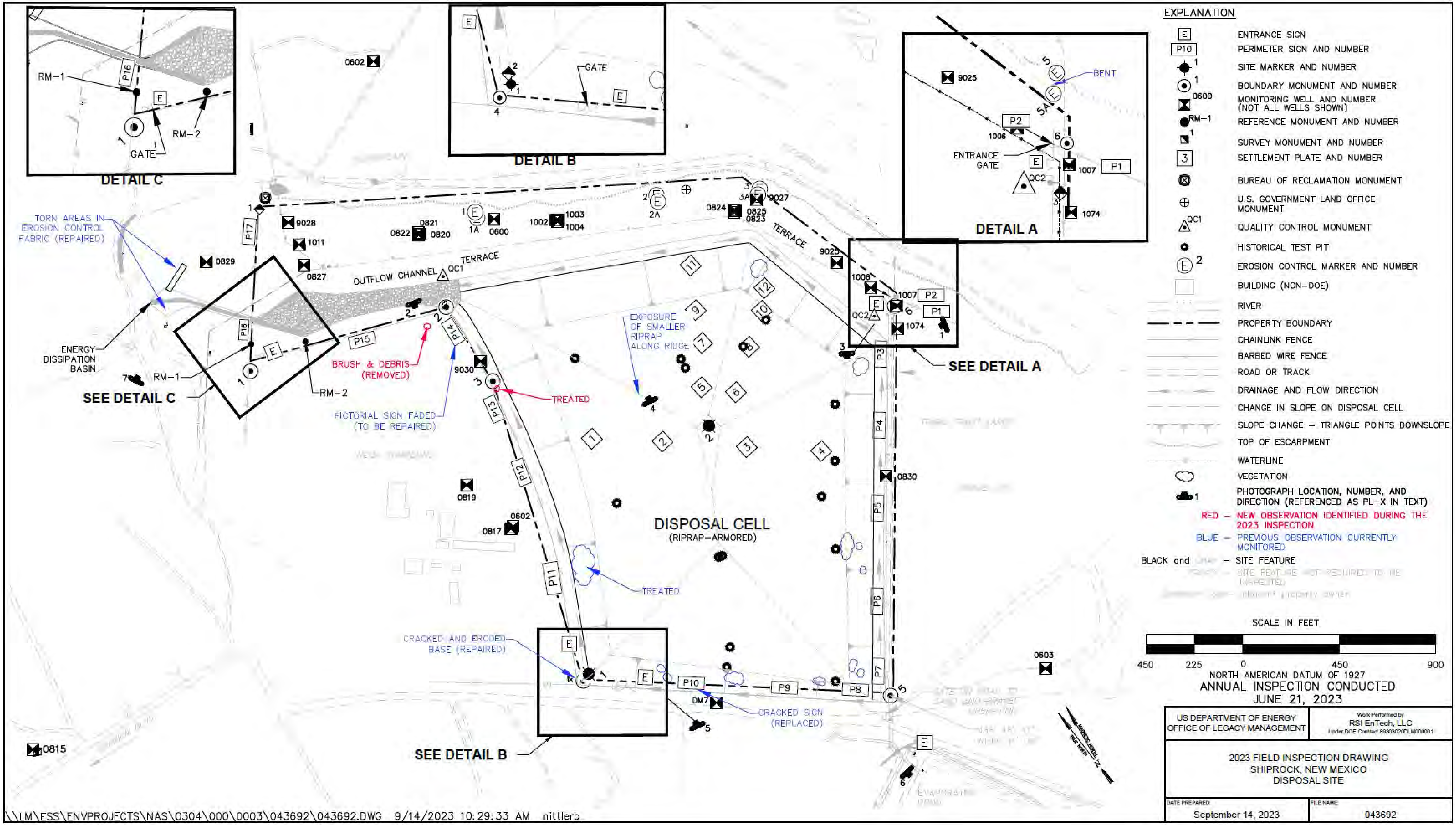


Figure 16-1. 2023 Annual Inspection Drawing for the Shiprock, New Mexico, Disposal Site

16.4.1.3 Site Markers

The site has two granite site markers. Site marker SMK-1 is just inside the west gate and contains minor cracks in its concrete base. SMK-1 cracks were sealed in 2023. Site marker SMK-2 is on the top slope of the disposal cell and is stable and legible. No maintenance needs were identified.

16.4.1.4 Survey and Boundary Monuments

Three survey monuments and six boundary monuments delineate the property boundary. Two additional boundary monuments are offsite; monitoring of these offsite monuments was discontinued in 2003. In 2002, boundary monument BM-1 was destroyed or removed by an adjacent landowner. It was replaced, and two reference monuments (RM-1 and RM-2) were installed next to it in 2003. Steel T-posts were installed next to all boundary monuments, as well as spray-painted rocks, to make them more visible and help inspectors locate them. The concrete at survey monument SM-1 was repaired. All survey and most boundary monuments were observed to be clear of vegetation and trash. Boundary monument BM-2 was cleared of vegetation and trash following the inspection (PL-2). No other maintenance needs were identified.

16.4.1.5 Aerial Survey Quality Control Monuments

Two aerial survey quality control monuments are present at the site and were inspected during the 2023 annual inspection (PL-3). No maintenance needs were identified.

16.4.1.6 Erosion Control Markers

The site has pairs of erosion control markers (1/1A, 2/2A, 3/3A, and 5/5A) along the edge of the terrace escarpment. Erosion control markers 4/4A are not inspected; they were installed on the terrace east of the site in the gravel pit. Erosion control marker 5A, which is near the east entrance gate, was previously bent by a vehicle, but it is functional and does not require repair. No maintenance needs were identified.

16.4.2 Inspection Areas

In accordance with the LTSP, the site is divided into three areas to ensure a thorough and efficient inspection. The inspection areas are (1) the disposal cell, diversion channels at the base of the disposal cell, and the outflow channel; (2) the terrace area north and northeast of the disposal cell; and (3) the outlying area, which includes the fenced evaporation pond south of the disposal cell and the former gravel pit southwest of the disposal cell. Inspectors examined site-specific surveillance features within each area and looked for evidence of erosion, settling, slumping, or other modifying processes that might affect the site’s conformance with LTSP requirements.

16.4.2.1 Disposal Cell, Diversion Channels, and Outflow Channel

The disposal cell, completed in 1986, occupies 77 acres and is armored in riprap to control erosion and deter animal and human intrusion. There was no evidence of erosion, settling, slumping, rock degradation, or other modifying processes that might affect the integrity of the disposal cell. Piezocones installed on the disposal cell cover that were associated with a research project are no longer in use. Some of the filled piezocone pits have subsided slightly or were never completely backfilled, which resulted in shallow conical depressions in the cover. As reported in previous site inspection reports, the surface of the disposal cell has numerous ruts associated with past vehicle traffic. An area where smaller riprap is exposed along the northern ridge of the disposal cell is monitored each year to detect possible changes that might indicate erosion or degradation of the cover (PL-4). The inspectors observed no changes in this area in 2023. The condition of other depressions and vehicle ruts is monitored annually and has not changed significantly since the 2014 inspection.

Windblown sediment has accumulated in the rock cover in several places. In accordance with the LTSP, woody, deep-rooted shrubs are controlled. Several woody shrubs found on the top and side slopes of the disposal cell were treated (PL-5).

Diversion channels around the base of the disposal cell contained scattered vegetation, including several woody shrubs. The channel along the southwestern side of the disposal cell has accumulated sediment, and a significant amount of vegetation has grown. Inspectors noted that nonwoody plants were growing within the outflow channel, and woody vegetation was growing on the banks of the outflow channel. Vegetation growth does not adversely affect the performance of any of these channels at this time and is not a concern; however, inspectors will continue to monitor this area. No other maintenance needs were identified.

16.4.2.2 Terrace Area

The terrace area is north and northeast of the disposal cell along the top of a steep escarpment. Other than annual weeds, little vegetation grows on the terrace. The edge of the escarpment varies between 175 and 345 feet from the base of the disposal cell and is prone to slumping. No new significant erosion was evident during the 2023 inspection. The LTSP states that the base of the terrace escarpment should be inspected for signs of seepage, and seeps were identified during previous site inspections. However, this is no longer part of the annual inspection, as the seeps are now monitored as part of the groundwater compliance program for the site. No maintenance needs were identified.

16.4.2.3 Outlying Area

The area 0.25 mile beyond the site boundary was visually observed for erosion, changes in land use, or other phenomena that might affect the long-term integrity of the site. No such impacts were observed. A former gravel pit that is no longer actively extracting aggregate is immediately southeast of the disposal cell. Inspectors identified no significant changes in land use associated with the gravel pit or with other outlying areas near the disposal cell during the 2023 inspection.

In 2002, LM constructed an 11-acre lined evaporation pond near the disposal cell as part of the groundwater compliance strategy. The pond, surrounded by a chainlink security fence, is maintained under the groundwater compliance program. The security fence was intact and functional at the time of the inspection. A quarterly inspection of the pond liner is conducted by a geotechnical engineer to identify any other potential issues that may arise. Water levels are monitored during the workweek to determine whether any actions need to be taken (PL-6). Torn areas in the erosion control fabric on the banks of the lower outflow channel were repaired prior to the inspection (PL-7).

Fences and warning signs posted in Bob Lee Wash are maintained under the groundwater compliance program and were not examined during the 2023 annual inspection. No maintenance needs were identified.

16.5 Follow-Up or Contingency Inspections

LM will conduct follow-up or contingency inspections if (1) a condition is identified during the annual inspection or other site visit that requires a return to the site to evaluate the condition or (2) LM is notified by a citizen or outside agency that conditions at the site are substantially changed. No need for a follow-up or contingency inspection was identified.

16.6 Maintenance and Repairs

Previous inspections have identified the following minor maintenance need that was not completed because of prior travel restrictions but will be conducted before the next inspection:

- Replacing faded pictorial signs and updating information on perimeter signs

Previous inspections have identified the following minor maintenance needs that were addressed following the 2023 inspection:

- Continuing to remove trash and debris (including tumbleweeds) along the perimeter fence
- Treating deep-rooted woody shrubs on the top and side slopes of the disposal cell

Inspectors noted the following additional maintenance need during the 2023 inspection and it was completed following the 2023 inspection:

- Boundary monument BM-2 cleared of vegetation and trash

16.7 Environmental Monitoring

16.7.1 Groundwater Monitoring

In accordance with the LTSP, groundwater monitoring to evaluate disposal cell performance is not required. However, groundwater monitoring is conducted in accordance with a groundwater compliance strategy. The monitoring wells associated with the groundwater compliance strategy (i.e., along the terrace and at offsite locations) are not included in the annual inspection process. All wells observed during the inspection were locked, and no maintenance needs were identified.

16.7.2 Vegetation Monitoring

In a 1999 letter to the Navajo Nation Abandoned Mine Lands (AML) Reclamation/Uranium Mill Tailings Remedial Action department (Bergman-Tabbert 1999), LM committed to spraying annual weeds on the disposal cell top slope. Annual weeds typically have grown on less than 1% of the top slope. After discussion among LM, Navajo Nation AML, and LMS ecologists in 2019, LM recommended that it cease treatment of nonnoxious weeds on the cell and allow natural plant succession to progress. In 2019, LM wrote to Navajo Nation AML outlining its proposed vegetation management plan (Kautsky 2019). Under the plan, LM will continue to treat weeds listed as noxious by the State of New Mexico and the Navajo Nation (primarily *Halogeton glomeratus*) in accordance with applicable laws. Deep-rooted woody species will be treated in accordance with the LTSP. Vegetation will continue to be monitored and treated accordingly to inform future management decisions.

16.8 Corrective Action

Corrective action is taken to correct out-of-compliance or hazardous conditions that create a potential health and safety problem or that may affect the integrity of the disposal cell or compliance with 40 CFR 192. No need for corrective action was identified.

16.9 References

10 CFR 40.27. U.S. Nuclear Regulatory Commission, "General License for Custody and Long-Term Care of Residual Radioactive Material Disposal Sites," *Code of Federal Regulations*.

40 CFR 192. U.S. Environmental Protection Agency, "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings," *Code of Federal Regulations*.

Bergman-Tabbert, 1999. D. Bergman-Tabbert, site manager, Office of Legacy Management, U.S. Department of Energy, letter (about the Shiprock Uranium Mill Tailings Remedial Action Site) to Madeline Roanhorse, director, Navajo Nation UMTRA Program Division of Natural Resources, May 13.

DOE (U.S. Department of Energy), 1994. *Long-Term Surveillance Plan for the Shiprock Disposal Site, Shiprock, New Mexico*, DOE/AL/62350-60F, Rev. 1, September.

Kautsky, 2019. Mark Kautsky, UMTRCA Title I manager, Office of Legacy Management, U.S. Department of Energy, letter (about Updated Agreement for Vegetation Control on the Shiprock Disposal Cell) to Madeline Roanhorse, director, Navajo Nation UMTRA Program Division of Natural Resources, October 10.

16.10 Photographs

Photograph Location Number	Azimuth	Photograph Description
PL-1	290	Perimeter Sign P1
PL-2	219	Boundary Monument BM-2 with Vegetation and Trash
PL-3	219	Quality Control Monument QC-2
PL-4	15	Smaller Riprap Exposed Along Northern Ridge of Disposal Cell Top Slope
PL-5	17	Treated Vegetation on Side Slope
PL-6	180	Evaporation Pond Liner
PL-7	70	Repaired Erosion Control Fabric

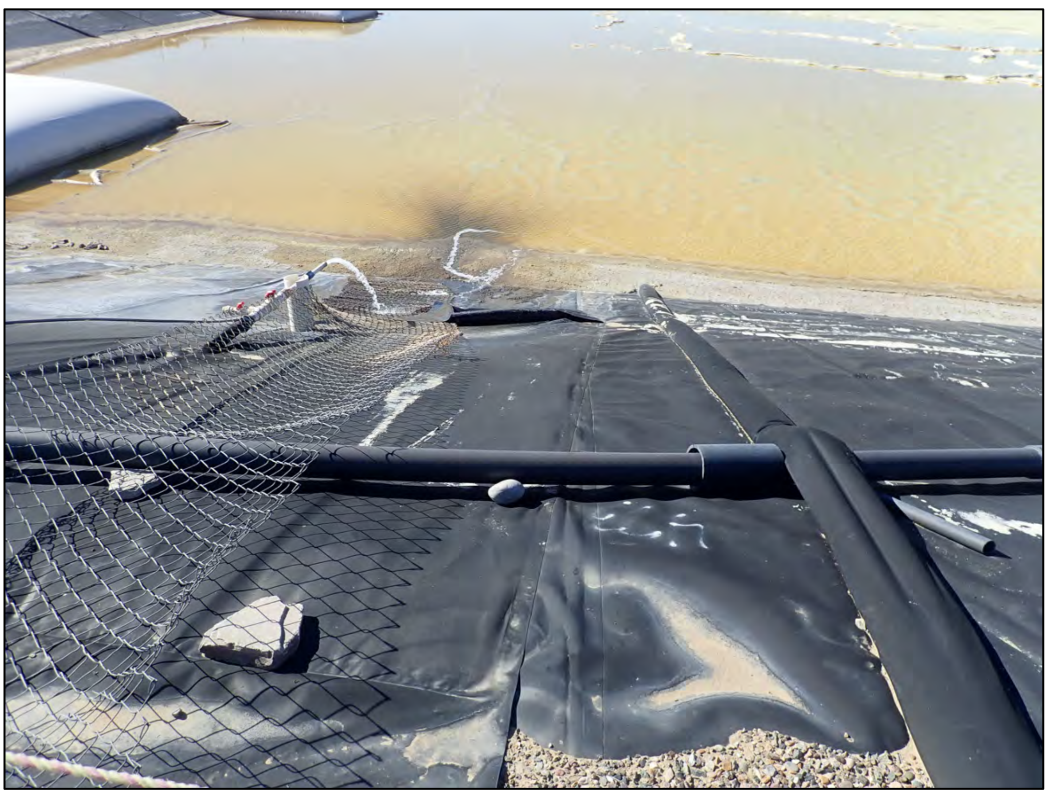
PL-1. Perimeter Sign P1

PL-2. Boundary Monument BM-2 with Vegetation and Trash

PL-3. Quality Control Monument QC-2

PL-4. Smaller Riprap Exposed Along Northern Ridge of Disposal Cell Top Slope

PL-5. Treated Vegetation on Side Slope



PL-6. Evaporation Pond Liner

PL-7. Repaired Erosion Control Fabric

17.0 Slick Rock, Colorado, Disposal Site

17.1 Compliance Summary

The Slick Rock, Colorado, Uranium Mill Tailings Radiation Control Act (UMTRCA) Title I Disposal Site was inspected on May 5, 2023. No changes were observed on the disposal cell or in the associated drainage features. Inspectors identified routine maintenance needs but found no cause for a follow-up or contingency inspection. Groundwater monitoring is not required.

17.2 Compliance Requirements

Requirements for the long-term surveillance and maintenance of the site are specified in the site-specific Long-Term Surveillance Plan (DOE 1998) (LTSP) in accordance with procedures established to comply with the requirements of the U.S. Nuclear Regulatory Commission (NRC) general license at Title 10 *Code of Federal Regulations* Section 40.27 (10 CFR 40.27). Table 17-1 lists these requirements. A revised LTSP is currently under review by NRC.

Table 17-1. License Requirements for the Slick Rock, Colorado, Disposal Site

Requirement	LTSP	This Report	10 CFR 40.27
Annual Inspection and Report	Sections 3.0 and 6.2	Section 17.4	(b)(3)
Follow-Up Inspections	Section 3.4	Section 17.5	(b)(4)
Maintenance and Repairs	Section 4.0	Section 17.6	(b)(5)
Groundwater Monitoring	Section 2.5	Section 17.7	(b)(2)
Corrective Action	Section 5.0	Section 17.8	--

17.3 Institutional Controls

The 62-acre site, identified by the property boundary shown in Figure 17-1, is owned by the United States and was accepted under the NRC general license in 1998. The U.S. Department of Energy (DOE) is the licensee and, in accordance with requirements for UMTRCA Title I sites, the Office of Legacy Management (LM) is responsible for the custody and long-term care of the site. Institutional controls (ICs) at the site include federal ownership of the property, administrative controls, and the following physical ICs that are inspected annually: the disposal cell and associated drainage features, entrance gate and sign, perimeter fence and signs, site markers, and survey and boundary monuments, and aerial survey quality control monuments.

17.4 Inspection Results

The site, 5 miles northeast of Slick Rock, Colorado, was inspected on May 5, 2023. The inspection was conducted by K. Meadows, L. Sheader, and L. Martin of the Legacy Management Support contractor. M. Hurt from LM and M. Cosby from the Colorado Department of Public Health and Environment were also in attendance. The purposes of the inspection were to confirm the integrity of visible features at the site, identify changes in conditions that might affect conformance with the LTSP, and evaluate whether maintenance or follow-up inspection and monitoring are needed.

17.4.1 Site Surveillance Features

Figure 17-1 shows the locations of site features, including site surveillance features and inspection areas, in black and gray font. Some site features that are present but not required to be inspected are shown in italic font. Observations from previous inspections that are currently monitored are shown in blue, and new observations identified during the 2023 annual inspection are shown in red. Inspection results and recommended maintenance activities associated with site surveillance features are described in the following subsections. Photographs to support specific observations are noted in the text and in Figure 17-1 by photograph location (PL) numbers. The photographs and photograph log are presented in Section 17.10.

17.4.1.1 Entrance Gate and Sign

Access to the site is from San Miguel County Road T11. Entrance to the site is through a chained and locked gate. The entrance gate was locked and is worn but remains functional. The entrance sign is next to the gate (PL-1). No maintenance needs were identified.

17.4.1.2 Perimeter Fence and Signs

A four-strand wire perimeter fence encloses the disposal cell, drainage structures, and much of the site. The top and bottom strands are smooth wire to allow wildlife to pass over and under, and the middle two strands are barbed wire.

Inspectors continued to monitor rills and gullies noted in previous inspections that were expanding on the southwest side of the site from the apron area extending to the fence line between perimeter signs P30 and P32. The gullies and rills terminate into the culvert along San Miguel County Road T11. Erosion that was observed along the fence line along County Road T11 has undercut the fence posts, making them unstable (PL-2). In addition, a small gully was observed forming parallel to the western fence line (PL-3). Stabilization of the fence posts was completed after the inspection. No other maintenance needs were identified.

There are 32 perimeter signs, attached to steel posts set in concrete, positioned along the property boundary; they are set back 5 feet (ft) from the boundary and cut in at the southwest corner. The printed overlay is cracked on perimeter sign P27 and was replaced following the inspection. The concrete bases on perimeter signs P14 and P15 are slightly undercut by erosion but remain stable. No other maintenance needs were identified.

17.4.1.3 Site Markers

The site has two granite site markers. Site marker SMK-1 is just inside the entrance gate, and site marker SMK-2 is on top of the disposal cell (PL-4). Rills and gullies identified in Section 17.4.1.2 includes erosion near site marker SMK-1. This area was repaired following the inspection (PL-5). No maintenance needs were identified.

17.4.1.4 Survey and Boundary Monuments

The site has three survey monuments. Six boundary monuments delineate the corners of the site boundary (PL-6). No maintenance needs were identified.

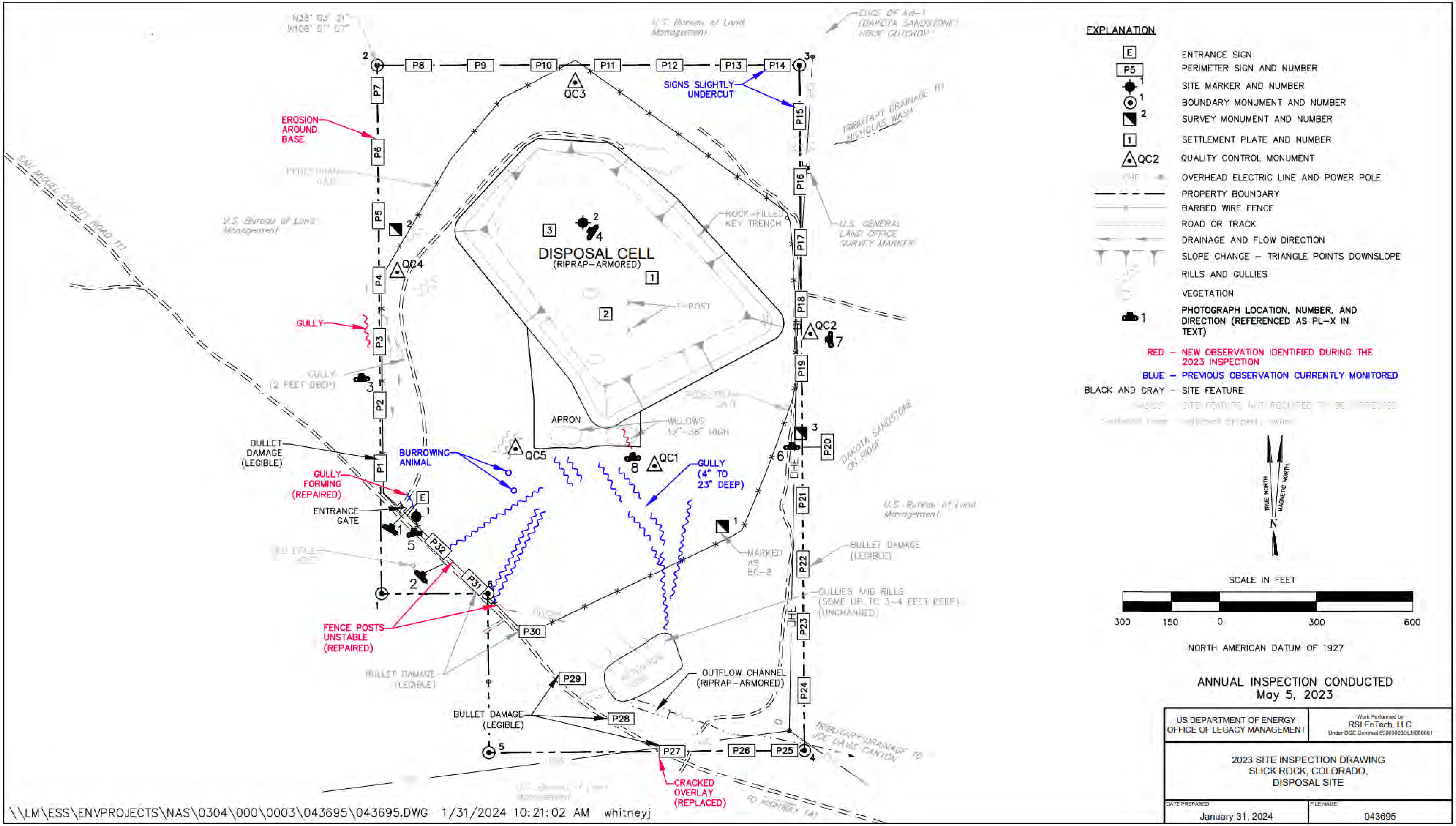


Figure 17-1. 2023 Annual Inspection Drawing for the Slick Rock, Colorado, Disposal Site

17.4.1.1 Aerial Survey Quality Control Monuments

The site has five aerial survey quality control monuments (PL-7). No maintenance needs were identified.

17.4.2 Inspection Areas

In accordance with the LTSP, the site is divided into three sections to ensure a thorough and efficient inspection. The inspection areas are (1) the disposal cell, including side slopes, key trench, and apron; (2) the area between the disposal cell and the site boundary; and (3) the outlying area. Inspectors examined specific site surveillance features within each area and looked for evidence of erosion, settling, slumping, or other modifying processes that might affect the site's conformance with LTSP requirements.

17.4.2.1 Disposal Cell, Key Trench, and Apron

The disposal cell, completed in 1996, occupies 12.9 acres and is armored with riprap, consisting of rounded, cobble-sized river rock, to control erosion and deter animal and human intrusion. The inspection found no evidence of erosion, settling, slumping, rock degradation, or other modifying processes that might affect the integrity of the disposal cell. Several patches of grass are growing on the top of the disposal cell but do not require treatment. No maintenance needs were identified.

At the toe of the disposal cell side slopes is a key trench that encloses the disposal cell. The key trench, designed to convey stormwater runoff away from the disposal cell, is approximately 5 ft deep and 20 ft wide and filled with rock. Stormwater runoff from the key trench discharges to an apron at the south (downslope) corner of the disposal cell. The apron extends 50 to 200 ft beyond the key trench. The key trench and apron are covered with rounded cobble- and pebble-sized river rock. Willows (a deep-rooted species) growing on a portion of the apron are not considered harmful to the integrity of the disposal cell. Gullies are forming near the apron but are not considered detrimental to the integrity of the disposal cell (PL-8). No maintenance needs were identified.

17.4.2.2 Area Between the Disposal Cell and the Site Boundary

The area around the disposal cell includes a stormwater retention pond. Surface drainage from the disposal cell flows south from the apron into the retention pond, which is constructed in a channel tributary that drains to Joe Davis Canyon. An outflow channel below the pond is lined with rounded riprap for a short distance. The pond was filled with water at the time of inspection.

The site was originally graded for sheet flow from the apron to the retention pond. Rills have been developing since 1998 on the northwest side of the retention pond and now are 3 ft deep or deeper adjacent to the pond and shallower farther upslope. Most of the rills have stabilized or are stabilizing. Deeper gullies identified in the 2020 inspection have not grown significantly since the previous inspection and do not threaten the integrity of the disposal cell. No maintenance needs were identified.

Vegetation in the reclaimed areas were healthy. Noxious weeds are controlled regularly to comply with state and county requirements. No maintenance needs were identified.

17.4.2.3 Outlying Area

The area beyond the site boundary for 0.25 mile was visually observed for erosion, changes in land use, or other phenomena that might affect the long-term integrity of the site. No such impacts were observed. The natural, undisturbed areas outside the site support grass and scattered pinyon and juniper trees. Steep hillsides north and northeast of the site slope eastward into Nicholas Wash. The primary land use is grazing. The areas north and northeast of the site also are routinely used for cutting firewood and recreational uses, such as hunting and off-road all-terrain vehicle use.

17.5 Follow-Up Inspections

LM will conduct follow-up inspections if (1) a condition is identified during the annual inspection or other site visit that requires a return to the site to evaluate the condition or (2) a citizen or outside agency notifies LM that conditions at the site are substantially changed. No need for a follow-up inspection was identified.

17.6 Maintenance and Repairs

Inspectors noted several maintenance items that were repaired following the inspection, including the following:

- Stabilization of the fence posts between perimeter signs P30 to P32
- Repairs to the rills and gullies forming along site marker SMK-1 and extending to the fence line along County Road T11
- Replacement of perimeter sign P27

No other maintenance needs were identified.

17.7 Groundwater Monitoring

In accordance with the LTSP, groundwater monitoring at this site is not required. Groundwater at the site qualifies for supplemental standards because it is designated as limited use, a designation given to groundwater that is not a current or potential source of drinking water. In addition, the groundwater in the uppermost aquifer is designated as limited use because of low yield since the aquifer does not yield enough water to be used for beneficial purposes. Monitoring wells were abandoned in 2001, and T-posts were installed to indicate their former locations. The standpipes in the disposal cell were abandoned in 2002. The LTSP has been revised to reflect these changes and was accepted by NRC in December 2023.

17.8 Corrective Action

In accordance with the LTSP, corrective action is taken to correct conditions that threaten the integrity of the disposal cell in compliance with 40 CFR 192. No need for corrective action was identified.

17.9 References

10 CFR 40.27. U.S. Nuclear Regulatory Commission, "General License for Custody and Long-Term Care of Residual Radioactive Material Disposal Sites," *Code of Federal Regulations*.

40 CFR 192. U.S. Environmental Protection Agency, "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings," *Code of Federal Regulations*.

DOE (U.S. Department of Energy), 1998. *Long-Term Surveillance Plan for the Burro Canyon Disposal Cell Slick Rock, Colorado*, DOE/AL/62350-236, Rev. 0, Ver. 4, May.

17.10 Photographs

Photograph Location Number	Azimuth	Photograph Description
PL-1	31	Entrance Sign
PL-2	45	Gully Forming Under Fence Line Along County Road T11
PL-3	357	Small Gully Along Western Perimeter Fence
PL-4	333	Site Marker SMK-2
PL-5	350	Erosion Forming Around Survey Monument SMK-1
PL-6	—	Survey Monument SM-3
PL-7	268	Aerial Survey Quality Control Monument QC-2
PL-8	356	Gully near Apron Area

Note:
— = Photograph taken vertically from above.

PL-1. Entrance Sign

PL-2. Gully Forming Under Fence Line Along County Road T11

PL-3. Small Gully Along Western Perimeter Fence

PL-4. Site Marker SMK-2

PL-5. Erosion Forming Around Survey Monument SMK-1

PL-6. Survey Monument SM-3

PL-7. Aerial Survey Quality Control Monument QC-2

PL-8. Gully near Apron Area

18.0 Spook, Wyoming, Disposal Site

18.1 Compliance Summary

The Spook, Wyoming, Uranium Mill Tailings Radiation Control Act (UMTRCA) Title I Disposal Site was inspected on July 25, 2023. No changes were observed on the land surface of the disposal cell. Groundwater monitoring is not required.

18.2 Compliance Requirements

Requirements for the long-term surveillance and maintenance of the site are specified in the site-specific Long-Term Surveillance Plan (DOE 1993) (LTSP) in accordance with procedures established to comply with the requirements of the U.S. Nuclear Regulatory Commission (NRC) general license at Title 10 *Code of Federal Regulations* Section 40.27 (10 CFR 40.27). Table 18-1 lists these requirements.

Table 18-1. License Requirements for the Spook, Wyoming, Disposal Site

Requirement	LTSP	This Report	10 CFR 40.27
Annual Inspection and Report	Section 6.0	Section 18.4	(b)(3)
Follow-Up or Contingency Inspections	Section 7.0	Section 18.5	(b)(4)
Maintenance	Section 8.0	Section 18.6	(b)(5)
Groundwater Monitoring	Section 5.0	Section 18.7	(b)(2)
Corrective Action	Section 9.0	Section 18.8	--

18.3 Institutional Controls

The 14-acre site, identified by the property boundary shown in Figure 18-1, is owned by the United States and was accepted under the NRC general license in 1993. The U.S. Department of Energy (DOE) is the licensee and, in accordance with the requirements for UMTRCA Title I sites, the Office of Legacy Management (LM) is responsible for the custody and long-term care of the site. Institutional controls (ICs) at the site include federal ownership of the property, administrative controls, and the following physical ICs that are inspected annually: the disposal cell, entrance sign, perimeter signs, site markers, and survey and boundary monuments.

18.4 Inspection Results

The site, 48 miles northeast of Casper, Wyoming, was inspected on July 25, 2023. The inspection was conducted by J. Cario, M. Guziak, J. Hugo, and T. Santonastaso of the Legacy Management Support contractor. C. Boger (LM site manager) attended the inspection along with T. Johnson and M. LaFranzo (NRC). The purposes of the inspection were to confirm the integrity of visible features at the site, identify changes in conditions that might affect conformance with the LTSP, and evaluate whether maintenance or follow-up inspection and monitoring are needed.

18.4.1 Site Surveillance Features

Figure 18-1 shows the locations of site features, including site surveillance features and inspection areas, in black and gray font. Some site features that are present but not required to be inspected are shown in italic font. Observations from previous inspections that are currently monitored are shown in blue, and new observations identified during the 2023 annual inspection are shown in red. Inspection results and recommended maintenance activities associated with site surveillance features are described in the following subsections. Photographs to support specific observations are noted in the text and in Figure 18-1 by photograph location (PL) numbers. The photographs and photograph log are presented in Section 18.10.

18.4.1.1 Access Road and Entrance Sign

Access to the site is from Wyoming Highway 95 from Glenrock or Wyoming Highway 93 from Douglas to Converse County Road 31 and onto Hornbuckle Ranch Road. Site access is maintained through perpetual easements across the Hornbuckle Ranch. The graded, hard-packed road to the site is maintained by the ranch. The entrance sign is mounted on a steel post set in concrete. No maintenance needs were identified.

18.4.1.2 Perimeter Signs

There are 10 perimeter signs (PL-1) attached to steel posts set in concrete and positioned around the site outside the unfenced property boundary. The number sticker on perimeter sign P8 was missing and was replaced during the inspection. Perimeter sign P1 is plastic and warped but still legible. Soil around the concrete base of perimeter sign P3 is eroded but remains stable (PL-2). Perimeter sign P4 has headcutting occurring near it (PL-3) but it remains stable and does not affect the integrity of the sign. Inspectors will continue to monitor the erosion areas. No other maintenance needs were identified.

18.4.1.3 Site Markers

The site has two granite site markers. Site marker SMK-1 is at the south side of the disposal cell. Its concrete base is damaged due to spalling but is stable; there were no apparent changes from the previous year. Site marker SMK-2 is at the north side of the disposal cell has slight spalling occurring at the base (PL-4). This spalling is not affecting the integrity of the site marker. Inspectors will continue to monitor these erosion features. No maintenance needs were identified.

18.4.1.4 Survey and Boundary Monuments

The site has three survey monuments and eight boundary monuments. Boundary monument BM-6 is bent, and the base is eroded but stable (PL-5). The boundary monuments, survey monuments, and perimeter signs are outside the property boundary. The owner of the surrounding property (Hornbuckle Ranch) is aware that the monuments are on his property, but he is not concerned. However, in spring 2024, new boundary monuments will be installed in the correct locations and the original boundary monuments will be removed. No maintenance needs were identified.

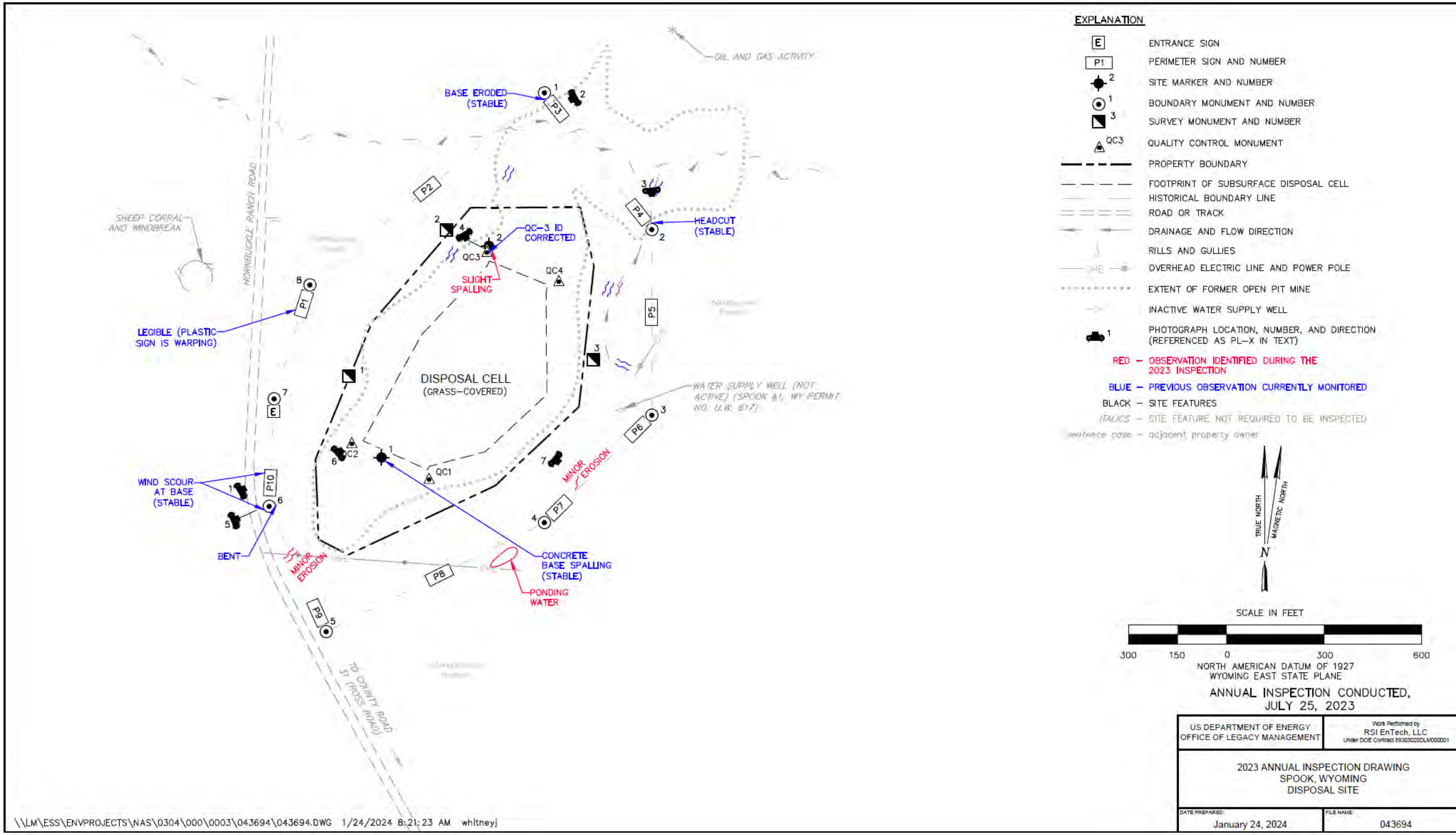


Figure 18-1. 2023 Annual Inspection Drawing for the Spook, Wyoming, Disposal Site

18.4.1.5 Aerial Survey Quality Control Monuments

Four aerial survey quality control (QC) monuments were inspected (PL-6). No maintenance needs were identified.

18.4.2 Inspection Areas

The site is divided into three inspection areas to ensure a thorough and efficient inspection. The inspection areas are (1) the disposal cell, (2) the site perimeter, and (3) the outlying area. Inspectors examined specific site surveillance features within each area, observed the condition of site vegetation, and looked for evidence of erosion, settling, slumping, or other modifying processes that might affect the site's conformance with the LTSP requirements.

18.4.2.1 Disposal Cell

The site is unique among Title I sites because the mill tailings were placed in the bottom of an open pit mine and covered with 40–60 feet of clean fill and topsoil. Therefore, many of the observations and concerns routinely associated with above-grade disposal cells—such as the quality of the riprap and the stability of side slopes—do not apply to this site. The ground surface over the 5-acre disposal cell, completed in 1989, showed no evidence of settling. Vegetation on the ground surface consisting of grasses and forbs, was healthy and indistinguishable from that growing on the remainder of the site and on the surrounding ranch land. No maintenance needs were identified.

18.4.2.2 Site Perimeter

There is no perimeter fence at the site. The area between the disposal cell and the site perimeter showed no evidence of settling or active erosion. No maintenance needs were identified.

18.4.2.3 Outlying Area

The area beyond the site boundary for a distance of 0.25 mile was visually observed for erosion, changes in land use, or other phenomena that might affect the long-term integrity of the site. No such impacts were observed. Inspectors noted erosion between perimeter signs P4 and P5, near perimeter sign P7 (PL-7), and below perimeter signs P9 and P10. These erosional areas are headcutting away from the direction of the disposal cell and pose no threat to the integrity of the disposal cell. The ephemeral drainage located north of the boundary is stable and well vegetated. A small area of ponding was identified near perimeter sign P8. Inspectors will continue to monitor those features that were identified in the 2023 inspection.

The access road has frequent truck traffic to service and maintain oil wells in the area. Although oil field activity has greatly increased near the site, inspectors found no evidence of trespassing or vandalism onsite. No maintenance needs were identified.

18.5 Follow-Up or Contingency Inspections

LM will conduct follow-up or contingency inspections if (1) a condition is identified during the annual inspection or other site visit that requires a return to the site to evaluate the condition or (2) LM is notified by a citizen or outside agency that conditions at the site are substantially changed. No need for a follow-up or contingency inspection was identified.

18.6 Maintenance

During the inspection, inspectors placed a new ID number sticker on perimeter sign P8. The label on quality control monument QC-3 was corrected prior to the inspection. No additional maintenance needs were identified.

18.7 Groundwater Monitoring

In accordance with the LTSP, groundwater monitoring is not required due to the application of supplemental standards. Groundwater at the site qualifies for supplemental standards because it is designated as limited use; this designation is given to groundwater that is not a current or potential source of drinking water. Groundwater in the uppermost aquifer is designated as limited use because it contains contamination from widespread, naturally occurring uranium mineralization and is of limited yield. Therefore, groundwater monitoring is not required.

18.8 Corrective Action

In accordance with the LTSP, corrective action is taken to correct conditions that threaten the integrity of the disposal cell or compliance with 40 CFR 192. No need for corrective action was identified.

18.9 References

10 CFR 40.27. U.S. Nuclear Regulatory Commission, "General License for Custody and Long-Term Care of Residual Radioactive Material Disposal Sites," *Code of Federal Regulations.*

40 CFR 192. U.S. Environmental Protection Agency, "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings," *Code of Federal Regulations.*

DOE (U.S. Department of Energy), 1993. *Final Long-Term Surveillance Plan for the Spook, Wyoming, Disposal Site*, UMTRA-DOE/AL-350215.0000, January.

18.10 Photographs

Photograph Location Number	Azimuth	Photograph Description
PL-1	60	Perimeter Sign P10
PL-2	240	Perimeter Sign P3 with Headcutting
PL-3	175	Perimeter Sign P4 with Headcutting
PL-4	150	Granite Site Marker SMK-2
PL-5	65	Boundary Monument BM-6
PL-6	50	Quality Control Monument QC-2
PL-7	130	Erosion Gully near Perimeter Sign P7 in Outlying Area

PL-1. Perimeter Sign P10

PL-2. Perimeter Sign P3 with Headcutting

PL-3. Perimeter Sign P4 with Headcutting

PL-4. Granite Site Marker SMK-2

PL-5. Boundary Monument BM-6

PL-6. Quality Control Monument QC-2

PL-7. Erosion Gully near Perimeter Sign P7 in Outlying Area

19.0 Tuba City, Arizona, Disposal Site

19.1 Compliance Summary

The Tuba City, Arizona, Uranium Mill Tailings Radiation Control Act (UMTRCA) Title I Disposal Site was inspected on May 2, 2023. No significant changes were observed on the disposal cell or in the associated drainage features. Inspectors identified maintenance needs but found no cause for a follow-up inspection.

The U.S. Department of Energy (DOE) Office of Legacy Management (LM) conducts semiannual groundwater monitoring at the site to compare current conditions to baseline postconstruction groundwater quality. Evaluative groundwater monitoring is performed instead of normal point of compliance (POC) monitoring, as preexisting milling-related groundwater contamination may mask contamination leaching from the disposal cell. The most recent semiannual sampling events occurred in February and August 2023. The corresponding results are presented in Section 19.7.

19.2 Compliance Requirements

Requirements for the long-term surveillance and maintenance of the site are specified in the site-specific Long-Term Surveillance Plan (DOE 1996) (LTSP) in accordance with procedures established to comply with the requirements of the U.S. Nuclear Regulatory Commission (NRC) general license at Title 10 *Code of Federal Regulations* Section 40.27 (10 CFR 40.27). Table 19-1 lists these requirements.

Table 19-1. License Requirements for the Tuba City, Arizona, Disposal Site

Requirement	LTSP	This Report	10 CFR 40.27
Annual Inspection and Report	Section 6.0	Section 19.4	(b)(3)
Follow-Up Inspections	Section 7.0	Section 19.5	(b)(4)
Maintenance and Repairs	Section 8.0	Section 19.6	(b)(5)
Environmental Monitoring	Section 5.2	Section 19.7	(b)(2)
Corrective Action	Section 9.0	Section 19.8	—

19.3 Institutional Controls

The 145-acre site, defined by the property boundary shown in Figure 19-1, is held in trust by the U.S. Bureau of Indian Affairs. The Navajo Nation retains title to the land. UMTRCA authorized DOE to enter into a Cooperative Agreement (DE-FC04-85AL26731) with the Navajo Nation to perform remedial actions at the former uranium processing sites (DOE 1984). DOE and the Navajo Nation executed a Custodial Access Agreement that conveys to the federal government title to the residual radioactive materials stabilized at the site and ensures that DOE has perpetual access to the site.

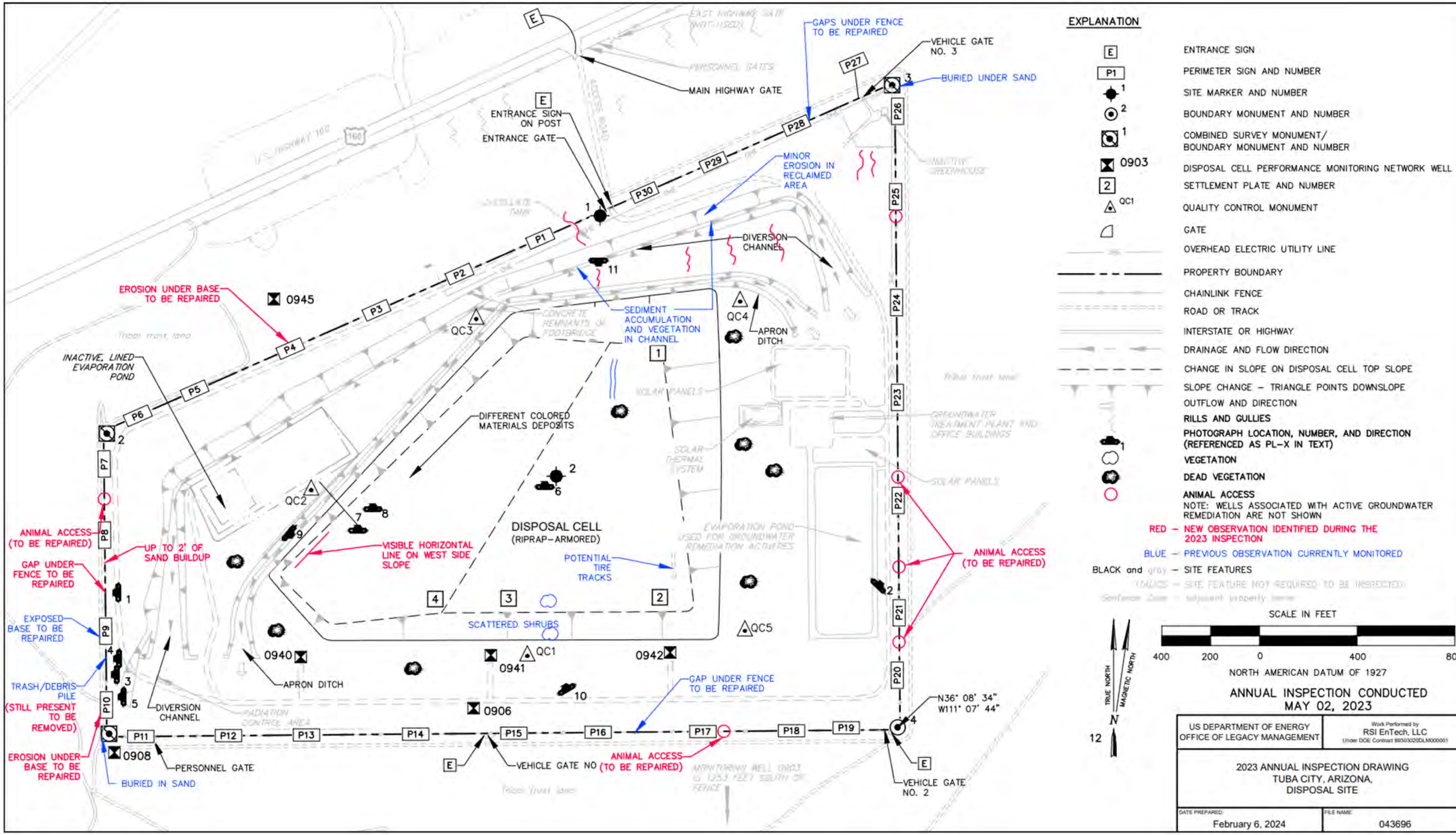


Figure 19-1. 2023 Annual Inspection Drawing for the Tuba City, Arizona, Disposal Site

The site was accepted under the NRC general license in 1996. DOE is the licensee and, in accordance with the requirements for UMTRCA Title I sites, LM is responsible for the custody and long-term care of the site. Institutional controls (ICs) at the site include federal custody of the disposal cell and its engineered features, administrative controls, and the following physical ICs that are inspected annually: the disposal cell and associated drainage features, entrance gate and sign, perimeter fence and signs, site markers, survey and boundary monuments, and wellhead protectors.

19.4 Inspection Results

The site, 6 miles northeast of Tuba City, Arizona, was inspected on May 2, 2023. The inspection was conducted by D. Marshall, H. Katz, and N. Lind of the Legacy Management Support contractor. B. Frazier (LM), M. De Lurdes Dinis (visitor of LM), R. Lamson (Hopi Tribe Department of Natural Resources, Office of Mining and Mineral Resources), D. Scott (Tuba City Chapter), and N. Baheshone (Diné Uranium Remediation Advisory Commission) also attended the inspection. The purposes of the inspection were to confirm the integrity of visible features at the site, identify changes in conditions that might affect conformance with the LTSP, and evaluate whether maintenance or follow-up inspection and monitoring are needed.

19.4.1 Site Surveillance Features

Figure 19-1 shows the locations of site features, including site surveillance features and inspection areas, in black and gray font. Some site features that are present but not required to be inspected are shown in italic font. Observations from previous inspections that are currently monitored are shown in blue, and new observations identified during the 2023 annual inspection are shown in red. Inspection results and recommended maintenance activities associated with site surveillance features are described in the following subsections. Photographs to support specific observations are noted in the text and in Figure 19-1 by photograph location (PL) numbers. The photographs and photograph log are presented in Section 19.10.

19.4.1.1 Access Road, Entrance Gates, and Entrance Signs

Access to the site is from U.S. Highway 160. Perpetual access to the site is granted by the Custodial Access Agreement. A gate in a chainlink fence on the main highway right-of-way (Figure 19-1) allows access to the site via a gravel road. The entrance gate is in the inner chainlink perimeter fence between perimeter signs P1 and P30. Both gates were operational at the time of the inspection. Vehicle gates are also present in the northeast corner of the site and along the southern fence line to facilitate access for offsite activities. All gates were secured and functional.

Entrance signs are posted on the main highway gate, near the entrance gate, and on two vehicle gates (No. 1 and No. 2). Vehicle Gate No. 3, in the northeast corner of the site, purposefully does not have a sign. An informational sign exists on the main entrance gate. No maintenance needs were identified.

19.4.1.2 Perimeter Fence and Signs

A chainlink perimeter fence encloses the site. Windblown sand and tumbleweeds regularly accumulate along the perimeter fence line. Wind scouring also occurs, which results in gaps under the fence (PL-1). Also noted are several gaps under the fence from animal access (PL-2). These areas will be repaired before the next inspection. A sediment deposition gage was installed before the annual inspection. It should be read every year to quantify sand deposition (PL-3). Trash and debris have accumulated outside the fence near perimeter sign P9 (P-4). The debris will be removed following the inspection.

Thirty pairs of perimeter signs, designated P1 through P30, are attached to steel posts set in concrete directly inside and along the perimeter fence. One of the sign pairs is textual, and the other is pictorial. The base of perimeter signs P4, P9, and P10 were undercut by wind erosion and will be repaired following the inspection (PL-5). Two faded signs that warn of high voltage near perimeter sign P12 were replaced before the inspection. No other maintenance needs were identified.

19.4.1.3 Site Markers

The site has two granite site markers. Site marker SMK-1 is just inside the entrance gate, and site marker SMK-2 is on the top slope of the disposal cell (PL-6). No maintenance needs were identified.

19.4.1.4 Survey and Boundary Monuments

One boundary monument and three combined survey and boundary monuments delineate the corners of the site. Combined survey and boundary monuments SM/BM-1 and SM/BM-3 tend to get covered with windblown sand and are marked with steel T-posts. All other survey and boundary monuments were located and in good condition. No maintenance needs were identified.

19.4.1.5 Aerial Survey Quality Control Monuments

Five aerial survey quality control monuments were located and in good condition (PL-7). No maintenance needs were identified.

19.4.1.6 Monitoring Wells

Seven monitoring wells (wells 0903, 0906, 0908, 0940, 0941, 0942, and 0945) constitute the disposal cell performance monitoring network. Monitoring wells 0906, 0908, 0940, 0941, and 0942 are inside or immediately outside the perimeter fence. Inspectors checked the wellhead protectors (with the exception of wells 0903 and 0945, which are offsite). All were found to be undamaged and locked. No other maintenance needs were identified.

19.4.2 Inspection Areas

In accordance with the LTSP, the site is divided into three inspection areas (referred to as “transects” in the LTSP) to ensure a thorough and efficient inspection. The inspection areas are (1) the disposal cell, (2) the area between the disposal cell and the site boundary, and (3) the outlying area. Inspectors examined specific site surveillance features within each area and looked for evidence of erosion, settling, slumping, or other modifying processes that might affect the site's conformance with LTSP requirements.

19.4.2.1 Disposal Cell

The disposal cell, completed in 1989, occupies 50 acres. The disposal cell is armored with riprap to control erosion and deter animal and human intrusion. Inspectors confirmed parallel tracks on the top slope of the disposal cell that were reported in previous annual reports. An evaporative mineral, caused by water pooling and subsequent evaporation, on top of windblown deposited sediment within riprap matrixes was noted on the top of the disposal cell (PL-8). These areas will continue to be monitored. There was no evidence of erosion, settling, slumping, or other modifying processes on the disposal cell.

The riprap-covered side slopes were in good condition. There were visible horizontal channels along the southwest slopes (PL-9). The channels are most likely formed from surface flow from melting snow cover or precipitation, or both. These features do not currently pose a threat to the integrity of the disposal cell; however, continued monitoring is recommended to ensure that erosion features do not create any problems that could undermine the soil and rock interface or the rock side slope below.

In accordance with the LTSP, deep-rooted vegetation is controlled to prevent potential penetration of the radon barrier. Windblown sediments continue to accumulate on the rock-covered surfaces, providing a favorable environment for plant growth. Periodic spot application of herbicide has been effective in controlling deep-rooted vegetation growth on the disposal cell cover. No deep-rooted shrubs were observed on top of the disposal cell, but some shrubs have become established on the side slopes (PL-10), as noted in previous inspections. This area will continue to be monitored. No maintenance needs were identified.

19.4.2.2 Area Between the Disposal Cell and the Site Boundary

The disposal cell is protected from stormwater runoff by a disposal cell apron ditch and a diversion channel, both of which are armored with riprap run along the north and northwest sides of the disposal cell. Windblown sand and vegetation accumulate in the apron ditch and the diversion channel along the north and northwest sides of the disposal cell. The sand deposition and associated vegetation establishment have not adversely affected the performance of these structures.

The north slope above the diversion channel consists of noncohesive sandy soil and is subject to erosion from stormwater runoff. Erosion repair conducted in this area in 2013 reduced the rate of erosion and subsequent soil deposition in the channel. Some erosion and deposition continue near the northeast corner of the diversion channel—an erosion gully and soil accumulation were observed (PL-11). Erosion will be monitored, and erosion control repairs will be performed as needed.

Similar to last year, inspectors noted that much of the woody vegetation, in reclaimed areas around the disposal cell was dead. In 2022, these areas were of concern to tribal officials (Mr. Honie) as they could present a potential fire hazard. The dead vegetation will be removed before the next inspection to reduce potential fire hazards at the site.

Two of the three evaporation ponds near the northwest side of the disposal cell were removed in 2007. The area was reclaimed and seeded with a native seed mix in 2007 and again in 2013.

The remaining historical evaporation pond, containing windblown sand and evaporites, is retained as a backup for the main evaporation pond on the east side of the site. The steel cable and caution signs surrounding the pond and the high-density polyethylene liner were intact. What was previously thought to be a plastic geofabric that stabilizes the south-facing slope of the pond is actually the geocell erosion-prevention grid. The visual exposure is the grid material. Vegetation was establishing in the geocells, and the slope is stable. Inspectors will continue to monitor this area. No other maintenance needs were identified.

Erosional gullies were noted along the northern perimeter fence. These gullies are originating near the main highway and are most prominent between the highway and the inner chainlink perimeter fence. This erosional area will be monitored but does not currently affect the integrity of the disposal cell. No maintenance needs were identified.

There are multiple structures and features associated with the former groundwater treatment system. Beginning in 2002, contaminated groundwater was extracted and treated through ion-exchange and distillation processes then returned to the aquifer through an infiltration trench upgradient of the disposal cell. Operation of the groundwater treatment plant (GWTP) was suspended in September 2014 due to hydrologic constraints on extraction and maintenance challenges. The structures associated with the GWTP remain onsite and include a Control Building; Lab and Shop Building; ion-exchange building, external tanks, and distillation skid; solar water-heating system; two photovoltaic panel arrays for utility power generation; evaporation ponds; network of extraction, injection, and monitoring wells; and treated water infiltration trench. An inactive greenhouse previously associated with the site was removed in 2023. No maintenance needs were identified.

19.4.2.3 Outlying Area

The 0.25-mile area beyond the site boundary was visually observed for erosion, changes in land use, or other phenomena that might affect the long-term integrity of the site. No evidence of changed land use or maintenance needs were identified.

19.5 Follow-Up Inspections

LM will conduct follow-up inspections if (1) a condition is identified during the annual inspection or other site visit that requires a return to the site to evaluate the condition or (2) LM is notified by a citizen or outside agency that conditions at the site are substantially changed. No need for a follow-up inspection was identified.

19.6 Maintenance and Repairs

The following maintenance items that were identified in the 2022 inspection will be completed before the next inspection:

- Repair the gaps in the fence near perimeter signs P9, P16, and P28
- Implement habitat enhancements to reduce potential fire hazards at the site

Installation of the sand deposition gage at perimeter sign P9 was completed before the inspection.

Inspectors noted the following maintenance items in 2023 that will be completed before the next inspection:

- Repair the eroding base at perimeter signs P4, P9, and P10
- Remove the trash and debris near perimeter sign P9
- Repair the animal access areas along the eastern and southern perimeter fence

19.7 Environmental Monitoring

In accordance with the LTSP, semiannual groundwater monitoring is conducted at the locations shown in Figure 19-2 to compare current conditions at the site to baseline postconstruction groundwater quality. Groundwater quality beneath and downgradient of the disposal cell has been degraded by contamination from former uranium-processing activities. This preexisting milling-related contamination might mask contamination leaching from the disposal cell, which limits the effectiveness of normal POC groundwater monitoring as a reliable indicator of disposal cell performance (40 CFR 192 Subpart A).

19.7.1 Groundwater Monitoring Program

Instead of POC monitoring, groundwater monitoring is performed in accordance with Section 5.2.2 of the LTSP and is defined as evaluative monitoring. Evaluative monitoring is performed to "(1) evaluate trends in ground water quality, (2) monitor the downgradient extent of contamination in ground water, (3) analyze the impacts of transient drainage and surface runoff, and (4) assess the effects of ground water restoration measures associated with containing the contamination related to uranium processing activities" (DOE 1996). Evaluative groundwater monitoring was conducted in February and August 2023 at the locations shown in Figure 19-2. Before addressing the most recent results of the evaluative groundwater monitoring program, a summary of historical and current groundwater remediation approaches is warranted.

Groundwater remediation is being conducted by an active treatment system that includes the operation of extraction wells and discharge of extracted (contaminated) groundwater to the onsite evaporation pond for volume reduction. The progress of groundwater remediation is evaluated and reported routinely (typically annually), separate from this compliance reporting (e.g., DOE 2023b). The remediation approach has changed over the years, from the continuous high-volume pumping approach applied at the start of active remediation in 2002 to the short-duration, high-intensity pumping regime applied currently. Details of historical pumping regimes are addressed in recent groundwater remedy performance evaluations (DOE 2022; DOE 2023b).

Pumping tests were performed in 2017 to determine groundwater drawdown and recovery rates and to characterize variations in hydraulic conductivity. Results were reported in the *Interim Treatment System Evaluation Report, Tuba City, Arizona, Disposal Site* (DOE 2020). Since June 2018, the remediation system has operated in high-volume, short-duration campaigns during periods of highest potential for evaporative flux that typically begin in July and end in October. As many as 11 extraction wells are operating during this period. The annual extraction volume is currently constrained to about 5 million gallons due to the evaporation pond capacity and the average annual evaporation rate of the pond (DOE 2023b).

Note: Well 0942 was converted from a monitoring well to an extraction well in 2015.

Figure 19-2. Evaluative Groundwater Monitoring Network at the Tuba City, Arizona, Disposal Site

Seven wells (Figure 19-2 and Table 19-2) identified in the LTSP are monitored for four hazardous constituents: molybdenum, nitrate, selenium, and uranium (Table 19-2) (DOE 1996). As a baseline for cell performance evaluation, provisional upper baseline limits (UBLs) for the four constituents were calculated in accordance with the U.S. Environmental Protection Agency's *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Final Guidance* (EPA 1989) and documented in the LTSP (DOE 1996). The UBLs are listed in Table 19-3.

Table 19-2. LTSP Groundwater Monitoring Network at the Tuba City, Arizona, Disposal Site

Monitoring Well	Hydrologic Relationship	Monitoring Frequency
0903	Downgradient (offsite)	Annually
0906	Downgradient	Semiannually
0908	Downgradient	Semiannually
0940[a]	Downgradient	Semiannually
0941	Downgradient	Semiannually
0942[b]	Downgradient	No Longer Monitored[b]
0945	Upgradient (background)	Annually

Notes:
[a] Between August 2004 and February 2010, samples from well 0940 could not be obtained because of an insufficient volume of water. This explains the data gaps in Figure 19-3 through Figure 19-6.
[b] Well 0942 was converted from a monitoring well to an extraction well in 2015 and, therefore, has not been sampled since then.

Table 19-3. Provisional UBLs for Groundwater at the Tuba City, Arizona, Disposal Site

Constituent	Provisional UBL (mg/L)[a]	MCL (mg/L)[b]
Molybdenum	0.14	0.10
Nitrate (as nitrogen)	311[c]	10
Selenium	0.05	0.01
Uranium	1.17	0.044

Notes:
[a] As documented in the LTSP (DOE 1996).
[b] MCLs as listed in 40 CFR 192 Subpart A.
[c] UBL for nitrate as nitrogen converted from the original UBL cited in the LTSP.

Abbreviations:
MCL = maximum concentration limit
mg/L = milligrams per liter

UBLs were described in the LTSP as provisional because "baseline conditions were established for locations other than the disposal cell monitor wells." Establishing baseline conditions at wells 0906 and 0908 was conducted to determine "transient excursions from baseline conditions, potential chemical gradients between baseline and disposal cell locations, and stabilization of postclosure disposal cell hydrology" (DOE 1996). UBLs are concentrations that, with 95% confidence, would be exceeded less than 5% of the time during long-term monitoring if groundwater conditions near the monitoring well did not change.

Because the four constituents are present in tailings material, relatively mobile in groundwater, and found in low concentrations in background groundwater quality, exceedance of UBLs in more than 5% of sampling events over the long term could indicate that the disposal cell is not performing to design standards. However, the LTSP also notes that elevated concentrations could result from transient drainage of tailings fluid into the subsurface (directly beneath the cell) or from rainfall infiltrating through contamination in the unsaturated zone in the mill ponds area not covered by the disposal cell. Elevated concentrations attributed to transient drainage or infiltration would not be indicative of substandard performance for the cell.

Active groundwater remediation was anticipated when the LTSP was prepared in 1996, and it was expected that deviations from anticipated disposal cell performance could be detected even with ongoing groundwater remediation. However, the LTSP also noted that (1) POC sampling and analysis protocol to monitor cell performance could not be established until groundwater restoration was complete and (2) the LTSP would be revised at that time.

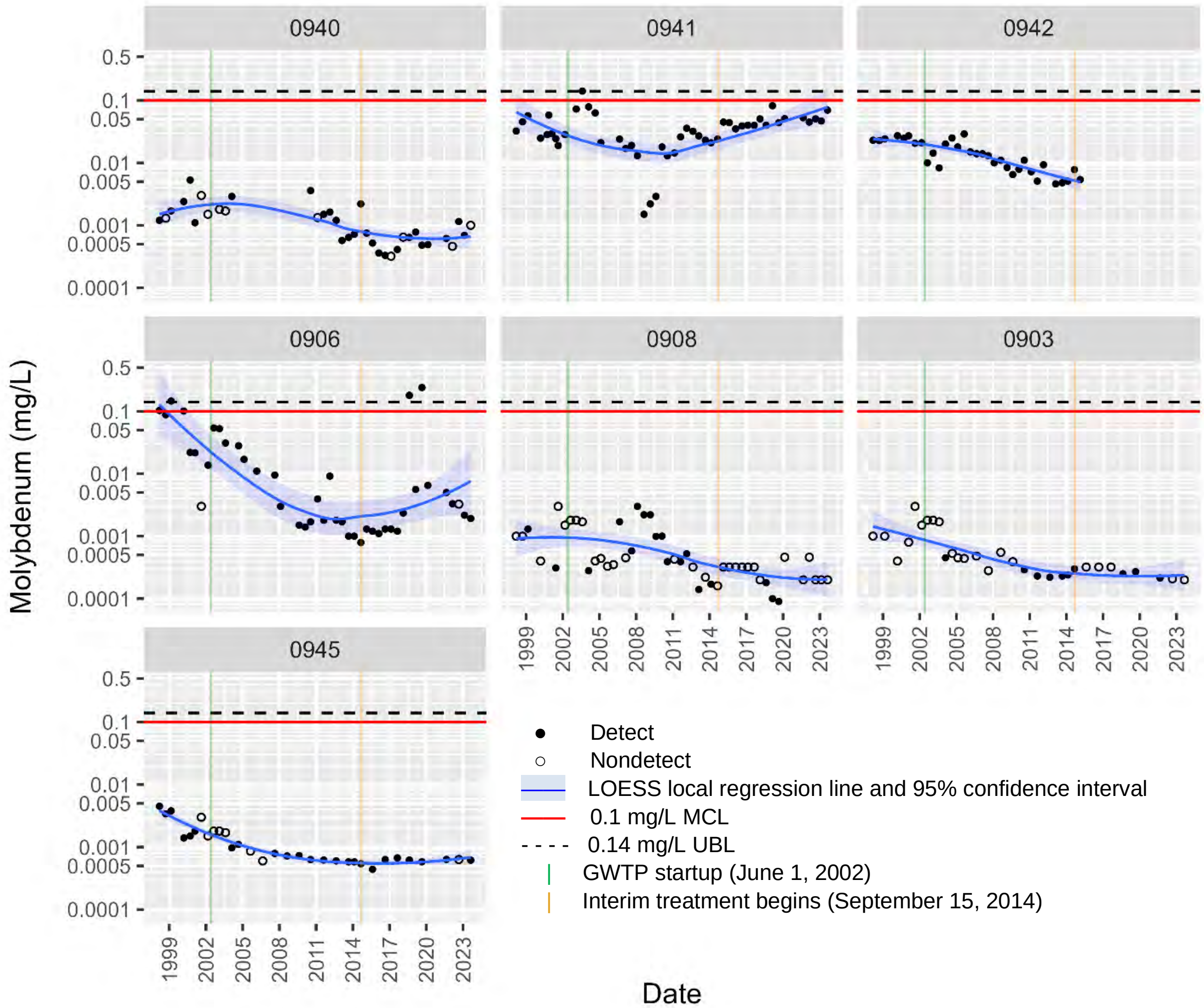
As noted in the LTSP, the UBL value should not be exceeded more than 5% of the time as long as conditions near the monitoring well do not change. Due to implementation of active remediation (2002–2014) and interim treatment (2015 to present), the conditions near the LTSP cell performance wells have constantly been affected, and exceedance of UBLs cannot be attributed to disposal cell performance. Recent operation of the interim treatment system, which potentially affects concentrations of target analytes in the LTSP-specified evaluative monitoring wells, is described in the following paragraphs.

19.7.2 Groundwater Monitoring Results

Figure 19-3 through Figure 19-6 show time-concentration plots for the four target analytes (molybdenum, nitrate, selenium, and uranium) along with corresponding UBLs and maximum concentration limits (MCLs). In these figures, data are plotted from 1998 to the present, consistent with the time frame evaluated in previous annual compliance reports (DOE 2023a). In each of these figures, downgradient wells (from Table 19-2) are ordered in the general direction of groundwater flow or the distance from the disposal cell (Figure 19-2). Data for the upgradient background well (0945) are plotted last. Interpretations of the analyte-specific data follow each figure.

Although data are plotted for the entire evaluative monitoring network, because well 0942 was converted from a monitoring well to an extraction well in 2015 (precluding sampling), corresponding trends are no longer discussed. All groundwater monitoring results for the site are reported and published on the LM Geospatial Environmental Mapping System (GEMS) website (https://gems.lm.doe.gov/#site=TUB). In this section, the MCLs shown are presented for informational purposes only. The LTSP requirement related to disposal cell performance is for evaluative monitoring over time, in comparison with the UBLs listed in Table 19-3.

In accordance with LTSP requirements to evaluate analyte concentration trends in the monitoring wells (Section 5.2.2 of DOE 1996), Mann-Kendall trend analysis was conducted for all analyte-well combinations to characterize the direction of the concentration trends. Table 19-4 identifies analyte-well combinations with statistically significant increasing (or decreasing) trends based on the full monitoring period addressed in Figure 19-3 through Figure 19-6 (1998–2023). To facilitate interpretation of more recent trends, Table 19-5 presents the same information, since interim treatment began (2015 to present).



Notes: Downgradient wells (from Table 19-2) are ordered in general direction of groundwater flow or distance from the disposal cell (Figure 19-2). Data for the upgradient background well are plotted last.
Abbreviations: LOESS = locally estimated scatterplot smoothing, mg/L = milligrams per liter

Figure 19-3. Time-Concentration Plots of Molybdenum in Groundwater at the Tuba City, Arizona, Disposal Site, 1998–2023

Since 1998, molybdenum concentrations have been mostly at or below the 0.14 milligram per liter (mg/L) UBL, and in most cases the 0.1 mg/L MCL, in all LTSP evaluative monitoring wells (Figure 19-3). The few exceptions apply to well 0906: 0.15 mg/L in February 1999 and 0.18–0.24 mg/L in 2018–2019. The latter spikes coincide with the short-duration, high-intensity pumping campaigns. Although a statistically significant decreasing trend is found for the 1998–2023 time frame (Table 19-4), molybdenum concentrations in well 0906 have been increasing since 2015 (Figure 19-3). That trend is not statistically significant, however (Table 19-5), and the most recent result, 0.0019 mg/L, is well below both the UBL and the MCL. Molybdenum concentrations in well 0941 have increased since 2015, accounting for the statistically significant trend overall, and are approaching the MCL (most recent result of 0.070 mg/L). Molybdenum concentrations in wells 0940, 0908, and 0903 have been comparable to concentrations in background well 0945. Most results for wells 0908 and 0903 have been below detection limits (Figure 19-3) (Table 19-4).

Table 19-4. Mann-Kendall Trend Analysis Results for Target Analytes in Tuba City, Arizona, Disposal Site Monitoring Wells, 1998–2023

Parameter[a]	Well	Number of Samples[b]	Number of Nondetects	Kendall's tau[c,d]	p-value[c,d]	Trend[c,d]
Molybdenum	0903	31	21	−0.07	0.58	No Trend
Molybdenum	0906	43	2	−0.37	0.001	Decreasing
Molybdenum	0908	48	30	−0.18	0.073	No Trend
Molybdenum	0940	36	10	−0.29	0.011	Decreasing
Molybdenum	0941	48	0	0.21	0.039	Increasing
Molybdenum	0945	32	8	−0.45	<0.001	Decreasing
Nitrate as N	0903	31	0	0.47	<0.001	Increasing
Nitrate as N	0906	43	0	0.13	0.24	No Trend
Nitrate as N	0908	48	0	0.64	<0.001	Increasing
Nitrate as N	0940	36	0	0.08	0.48	No Trend
Nitrate as N	0941	48	0	0.72	<0.001	Increasing
Nitrate as N	0945	32	0	0.52	<0.001	Increasing
Selenium	0903	31	0	0.19	0.14	No Trend
Selenium	0906	43	0	0.35	0.001	Increasing
Selenium	0908	48	1	−0.27	0.006	Decreasing
Selenium	0940	36	0	−0.23	0.051	No Trend
Selenium	0941	48	0	0.51	<0.001	Increasing
Selenium	0945	32	2	0.45	<0.001	Increasing
Uranium	0903	31	0	0.54	<0.001	Increasing
Uranium	0906	43	0	0.03	0.79	No Trend
Uranium	0908	48	0	−0.64	<0.001	Decreasing
Uranium	0940	36	0	0.27	0.021	Increasing
Uranium	0941	48	0	0.57	<0.001	Increasing
Uranium	0945	32	0	−0.21	0.10	No Trend

Notes:

[a] For all well-parameter combinations, the initial trend analysis date is March 1998 (March 11–14, depending on location) and the final trend analysis date is August 2023 (August 21–23, depending on location). Trends for well 0942 are not shown because sampling was discontinued in 2015.

[b] Duplicate sample results were excluded from the trend analysis.

[c] Trend tests were performed using the "NADA: Nondetects and Data Analysis for Environmental Data" package in R, version 1.6-1.1 (Lee 2020). The NADA trend test is similar to the traditional Mann-Kendall trend test except that it accounts for the presence of nondetects at multiple detection limits.

[d] Trend analyses were conducted at the 0.05 significance level using a two-sided test. A calculated p-value of less than 0.05 indicates that a significant trend in the time series exists. The test statistic, Kendall's tau, is a measure of the strength of the association between two variables, with values always falling between −1 and +1.

Abbreviation:

N = nitrogen

Table 19-5. Mann-Kendall Trend Analysis Results for Target Analytes in Tuba City, Arizona, Disposal Site Monitoring Wells, 2015–2023

Parameter	Well[a]	Initial Trend Analysis Date	Number of Samples[b]	Number of Nondetects	Kendall's tau[c,d]	p-value[c,d]	Trend[c,d]
Molybdenum	0903	8/12/2015	8	5	−0.25	0.37	No Trend
Molybdenum	0906	2/16/2015	16	1	0.25	0.19	No Trend
Molybdenum	0908	2/16/2015	16	13	−0.03	0.91	No Trend
Molybdenum	0940	2/17/2015	16	4	0.17	0.38	No Trend
Molybdenum	0941	2/17/2015	16	0	0.45	0.016	Increasing
Molybdenum	0945	8/11/2015	8	1	−0.07	0.90	No Trend
Nitrate as N	0903	8/12/2015	8	0	0.68	0.025	Increasing
Nitrate as N	0906	2/16/2015	16	0	−0.47	0.013	Decreasing
Nitrate as N	0908	2/16/2015	16	0	0.46	0.015	Increasing
Nitrate as N	0940	2/17/2015	16	0	0.29	0.13	No Trend
Nitrate as N	0941	2/17/2015	16	0	−0.1	0.62	No Trend
Nitrate as N	0945	8/11/2015	8	0	−0.18	0.62	No Trend
Selenium	0903	8/12/2015	8	0	0.75	0.013	Increasing
Selenium	0906	2/16/2015	16	0	0.53	0.005	Increasing
Selenium	0908	2/16/2015	16	1	−0.32	0.092	No Trend
Selenium	0940	2/17/2015	16	0	0.68	0.0003	Increasing
Selenium	0941	2/17/2015	16	0	−0.13	0.50	No Trend
Selenium	0945	8/11/2015	8	0	−0.04	1	No Trend
Uranium	0903	8/12/2015	8	0	0.79	0.009	Increasing
Uranium	0906	2/16/2015	16	0	0.85	<0.001	Increasing
Uranium	0908	2/16/2015	16	0	−0.39	0.037	Decreasing
Uranium	0940	2/17/2015	16	0	−0.16	0.42	No Trend
Uranium	0941	2/17/2015	16	0	−0.09	0.65	No Trend
Uranium	0945	8/11/2015	8	0	−0.25	0.42	No Trend

Notes:

[a] For all well-parameter combinations, the final trend analysis date is August 21–23, depending on location. Trends for well 0942 are not shown because sampling was discontinued in 2015.

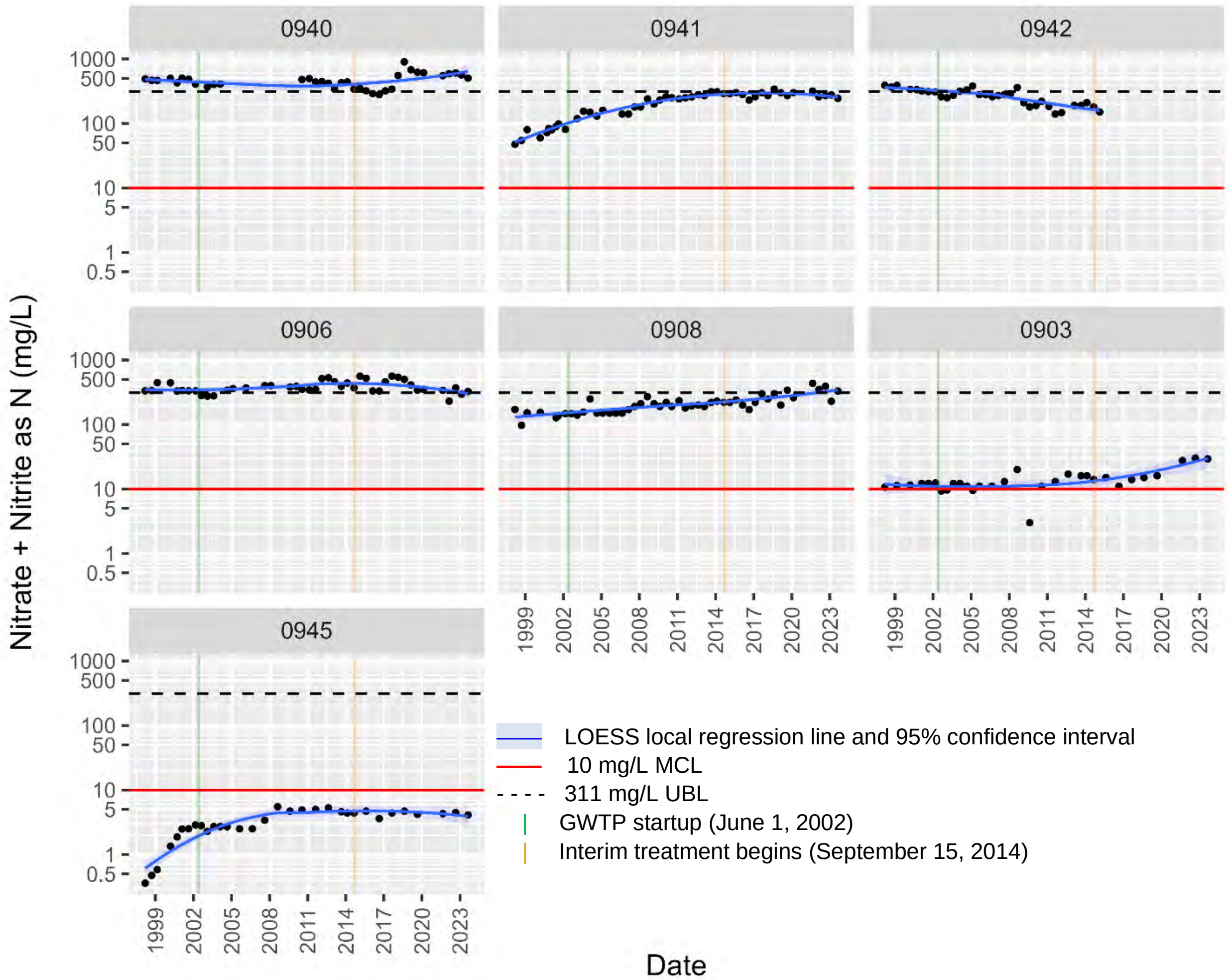
[b] Duplicate sample results were excluded from the trend analysis.

[c] Trend tests were performed using the "NADA: Nondetects and Data Analysis for Environmental Data" package in R, version 1.6-1.1 (Lee 2020). The NADA trend test is similar to the traditional Mann-Kendall trend test except that it accounts for the presence of nondetects at multiple detection limits.

[d] Trend analyses were conducted at the 0.05 significance level using a two-sided test. A calculated p-value of less than 0.05 indicates that a significant trend in the time series exists. The test statistic, Kendall's tau, is a measure of the strength of the association between two variables, with values always falling between −1 and +1.

Abbreviation:

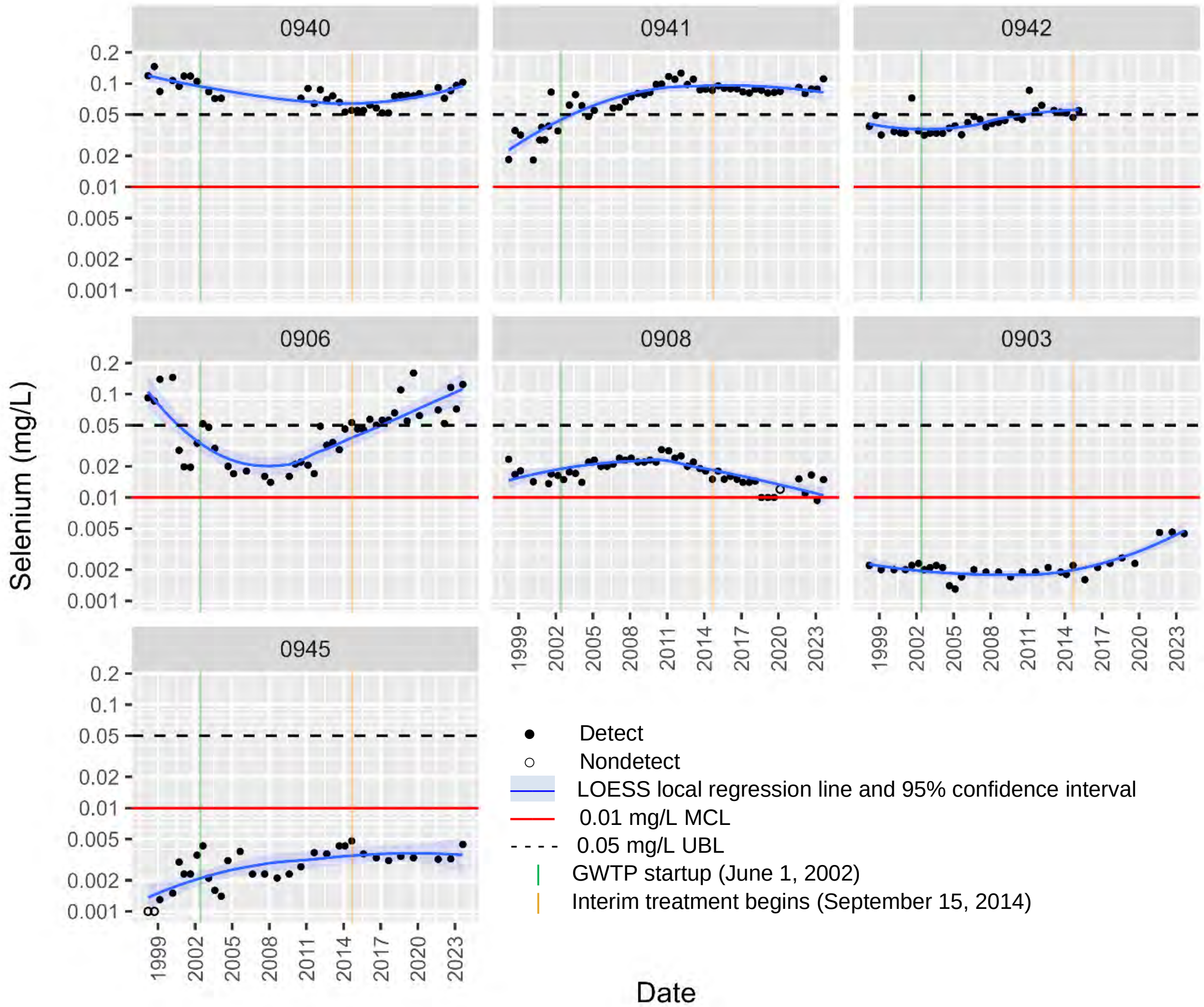
N = nitrogen



Notes: Downgradient wells (from Table 19-2) are ordered in general direction of groundwater flow or distance from the disposal cell (Figure 19-2). Data for the upgradient background well are plotted last.
Abbreviations: LOESS = locally estimated scatterplot smoothing, N = nitrogen

Figure 19-4. Time-Concentration Plots of Nitrate (as N) in Groundwater at the Tuba City, Arizona, Disposal Site, 1998–2023

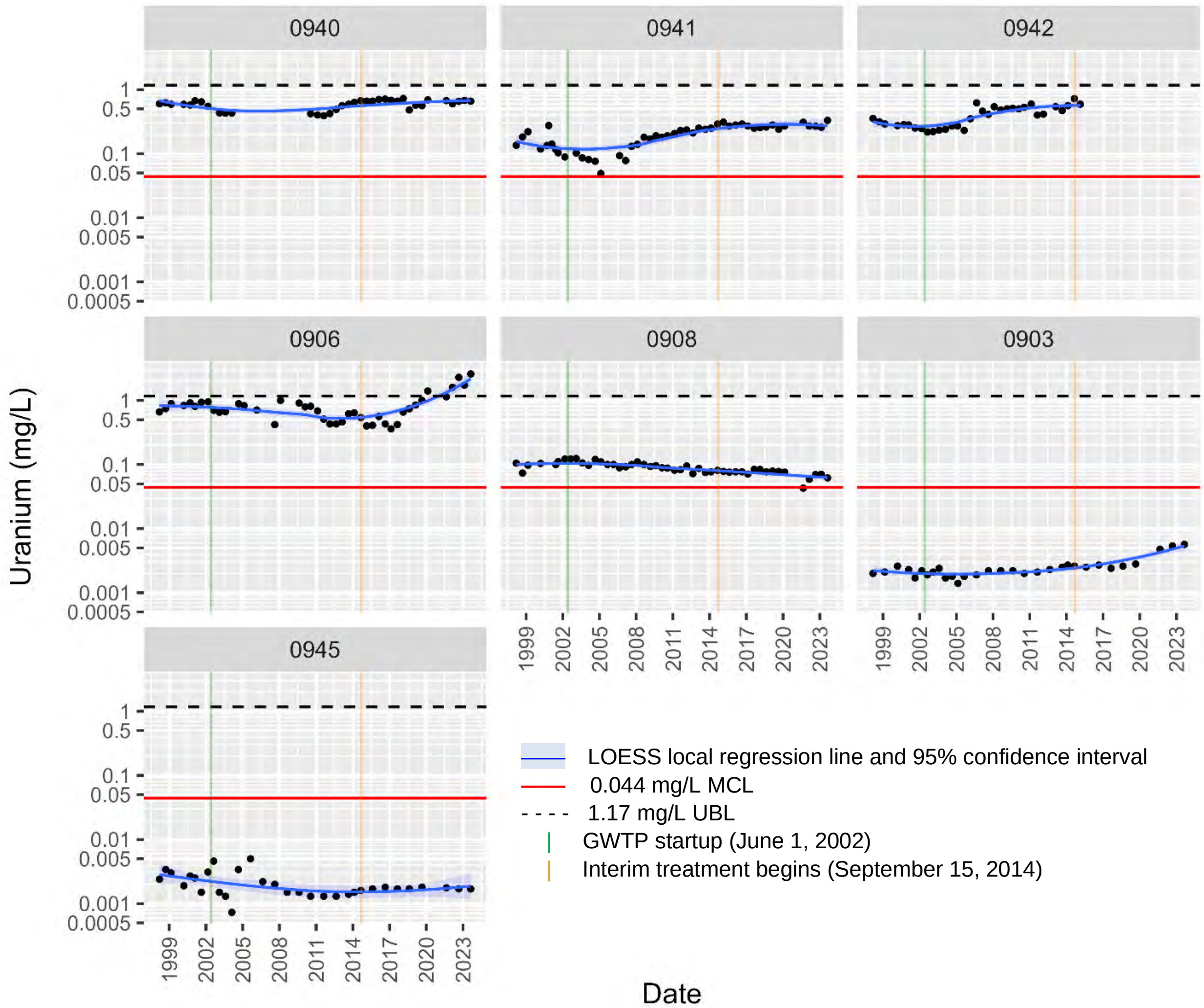
Nitrate (+ nitrite as nitrogen [N]) concentrations have historically exceeded the 10 mg/L MCL in all LTSP evaluative wells except background well 0945 (Figure 19-4). The 311 mg/L UBL has been exceeded in all downgradient evaluative monitoring wells except southernmost well 0903, approximately 1250 feet south of the site perimeter. Mann-Kendall trend analysis for 1998–2023 indicates statistically significant increasing nitrate concentration trends in four of the six wells currently monitored: wells 0903, 0908, 0941, and background well 0945 (Table 19-4). For the 2015–2023 period, however, trends remain statistically significant only for wells 0903 and 0908 (Table 19-5). The UBL has been exceeded fairly consistently in wells 0940 and 0906, but only recently (2018–2023) in wells 0941 and 0908. In 2023, the UBL was exceeded in wells 0906 (325 mg/L), 0908 (329 mg/L), and 0940 (505–565 mg/L). Nitrate concentrations in southernmost downgradient well 0903, although regularly exceeding the 10 mg/L MCL since 2004, have remained below the UBL. However, results have increased in the last several years, with the maximum result (30.1 mg/L) detected in August 2022. The most recent (August 2023) nitrate result for well 0903 is 29.3 mg/L.



Notes: Downgradient wells (from Table 19-2) are ordered in general direction of groundwater flow or distance from the disposal cell (Figure 19-2). Data for the upgradient background well are plotted last.
Abbreviation: LOESS = locally estimated scatterplot smoothing

Figure 19-5. Time-Concentration Plots of Selenium in Groundwater at the Tuba City, Arizona, Disposal Site, 1998–2023

Selenium concentrations have historically exceeded the 0.01 mg/L MCL in all non-background evaluative monitoring wells except southernmost well 0903 (Figure 19-5). The 0.05 mg/L UBL has been exceeded consistently in wells 0940 and 0941, immediately downgradient of the disposal cell, since 1998 and 2005, respectively. Since 2018, the highest selenium concentrations have been measured in well 0906. After declining by an order of magnitude between 2000 and 2008 (from 0.15 to 0.014 mg/L), concentrations have since increased; the most recent result was 0.12 mg/L. This increase in selenium concentrations in well 0906 since 2009 correlates with the period when average annual cumulative extraction rates dropped from 80 to 35 gallons per minute (gpm) due to intermittent shutdowns of the GWTP (DOE 2020). Mann-Kendall trend analysis for 1998–2023 indicates statistically significant increasing trends in wells 0906 and 0941, but for the more recent period (2015–2023), two additional wells (0940 and 0903) show significant increasing trends (Table 19-4 and Table 19-5).



Notes: Downgradient wells (from Table 19-2) are ordered in general direction of groundwater flow or distance from the disposal cell (Figure 19-2). Data for the upgradient background well are plotted last.
Abbreviation: LOESS = locally estimated scatterplot smoothing

Figure 19-6. Time-Concentration Plots of Uranium in Groundwater at the Tuba City, Arizona, Disposal Site, 1998–2023

Uranium concentrations have historically exceeded the 0.044 mg/L MCL in all downgradient compliance wells except for well 0903 and a single (August 2021) measurement in well 0908 (Figure 19-6). The 1.17 mg/L UBL has not been exceeded except for recent measurements in well 0906. Uranium concentrations in well 0906 exceeded the UBL for the first time in February 2020 and have since increased to 2.59 mg/L (a historical maximum) in August 2023. Mann-Kendall trend analysis for 1998–2023 indicates statistically significant increasing nitrate concentration trends in three of the six wells currently monitored: wells 0903, 0940, and 0941. For 2015–2023, the statistically significant increasing trend for downgradient well 0903 continues, and a significant increasing trend was also found for well 0906 (Table 19-5), in contrast to the previous stable trend (Figure 19-6). Although still below both the MCL and the UBL, the most recent (August 2023) uranium concentration in well 0903 is the highest result on record for this well at 0.0057 mg/L.

A detailed evaluation of the recent increasing concentration trends in these wells is provided in the 2019–2021 groundwater remedy performance update (DOE 2022). Well 0908 is the only well with a significant decreasing uranium concentration trend (Table 19-4, Table 19-5). The most recent result (0.062 mg/L) slightly exceeds the 0.044 mg/L MCL.

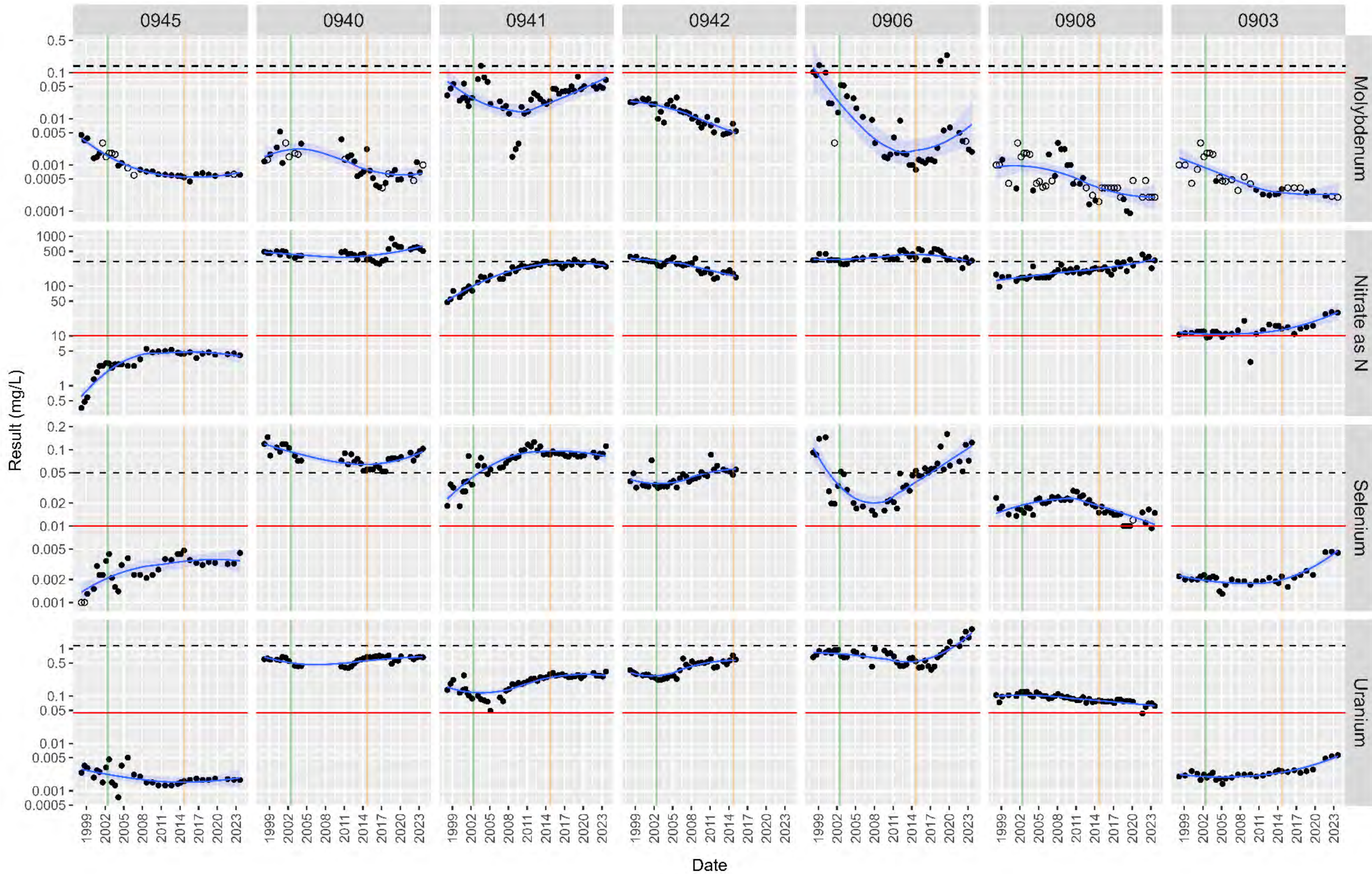
Similar to conclusions drawn in the previous annual report (DOE 2023a), analytical results from the 2023 evaluative monitoring effort indicate that groundwater quality in downgradient wells is still degraded relative to background concentrations in upgradient well 0945 (Figure 19-7). The only exceptions to the latter are molybdenum concentrations in wells 0908 and 0903, which are comparable to background. Since 2015 (when interim treatment began), contaminant concentrations are significantly increasing for the following well-analyte combinations (wells ordered in the general direction of groundwater flow or the distance from the disposal cell):

- Well 0940—selenium
- Well 0941—molybdenum
- Well 0906—selenium and uranium
- Well 0908—nitrate
- Well 0903—nitrate, selenium, and uranium

These increasing trends warrant continued monitoring, especially those in well 0903, the southernmost downgradient well. These increases correlate with the timing of the GWTP shutdown, after which the site began operating under interim treatment with an average annual cumulative extraction rate of 7 gpm. Analysis of water quality trending and progress of the groundwater remedy are reported in the site-specific remedy performance reports for the Tuba City site (DOE 2022; DOE 2023b).

19.8 Corrective Action

Corrective action is taken to correct out-of-compliance or hazardous conditions that create a potential health and safety problem or that may affect the integrity of the disposal cell or compliance with 40 CFR 192. No need for corrective action was identified.



● Detect ○ Nondetect —— LOESS local regression line and 95% confidence interval
Limits from Table 19-3: —— = MCL; - - - = UBL
| GWTP startup (June 1, 2002); | Interim treatment begins (September 15, 2014)
Note: Wells are ordered in general direction of groundwater flow or distance from the disposal cell (Figure 19-2); data for upgradient well 0945 are plotted first.
Abbreviation: LOESS = locally estimated scatterplot smoothing

Figure 19-7. Summary of Historical Evaluative Monitoring Results at the Tuba City, Arizona, Disposal Site (1998–2023)

19.9 References

10 CFR 40.27. U.S. Nuclear Regulatory Commission, “General License for Custody and Long-Term Care of Residual Radioactive Material Disposal Sites,” *Code of Federal Regulations*.

40 CFR 192. U.S. Environmental Protection Agency, “Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings,” *Code of Federal Regulations*.

40 CFR 192 Subpart A. U.S. Environmental Protection Agency, “Standards for the Control of Residual Radioactive Materials from Inactive Uranium Processing Sites,” *Code of Federal Regulations.*

DOE (U.S. Department of Energy), 1984. *Cooperative Agreement Between the United States Department of Energy, the Navajo Tribe of Indians, and the Hopi Tribe of Indians*, DE-FC04-85AL26731, December.

DOE (U.S. Department of Energy), 1996. *Long-Term Surveillance Plan for the Tuba City, Arizona, Disposal Site,* DOE/AL/62350-182, Rev. 0, October.

DOE (U.S. Department of Energy), 2020. *Interim Treatment System Evaluation Report, Tuba City, Arizona, Disposal Site*, LMS/TUB/S18785, Office of Legacy Management, March.

DOE (U.S. Department of Energy), 2022. *Draft Tuba City, Arizona, Disposal Site Groundwater Remedy Performance Update, 2019 Through 2021*, LMS/TUB/S33713, Office of Legacy Management, February.

DOE (U.S. Department of Energy), 2023a. *2022 Annual Site Inspection and Monitoring Report for Uranium Mill Tailings Radiation Control Act Title I Disposal Sites*, LMS/S38159, Office of Legacy Management, March.

DOE (U.S. Department of Energy), 2023b. *Draft Tuba City, Arizona, Disposal Site Groundwater Remedy Performance Update, 2022*, LMS/TUB/43943, Office of Legacy Management, June.

EPA (U.S. Environmental Protection Agency), 1989. *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Final Guidance*, EPA/530-SW-89-026, Office of Solid Waste, Waste Management Division, Washington, D.C., February.

Lee, L., 2020. “NADA: Nondetects and Data Analysis for Environmental Data,” R package, version 1.6-1.1, https://CRAN.R-project.org/package=NADA, accessed January 8, 2024.

19.10 Photographs

Photograph Location Number	Azimuth	Photograph Description
PL-1	270	Gap Under Fence near Perimeter Sign P9
PL-2	45	Gap Created by Animals Under Fence Between Perimeter Signs P21 and P22
PL-3	270	Sediment Deposition Gage Between Perimeter Signs P9 and P10
PL-4	270	Debris near Perimeter Sign P9
PL-5	270	Erosion Under Base of Perimeter Sign P10
PL-6	—	Site Marker SMK-2
PL-7	—	Quality Control Monument QC-2
PL-8	0	Evaporative Minerals on Top Slope of Disposal Cell
PL-9	130	Horizontal Lines on West Slope of Disposal Cell
PL-10	45	Vegetation on South Slope of Disposal Cell
PL-11	180	Erosion Gully and Soil Accumulation in Diversion Ditch North of Disposal Cell

Note:
— = Photograph taken vertically from above.

PL-1. Gap Under Fence near Perimeter Sign P9

PL-2. Gap Created by Animals Under Fence Between Perimeter Signs P21 and P22

PL-3. Sediment Deposition Gage Between Perimeter Signs P9 and P10

PL-4. Debris near Perimeter Sign P9

PL-5. Erosion Under Base of Perimeter Sign P10

PL-6. Site Marker SMK-2

PL-7. Quality Control Monument QC-2

PL-8. Evaporative Minerals on Top Slope of Disposal Cell

PL-9. Horizontal Lines on West Slope of Disposal Cell

PL-10. Vegetation on South Slope of Disposal Cell

PL-11. Erosion Gully and Soil Accumulation in Diversion Ditch North of Disposal Cell