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 19, 2024. 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 D. Atkinson, C. Murphy, J. Graham, and N. Lind of the Legacy Management Support contractor. 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 2024 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 (PL-1) is near the access road next to site marker SMK-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 (PL-3) during the 2021 inspection and have been observed during every inspection since. 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 is just inside the site entrance, and site marker SMK-2 (PL-4) is on the top slope of the disposal cell. No maintenance needs were identified.

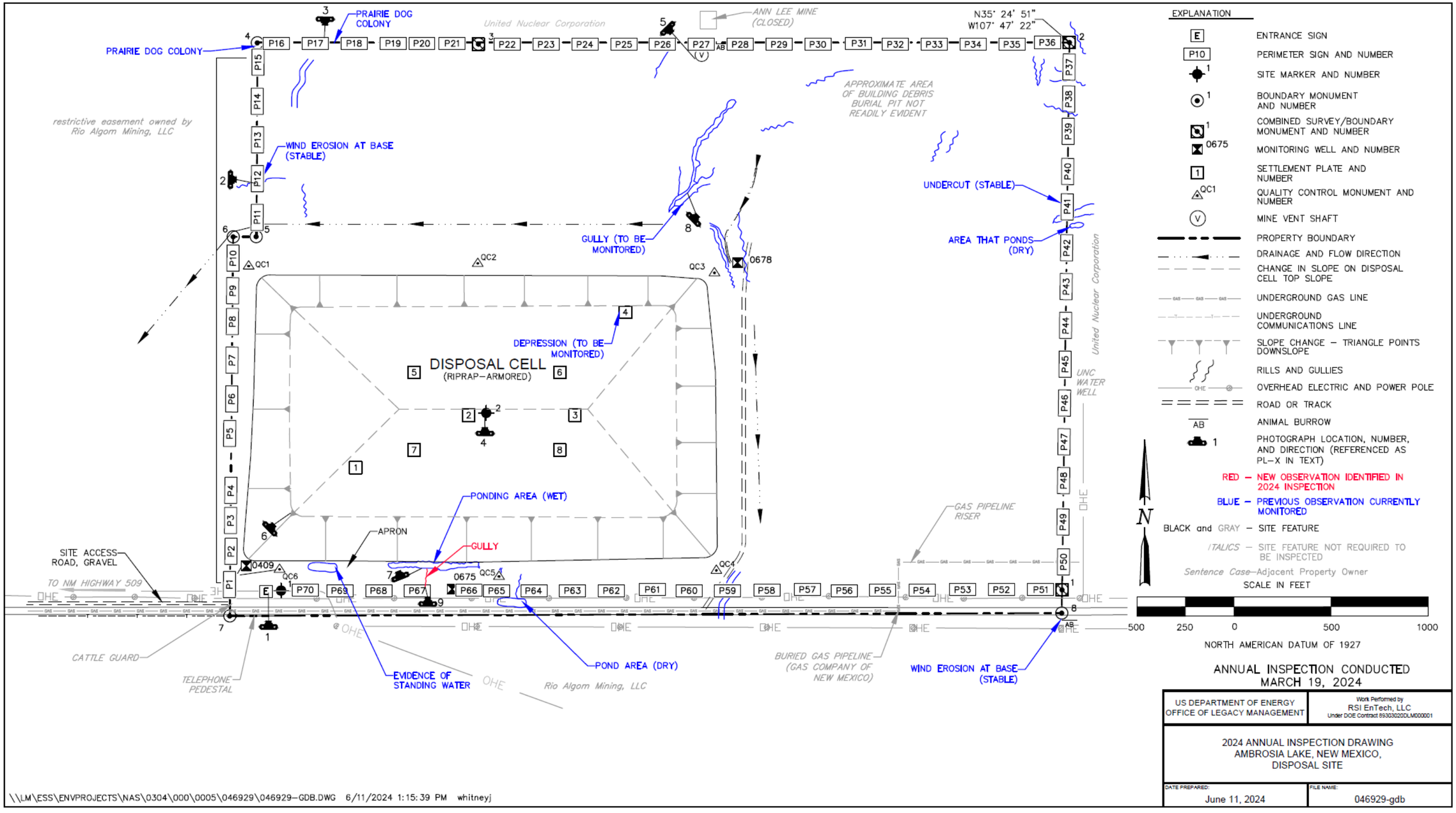


Figure 1-1. 2024 Annual Inspection Drawing for the Ambrosia Lake, New Mexico, Disposal Site

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 the 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 2024 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. 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 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 2024 annual inspection, the settlement was shallow enough that it was determined not to have

changed significantly. 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 top of the disposal cell (PL-6). 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 is performed as necessary, and the need for weed control will be evaluated again during the next annual inspection.

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, and the area was wet during the 2024 inspection (PL-7). An additional ponding area, which was dry, exists 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 near aerial survey quality control monument QC-5. During the 2024 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-8). Inspectors collected GPS locations and measurements of this gully in 2021 and 2024. While no immediate maintenance needs were identified during the 2024 inspection, an evaluation of the need for erosion control structures around the large gully northeast of the disposal cell is ongoing. Small rills observed around the site during the 2022 annual inspection near perimeter signs P17, P59, and P65 have not grown significantly. An additional small gully was observed in 2024 extending from south of the disposal cell toward perimeter sign P67 (PL-9).

1.4.2.4 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 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 2024 inspection.

1.7 Groundwater Monitoring

In accordance with the LTSP, groundwater monitoring is not required at the 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 these locations 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	Screened Interval Elevations (ft NAVD 88)	Hydrologic Interval Monitored
0409	6939.49 to 6934.73	Contact between alluvium and Tres Hermanos C unit, downgradient
0675	6944.89 to 6934.89	Weathered Mancos Shale, downgradient
0678	6751.71 to 6731.71	Tres Hermanos B unit, downgradient

Abbreviation:
NAVD 88 = 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.

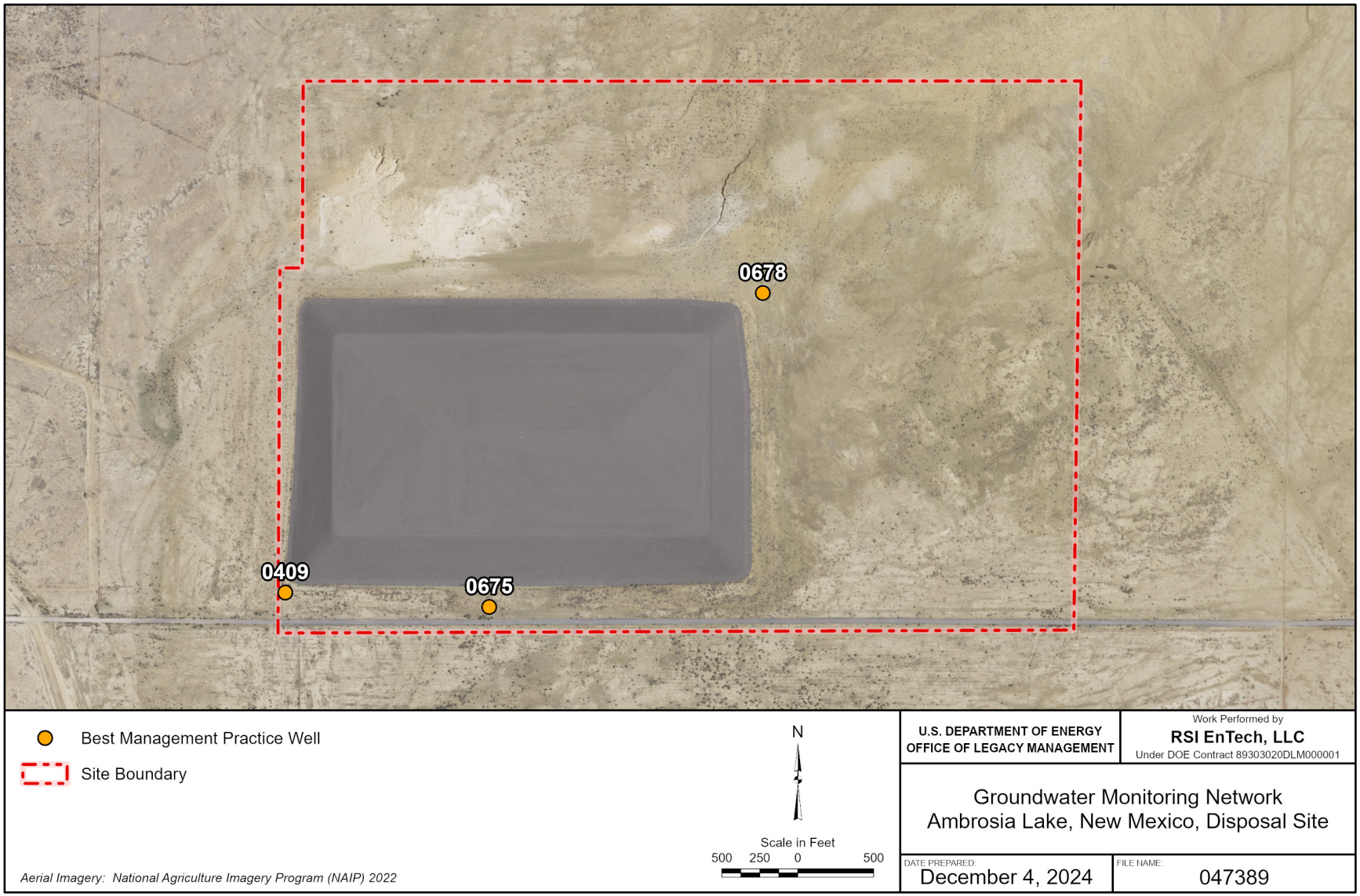
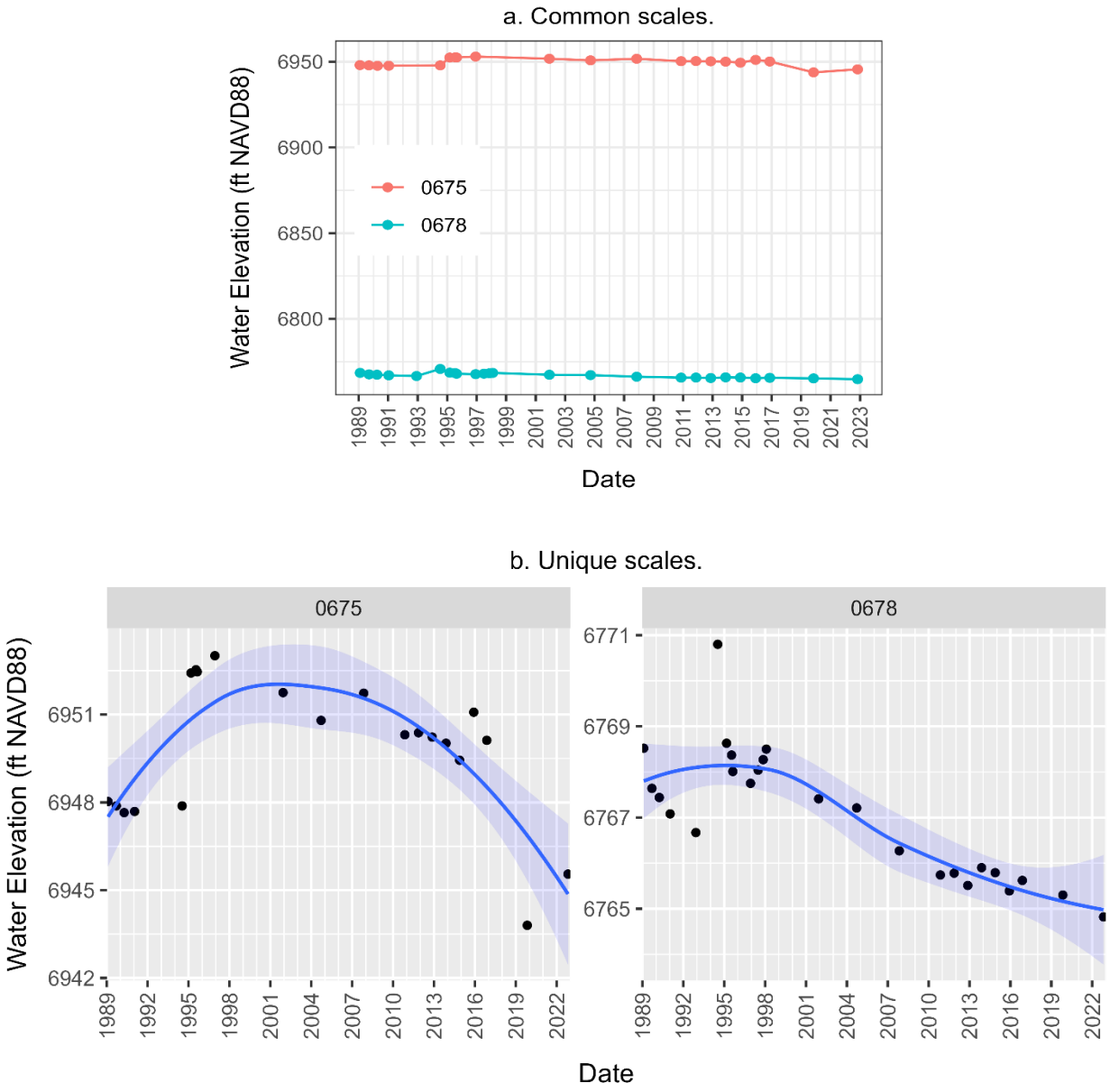


Figure 1-2. Ambrosia Lake Disposal Site Groundwater Best Practice Monitoring Locations

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.



LOESS local regression line and 95% confidence interval

Abbreviations: LOESS = locally estimated scatterplot smoothing, NAVD 88 = North American Vertical Datum of 1988

Figure 1-3. Groundwater Elevation Trends in Ambrosia Lake, New Mexico, Disposal Site Monitoring Wells (a: Common Scales, b: Unique Scales)

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 (GEMS) website (https://gems.lm.doe.gov). 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 2022 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).

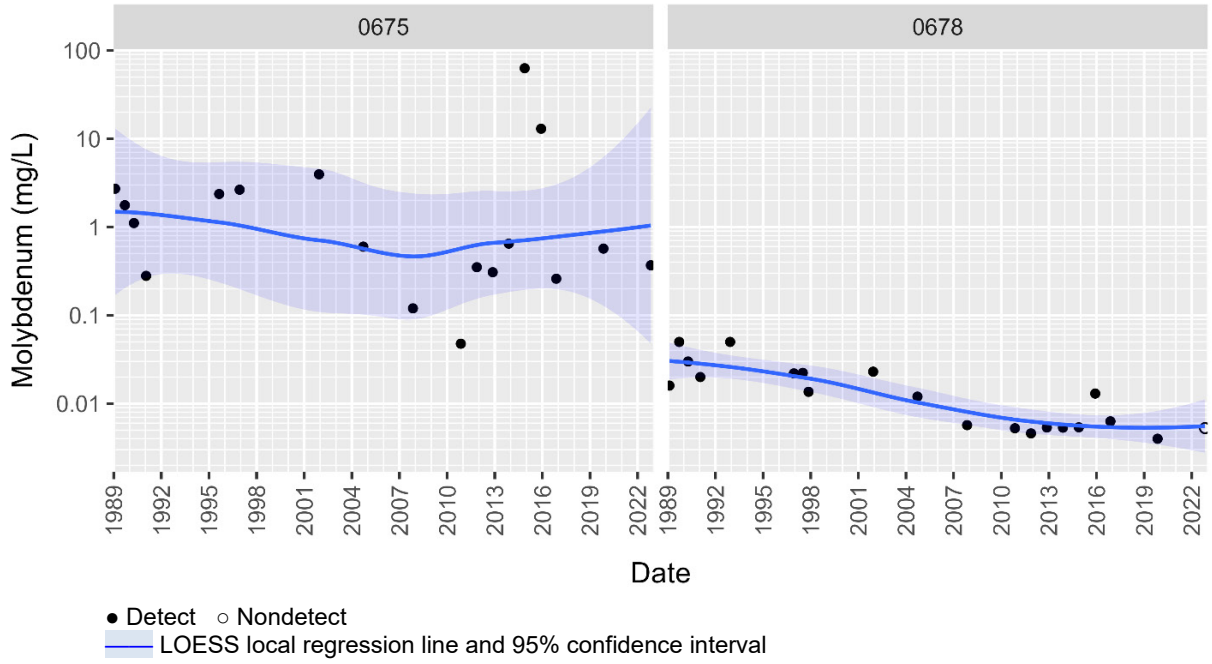
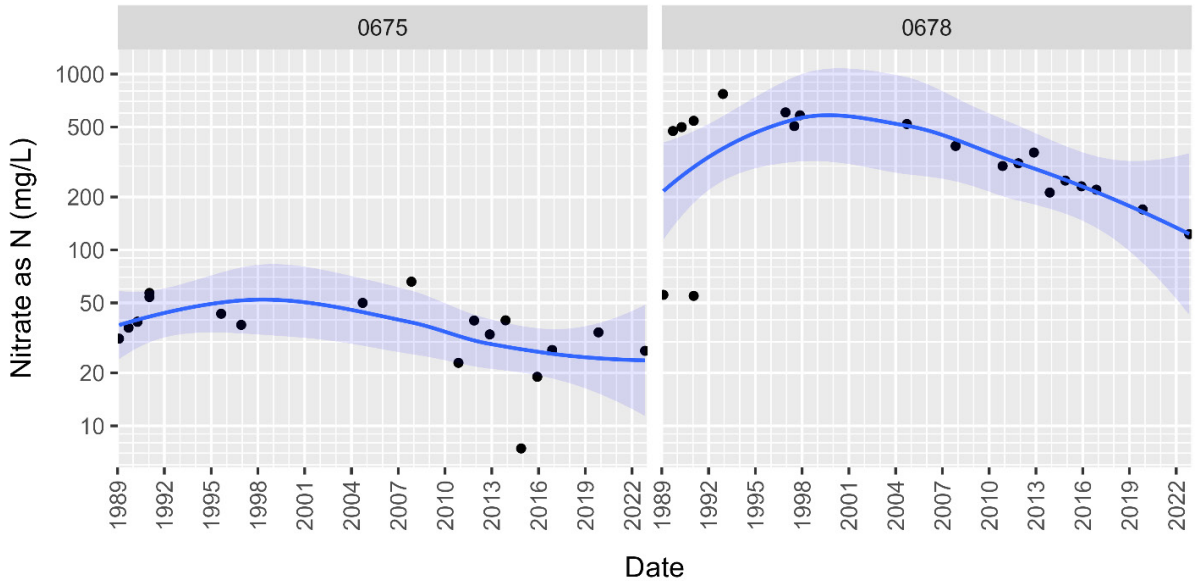


Figure 1-4. Molybdenum Concentrations in Groundwater at the Ambrosia Lake, New Mexico, Disposal Site

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).



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 upward 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).

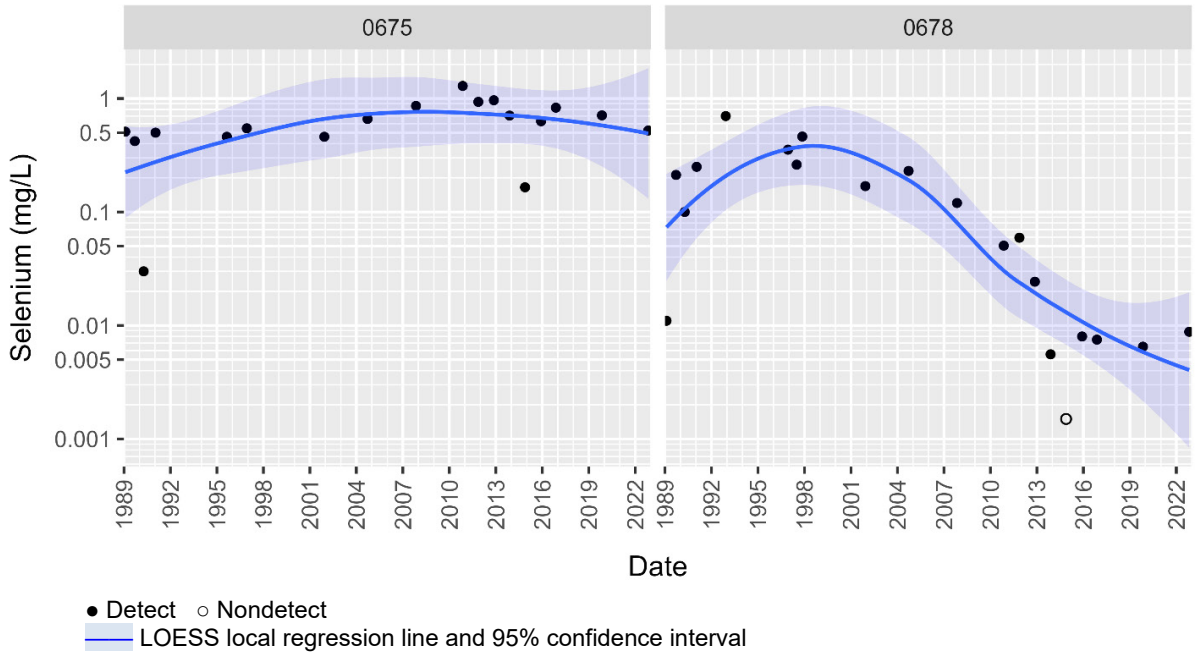


Figure 1-6. Selenium Concentrations in Groundwater at the Ambrosia Lake, New Mexico, Disposal Site

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.

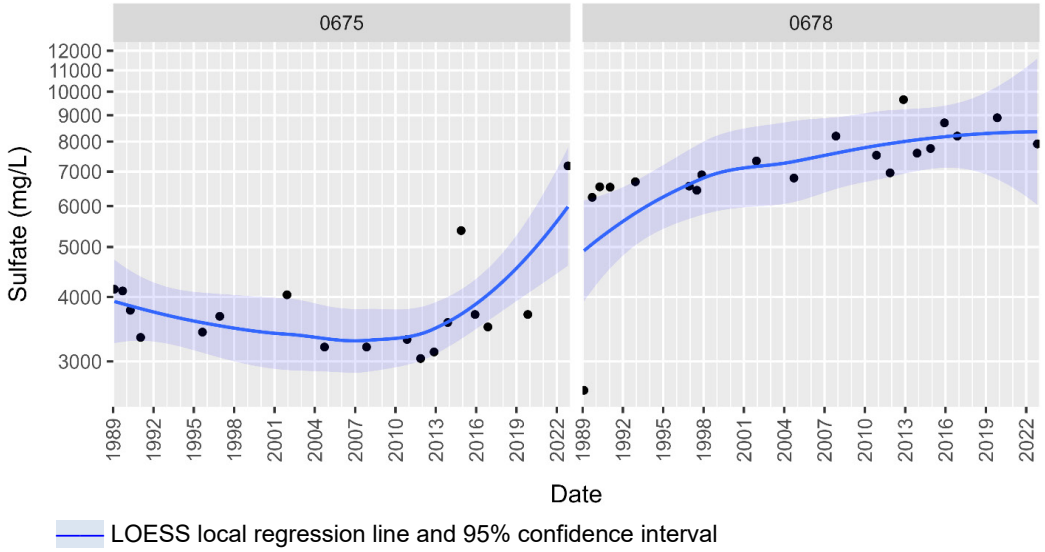


Figure 1-7. Sulfate Concentrations in Groundwater at the Ambrosia Lake, New Mexico, Disposal Site

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).

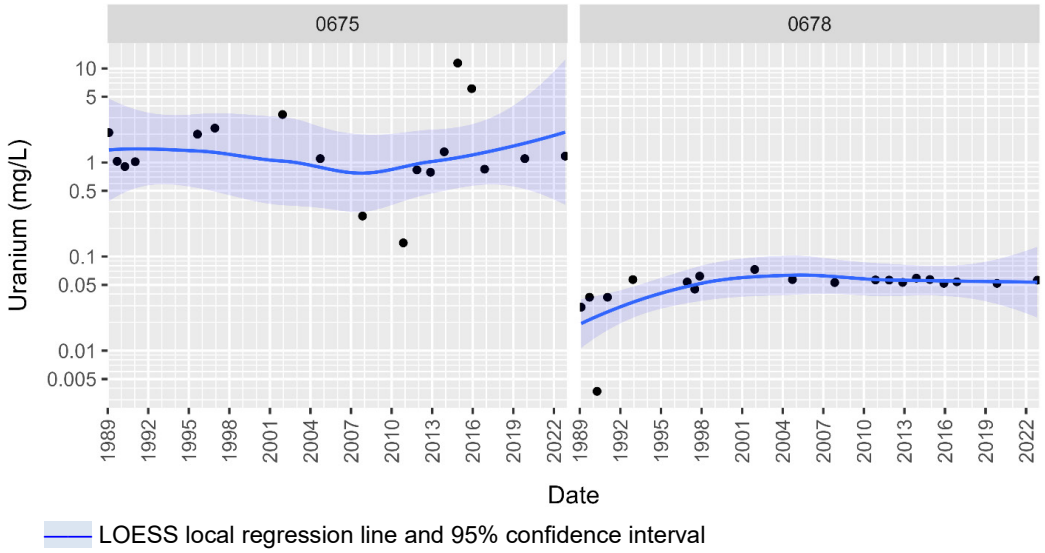


Figure 1-8. Uranium Concentrations in Groundwater at the Ambrosia Lake, New Mexico, Disposal Site

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

Note

Site-related documents are available on the LM public webpages at https://lmpublicsearch.lm.doe.gov/SitePages.

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, A., 2001. A. 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 M. Leavitt, branch chief, Ground Water Quality Bureau, New Mexico Environment Department, August 29.

1.10 Photographs

Photograph Location Number	Azimuth	Photograph Description
PL-1	0	Entrance Sign and Site Marker SMK-1
PL-2	90	Perimeter Sign P12 with Wind Erosion at Base (Stable)
PL-3	180	Prairie Dog Colony near Perimeter Sign P17
PL-4	—	Site Marker SMK-2
PL-5	135	Mine Vent Shaft
PL-6	45	Vegetation on Disposal Cell Top Slope
PL-7	337	Ponding Water on South Disposal Cell Apron
PL-8	45	Gully Northeast of Disposal Cell
PL-9	0	Gully South of Disposal Cell

Note:
— = Photograph taken vertically from above.

PL-1. Entrance Sign and Site Marker SMK-1

PL-2. Perimeter Sign P12 with Wind Erosion at Base (Stable)

PL-3. Prairie Dog Colony near Perimeter Sign P17

PL-4. Site Marker SMK-2

PL-5. Mine Vent Shaft

PL-6. Vegetation on Disposal Cell Top Slope

PL-7. Ponding Water on South Disposal Cell Apron

PL-8. Gully Northeast of Disposal Cell

PL-9. Gully South of Disposal Cell