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 January 20, 2015. The site was in excellent condition. Some perimeter signs are discolored and becoming illegible; these will be replaced. Inspectors identified no other maintenance needs or cause for a follow-up inspection.

5.2 Compliance Requirements

Requirements for the long-term surveillance and maintenance of the site are specified in the *Long-Term Surveillance Plan for the U.S. Department of Energy Falls City Uranium Mill Tailings Disposal Site, Falls City, Texas* (LTSP) (DOE-LM/1602-2008, U.S. Department of Energy [DOE], March 2008) and in procedures that DOE established to comply with the requirements of 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 Disposal Site

Requirement	Long-Term Surveillance Plan	This Report
Annual Inspection and Report	Section 3.3	Section 5.4
Follow-Up Inspections	Section 3.4	Section 5.5
Maintenance	Section 3.5	Section 5.6
Emergency Response	Section 3.6	Section 5.7
Environmental Monitoring	Section 3.7	Section 5.8

5.3 Institutional Controls

The 127-acre disposal site is owned by the United States of America and was accepted under the U.S. Nuclear Regulatory Commission (NRC) general license (10 CFR 40.27) in 1997. DOE is the licensee and, in accordance with the requirements for UMTRCA Title I sites, is responsible for the custody and long-term care of the site. Institutional controls at the site include federal ownership of the property and the following physical features that are inspected annually: perimeter fence, perimeter warning signs, site markers, survey and boundary monuments, and locked gates.

An adjacent 513-acre offsite property was sold by the State of Texas to Alamo Funding Group in 2005. The State 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 disposal site. DOE and the State complied with requirements for parcel transfers stipulated in UMTRCA. The warranty deed stipulates that the owners agree to not use any groundwater underlying the property for commercial or industrial uses. No human habitation structures shall be constructed on the property and nothing may be done to impact groundwater quality or interfere with UMTRCA groundwater remediation activities. Permission must be obtained from the State and DOE prior to constructing wells or otherwise exposing groundwater to the surface; performing construction, excavation, or soil removal of any kind; or selling the property. Inspectors saw no evidence of violation of any of the above-stated use restrictions during the site inspection.

5.4 Inspection Results

The site was inspected on January 20, 2015. The inspection was conducted by M. Widdop and D. Traub of the DOE Legacy Management Support contractor. A. Kleinrath (DOE Site Manager); S. Vigil (DOE Health and Safety Manager); K. Tu, M. Sullivan, A. Stallard, and S. Molina (Uranium and Technical Assessments Section, Radioactive Materials Division, Texas Commission on Environmental Quality); and R. Lyssy (site maintenance subcontractor) attended the inspection.

The purposes of the inspection were to confirm the integrity of visible features at the site, to identify changes in conditions that might affect site integrity, and to determine the need, if any, for maintenance or additional inspections and monitoring. Numbers in the left margin of this report refer to items summarized in Table ES-1 of the "Executive Summary."

5.4.1 Site Surveillance Features

Figure 5-1 shows the locations of site surveillance features. Inspection results and recommended maintenance activities associated with site surveillance features are included in the following subsections. Photographs to support specific observations are identified in the text and on Figure 5-1 by photograph location (PL) numbers.

5.4.1.1 Fence and Gates

A 5-strand barbed wire fence is installed around the disposal site. The fence was in good condition. Fence strands are beginning to rust except along the northwest side, where the fence was replaced in 2006. Mr. Lyssy recommended that DOE consider replacing the barbed wire with welded wire mesh when the rusted barbed wire reaches the end of its service life.

Entrance to the site is directly off Farm-to-Market Road 1344. The main entrance gate at the east corner of the site and the vehicle gate at the north corner were locked and functional.

5.4.1.2 Perimeter Signs

The entrance sign located next to the main entrance gate was in good condition. There are 64 perimeter signs installed along the perimeter fence. One sign has a bullet hole but remains legible. Other signs, particularly those facing Farm-To-Market Road 1344, are discolored and several polypropylene signs are bent; these will be replaced (PL-1).

5.4.1.3 Site Markers

There are two site markers. The marker on top of the disposal cell (SMK-2) was in excellent condition. The marker at the entrance gate (SMK-1) was also in excellent condition (PL-2), but the corners of the concrete base around the marker are cracked. The cracks appear to be unchanged from last year, and repairs are not needed at this time.

5.4.1.4 Boundary and Survey Monuments

Three survey monuments and two boundary monuments situated at the corners of the site were undisturbed and in excellent condition (PL-3).

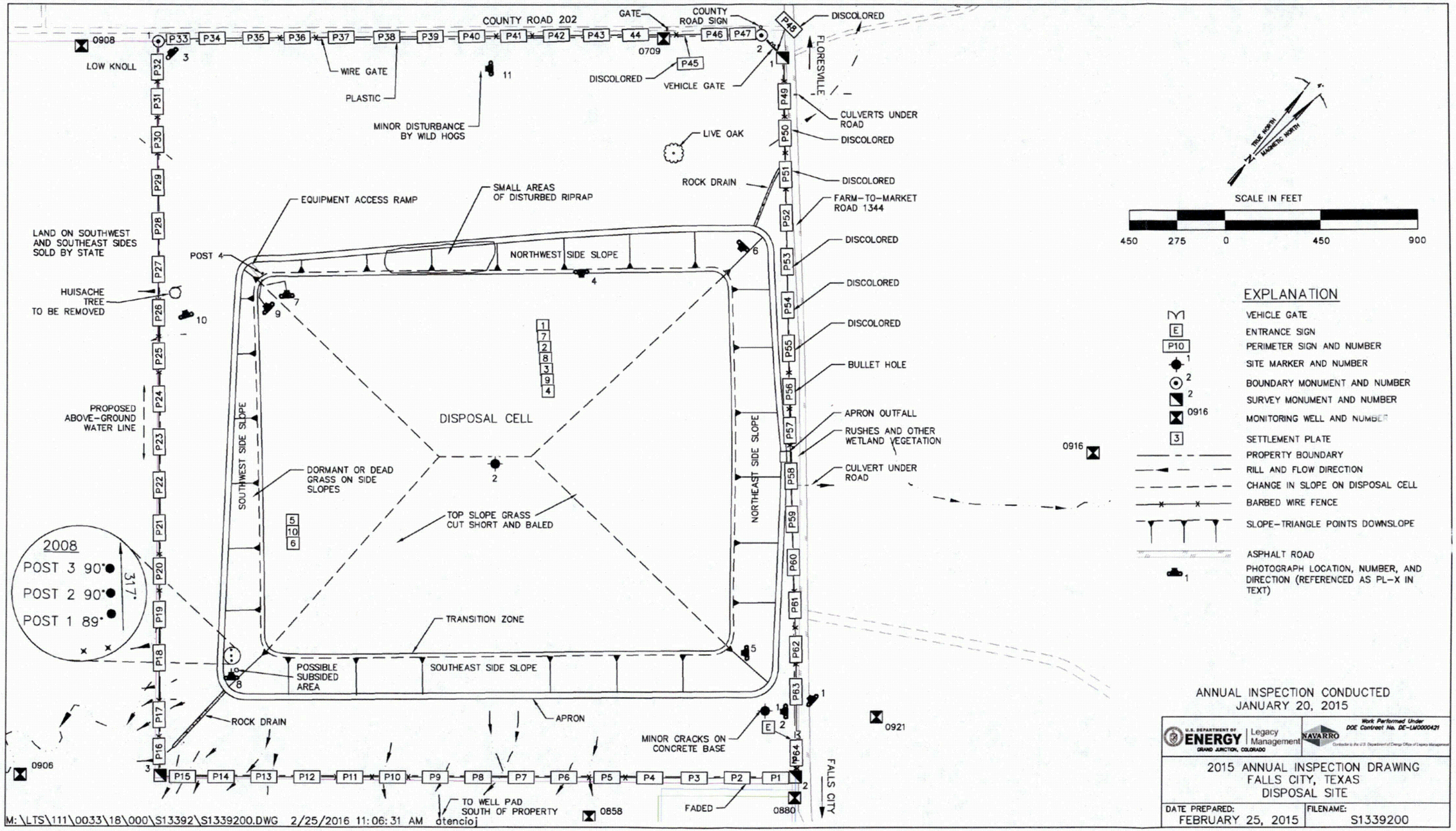

Figure 5-1. 2015 Annual Inspection Drawing for the Falls City Disposal Site

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5.4.1.5 Monitoring Wells

The monitoring wells observed during the inspection were secure and in excellent condition. All of the wells in the monitoring network were inspected during the sampling event that occurred in April 2015.

5.4.2 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 top and side slopes of the disposal cell; (2) the region between the apron at the toe of the side slopes and the site perimeter; and (3) the outlying area.

Within each area, inspectors examined specific site surveillance features. Inspectors also looked for evidence of erosion, settling, slumping, or other processes that might affect site integrity or the long-term performance of the site.

5.4.2.1 Top and Side Slopes of the Disposal Cell

The top of the disposal cell was in excellent condition (PL-4). The cell is covered with well-established coastal Bermuda grass, kleingrass and other species are interspersed. Inspectors found very few woody plants in the turf areas. The maintenance subcontractor spot-sprays woody vegetation on the top slope and between the cell and the site perimeter.

The site maintenance subcontractor can take as many as three cuttings of hay each year from the property, including from the top of the disposal cell. A portion of the cell top was not cut to allow the grasses to reseed.

In past inspections small desiccation cracks were present in the surface of the soil on the top and upper edges of the disposal cell. Desiccation cracks near the surface of a soil profile are common, especially in clayey or loamy soils when soil conditions are dry. Rain occurred in the week before this inspection, and no desiccation cracks were observed. No areas of ponded water were observed on top of the disposal cell, and no areas of settlement were observed.

The side slopes are covered with riprap and were in excellent condition (PL-5). DOE has 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.

Fractured riprap has been observed on the side slopes of the disposal cell since the cell was completed. Pieces of riprap are fractured in place, indicating that the fracturing occurred after placement (PL-6). Inspectors suggest this is a consequence of thermal expansion and contraction. Riprap condition does not appear to be continuing to deteriorate. During this year's inspection, photos were taken of riprap at the base of Post 4, near the access ramp on the west corner of the disposal cell (PL-7). Compared to photos taken in previous years at this location, there is no indication that the riprap is degrading. DOE will continue to monitor this process during future inspections and, if the number of fractured rocks appears to be increasing, will establish a more quantitative monitoring program, which may consist of establishing plots and conducting rock size or mass surveys.

In 2007, inspectors noted a possible slight slumping of riprap at the toe of the south corner of the side slope. Three t-posts were installed in a straight line running at an orientation of 317 degrees in 2008. Each post was installed at a vertical pitch of 90 degrees. These three posts provide reference points that are used to assess if the area is undergoing movement. Movement of a post out of line with the other two posts or the change in pitch of an individual post will indicate possible movement in the area. The three posts remain in the same straight line at which they were installed and are at the same vertical pitch, indicating that no movement has occurred (PL-8).

An equipment access ramp to the top of the cell is located at the west corner of the side slope (PL-9). The ramp was installed in 2008 using clean angular riprap of progressively smaller sizes of rock 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 on the cell and side slopes was excellent. Much of the vegetation observed during the inspection on the side slopes was either dead or dormant grass. Range management technical staff will evaluate whether the grass should be controlled. Deep roots of woody vegetation could penetrate the radon barrier, so the woody vegetation is controlled through cutting and applying herbicide.

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

The area between the fence and the apron at the toe of the disposal cell side slopes is covered with well-established grass, primarily kleingrass, with some coastal Bermuda grass. Grass is cut and baled one to three times annually, depending on precipitation. Grass is usually left uncut along the fence, along rock drains, and around some of the surveillance features such as the survey monuments. DOE will evaluate the use of controlled grazing to remove the grass along the edges and around the site surveillance features in this area.

A Huisache tree was growing along the fence line near perimeter sign P27 (PL-10). Huisache aggressively invade south Texas rangelands competing with other plants for water and nutrients. The tree was sprayed with herbicide in 2014 and will be removed.

Wild hogs burrow along the fence line in some areas. Their burrows are filled in by the maintenance contractor as they are located because they might compromise the integrity of the fence or create depressions that could result in damage to haying equipment. Several areas along the northwest fence line were disturbed by hogs, resulting in minor bare spots (PL-11).

No water was flowing in the south rock drain during this year's inspection, but the south corner of the site was muddy from the recent rainfall. No water was observed in the north rock drain. Vegetation is left uncut at the outlets of the rock drains to assist in dissipating the energy of site runoff during storm events. Baffling the flow of water at the outlets helps to alleviate soil erosion near the outlet areas during large precipitation events. Tall thick grass at the drain outlets is therefore considered to be a desirable feature. No willows were growing along the south rock drain; these are removed by the maintenance contractor. Vegetation in the apron outfall, located midway along the northeast side slope, was cut back.

5.4.2.3 Outlying Area

The area outward from the disposal site 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. These observations included the remainder of the former processing site that was sold to Alamo Holdings in 2005. The Alamo Holdings parcel is used for occasional livestock grazing and was reverting to native brush land. The new owner has removed some of the brush to restore grazing. Survey laths were noted outside the northwest fence line, marking the alignment of a proposed above-ground 10-inch-diameter water line. No developments or disturbances that violate deed restrictions at the site were observed.

DOE was informed that two saltwater disposal wells are proposed for the former processing site. The well permittee confirmed they are aware of and will comply with the use restrictions conveyed in the deed. DOE informed the Texas Railroad Commission that DOE has no objection to drilling and using the wells. Local residents submitted comments in opposition to the wells and the operator withdraw the application.

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

A significant increase in oil and gas industry activity continues in the surrounding area. This activity has not impacted the security of the site.

5.5 Follow-Up Inspections

DOE will conduct follow-up inspections if (1) an annual inspection or other site visit reveals a condition that must be reevaluated during a return to the site, or (2) a citizen or outside agency notifies DOE that conditions at the site are substantially changed. No need for a follow-up inspection was identified.

5.6 Maintenance

A Huisache tree located near perimeter sign P27 was treated with herbicide and will be removed. Routine site vegetation management continued in 2015 and DOE will recommend a program for controlling grass on the side slopes. DOE will determine if controlled grazing will be beneficial for vegetation management and turf vitality. DOE will replace weathered and discolored perimeter signs.

5.7 Emergency Response

Emergency response is action DOE 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 identified.

5.8 Environmental Monitoring

5.8.1 Groundwater Monitoring

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). Although NRC does not require groundwater monitoring at the site, DOE conducts monitoring as a best
5A management practice. Annual groundwater sampling at the site occurred in April 2015. As prescribed in the LTSP, site groundwater monitoring has the following two components:

- 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

Because supplemental standards apply to the uppermost aquifer at the site, no concentration limits or points of compliance have been established. Groundwater in the uppermost aquifer beneath the site has a U.S. Environmental Protection Agency designation 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 cleaned up using methods reasonably employed by public water supply systems (40 CFR 192.11[e]). Background groundwater quality varies by orders of magnitude in the area because the uppermost aquifer is in a location of naturally occurring uranium mineralization.

Two hydraulically connected groundwater units comprise the uppermost aquifer beneath the site. The shallower of the two units is in sandstone units of the Deweesville Sandstone and Conquista Clay of the Whitsett Formation. The deeper unit is in the Dilworth Sandstone of the Whitsett Formation. The Dilworth Sandstone is underlain by the Manning Clay, a 300-foot-thick aquitard that isolates the uppermost aquifer from better-quality groundwater in deeper aquifers. Samples are collected from both the Deweesville/Conquista and the Dilworth groundwater units.

The disposal cell performance monitoring network consists of seven monitoring wells (0709, 0858, 0880, 0906, 0908, 0916, and 0921) that are near the disposal cell and are completed in the Deweesville/Conquista unit. The groundwater compliance monitoring network consists of five monitoring wells (0862, 0886, 0891, 0924, and 0963) that are downgradient of the site and completed in both the Deweesville/Conquista unit and the Dilworth unit. Figure 5-2 shows the monitoring well networks.

In accordance with the LTSP, groundwater is monitored 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 level. The LTSP identifies low pH levels in groundwater as an indicator of the extent and movement of the legacy groundwater plumes. Changes in geochemical conditions might also indicate leachate movement from the disposal cell into the uppermost aquifer.

Tailings pore fluids were lower in pH than background groundwater. However, because pH levels and other signature contaminants in tailings pore fluids are essentially indistinguishable from processing-related contamination, it is difficult to determine whether contamination comes from the disposal cell or from legacy processing activities.

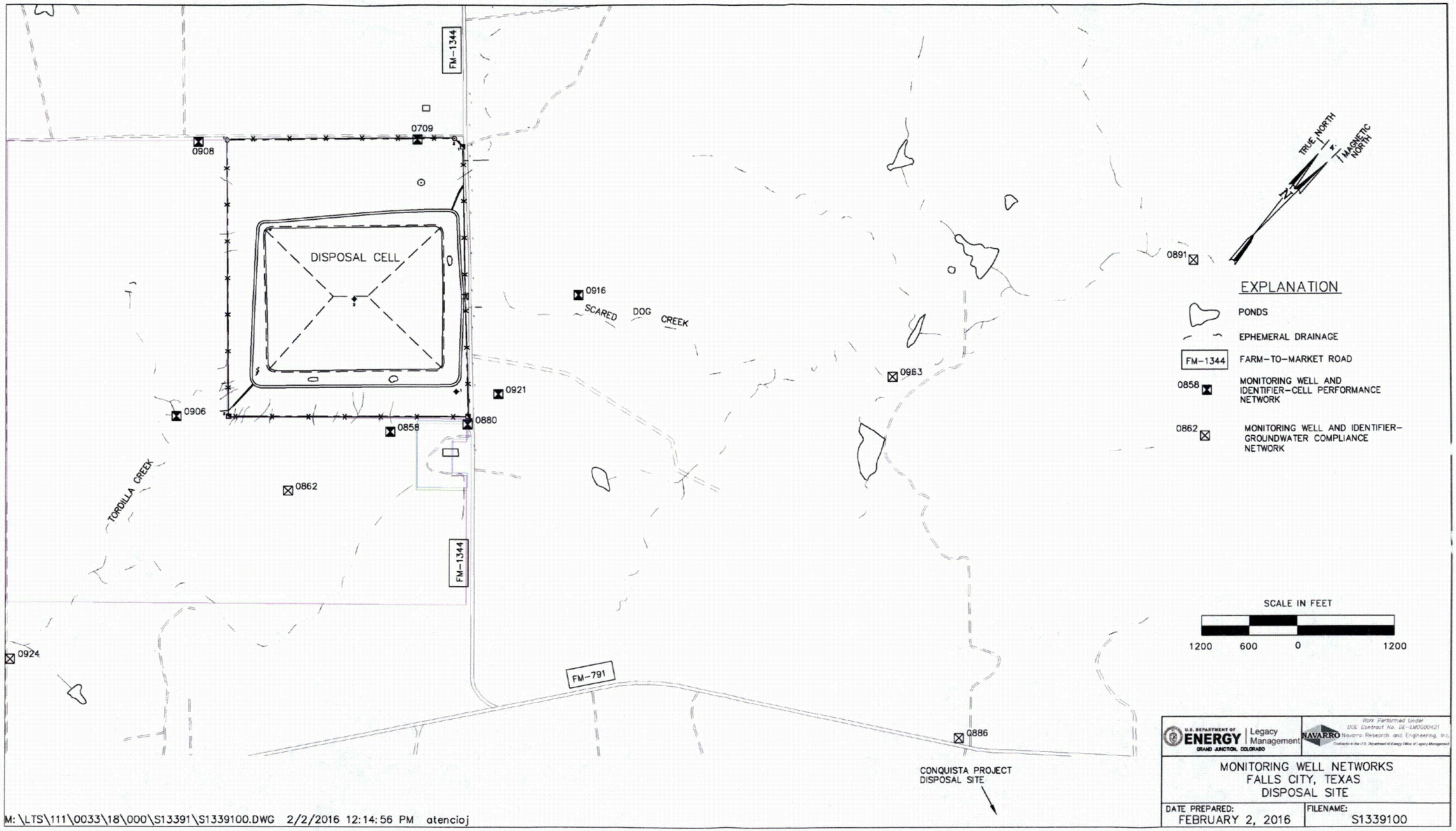

Figure 5-2. Combined Monitoring Well Network at the Falls City Disposal Site

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DOE has determined that pH and uranium concentrations do not co-vary. This is an indication that other factors contribute to uranium distribution in the uppermost aquifer, such as natural redistribution of uranium in this active ore-forming environment. Therefore, increasing uranium levels at a monitoring location without an attendant drop in pH probably does not indicate movement of processing-related contamination. Groundwater chemistry at monitoring locations near the formation subcrop can also be influenced by residence time as a response to precipitation or changes in oxidation state within the formation. If increases in uranium are sporadic and not accompanied by decreases in pH, DOE concludes that the elevated uranium is naturally occurring.

5.8.2 Groundwater Quality Monitoring Results

pH: At the cell performance monitoring wells, pH levels historically have been higher than the pH in tailings pore fluids (pH level of 2.93), with no significant upward or downward trends. In 2015, the pH levels for the cell performance wells continued to increase slightly (Figure 5-3) as would be expected as the pore fluids dissipate with time. Wells 0908 and 0916 are not shown in Figure 5-3 because those wells have been dry since 1996.

At the groundwater compliance monitoring wells, pH levels have historically been higher than the pH in groundwater contaminated by processing activities, with no significant upward or downward trends. The pH levels for these wells remained within the historical range (Figure 5-4). The pH in well 0963 historically has been lower than at the other locations but, in 2014 at a level of 3.24, it remains higher than the pH in the tailings pore fluids. This location was not accessible in 2015 due to high water in a gravel pit, and was therefore not sampled.[1]

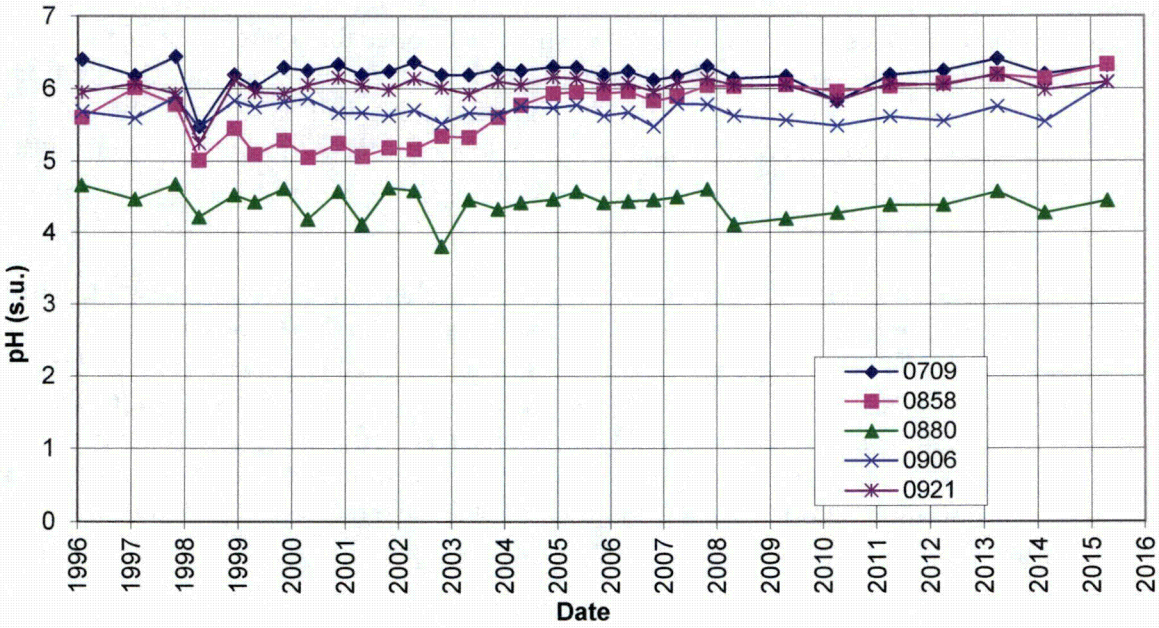


Figure 5-3. pH in Groundwater at Cell Performance Monitoring Locations at the Falls City Disposal Site

[1] Prior to the sampling event there was heavy rainfall on April 23, 2015, that resulted in the active gravel pit being filled with several feet of water. Routine access to this location (0963) is directly through the gravel pit. Alternate routes were discussed with the gravel pit operator; but no viable alternative routes were identified. The LMS site lead was notified of site conditions. The LMS site lead provided concurrence to the field team that location 0963 could not be accessed for the sampling event.

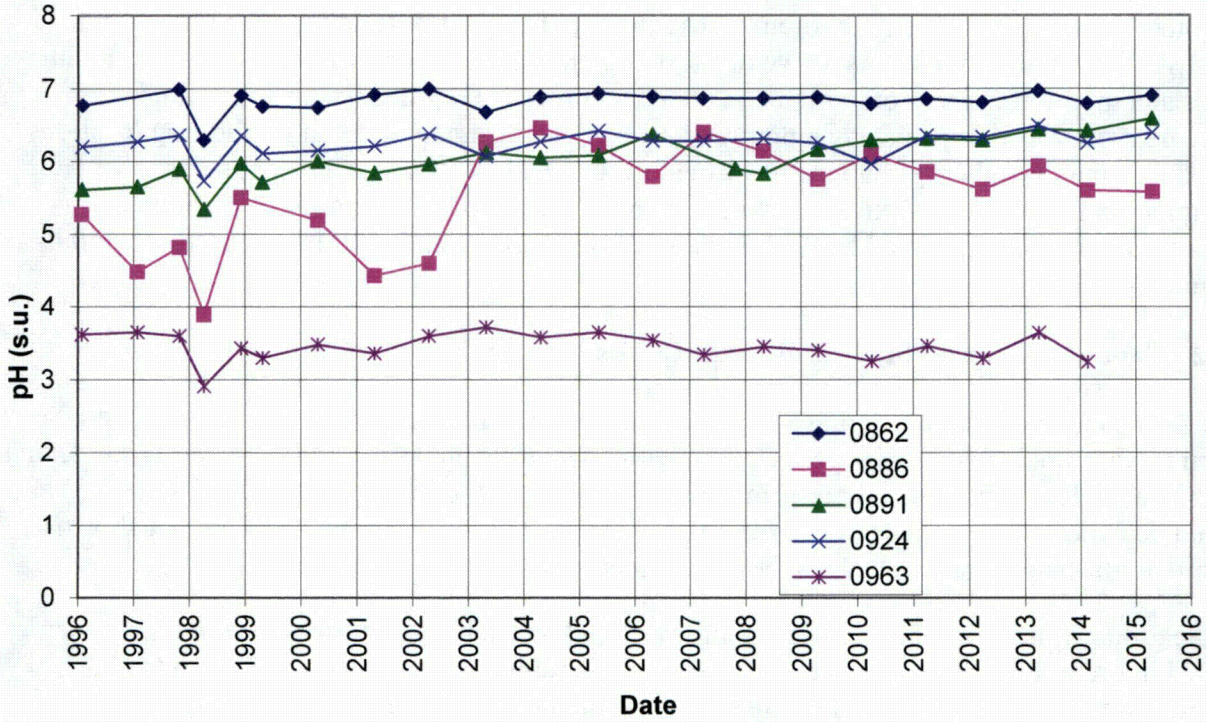


Figure 5-4. pH in Groundwater at Compliance Monitoring Locations at the Falls City Disposal Site

Uranium: Uranium concentrations in the cell performance wells remained within the historical range (Figure 5-5). The concentration in well 0921 showed a noticeable increase in 2013 following a gradual increase since 2002, but the 2015 result showed no significant change from 2014. A downward trend has occurred in well 0880 since 2004. At well 0880, uranium concentrations have varied considerably, ranging from a low of 1.38 milligrams per liter (mg/L) in 2008 to a high of 14 mg/L in 2004. Wells 0908 and 0916 are not shown in Figure 5-5 because those wells have been dry since 1996.

The concentration of uranium in groundwater within the compliance monitoring network shows that the uranium concentrations at monitoring wells 0862, 0886, and 0963(not sampled in 2015) remain stable at low levels (<0.2 mg/L) (Figure 5-6). The uranium concentration in well 0924 has been relatively stable since 2004, fluctuating between 0.4 mg/L and 0.6 mg/L. Since 2008, the uranium concentrations measured at well 0891 have been significantly higher than the other wells. The 2015 result (3.2 mg/L) is the highest measured in the well to date and is slightly above the maximum concentration reported for the aquifer, which is also the value used in the risk assessment for the Dilworth groundwater (3.04 mg/L).

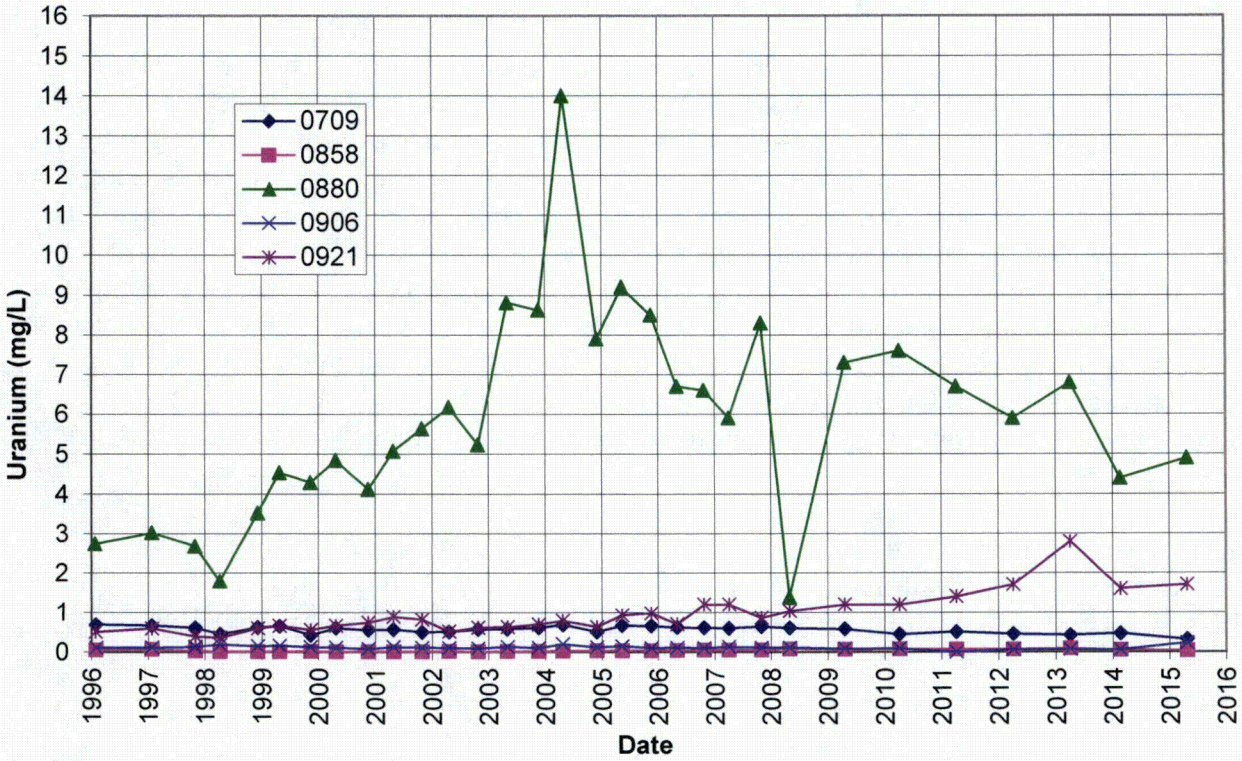


Figure 5-5. Uranium in Groundwater at Cell Performance Monitoring Locations at the Falls City Disposal Site

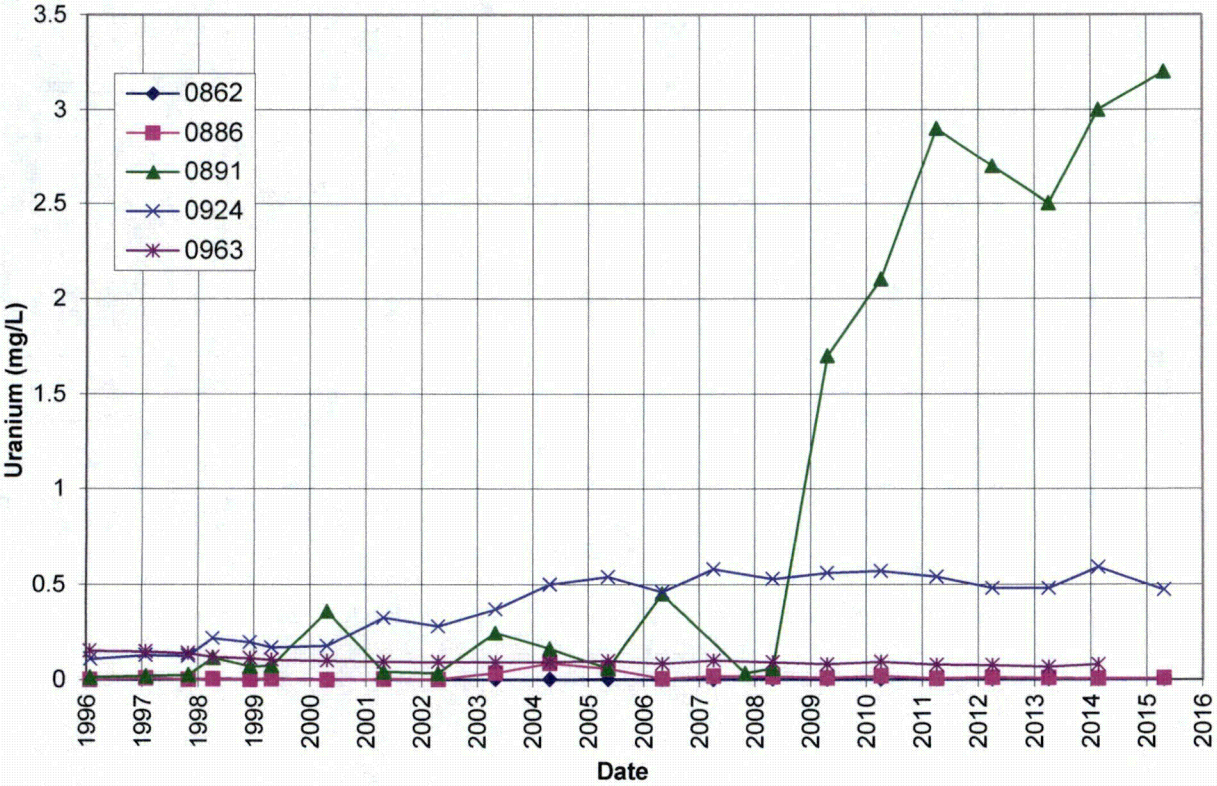


Figure 5-6. Uranium in Groundwater at Compliance Monitoring Locations at the Falls City Disposal Site

5.8.3 Groundwater Level Monitoring Results

Water levels in the disposal cell performance network reached new lows for every well in 2014, and the changes from 2014 to 2015 were varied but not large (Figure 5-7). Since 1996, groundwater levels in the disposal cell performance network wells have all decreased, ranging from approximately 2 feet to 12 feet lower than 1996 levels. The water level in monitoring well 0906 has fluctuated more than levels in the other wells. This well is directly downslope of the disposal cell, and the historical fluctuation may be the result of the infiltration of water that is shed by and conveyed away from the disposal cell, reflecting variations in annual precipitation. Other contributors that may influence local groundwater levels include: (1) the dissipation of the processing-site-related groundwater mound beneath the disposal cell, and (2) the reduction of transient drainage from the disposal cell. Wells 0908 and 0916 are not shown in Figure 5-7 because these wells, completed in an unsaturated zone of the Conquista Sandstone, have been dry since 1996.

Water level trends vary in the groundwater compliance monitoring network wells (Figure 5-8). Levels show a slight upward trend in wells 0862, 0886, and 0891 increasing about 4 feet since 1996. Water levels have fluctuated in the other wells and are currently near their 1996 levels.

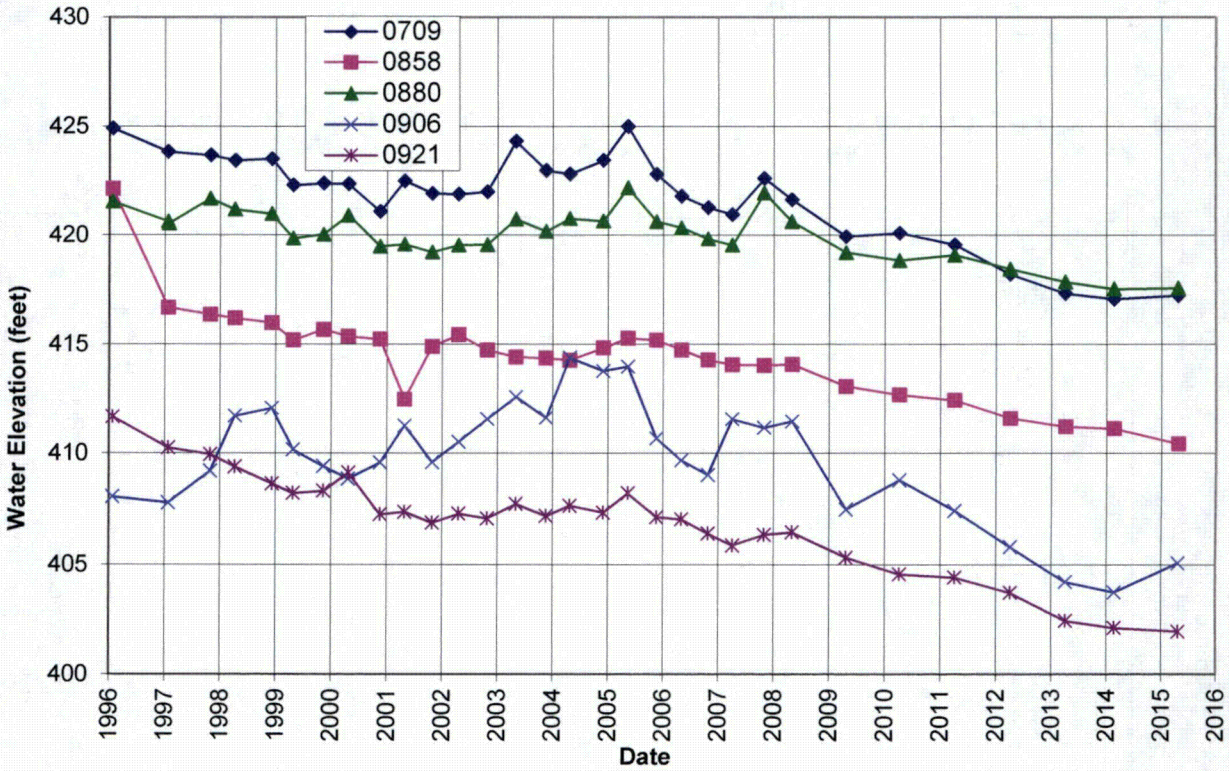


Figure 5-7. Water-Level Measurements at Cell Performance Monitoring Locations at the Falls City Disposal Site

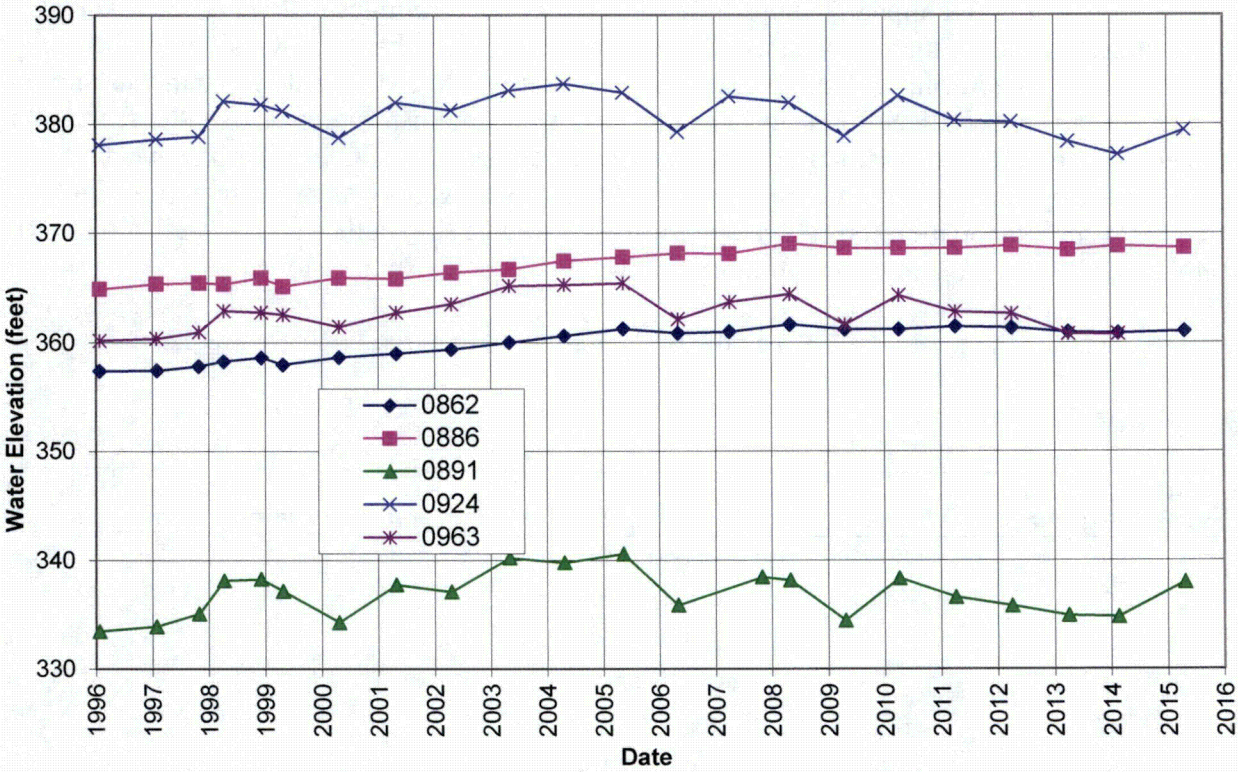


Figure 5-8. Water-Level Measurements at Compliance Monitoring Locations at the Falls City Disposal Site

5.8.4 Evaluation of Groundwater Monitoring

Uranium concentrations in cell performance well 0880 have varied considerably since 1996, but the 2015 results show little change from 2014 (Figure 5-5). The pH at this location is lower than at other locations in the cell performance monitoring network. Water levels are also declining at well 0880 (Figure 5-7). These results suggest that the interaction among the disposal cell, the legacy groundwater mound, and processing plumes is still equilibrating. However, monitoring results do not indicate that the disposal cell is contributing to the degradation of the uppermost aquifer. The cause of the anomalously high uranium concentrations in groundwater compliance well 0891 since 2008 (Figure 5-6) has not been determined.

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 2,000 feet below the surface near the site. Additionally, a 300-foot-thick aquitard isolates the uppermost aquifer from the better-quality groundwater in deeper aquifers.

DOE evaluated the groundwater monitoring program at the site in 2010 as required by the LTSP. Groundwater monitoring data collected from 2006 through 2010 were compared to previous data (1996 through 2005). The comparison showed that contaminant concentrations continued to fluctuate in the uppermost aquifer, but the fluctuations were within the historical range reported for the aquifer in the area of the site. The comparison also showed no unexpected water level changes.

The 2010 evaluation recommended that, after the collection of samples in 2011, groundwater monitoring activities at the site be discontinued. It was proposed that DOE would not plug and abandon the 12 monitoring wells at the site until the nearby UMTRCA Title II Conquista site transfers to the DOE Office of Legacy Management. The Conquista site is just south of, and adjacent to, the Falls City site. Upon transfer of the Conquista site, DOE will assess whether a joint monitoring approach is warranted (either as a one-time event or as periodic monitoring). Once NRC accepts the monitoring strategy for the Conquista site, Falls City site wells no longer deemed necessary to a Conquista monitoring effort would be decommissioned.

Recommendations made in the 2010 evaluation continue to undergo NRC review.

5.9 Photographs

Photograph Location Number	Azimuth	Photograph Description
PL-1	270	Perimeter sign P63.
PL-2	225	Site marker SMK-1.
PL-3	270	Boundary monument BM-1.
PL-4	135	Cell top slope.
PL-5	200	Southeast side slope.
PL-6	180	Fractured riprap.
PL-`7	315	Riprap at post 4 near ramp.
PL-8	315	Posts at south corner of cell for monitoring slope creep.
PL-9	270	Ramp on east corner of cell.
PL-10	300	Huisache tree on southwest property boundary.
PL-11	225	Area denuded by wild hogs.

FCT 1/2015. PL-1. Perimeter sign P63.

FCT 1/2015. PL-2. Site marker SMK-1.

FCT 1/2015. PL-3. Boundary monument BM-1.

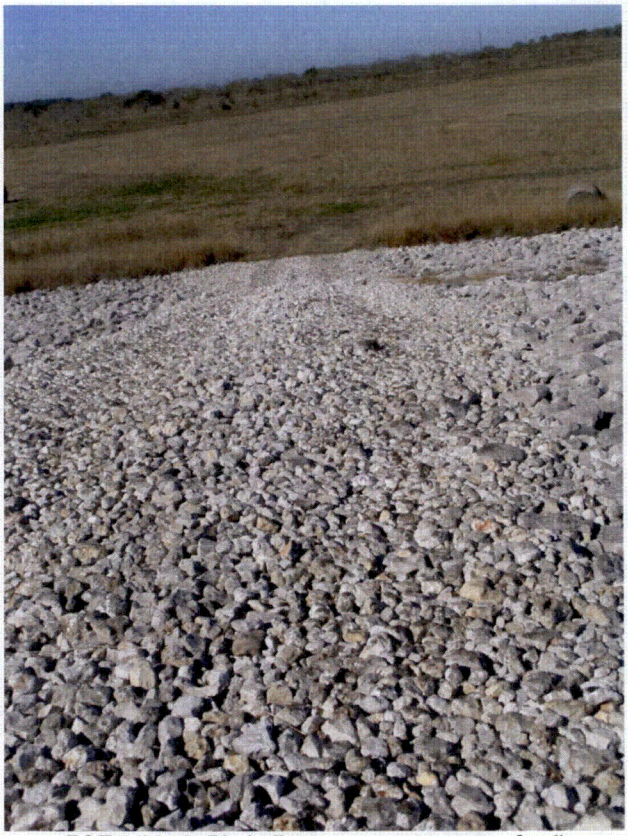
FCT 1/2015. PL-4. Cell top slope.

FCT 1/2015. PL-5. Southeast side slope.

FCT 1/2015. PL-6. Fractured riprap.

FCT 1/2015. PL-7. Riprap at post 4 near ramp.

FCT 1/2015. PL-8. Posts at south corner of cell for monitoring slope creep.



FCT 1/2015. PL-9. Ramp on east corner of cell.

FCT 1/2015. PL-10. Huisache tree on southwest property boundary.

FCT 1/2015. PL-11. Area denuded by wild hogs.

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 December 8, 2015. A portion of the disposal cell remains open to receive low-level radioactive materials from various sources; the open cell and its supporting structures and facilities are not included in the annual inspection. Ongoing cell cover study areas, which include a lysimeter facility adjacent to the disposal cell, are also not inspected. The annual inspection includes the completed portion of the disposal cell and the remaining portions of the disposal site.

The disposal cell and all associated surface water diversion and drainage structures were in good condition and functioning as designed. All site surveillance features are in good condition. Inspectors identified no significant maintenance needs or cause for a follow-up inspection.

6.2 Compliance Requirements

Requirements for the long-term surveillance and maintenance of the site are specified in the *Interim Long-Term Surveillance Plan for the Cheney Disposal Site Near Grand Junction, Colorado* (LTSP) (DOE/AL/62350-243, Rev. 1, U.S. Department of Energy [DOE], April 1998) and in procedures that DOE established to comply with the requirements of 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 Disposal Site

Requirement	Long-Term Surveillance Plan	This Report
Annual Inspection and Report	Sections 3.0 and 6.2	Section 6.4
Follow-Up Inspections	Section 3.4	Section 6.5
Routine Maintenance and Repairs	Sections 2.7.3 and 4.0	Section 6.6
Corrective Action	Section 5.0	Section 6.7
Groundwater Monitoring	Section 2.6	Section 6.8

6.3 Institutional Controls

The United States of America owns the 360-acre site. The open portion of the disposal cell is projected to remain open until 2023 or until it is filled to its design capacity. DOE's Office of Legacy Management (LM) operates the site under authority of House Rule 2967 Section 2(a)(1)(B). Until the disposal cell is closed, it will not be accepted under the U.S. Nuclear Regulatory Commission (NRC) general license (10 CFR 40.27). Institutional controls at the site include federal ownership of the property and the following physical features that are inspected annually: boundary monuments, a perimeter fence and gates, and warning/no trespassing signs (perimeter signs) placed along the property boundary.

6.4 Inspection Results

The site, located southeast of Grand Junction, Colorado, was inspected on December 8, 2015. The inspection was conducted by L. Sheader, S. Woods, G. Baur, and P. Wetherstein of the Legacy Management Support contractor. W. Dam (DOE Site Manager), M. Cosby (Colorado

Department of Public Health and Environment), and K. Hyatt (U.S. Bureau of Land Management) also attended the inspection.

The purposes of the inspection were to confirm the integrity of visible features at the site, to identify changes in conditions that might affect site integrity, and to determine the need, if any, for maintenance or additional inspections and monitoring. Numbers in the left margin of this report refer to items summarized in Table ES-1 of the "Executive Summary."

6.4.1 Site Surveillance Features

Figure 6-1 shows the locations of site surveillance features. Inspection results and recommended maintenance activities associated with site surveillance features are included in the following subsections. Photographs to support specific observations are identified in the text and on Figure 6-1 by photograph location (PL) numbers.

6.4.1.1 Entrance Gates, Entrance Signs, and Access Road

Access to the site is off of U.S. Highway 50, approximately 18 miles southeast of Grand Junction, Colorado. A steel tube double-swing access gate, secured by a locking device, is located along the highway right-of-way fence. DOE is one of several parties with access to the locking device. A right-of-way grant on federal land, administered by the U.S. Bureau of Land Management (BLM), extends approximately 1.7 miles between Highway 50 and the site's entrance gate. DOE maintains this right-of-way, including a two-lane asphalt access road. The site entrance gate is a double-swing chainlink gate secured by a DOE lock and chain.

The access gate, access road, right-of-way fence, and site entrance gate were all in good condition. The site entrance sign was present and legible.

6.4.1.2 Perimeter Fence and Perimeter Signs

A perimeter fence, consisting of a standard four-strand barbed-wire fence in some areas and a woven wire fence topped with barbed wire in others, surrounds the disposal cell features and operations areas. A total of 29 perimeter signs are at regular intervals along the DOE property boundary. The signs are installed on galvanized steel posts set in concrete.

The perimeter fence was functional, secure, and in good condition. Sign P16 was damaged by a bullet hole but legible, and sign P24 has been displaced over time but is also legible and stable. All of the other perimeter signs were present and in good condition (PL-1).

6.4.1.3 Site Markers

Granite site markers similar to those at other UMTRCA sites will not be installed until the disposal cell is closed.

6.4.1.4 Survey Monuments and Boundary Monuments

The site has four permanent boundary monuments, one at each of the four corners. All of the boundary monuments were located by inspectors and are in good condition (PL-2).

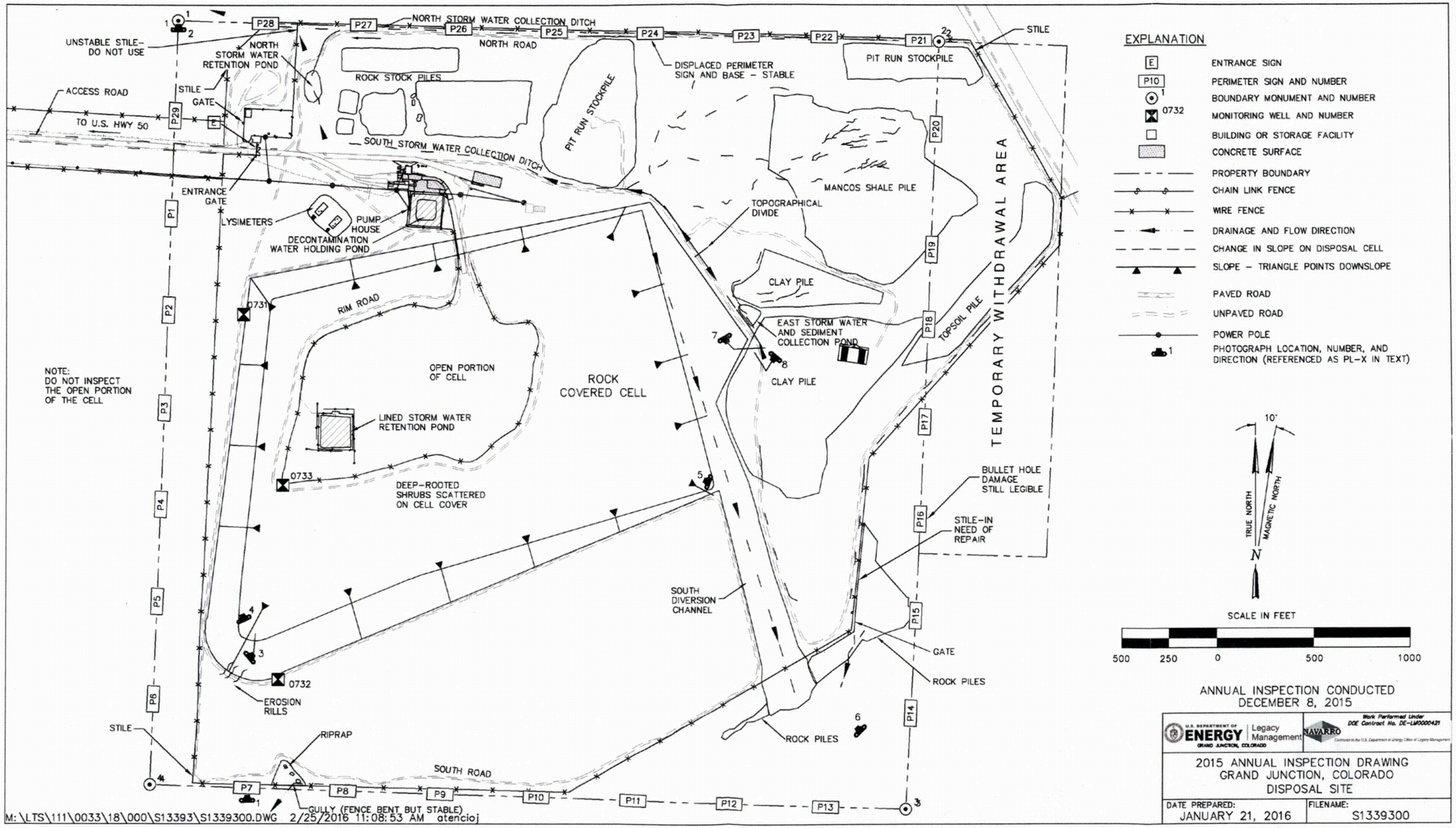


Figure 6-1. 2015 Annual Inspection Drawing for the Grand Junction Disposal Site

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6.4.1.5 Monitoring Wells

The groundwater monitoring network consists of three monitoring wells. All three are inside the site boundary. The well protective casings were locked and undamaged.

6.4.2 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 closed portion of the disposal cell, (2) diversion structures and drainage channels, (3) the area between the disposal cell and the site boundary, and (4) the outlying area.

Within each area, inspectors examined specific site surveillance features (including monitoring wells, boundary monuments, and signs) and inspected the area for evidence of erosion, settling, slumping, or other disturbance that might affect the site's integrity, protectiveness, or long-term performance.

6.4.2.1 Closed Portion of the Disposal Cell

Basalt riprap covers the top and side slopes of the disposal cell. The rock was in good condition with no significant weathering. The disposal cell top and side slopes showed no evidence of settling, slumping, cracking, erosion, or slope instability (PL-3, PL-4).

On the disposal cell cover, numerous areas with alkali deposits have been reported during previous inspections. The deposits are thought to be evaporite minerals. There is no indication that the alkali areas are related to the performance of the disposal cell, and these areas are no longer noted by inspectors.

Grasses and weeds were growing on most of the cell cover, and scattered shrubs were also present (PL-5). Historically, shrubs have been treated with herbicide on the cell top. Although treatment is not required by the interim LTSP, DOE plans to continue controlling the shrubs as needed until more is known about the potential effects of vegetation on the cover.

During the 2014 annual inspection, several small erosion channels were noted in soils at the base of the cell's southwestern corner. The channels do not threaten the integrity of the cell, and no significant changes were noted in 2015.

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 runoff from the disposal cell, and conveys the water into a natural drainage that flows away from the site to the southwest. The diversion channel was in good condition (PL-6). Grasses, weeds, and shrubs grow within the channel, but this vegetation is not expected to degrade the channel's performance. The discharge area of the channel is armored with large-diameter basalt riprap and was also in good condition.

Other drainage features at the site include north and south storm water collection ditches, the north storm water retention pond, and the east storm water and sediment collection pond. These small drainage features control storm water runoff primarily from the various stockpiles of cover

materials (Figure 6-1). The storm water collection ditches also capture storm water run-on from offsite locations.

The ditches and ponds were functioning as designed with the exception of the north storm water collection ditch. This ditch is impaired by sediment deposition resulting from offsite activities outside of DOE's control. However, during the 2015 annual inspection, inspectors and a representative from BLM examined the source of the run-on water, a breached ditch upgradient from the disposal site. Sediment and altered run-on patterns in the north storm water collection ditch do not threaten the integrity of the disposal cell.

6.4.2.3 Area Between the Disposal Cell and the Site Boundary

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

Most of the flat areas between the disposal cell and the site boundary are vegetated with native shrubs, scant perennial grasses, and annual weeds. Some localized erosion has occurred along the perimeter road. Erosion rills have deepened in one area near the east storm water and sediment collection pond (PL-7, PL-8); these rills will continue to be monitored. No areas of significant erosion were present that could threaten the integrity of the disposal cell or site features.

6.4.2.4 Outlying Area

The area within 0.25 mile of 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 land use changes associated with a proposed treatment facility on private property west of the site were evident. Most of the remaining land surrounding the site is rangeland administered by BLM and used primarily for cattle grazing.

Outside the site's eastern boundary is a 40-acre temporary withdrawal area of federal land administered by BLM. Some of the withdrawal area is included within the perimeter fence and contains materials stockpiles. This area is not included in the interim LTSP and therefore is inspected as an offsite area.

6.5 Follow-Up Inspections

DOE will conduct follow-up or contingency inspections if (1) an annual inspection or other site visit identifies a condition that requires a return to the site to evaluate the condition, or (2) a citizen or outside agency notifies DOE that conditions at the site or in the vicinity of the site are substantially changed. No need for a follow-up or contingency inspection was identified.

6.6 Maintenance and Repairs

No maintenance needs related to site surveillance features were identified during the inspection.

6.7 Corrective Action

Corrective action is taken to address a condition that may affect the integrity of the disposal cell or compliance with 40 CFR 192. No need for corrective action was identified during the inspection.

6.8 Groundwater Monitoring

Because total dissolved solids in the uppermost aquifer (Dakota Sandstone) beneath the site exceed 10,000 milligrams per liter (mg/L), the groundwater is designated as "limited use" and supplemental standards apply (40 CFR 192.21[g]). Under this designation, groundwater monitoring is not required. Confined groundwater in the uppermost aquifer lies approximately 750 feet below ground surface and is geologically isolated from the tailings material by low-permeability mudstones and shales of the Mancos Shale.

6A In lieu of monitoring groundwater in the uppermost aquifer, as a best management practice DOE monitors groundwater from three monitoring wells. Two wells (0731 and 0732) are completed in (or very near) buried alluvial paleochannels adjacent to the disposal cell, and one monitoring well (0733) is in the disposal cell (Table 6-2). This best-management-practice monitoring is done to assess the disposal cell's performance and to verify that groundwater that may be present in the paleochannels is not impacted if seepage (transient drainage) occurs from the disposal cell. The paleochannel monitoring wells are along the west (downgradient) edge of the disposal cell and are screened at the interface between the alluvium and shallow Mancos Shale. The third well is in the southwest corner of the open portion of the disposal cell and is used primarily for the measurement of water levels in the deepest part of the disposal cell to demonstrate that the groundwater elevation directly beneath the cell has not risen enough to move laterally into the paleochannels.

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

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

6.8.1 Groundwater-Level Monitoring

Static water level measurements are obtained from each well before water quality samples are collected (Figure 6-2). In September 2006, a datalogger was installed in each well to obtain water level measurements at 4-hour intervals continuously.

Since 1998, the water level in disposal cell well 0733 has stabilized. It has risen only an estimated 4 feet over the last few years, and it has remained substantially lower than the water levels in paleochannel monitoring wells 0731 and 0732 (Figure 6-2). Water levels within the two paleochannel monitoring wells continue to fluctuate and in 2015 were near 1998 levels. The water levels verify that groundwater at the base of the disposal cell at well 0733 has not risen to an elevation where it could potentially migrate into paleochannel groundwater at wells 0731 and 0732.

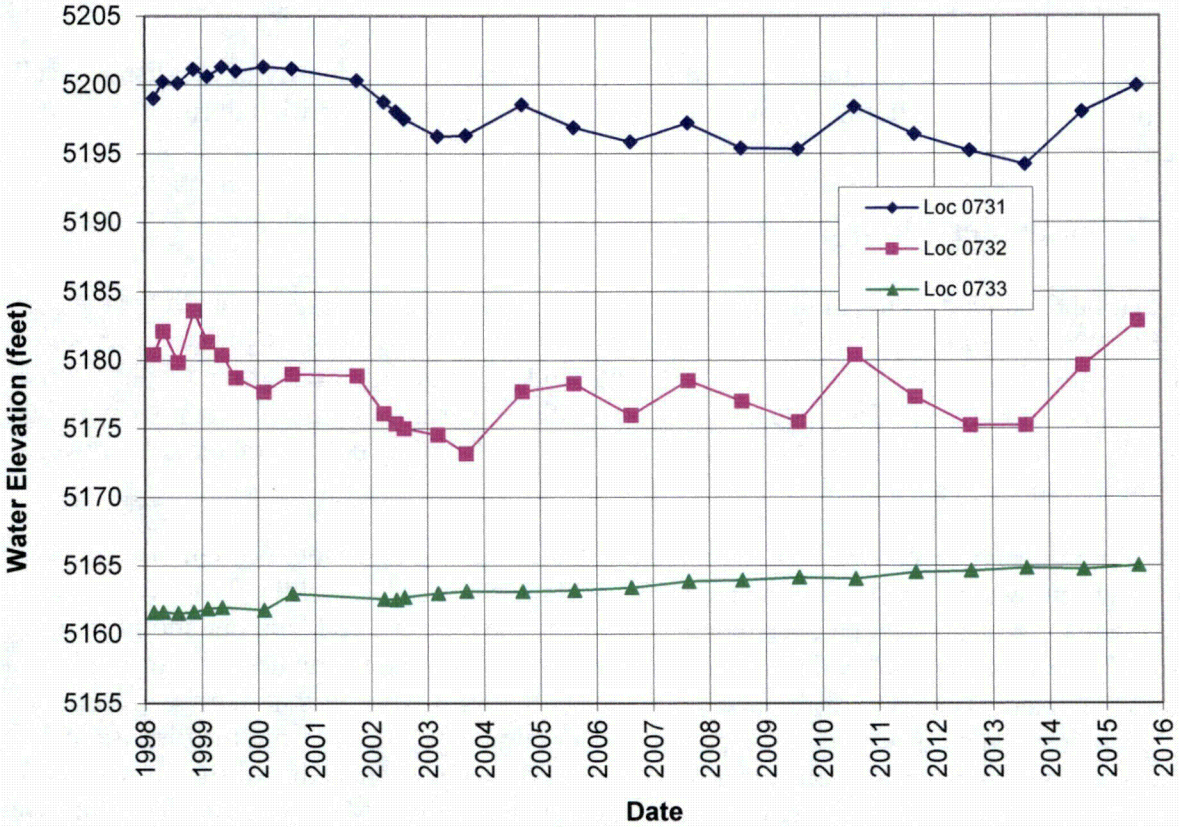

Figure 6-2. Water Level Measurements at the Grand Junction Disposal Site

6.8.2 Groundwater Quality Monitoring

Groundwater samples are analyzed for standard field parameters and the following indicator analytes: molybdenum, nitrate, selenium, sulfate, total dissolved solids, uranium, vanadium, and polychlorinated biphenyls. Key indicator analytes are molybdenum, nitrate, selenium, and uranium. In Table 1 to Subpart A of 40 CFR 192, the U.S. Environmental Protection Agency (EPA) has established maximum concentration limits (MCLs) for these analytes in groundwater (Table 6-3). Monitoring results are compared to the MCLs for evaluation only and not for compliance purposes.

Molybdenum concentrations in all three wells have remained steady since 1998; 2015 concentrations were less than or about equal to 0.003 mg/L. Time-concentration plots from 1998 through 2015 for the other key indicator analytes—nitrate (as nitrogen), selenium, and uranium—are shown on Figures 6-3 through 6-5.

Nitrate (as nitrogen) concentrations in groundwater continued to exceed the MCL of 10 mg/L in the paleochannel monitoring wells (0731 and 0732) in 2015 (Figure 6-3). Concentrations in these wells have varied substantially since 1998 with no overall trend. Nitrate concentrations in disposal cell well 0733 have shown a continuous downward trend since 1999 and reached a low of 1.5 mg/L in 2015. There is no apparent correlation of nitrate concentrations between the paleochannel wells and the disposal cell well.

Table 6-3. Maximum Concentration Limits for Groundwater at the Grand Junction Disposal Site

Constituent	MCL[a] (mg/L)
Molybdenum	0.1
Nitrate (as Nitrogen)	10
Selenium	0.01
Uranium	0.044

[a] EPA MCLs as listed in 40 CFR 192, Subpart A, Table 1

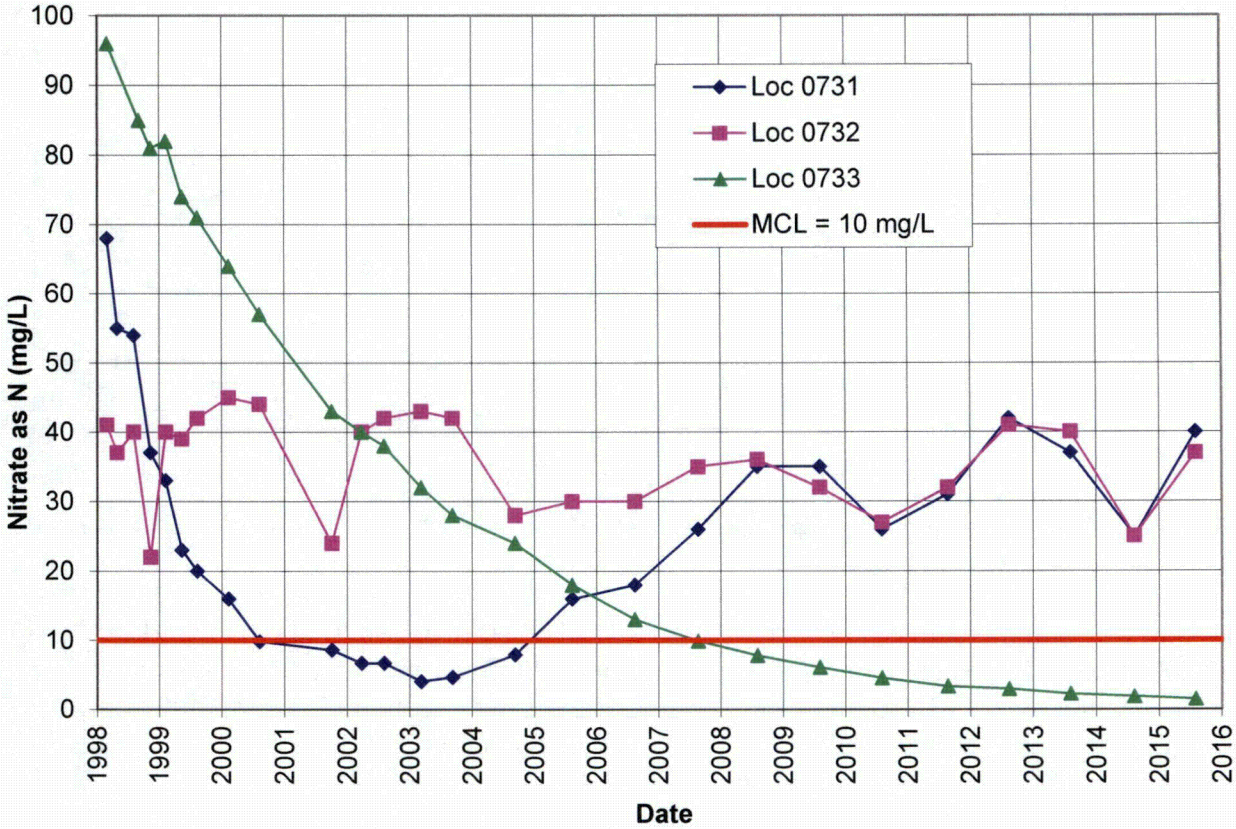

Figure 6-3. Time-Concentration Plots of Nitrate (as Nitrogen) in Groundwater at the Grand Junction Disposal Site

Selenium concentrations continued to exceed the MCL of 0.01 mg/L in the paleochannel monitoring wells (0731 and 0732), with no apparent trend in either well since 2001 (Figure 6-4). Selenium occurs naturally in the Mancos Shale deposits that underlie the disposal cell, and it might be the cause of the elevated concentrations reported in both paleochannel monitoring wells. In well 0733, the selenium concentration of 0.0052 mg/L in 2015 remained well below the MCL, with no trend evident. There is no apparent correlation of selenium concentrations between the paleochannel wells and the disposal cell well.

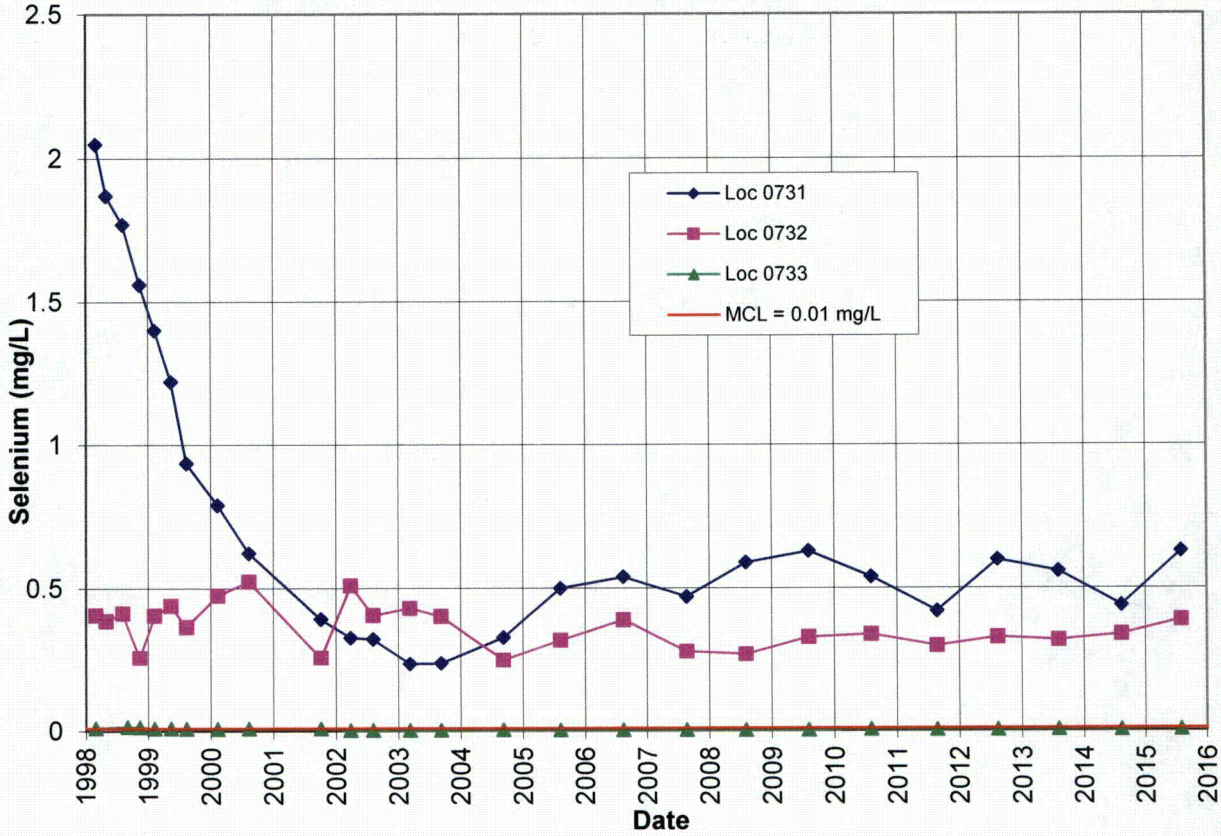

Figure 6-4. Time-Concentration Plots of Selenium in Groundwater at the Grand Junction Disposal Site

Uranium concentrations in groundwater continued to be below the MCL of 0.044 mg/L in wells 0731 and 0732, showing no apparent trend since 2007 (Figure 6-5). The uranium concentration in well 0733 continued to be above the MCL and continued an upward trend; the 2015 concentration was 0.18 mg/L. There is no apparent correlation of uranium concentrations between the paleochannel wells and the disposal cell well.

The groundwater level and contaminant concentration measurement results combine to verify that the groundwater in the paleochannels continues to be unaffected by potential transient drainage from the disposal cell.

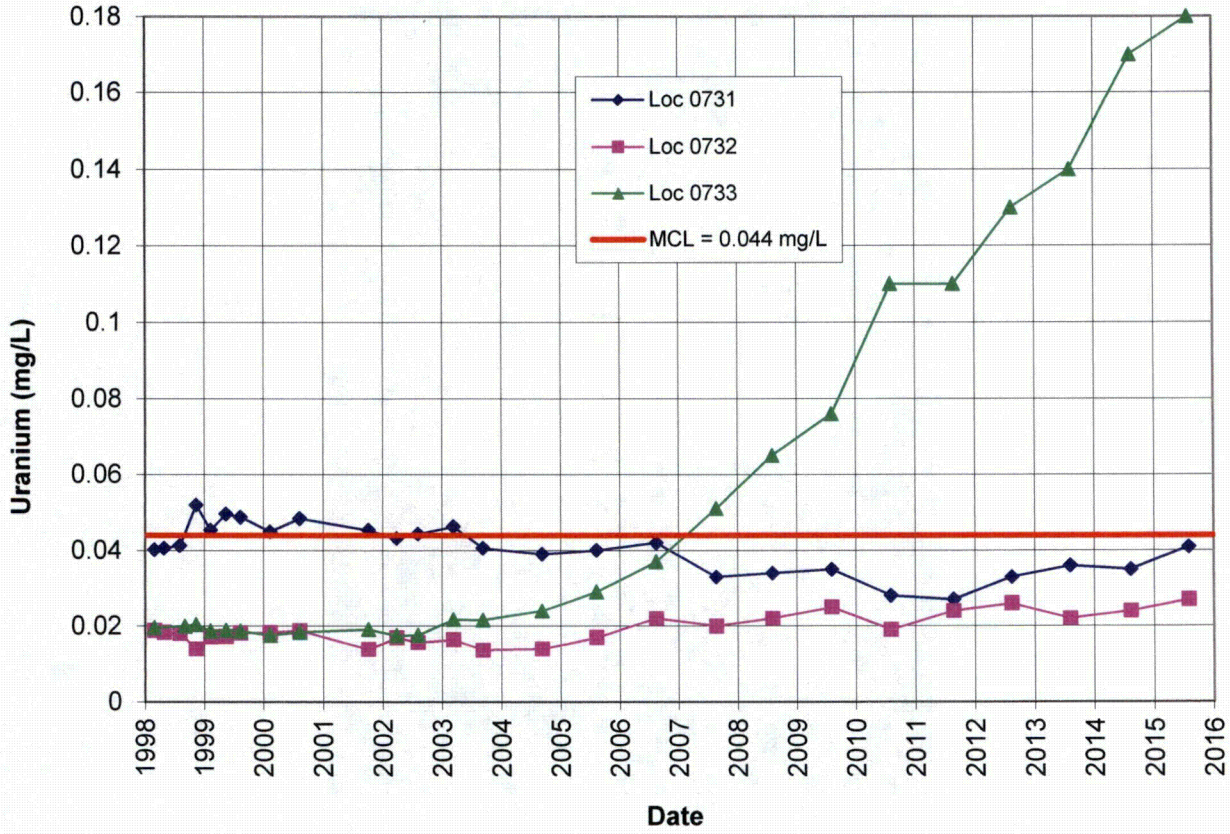

Figure 6-5. Time-Concentration Plots of Uranium in Groundwater at the Grand Junction Disposal Site

6.9 Photographs

Photo Location Number	Azimuth	Photograph Description
PL-1	0	Perimeter sign P7.
PL-2	n/a	Boundary monument 1.
PL-3	50	Disposal cell cover.
PL-4	335	West side slope of the disposal cell.
PL-5	290	Southeast portion of the disposal cell cover showing shrub growth.
PL-6	315	Outlet of the south diversion channel and surrounding area.
PL-7	150	Erosion rill east of the access road, east of the disposal cell.
PL-8	220	Erosion rill west of the access road, east of the disposal cell.

GRJ 12/2015. PL-1. Perimeter sign P7.

GRJ 12/2015. PL-2. Boundary monument 1.

GRJ 12/2015. PL-3. Disposal cell cover.

GRJ 12/2015. PL-4. West side slope of the disposal cell.

GRJ 12/2015. PL-5. Southeast portion of the disposal cell cover showing shrub growth.

GRJ 12/2015. PL-6. Outlet of the south diversion channel and surrounding area.

GRJ 12/2015. PL-7. Erosion rill east of the access road, east of the disposal cell.

GRJ 12/2015. PL-8. Erosion rill west of the access road, east of the disposal cell.

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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 March 18, 2015. The disposal cell was in excellent condition. One missing perimeter sign was replaced during the inspection. Inspectors identified no other maintenance needs or cause for a follow-up or contingency inspection.

7.2 Compliance Requirements

Requirements for the long-term surveillance and maintenance of the site are specified in the *Long-Term Surveillance Plan for the Green River, Utah, Disposal Site* (LTSP) (DOE/AL/62350-89, Rev. 2, U.S. Department of Energy [DOE], July 1998) and in procedures that DOE established to comply with the requirements of 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 Disposal Site

Requirement	Long-Term Surveillance Plan	This Report
Annual Inspection and Report	Section 6.0	Section 7.4
Follow-Up or Contingency Inspections	Section 7.0	Section 7.5
Maintenance and Repairs	Section 8.0	Section 7.6
Groundwater Monitoring	Section 5.2	Section 7.7
Corrective Action	Section 9.0	Section 7.8

7.3 Institutional Controls

The 25-acre site (Figure 7-1) is owned by the United States of America and was accepted under the U.S. Nuclear Regulatory Commission (NRC) general license (10 CFR 40.27) in 1998. DOE is the licensee and, in accordance with the requirements for UMTRCA Title I sites, is responsible for the custody and long-term care of the site. Institutional controls at the site include federal ownership of the property and the following physical features that are inspected annually: site markers, survey and boundary monuments, perimeter warning signs, DOE wellheads, and a site security fence.

7.4 Inspection Results

The site, southeast of Green River, Utah, was inspected on March 18, 2015. The inspection was conducted by R. Johnson and T. Jasso of the DOE Legacy Management Support contractor. J. Linard (DOE Site Manager) and J. Price (DOE Support Contractor) also attended the inspection.

The purposes of the inspection were to confirm the integrity of visible features at the site, to identify changes in conditions that might affect site integrity, and to determine the need, if any, for maintenance or additional inspections and monitoring. Numbers in the left margin of this report refer to items summarized in Table ES-1 of the "Executive Summary."

7.4.1 Site Surveillance Features

Figure 7-1 shows the locations of site surveillance features. Inspection results and recommended maintenance activities associated with site surveillance features are included in the following subsections. Photographs to support specific observations are identified in the text and on Figure 7-1 by photograph location (PL) numbers.

7.4.1.1 Access Road, Entrance Gate, and Entrance Sign

The site can be accessed either from the town of Green River or from U.S. Interstate Highway 70 via a paved road. The access routes cross State of Utah owned land.

Entrance to the site can be accessed through the vehicle access gate on the west side of the site, or the southern site access gate (Figure 7-1). Past these gates, a dirt access road leads across State land to the disposal cell. The access road divides at the disposal cell security fence, with one branch entering the enclosure through the locked south vehicle gate and providing access to the disposal cell and several monitoring wells, and the other providing access around the outside of the security fence. The access road was in good condition, and no maintenance needs were identified.

The site entrance sign is positioned on the site property boundary (PL-1) where the access road enters the south vehicle access gate of the disposal site. The sign was in excellent condition.

7.4.1.2 Security Fence and Perimeter Signs

The disposal cell is enclosed within a chain-link security fence (PL-2). Two vehicle access gates are at the south and east corners of the fence line, and a personnel gate is at the north corner of the fence line. The security fence and gates were in excellent condition.

Seventeen perimeter signs are positioned on steel posts set in concrete along the property boundary. Perimeter sign P8 was missing at the time of the 2014 inspection and was replaced; however, the sign was missing again. This sign was replaced at the conclusion of the site inspection. Perimeter sign P12 has a bullet dent, but is legible. The other perimeter signs were in excellent condition.

7.4.1.3 Site Markers

Two granite markers are on the site. Site marker SMK-1 (PL-3) is on the ground inside the southwest security fence line. Its concrete base has several minor cracks, but the marker is stable and repairs are not needed at this time. Site marker SMK-2, located on the crest of the disposal cell (PL-4), was in excellent condition.

7.4.1.4 Survey Monuments and Boundary Monuments

Eleven boundary monuments and three survey monuments are along the site perimeter. The monuments were in excellent condition with the exception of boundary monument BM-5, which was bent but remains stable.

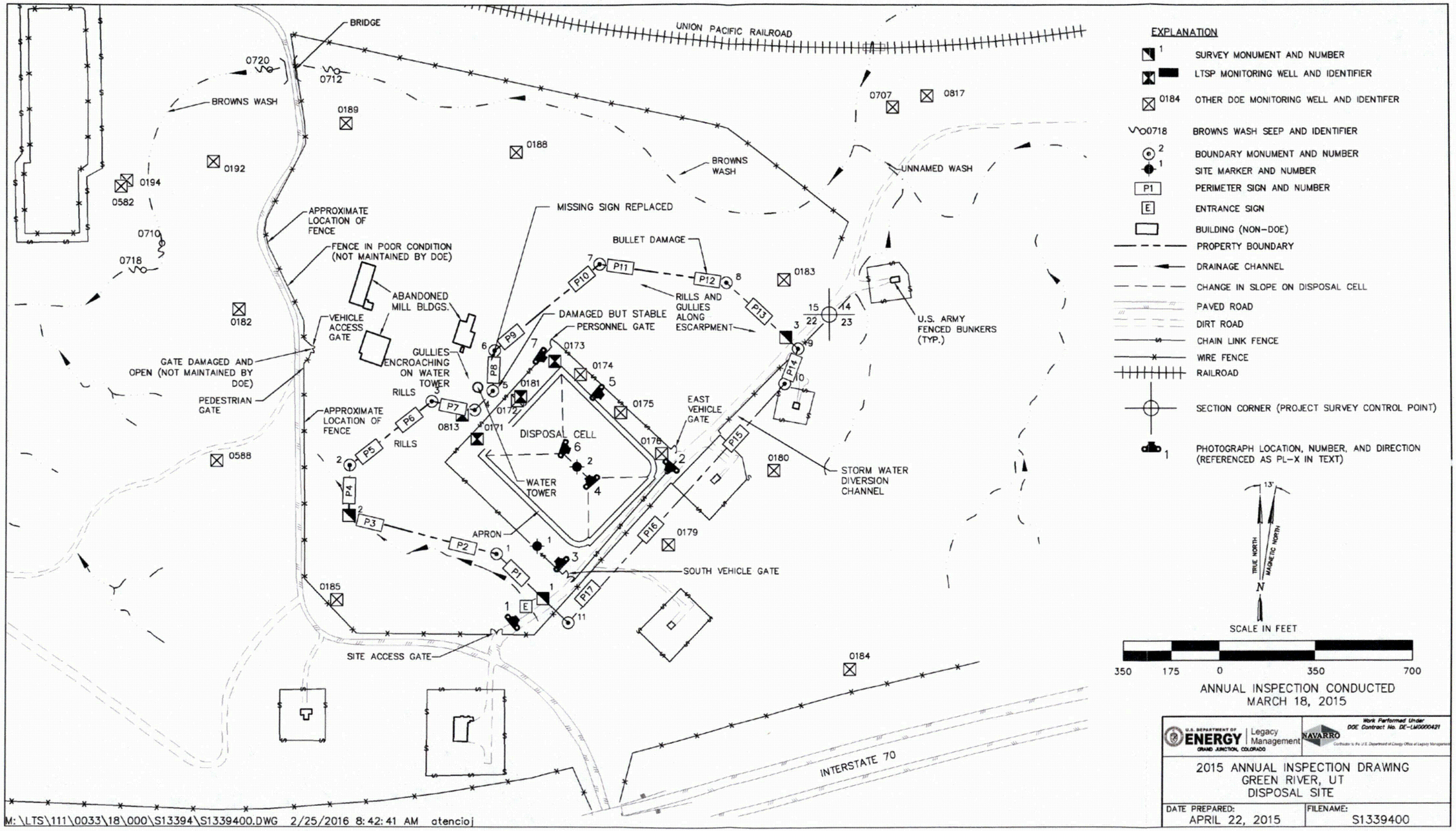

Figure 7-1. 2015 Annual Inspection Drawing for the Green River Disposal Site

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7.4.1.5 Monitoring Wells

Four wells are monitored in accordance with the LTSP (0171, 0173, 0181, and 0813). The other DOE wells shown on Figure 7-1 are monitored in accordance with a draft groundwater compliance action plan associated with the former processing site.

The wells were secure at the time of the inspection and the visible portions of the wells were in good condition (PL-5). Telemetry system on the site was permanently removed prior to this inspection.

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 property boundary, and (3) the outlying area.

Within each inspection area, inspectors examined specific site surveillance features. Inspectors also looked for evidence of settlement, erosion, or other modifying processes that might affect site integrity or long-term performance.

7.4.2.1 Disposal Cell and Adjacent Area Inside the Security Fence

The 6-acre disposal cell was completed in 1989. The slopes of the disposal cell cover are armored with basalt rock (PL-6). The quality of the rock is excellent, and the disposal cell cover was in excellent condition. No evidence of settling, slumping, erosion, or any other disturbance of the cell surfaces was observed. No vegetation was present on the cell. A basalt-boulder-filled trench, called an apron, surrounds the disposal cell (PL-7). The apron was in excellent condition.

The area between the disposal cell and the security fence consists of the cell perimeter dirt road, several monitoring wells and open space. This area was in good condition. A few small areas of erosion were apparent between wells 0174 and 0176 from storm-water runoff along the road; the runoff water drains into the cell apron. These areas are not a concern because the erosion is minor and sedimentation in the apron is insignificant.

7.4.2.2 Site Perimeter Between the Security Fence and the Property Boundary

Rills and gullies are present on the west side of the property but do not encroach on disposal cell structures and currently are not affecting any site surveillance features. Rills and gullies are also present along the escarpment northeast of the disposal cell in the area between boundary monument BM-7 and survey monument SM-3. Maximum gully depth in this area is approximately 3 feet. The rill and gully erosion could eventually damage perimeter signs and boundary monuments and will continue to be monitored.

Trespassing can occur on the site from several access points through State land. The barbed-wire stock fence on the surrounding State-owned property provides only minimal security; the fence west of the site was in poor condition, and a gate providing access to the former mill buildings and the DOE site was broken off its hinges. The site is also accessible through remote open access points north and east of the property. DOE property will continue to be monitored for

adverse public use indicated by trash, tire ruts, and vandalism. The missing perimeter sign was the only indication of vandalism at the site.

7.4.2.3 Outlying Area

The area within 0.25 mile of the property boundary was visually observed for erosion, changes in land use, or other phenomena that might affect the long-term integrity of the site. Areas of erosion noted during previous inspections include the natural drainage southwest of the site, and rills and gullies northwest of the water tower. Minor erosion continues but currently does not threaten the integrity of the disposal cell or site surveillance features.

Abandoned buildings and a water tower associated with the former milling activities at the site are northwest of the DOE property. The buildings are in a severe state of disrepair, and debris (e.g., roofing materials, siding, trash) tends to be blown from the buildings onto the DOE property. Accumulation of materials blown onto DOE property was not significant but will continue to be monitored; debris will be removed as necessary.

7.5 Follow-Up or Contingency Inspections

DOE will conduct follow-up or contingency inspections if (1) an annual inspection or other site visit reveals a condition that must be reevaluated during a return to the site, or (2) a citizen or outside agency notifies DOE that conditions at the site are substantially changed. No need for a follow-up or contingency inspection was identified.

7.6 Maintenance and Repairs

7A The missing perimeter sign was replaced the same day following the inspection. The telemetry
7B system was removed on March 18, 2015, prior to the site inspection. No other maintenance needs were identified.

7.7 Groundwater Monitoring

In compliance with 40 CFR 192, Subpart A, and as stipulated in the LTSP, the groundwater monitoring network consists of four point-of-compliance (POC) wells northwest of the disposal cell (0171, 0173, 0181, and 0813). These wells are completed in the middle sandstone unit of the Cedar Mountain Formation, which contains the uppermost aquifer. The LTSP included POC well 0172. However, its construction integrity was suspect, so well 0181 was installed next to it in 2001; well 0181 has been monitored as the replacement POC well since then. The purpose of the monitoring is to evaluate the performance of the disposal cell.

In accordance with the LTSP, groundwater levels in the POC wells were initially monitored to evaluate the relationship between precipitation in the cell watershed and aquifer water levels. Water levels continue to be measured in wells 0171, 0173, 0176, 0179, 0183, 0813, and 0817 to monitor aquifer flow in the contaminated middle sandstone unit of the Cedar Mountain Formation, and are continuously measured in wells 0182, 0184, 0185, 0582, and 0588 to monitor aquifer flow in the formation's uncontaminated basal sandstone unit.

7.7.1 Cell Performance Monitoring

The LTSP proposed well-specific concentration limits for nitrate and uranium that were equal to or greater than the U.S. Environmental Protection Agency (EPA) maximum concentration limits (MCLs) provided in 40 CFR 192, Subpart A, Table 1. Sulfate, which does not have an MCL, also had proposed well-specific concentration limits. Table 7-2 lists the LTSP-proposed limits for the POC wells. Risk-based alternate concentration limits (ACLs) are proposed for nitrate and uranium in the draft groundwater compliance action plan under review by NRC; no concentration limit is proposed for sulfate. Table 7-3 provides the analytical results for the
7C June 2015 sampling event at the POC wells.

Table 7-2. LTSP-Proposed Concentration Limits for Point-of-Compliance Wells at the Green River Disposal Site

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

Notes:
[a] EPA MCL (40 CFR 192, Subpart A, Table 1)
mg/L = milligrams per liter

Table 7-3. 2015 Analytical Results for Point-of-Compliance Wells at the Green River Disposal Site

Monitoring Well	Nitrate[a] (mg/L)	Uranium (mg/L)	Sulfate (mg/L)
0171	43	0.130	4000
0173	160	0.016	7300
0181	76	0.022	6700
0813	0.02	0.019	3700

Notes:
[a] Nitrate = nitrate plus nitrite as nitrogen
mg/L = milligrams per liter

Nitrate concentrations have been measured as nitrate plus nitrite reported as nitrogen since early 2004 (before then, nitrate was reported as NO_3). Concentrations continued to exceed the LTSP limits in wells 0171 and 0173, but they are considerably below the proposed ACL of 1,000 milligrams per liter (mg/L). Concentrations of nitrate for 2015 in the POC wells are similar to previous measurements (Figure 7-2).

Uranium concentrations in groundwater remain below the LTSP limits in all POC wells except well 0171, and remain considerably below the proposed ACL of 4.4 mg/L in all POC wells (Figure 7-3). Uranium concentrations at well 0171 have varied considerably, ranging from a low of 0.0184 mg/L in 1999 to a high of 0.13 mg/L in 2006, 2008, and again in 2015. No conclusions regarding the variability of uranium concentrations in well 0171 have been reached.

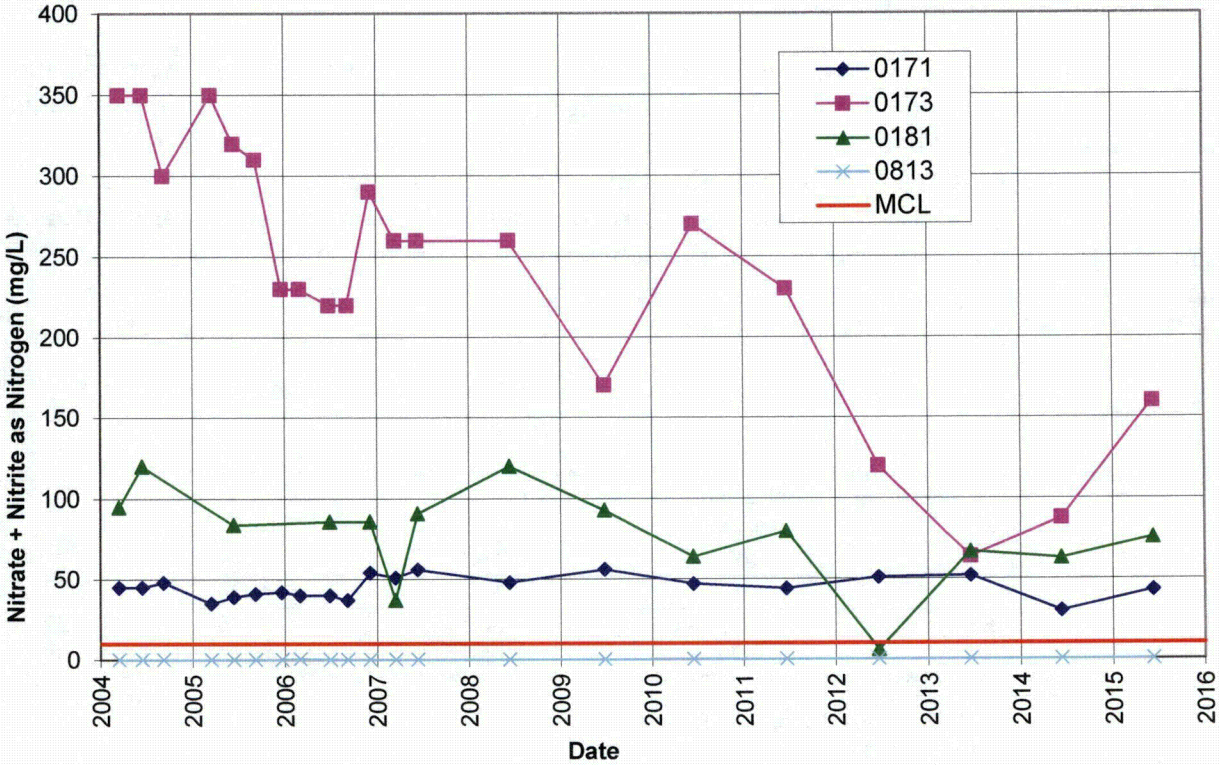

Figure 7-2. Time-Concentration Plots of Nitrate in Groundwater at the Green River Disposal Site

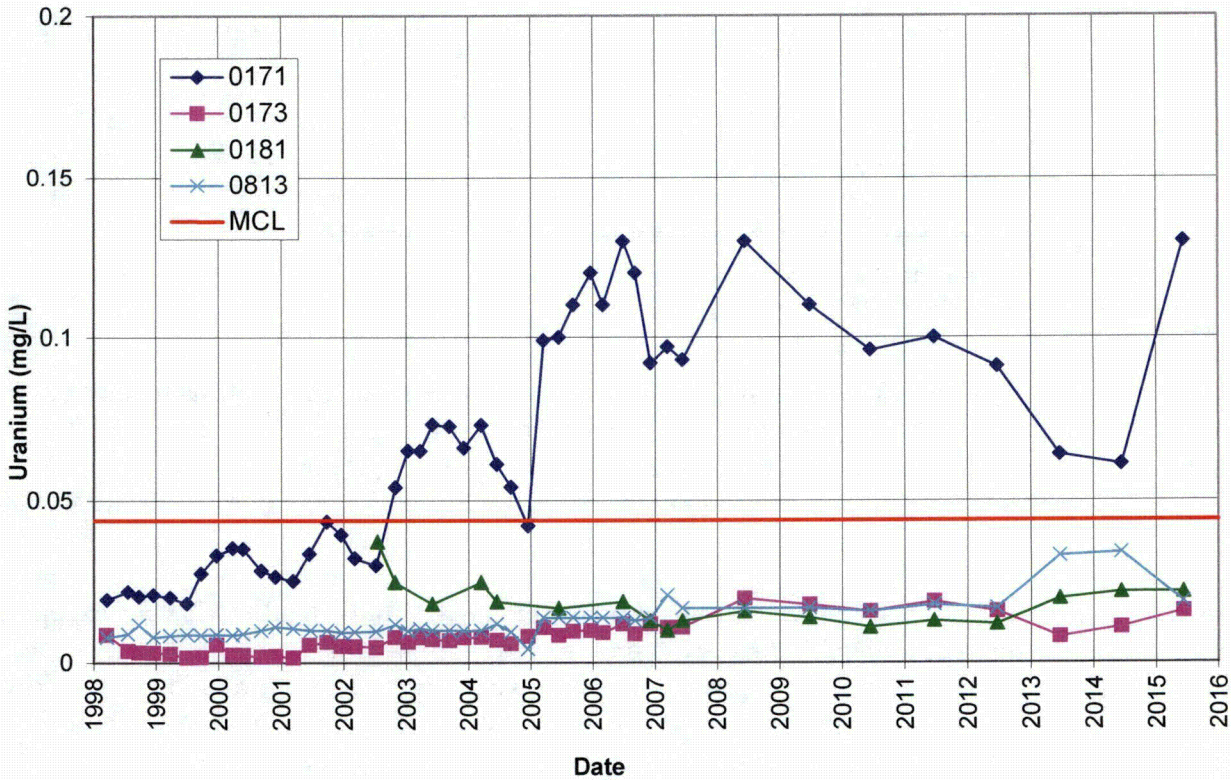

Figure 7-3. Time-Concentration Plot of Uranium in Groundwater at the Green River Disposal Site

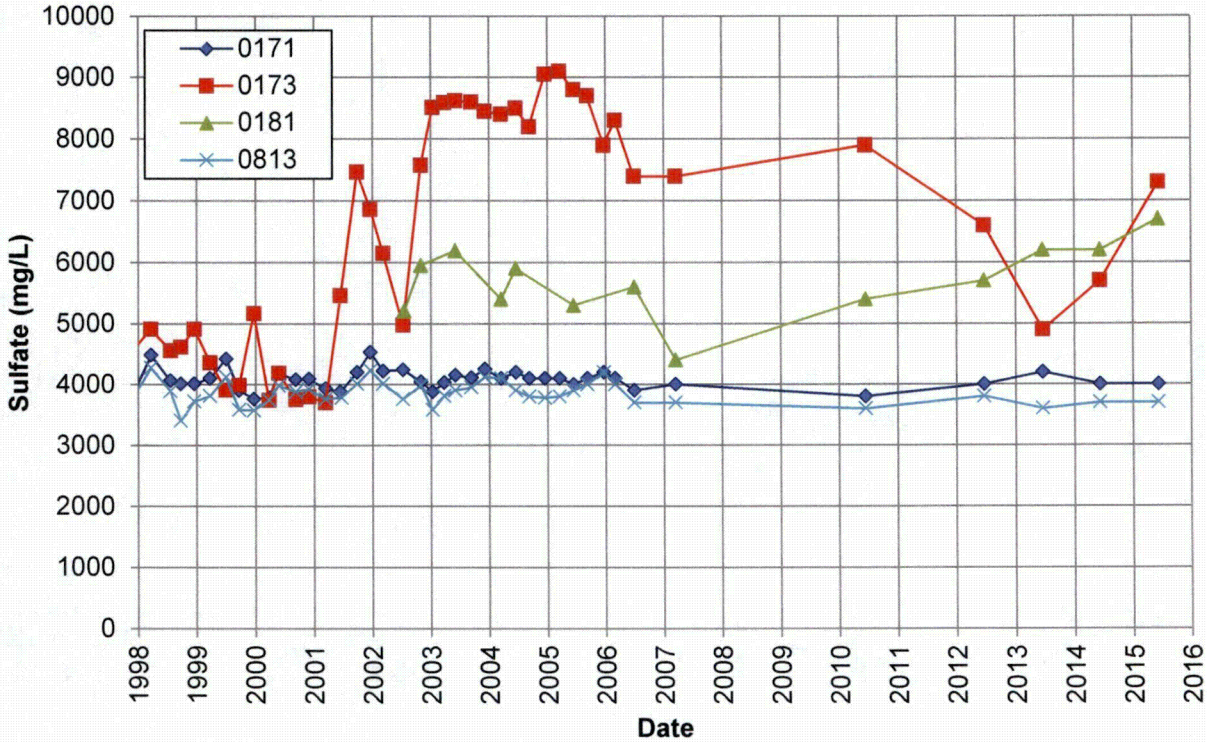

Figure 7-4. Time-Concentration Plot of Sulfate in Groundwater at the Green River Disposal Site

Sulfate concentrations continue to exceed the LTSP limits in all POC wells except 0813. The 2015 concentrations were within historical results (Figure 7-4).

The cell performance monitoring results were similar to results in recent years. The results do not indicate degradation of cell performance but will continue to be evaluated.

7.7.2 Groundwater-Level Monitoring

The hydraulic gradients and flow directions in the two Cedar Mountain Formation aquifers near the disposal cell are monitored using water-level measurements from several wells adjacent to the disposal cell. Water levels have been manually measured in these wells since 1991. High-frequency water-level data has been collected since 1999 using downhole dataloggers. Thirteen wells have dataloggers. A telemetry system was installed in 2007 to transmit the continuous water-level monitoring data to the LM office in Grand Junction. The telemetry system remained operational until its removal in 2015.

Groundwater-level monitoring near the disposal cell, using the POC wells, has shown little change since 2013. These POC wells, which are completed in the middle sandstone aquifer, indicate that the groundwater elevation decreased approximately 3 feet overall from 1998 through 2004, and then increased approximately 8 feet between 2004 and 2007. Water levels have decreased approximately 4 to 5 feet since 2007 (Figure 7-5).

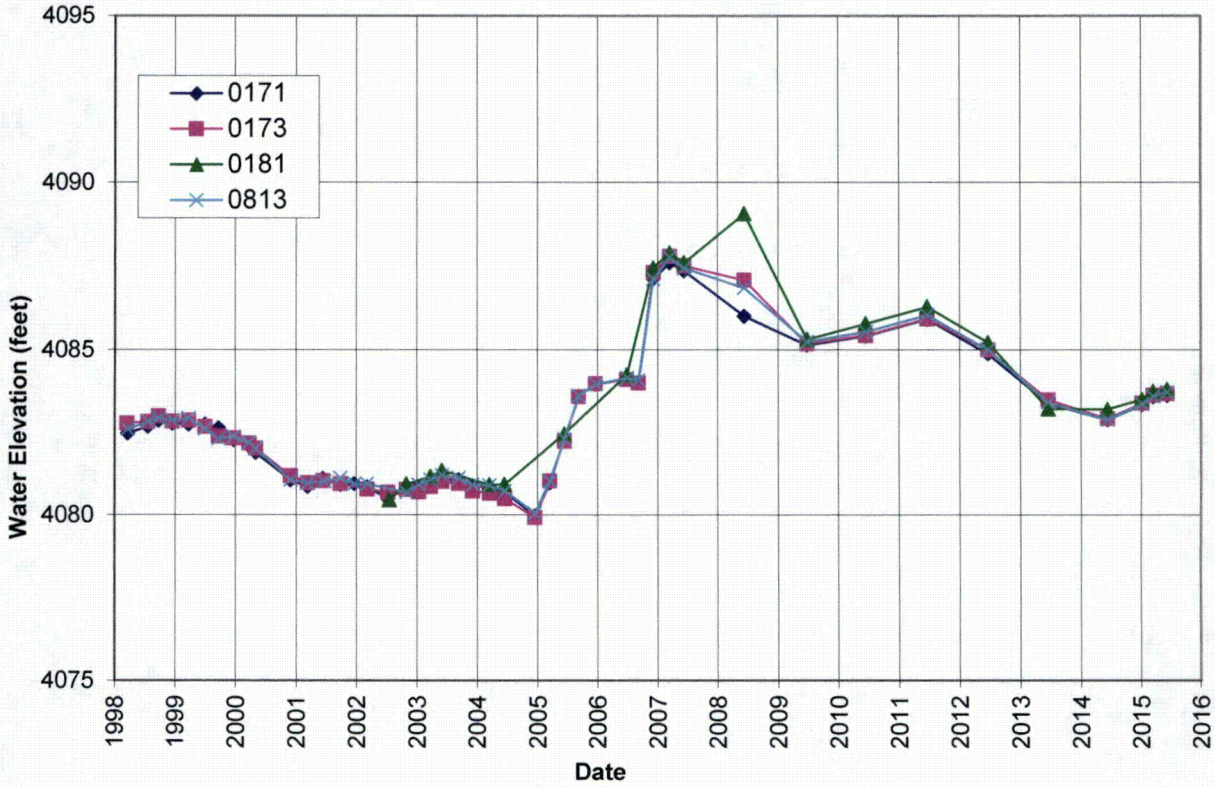

Figure 7-5. Groundwater Elevations at the Green River Disposal Site

The monitoring well locations in the two Cedar Mountain aquifers are not ideal (i.e., no nested well pairs in the upper and lower aquifers) to define both the groundwater flow directions and the hydraulic gradient between the aquifers. However, groundwater elevation data derived from the existing well network are adequate to determine that flow direction in the upper aquifer is toward the west-northwest, while flow direction in the lower aquifer is toward the southwest. The data also suggest that there is a neutral gradient between the two aquifers, therefore neither inducing nor retarding contaminant migration from the contaminated upper aquifer to the uncontaminated lower aquifer.

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 Photographs

Photograph Location Number	Azimuth	Photograph Description
PL-1	50	Entrance sign.
PL-2	220	Security fencing along the southeast side of disposal cell.
PL-3	315	Site marker SMK-1.
PL-4	320	Site marker SMK-2.
PL-5	130	Monitoring well 0175.
PL-6	110	Northeast side slope of disposal cell.
PL-7	125	Northwest disposal cell apron and side slope.

GRN 3/2015. PL-1. Entrance sign.

GRN 3/2015. PL-2. Security fencing along the southeast side of disposal cell.

GRN 3/2015. PL-3. Site marker SMK-1.

GRN 3/2015. PL-4. Site marker SMK-2.

GRN 3/2015. PL-5. Monitoring well 0175.

GRN 3/2015. PL-6. Northeast side slope of disposal cell.

GRN 3/2015. PL-7. Northwest disposal cell apron and side slope.

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8.0 Gunnison, Colorado, Disposal Site

8.1 Compliance Summary

The Gunnison, Colorado, Uranium Mill Tailings Radiation Control Act (UMTRCA) Title I Disposal Site was inspected on July 1, 2015. The disposal cell and all associated surface water diversion and drainage structures were in excellent condition and functioning as designed. Six riprap test areas on the cell apron and diversion ditches were visually inspected; no rock degradation was noted when compared to 2012 photos. Inspectors identified no maintenance needs or cause for a follow-up inspection.

8.2 Compliance Requirements

Requirements for the long-term surveillance and maintenance of the site are specified in the *Long-Term Surveillance Plan for the Gunnison, Colorado, Disposal Site* (LTSP) (DOE/AL/62350-222, Rev. 2, U.S. Department of Energy [DOE], April 1997) and in procedures that DOE established to comply with the requirements of 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 Disposal Site

Requirement	Long-Term Surveillance Plan	This Report
Annual Inspection and Report	Section 3.0	Section 8.4
Follow-Up Inspections	Section 3.5	Section 8.5
Maintenance and Repairs	Section 5.0	Section 8.6
Groundwater Monitoring	Section 4.0	Section 8.7
Corrective Action	Section 6.0	Section 8.8

8.3 Institutional Controls

The 92-acre site (Figure 8-1) is owned by the United States of America and was accepted under the U.S. Nuclear Regulatory Commission (NRC) general license (10 CFR 40.27) in 1997. DOE is the licensee and, in accordance with the requirements for UMTRCA Title I sites, is responsible for the custody and long-term care of the site. Institutional controls at the site include federal ownership of the property and the following physical features that are inspected annually: site markers, survey and boundary monuments, perimeter warning signs, a site perimeter fence, and a locked gate at the site entrance.

8.4 Inspection Results

The site, southeast of Gunnison, Colorado, was inspected on July 1, 2015. The inspection was conducted by R. Johnson and T. Jasso of the DOE Legacy Management Support contractor. J. Linard (DOE Site Manager), M. Cosby (Colorado Department of Public Health and Environment) and R. Evans (NRC) also attended the inspection.

The purposes of the inspection were to confirm the integrity of visible features at the site, to identify changes in conditions that might affect site integrity, and to determine the need, if any,

for maintenance or additional inspections and monitoring. Numbers in the left margin of this report refer to items summarized in Table ES-1 of the "Executive Summary."

8.4.1 Site Surveillance Features

Figure 8-1 shows the locations of site surveillance features. Inspection results and recommended maintenance activities associated with site surveillance features are included in the following subsections. Photographs to support specific observations are identified in the text and on Figure 8-1 by photograph location (PL) numbers.

8.4.1.1 Site Access, Entrance Gate, and Entrance Sign

Access to the site is off Gunnison County Road 42 onto U.S. Bureau of Land Management (BLM) Road 3068 to the site entrance gate. The road to the site is a gravel road maintained by BLM and was in acceptable condition.

The entrance gate is a barbed-wire gate in the stock fence that surrounds the site. The entrance gate, located along the south portion of the perimeter fence, was secured by a padlock and chain to the adjoining post and was in good condition. An entrance sign is bolted to a perimeter fence post next to the entrance gate. The sign was in excellent condition.

8.4.1.2 Perimeter Fence and Perimeter Signs

A barbed-wire fence delineates the site; most of it is set along the property boundary. The fence was in good condition (PL-1). Two locked barbed-wire gates—one on the north fence line and the other on the east fence line—provide access to offsite monitoring wells. The gates were locked and in good condition.

Forty-five perimeter signs are bolted to the perimeter fence posts. Several perimeter signs have bullet holes but were legible. The other signs were in good condition (PL-2).

8.4.1.3 Site Markers

The site has two granite site markers. Site markers SMK-1 (just inside the entrance gate; PL-3) and SMK-2 (on top of the disposal cell) were in excellent condition.

8.4.1.4 Survey Monuments and Boundary Monuments

The three combined survey/boundary monuments (SM-1/BM-1, SM-2/BM-2, and SM-3/BM-3) and eight additional boundary monuments (BM-4 through BM-11) were in excellent condition.

8.4.1.5 Monitoring Wells

Sixteen wells constitute the groundwater monitoring network for the site. The wells were secure and in excellent condition (PL-4). The Gunnison County landfill operators have placed concrete barriers to protect monitoring well 0716, which is located on landfill property, from landfill activities (PL-5). The edge of the spoil pile was approximately 10 feet from the barriers, and was

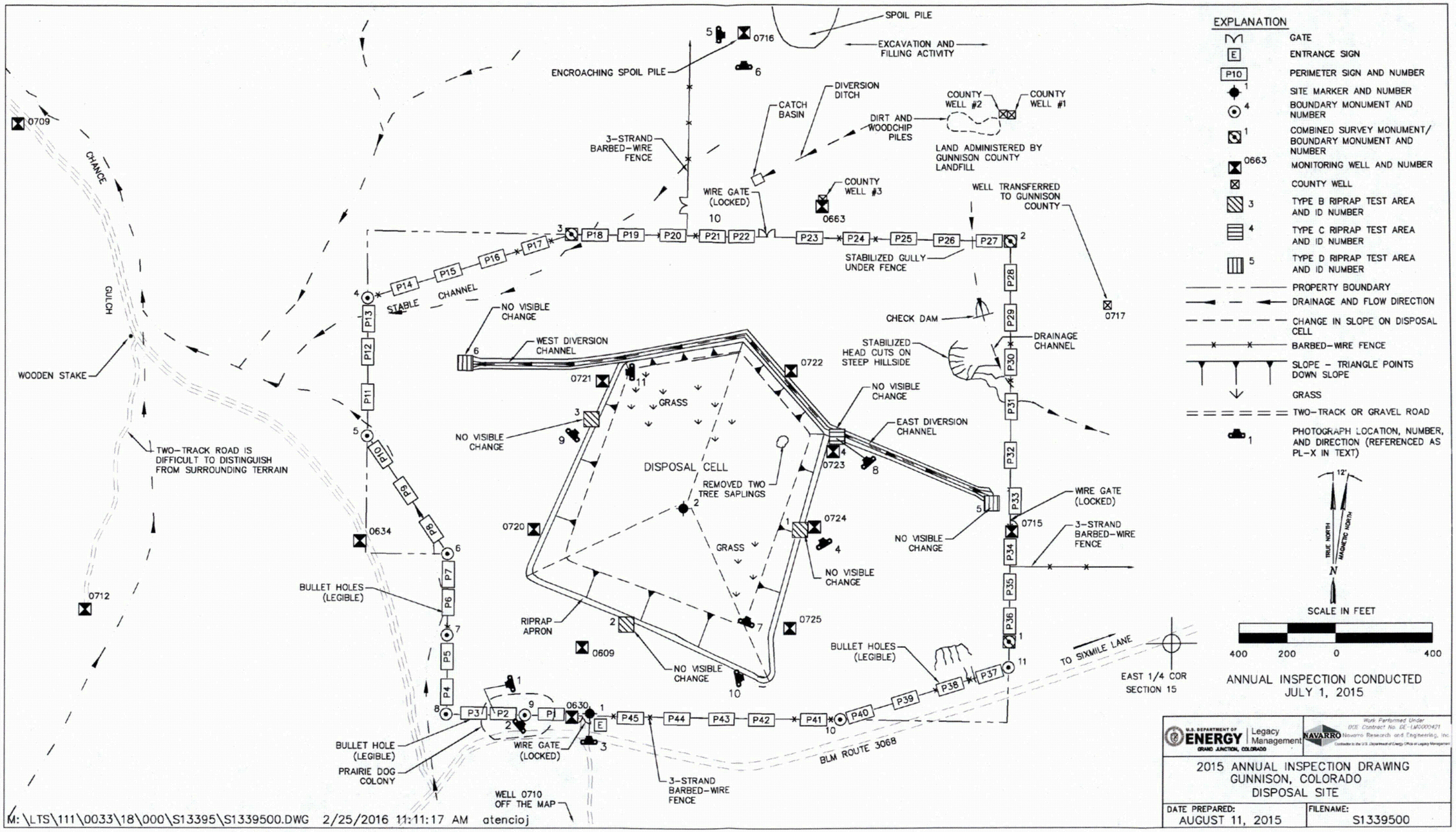

Figure 8-1. 2015 Annual Inspection Drawing for the Gunnison Disposal Site

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observed to be encroaching on the monitoring well (PL-6). In previous inspections the pile was observed to be approximately 30 feet from the barriers. The Office of Legacy Management will contact the Gunnison County Landfill to notify them of the proximity of the spoils pile to monitoring well 0716.

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.

Within each area, the inspectors examined specific site-surveillance features. Inspectors also looked for evidence of erosion, settling, slumping, or other disturbances that might affect the site's integrity, protectiveness, or long-term performance.

8.4.2.1 Top of the Disposal Cell

The rock-covered top of the disposal cell was in excellent condition. There was no evidence of erosion, settling, slumping, or rock degradation. Several isolated patches of grass are randomly distributed over the disposal cell cover; however, these shallow-rooted plants are not a cause for concern.

8.4.2.2 Disposal Cell Side Slopes, Apron, and Diversion Channels

The riprap-covered side slopes, apron, and diversion channels were in good condition (PL-7 and PL-8). No evidence of slumping, settling, rock degradation or encroachment of vegetation was observed.

8A The condition of the riprap in six monitoring test areas was visually inspected. The test areas, each approximately 1 square meter in area, are in critical flow-path locations in the apron and diversion channels (PL-9). The corners of each monitoring plot are marked with orange paint; the corners were repainted during the inspection. The riprap in all of the test areas was in excellent condition. When the rocks were compared to the photos taken in 2012, there was no evidence that individual rocks had split or otherwise been degraded. Annual photographing and comparing of these test areas was performed through 2002 in accordance with the LTSP; after that, the LTSP requires the test areas to be photographed every 5 years through 2017. The next and final set of photos will be taken in 2017.

Precipitation runoff from the cell occasionally ponds in a low-lying area along the southeast corner of the cell. The riparian-type vegetation that has become established there indicates that the area retains moisture much of the time. Water collection in this area does not pose a problem because the cell is designed to drain to the southeast, and any water that ponds there is below the elevation of the encapsulated tailings material. Standing water and moss rock cover was observed within the southeast side of the apron during this inspection (PL-10); however, it is not cause for concern given the recent increased number of rain events.

8.4.2.3 Area Between the Disposal Cell and the Site Boundary

There are reclaimed and undisturbed areas between the disposal cell and the site perimeter. Both types of areas were in good condition (PL-11). No erosion concerns were observed. In general, reclaimed areas have good vegetation coverage, consisting mostly of grass. Shrubs and forbs are much less abundant and less diverse in reclaimed areas than they are in undisturbed areas.

8.4.2.4 Outlying Area

The area within 0.25 mile of 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. Gunnison County owns the land that adjoins 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 from the northeast corner of the DOE property boundary. Although landfill activities do not impact the site, future inspections will continue to monitor the level of activity occurring near the DOE property boundaries and site surveillance features (e.g., fences and monitoring wells). The proximity of the spoils pile to monitoring well 0716 was the only concern for activities that could impact the site or its assets.

8.5 Follow-Up Inspections

DOE will conduct follow-up or contingency inspections if (1) an annual inspection or other site visit identifies a condition that requires a return to the site to evaluate the condition or (2) a citizen or outside agency notifies DOE that conditions at the site or in the vicinity of the site are substantially changed. No need for a follow-up or contingency inspection was identified.

8.6 Maintenance and Repairs

No maintenance items were identified.

8.7 Groundwater Monitoring

DOE monitors groundwater at the site to demonstrate compliance with U.S. Environmental Protection Agency (EPA) groundwater protection standards in 40 CFR 192.03 and to demonstrate that the disposal cell is performing as designed. The monitoring network consists of 16 wells, including six point-of-compliance wells to monitor cell performance, two wells to monitor background groundwater quality, and eight wells for water level measurements (Table 8-2).

The indicator analyte for cell performance at the site is uranium. This analyte was selected on the basis of its presence in tailings pore fluid, its relatively high mobility in groundwater, and its low concentration in upgradient (background) groundwater. The target concentration for uranium is 0.013 milligram per liter (mg/L). The basis for this value is the maximum observed concentration of uranium in background samples determined before long-term surveillance and maintenance activities began. The maximum concentration limit for uranium that EPA established in Table 1 to Subpart A of 40 CFR 192 is 0.044 mg/L.

Table 8-2. Monitoring Wells at the Gunnison Disposal Site

Point-of-Compliance (POC) and Background Wells	Water 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

8B In accordance with the LTSP, groundwater monitoring was required annually from 1998 through 2001 and every 5 years thereafter. The most recent sampling event was conducted in 2011, so monitoring was not required in 2015. The next sampling event will occur in 2016. To date, uranium concentrations in all wells have been substantially below the target concentration, indicating that the disposal cell continues to perform as an efficient containment system.

8.8 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.

8.9 Photographs

Photograph Location Number	Azimuth	Photograph Description
PL-1	255	Perimeter fence.
PL-2	50	Perimeter sign P1.
PL-3	0	Site marker SMK-1.
PL-4	330	Monitoring well 0724 near east side of disposal cell.
PL-5	90	Monitoring well 0716 protected by jersey barriers.
PL-6	0	Monitoring well 0716 near west edge of landfill cover material spoil pile.
PL-7	20	Side slope near the southeast side of disposal cell.
PL-8	320	Diversion channel along the northeast side of disposal cell.
PL-9	45	Riprap test area No. 3.
PL-10	80	Standing water and moss coverage along the southeast side of disposal cell apron.
PL-11	270	Revegetated area near the northwestern side of disposal cell.

GUD 6/2015. PL-1. Perimeter fence.

GUD 6/2015. PL-2. Perimeter sign P1.

GUD 6/2015. PL-3. Site marker SMK-1.

GUD 6/2015. PL-4. Monitoring well 0724 near east side of disposal cell.

GUD 6/2015. PL-5. Monitoring well 0716 protected by jersey barriers.

GUD 6/2015. PL-6. Monitoring well 0716 near west edge of landfill cover material spoil pile.

GUD 6/2015. PL-7. Side slope near the southeast side of disposal cell.

GUD 6/2015. PL-8. Diversion channel along the northeast side of disposal cell.

GUD 6/2015. PL-9. Riprap test area No. 3.

GUD 6/2015. PL-10. Standing water and moss coverage along the southeast side of disposal cell apron.

GUD 6/2015. PL-11. Revegetated area near the northwestern side of disposal cell.

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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 September 16 and 17, 2015. Other than some ongoing concern with erosion-control rock riprap degradation, the disposal cell was in good condition. Some minor fence repairs and vegetation removal, and minor erosion repair work along the west site fence is planned. Inspectors identified no other maintenance needs or cause for a follow-up or contingency inspection.

Disposal cell riprap is evaluated annually to ensure continued long-term protection of the cell from erosion during a severe precipitation event. Degradation of the rock riprap was first observed at the site in the mid-1990s. Rock gradation monitoring of the riprap on the west side slope has been performed as part of the annual inspection since 1997 to determine the mean diameter (D_{50}) value. As prescribed by the monitoring procedure, the rock monitoring is routinely conducted at random locations. However, at the U.S. Nuclear Regulatory Commission's (NRC's) request, the 2015 rock monitoring approach deviated from the normal procedure by using a pre-established monitoring grid in a subset area of the west side slope. This changed the monitoring approach from random sampling to biased sampling. The D_{50} value measured during the 2015 gradation monitoring is 2.39 inches, which falls below the original D_{50} design size range of 2.7–3.9 inches for the Type B size side slope riprap.

At NRC's request, rock durability monitoring was added to the gradation monitoring in 2009 to monitor durability by rock type. Results of the 2015 durability monitoring showed that74 percent of the total rock sampled is durability class code A rock with an assigned durability class of "highly durable" or durability class code B "durable" rock, and that over 90 percent of the 3-inch or larger rock is durability class code A or B. The rock durability classifications are further explained in Section 9.4.2.2.

9.2 Compliance Requirements

Requirements for the long-term surveillance and maintenance of the site are specified in the *Long-Term Surveillance Plan for the Collins Ranch Disposal Site, Lakeview, Oregon* (LTSP) (DOE/AL/62350-19F, Rev. 3, U.S. Department of Energy [DOE], August 1994) and in procedures that DOE established to comply with the requirements of Title 10 *Code of Federal Regulations* Section 40.27 (10 CFR 40.27). These requirements are listed in Table 9-1.

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

Requirement	Long-Term Surveillance Plan	This Report
Annual Inspection and Report	Section 6.0	Section 9.4
Follow-Up or Contingency Inspections	Section 7.0	Section 9.5
Maintenance and Repairs	Section 8.0	Section 9.6
Groundwater Monitoring	Section 5.3	Section 9.7
Corrective Action	Section 9.0	Section 9.8

9.3 Institutional Controls

The 40-acre site (Figure 9-1) is owned by the United States of America and was accepted under the NRC general license (10 CFR 40.27) in 1995. DOE is the licensee and, in accordance with the requirements for UMTRCA Title I sites, is responsible for the custody and long-term care of the site. Institutional controls at the site include federal ownership of the property and the following physical features that are inspected annually: site markers, survey and boundary monuments, perimeter warning signs, a site perimeter fence, and locked gates at the site entrances.

9.4 Inspection Results

The site, located approximately 8 miles northwest of Lakeview, Oregon, was inspected on September 16 and 17, 2015. The inspection was conducted by C. Goodknight and K. Turley of the DOE Legacy Management Support contractor, and by G. Smith (Geo-Smith Engineering, LLC). T. Petrosky (DOE Site Manager), D. Engstrom (Oregon Department of Energy), and Z. Cruz and M. Meyer (NRC) also attended the inspection.

The purposes of the inspection were to confirm the integrity of visible features at the site, to identify changes in conditions that might affect site integrity, and to determine the need, if any, for maintenance or additional inspections and monitoring. Numbers in the left margin of this report refer to items summarized in Table ES-1 of the "Executive Summary."

9.4.1 Site Surveillance Features

The locations of site surveillance features are shown on Figure 9-1. Inspection results and recommended maintenance activities associated with site surveillance features are included in the following subsections. Photographs to support specific observations are identified in the text and on Figure 9-1 by photograph location (PL) numbers.

9.4.1.1 Access Road, Entrance Gates, and Entrance Sign

Access to the site is gained by traveling a gravel road that heads west off County Road 2-16B. DOE was granted a perpetual easement on the approximately 1.2 mile access road between the county road and the DOE property boundary. A lockable gate across the access road on the adjacent privately owned land limits access to the site. The site access road was in good condition.

The site entrance gate and the pedestrian gate were locked and in good condition. The site's entrance sign was in good condition and clearly visible. No indication of recent vandalism was observed at the site during the inspection.

9.4.1.2 Perimeter Fence and Perimeter Signs

A wire fence is located along the site boundary. The perimeter fence was generally in good condition, but some loose and broken wire strands, and some loose t-posts, were noted. Tightening and minor maintenance of the fence, including the removal of involved vegetation (PL-1), is planned.

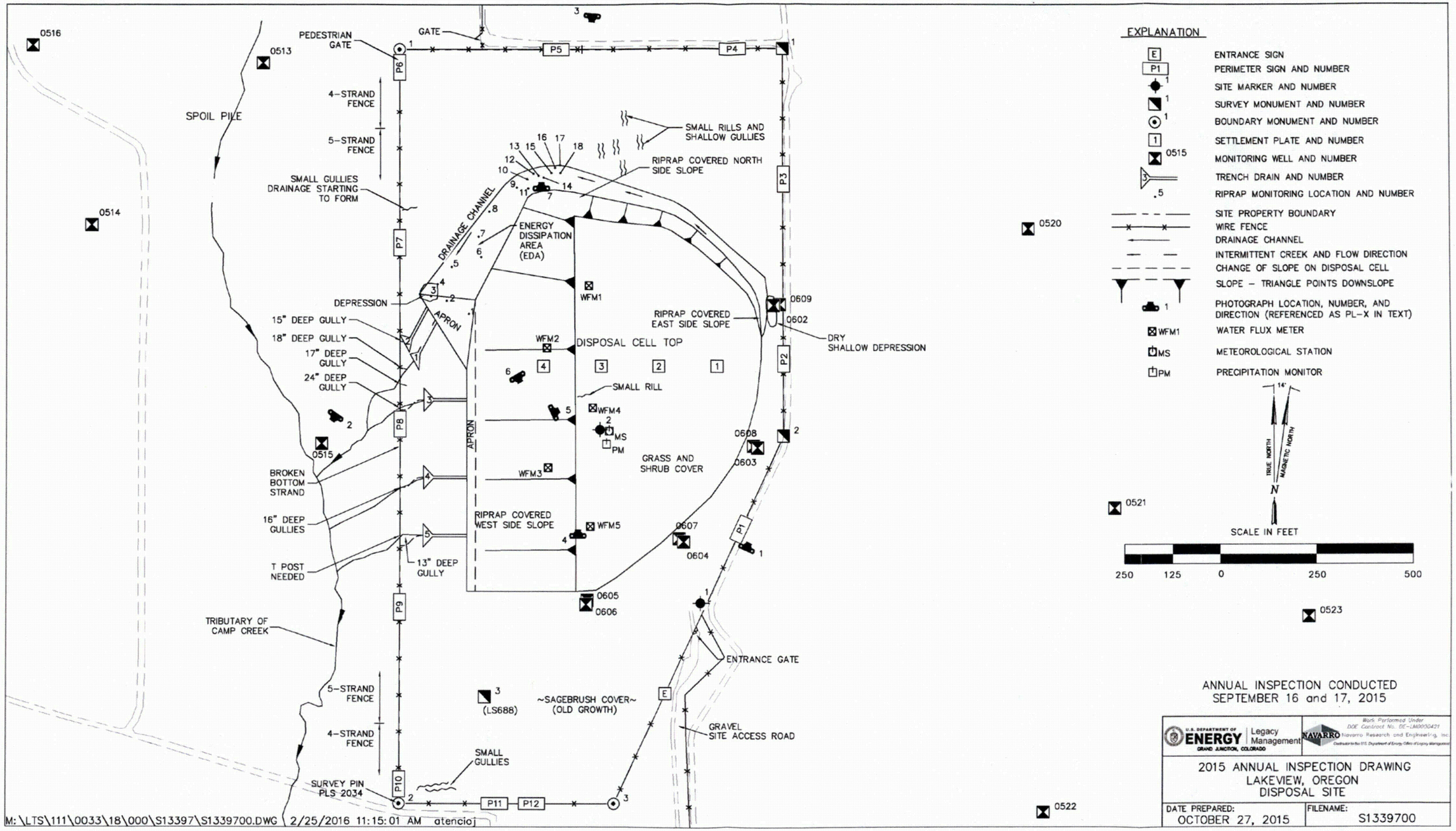

Figure 9-1. 2015 Annual Inspection Drawing for the Lakeview Disposal Site

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Twelve perimeter signs attached to steel posts set in concrete are along the perimeter fence. The signs were in good condition and clearly visible from outside the site.

9.4.1.3 Site Markers

The two site markers, SMK-1 near the site entrance and SMK-2 on top of the disposal cell, were in good condition.

9.4.1.4 Survey Monuments and Boundary Monuments

The three survey monuments and three boundary monuments were in good condition.

9.4.1.5 Monitoring Wells

The groundwater monitoring network comprises eight onsite point-of-compliance (POC) wells located east and south of the cell and one upgradient well (PL-2) located offsite to the west of the disposal site. All nine wells were inspected and were locked, labeled, and in good condition.

Seven additional DOE-owned monitoring wells exist on privately owned property near the site but are not part of the groundwater compliance monitoring network. These wells were also inspected and were locked, labeled, and in fair condition. Of the five offsite, non-POC wells with concrete surface pads, three of the pads were cracked or broken and had some soil undercutting from water and wind erosion.

9.4.2 Inspection Areas

In accordance with the LTSP, the site, shown in PL-3, 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 and adjacent drainage channel, aprons, and trench drains; and (3) the site perimeter and the outlying area.

Within each area, the inspectors examined specific site surveillance features. Inspectors also looked for evidence of erosion, settling, slumping, or other disturbances that might affect the site's integrity, protectiveness, or long-term performance.

9.4.2.1 Top of Disposal Cell

At the time of cell construction, the entire cell top slope was covered in 12 inches of Type A size riprap, with 4 inches of soil placed over the riprap. The soil was included to allow for a grass cover to be established, which would help minimize the visual impacts of the 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 is favored by movement of precipitation through the riprap, bedding, and compacted soil (radon barrier) layers. Grasses and forbs (rabbitbrush, sagebrush, and bitterbrush plants) growing on the top of the disposal cell have gradually increased over the years, and areas of deeper-rooted wheatgrasses have spread. Some sparsely vegetated areas still remain on the top of the disposal cell. In general, the vegetation at the site appeared to be drier in recent years, which would be expected given the drought conditions experienced in the region.

Riprap was observed through the soil on the top slope in numerous small areas during the inspection. The areas ranged in size from approximately 4 inches to 2.5 feet. These areas are sporadically located across the top slope and are likely caused by the infilling of the soil into the riprap-void spaces below. No structural or cell performance concerns are associated with the riprap becoming visible on the top slope.

The incipient development of soil checkerboard erosion patterns was observed sporadically in some of the more sparsely vegetated areas on the top slope; no changes were noted during this year's inspection. This minor erosion pattern could indicate that water on the top slope is attempting to channelize, or it could be associated with the soil settling into the riprap voids beneath the soil. No structural or cell performance concerns are associated with this condition because the riprap rock cover is continuous beneath the top-slope soil cover, the slope crests, and the side slopes. However, future inspections will monitor this condition.

The contact boundary between the cell top and side slopes (PL-4) was inspected and generally appears stable and uniform except at the northwest corner of the cell top, where some soil has been transported off the top slope, allowing for some grass to establish at the top of the side slopes. One minor erosion rill was observed along the west edge (slope crest) of the top slope during this inspection (see Figure 9-1 and PL-5). No structural or cell performance concerns are associated with the minor encroachment of the grass onto the side slope or the presence of the minor rill because the riprap rock cover is continuous beneath the top-slope soil cover, the slope crests, and the side slopes. The extent of rilling along the slope crest will continue to be monitored.

No evidence of active animal burrowing on the top slope or evidence of cell settlement, displacement, or slumping was observed during the inspection.

9.4.2.2 Disposal Cell Side Slopes and Adjacent Drainage Channel, Aprons, and Trench Drains

Deterioration of the basalt rock riprap is occurring and is likely due to physical weathering and chemical processes. The crumbling rocks on the surface appear to have increased in the mid-1990s, and rock monitoring continues to be performed.

Addendums to the LTSP commit DOE to annually determining the D_{50} value of the west side slope rock riprap through gradation monitoring to ensure that the riprap is large enough to protect the disposal cell from erosion during a major precipitation event. This gradation monitoring method measures the number of rocks retained per sieve size. With NRC's consent, an additional sieve size (1 inch) has been included in the monitoring since 2009. Normally, sampling locations are randomly selected before each monitoring event. However, for the 2015 inspection, the rock monitoring approach deviated from the normal procedure, at NRC's request, by using a pre-established monitoring grid in a subset area of the west side slope (see Figure 9-1). This changed the sampling approach from random to biased, thus potentially compromising data comparability. Particle size distribution by count data was collected at 20 locations, and approximately 25 rocks were sampled at each location. Monitoring on the west side slope is shown in PL-6.

9A DOE committed to performing annual rock durability monitoring in a letter to NRC dated October 17, 2008.[1] Rock durability monitoring was conducted to quantify the various rock types and durability classes of the basalt rock on the west side slope. The rock durability monitoring was performed in 2015 for a seventh consecutive year using the rock type classifications developed for the site as shown in Table 9-2. This table identifies the rock types, which are representative of the rocks found on the side slopes, provides rock descriptions, and assigns a durability class and code (ranging from "highly durable" to "nondurable – crumbled/rubblized"). The Table 9-2 durability classes were assigned by a geologist/mineralogist's examination of the rocks.

Table 9-2 consists of eight durability classes (A, B, Ca, Cb, Da, Db, E, and F). As requested by NRC, starting with the 2010 monitoring, Durability Class A rocks were divided into four subclasses: unfractured (Au); hairline fractured (Ah*, where the number in place of the asterisk indicates the number of fractures present [e.g., Ah3]); open fractured (Ao*, where the number in place of the asterisk indicates the number of fractures present [e.g., Ao3]); and a rock that had split since placement on the cell (As). The 2010 table (Table 9-2) was retained for the subsequent durability monitoring events.

The rock durability monitoring was performed in conjunction with the gradation monitoring with the same rock being used for both types of monitoring. After the size of a rock was determined, the rock was handed to a geologist/mineralogist for rock type identification using Table 9-2. The associated durability class (or subclass) code was then recorded under the appropriate rock size column for that sample location.

Table 9-3 provides the results of the 2015 durability monitoring by rock count and shows the correlation between rock size and durability class. Table 9-4 provides the percentage of each durability class by sieve size. Table 9-5 shows the percentage of sieve size by durability class.

General observations about the data include:

- Seventy-four percent of the total rock sampled is durability class code A "highly durable" or durability class code B "durable."
- Over 70 percent of the 4 inch or larger rock is durability class code B "durable."
- Over 90 percent of the 3 inch or larger rock is durability class code A or B.
- Over 80 percent of the 1.5 inch or larger rock is durability class code A or B.
- The smallest rock (less than 1 inch) is mostly durability class code Da "susceptible to near-term degradation."
- Only 6.8 percent of the rock in this biased sample is "moderately durable" (durability class codes Ca and Cb), and less than 18 percent of the total sampled rock is "susceptible to near-term degradation" (durability class codes Da and Db).

The annual photographic monitoring of the 18 photograph locations for long-term rock monitoring was conducted in the energy dissipation area (EDA). The rock at photo-monitoring location 12 is shown in PL-7. Minor rock degradation has been observed since monitoring began at the original 10 photograph locations established in 1997 and at the eight additional locations established in 2000. The rock used in the EDA and drainage channel areas is much more

[1] Jalena Dayvault, DOE Site Manager, Lakeview, Oregon, Disposal Site, LM, DOE, letter (about NRC suspension of revised LTSP [August 2002], Lakeview, Oregon, UMTRCA Title I Disposal Site) to Myron Fliegal, Senior Project Manager, NRC, October 17, 2008.

homogeneous (predominantly Class Code B rock type) than the varied rock used on the side slopes, and appeared in good condition.

Water previously observed at times in the large depression in the EDA at the lower end of the drainage channel was absent. Water is potentially a concern because inundation might accelerate deterioration of the large riprap by the freeze-thaw process, although the rock used in the EDA is apparently not as susceptible to freeze-thaw as other rock types present on the cell.

Table 9-2. Rock Types and Durability Classes and Subclasses

Rock Type Identification Number	Rock Type Description	Durability Class	Durability Class Code	Durability Subclass Code
1	Dense, hard, very fine-grained, dark gray basalt with no joints, fractures, white deposits, or alteration.	Highly Durable	A	Au
	As above in Au, except with tight, hairline fracture(s). Asterisk indicates the number of tight, hairline fractures.		A	Ah*
	As above in Au, except with open fracture(s). Asterisk indicates the number of open fractures in the rock that are ready to split.		A	Ao*
	As above in Au, except that the rock has split along fractures since placement on the cover, but the rocks are still in place.[1]		A	As
2	Dense, hard, dark gray to grayish brown, olivine basalt. No joints or white deposits; olivine phenocrysts have altered to amber and brown material representing various minerals such as iddingsite, antigorite, chlorite, and nontronite. On some exposed surfaces, altered olivine phenocrysts have weathered out to give a vesicular appearance.	Durable	B	----
3a	Dense, fine-grained, grayish brown to brown basalt with hairline fractures. Basalt is slightly altered and fractured outer surfaces have a brown, limonite-like coating.	Moderately Durable	Ca	----
3b	Greenish gray to green, dense basalt with hairline fractures. Some fractures may have white or light brown coatings. Deuteric and hydrothermal alteration have imparted a distinctive greenish cast to the basalt resulting from alteration of calcic plagioclase to the more sodic plagioclase, albite-oligoclase.	Moderately Durable	Cb	----
4a	Fine-grained, highly fractured gray to greenish gray basalt. Hairline to open fractures are mostly coated with white to pink calcite and commonly with the zeolite mineral, analcime.	Susceptible to Near-Term Degradation	Da	----
4b	Greenish gray to grayish brown olivine basalt that is highly fractured. Olivine phenocrysts have altered to brown material, possibly nontronite.	Susceptible to Near-Term Degradation	Db	----
5	Fine- to medium-grained, soft, grayish green, highly altered basalt. Rock has a granular appearance, has relatively low specific gravity, is probably highly chloritized, and it has commonly disintegrated (rubblized) into pieces smaller than 1 inch in diameter.	Nondurable - Crumbled/ Rubblized	E	----
6	Non-basaltic rocks such as sandstone or quartzite.	Highly Durable to Nondurable	F	----

[1] "As" must be determined while the rocks are still in place on the side slope before the rocks are picked up for gradation monitoring. The size of the monitored rock reflects the size of the selected/marked split piece, not the size of the pre-split rock.

Table 9-3. 2015 Durability Monitoring – Percent of Total Rock Count by Durability Class and Sieve Size

Durability Class & Subclass	Rock Count by Sieve Size (Retained on Sieve)						Total By Durability Class	Percent of Total
	4 Inch	3 Inch	2.5 Inch	1.5 Inch	1 Inch	< 1 Inch		
Class Au	1	9	12	48	18	6	94	19.3
Class As	1	0	0	2	1	0	4	0.8
Class Ao1	0	6	2	15	2	0	25	5.1
Class Ao2	0	8	8	4	1	0	21	4.3
Class Ao3	0	0	0	0	0	0	0	0
Class Ao4	0	0	0	0	0	0	0	0
Class Ao5	0	0	0	0	0	0	0	0
Class Ah1	2	15	17	23	2	0	59	12.1
Class Ah2	1	6	4	10	1	0	22	4.5
Class Ah3	0	1	0	1	0	0	2	0.4
Class Ah4	0	0	0	0	0	0	0	0
Total A Class	5	45	43	103	25	6	227	46.5
Class B	17	53	28	31	5	0	134	27.5
Class Ca	0	0	5	9	5	3	22	4.5
Class Cb	0	0	0	6	3	2	11	2.3
Class Da	1	6	10	28	16	11	72	14.8
Class Db	1	3	1	6	0	4	15	3.1
Class E	0	0	0	0	1	6	7	1.4
Class F	0	0	0	0	0	0	0	0
Total by Sieve Size	24	107	87	183	55	32	488	–
Percent of Total	4.9	21.9	17.8	37.5	11.3	6.6	100	–
Total by Durability Class	–	–	–	–	–	–	488	100

Table 9-4. 2015 Durability Monitoring – Percent Durability Class by Sieve Size

Durability Class & Subclass	Percent by Sieve Size (Retained on Sieve)					
	4 Inch	3 Inch	2.5 Inch	1.5 Inch	1 Inch	< 1 Inch
Class Au	4.2	8.4	13.8	26.2	32.7	18.8
Class As	4.2	0.0	0.0	1.1	1.8	0.0
Class Ao1	0.0	5.6	2.3	8.2	3.6	0.0
Class Ao2	0.0	7.5	9.2	2.2	1.8	0.0
Class Ao3	0.0	0.0	0.0	0.0	0.0	0.0
Class Ao4	0.0	0.0	0.0	0.0	0.0	0.0
Class Ao5	0.0	0.0	0.0	0.0	0.0	0.0
Class Ah1	8.3	14.0	19.5	12.6	3.6	0.0
Class Ah2	4.2	5.6	4.6	5.5	1.8	0.0
Class Ah3	0.0	0.9	0.0	0.5	0.0	0.0
Class Ah4	0.0	0.0	0.0	0.0	0.0	0.0
Total A Class	20.9	42.0	49.4	56.3	45.3	18.8
Class B	70.8	49.5	32.2	16.9	9.1	0.0
Class Ca	0.0	0.0	5.7	4.9	9.1	9.4
Class Cb	0.0	0.0	0.0	3.3	5.4	6.3
Class Da	4.2	5.6	11.5	15.3	29.1	34.4
Class Db	4.2	2.8	1.2	3.3	0.0	12.5
Class E	0.0	0.0	0.0	0.0	1.8	18.8
Class F	0.0	0.0	0.0	0.0	0.0	0.0
Total Percent	100	100	100	100	100	100

Table 9-5. 2015 Durability Monitoring – Percentage Sieve Size by Durability Class

Durability Class & Subclass	Percent By Sieve Size (Retained on Sieve)						Total Percent
	4 Inch	3 Inch	2.5 Inch	1.5 Inch	1 Inch	< 1 Inch	
Class Au	1.1	9.6	12.8	51.1	19.1	6.4	100
Class As	25.0	0.0	0.0	50.0	25.0	0.0	100
Class Ao1	0.0	24.0	8.0	60.0	8.0	0.0	100
Class Ao2	0.0	38.1	38.1	19.0	4.8	0.0	100
Class Ao3	0.0	0.0	0.0	0.0	0.0	0.0	0
Class Ao4	0.0	0.0	0.0	0.0	0.0	0.0	0
Class Ao5	0.0	0.0	0.0	0.0	0.0	0.0	0
Class Ah1	3.4	25.4	28.8	39.0	3.4	0.0	100
Class Ah2	4.5	27.3	18.2	45.5	4.5	0.0	100
Class Ah3	0.0	0.0	0.0	0.0	0.0	0.0	0
Class Ah4	0.0	50.0	0.0	50.0	0.0	0.0	100
Total A Class	2.2	19.8	18.9	45.4	11.0	2.6	100
Class B	12.7	39.6	20.9	23.1	3.7	0.0	100
Class Ca	0.0	0.0	22.8	40.9	22.8	13.6	100
Class Cb	0.0	0.0	0.0	54.5	27.3	18.2	100
Class Da	1.4	8.3	13.9	38.9	22.2	15.3	100
Class Db	6.7	20.0	6.7	40.0	0.0	26.7	100
Class E	0.0	0.0	0.0	0.0	14.3	85.7	100
Class F	0.0	0.0	0.0	0.0	0.0	0.0	0

Minor amounts of grass have encroached on the riprap on the side slopes, on the upper (eastern) part of the drainage channel, on the EDA at the lower end of the drainage channel, and on the western apron area. This relatively sparse plant growth will not affect the function of the erosion control features and is not considered a problem. A few small bushes are located in the upgradient portion of the drainage channel, but their presence will not obstruct water flow. This location is evaluated during each inspection. Should the potential for flow obstruction become a concern in the future, maintenance activities would be performed. An area of dense, high grass exists near trench drains 1 and 3, which suggests wetter conditions that would periodically occur in this area due to the presence of the runoff control features. No ponded water was observed. Some sporadic areas of soil cracking were observed in soils in the areas west of the trench drains, but the grasses covering this area are dense and provide erosion protection.

No evidence of active animal burrowing on the side slopes or evidence of cell settlement, displacement, or slumping was observed during the inspection.

9.4.2.3 Site Perimeter and Outlying Area

The area within 0.25 mile of 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. This includes the seeded grass area extending from the disposal cell to the site boundary and the site perimeter fence.

Gullies that formed in seeded areas extending west of trench drains 1 through 5 were filled with rock in 2000. Although the rock has generally arrested the head cutting that was advancing eastward from the private property onto the DOE property, some minor head cutting is still evident but it did not appear to be recent. Several small gullies have formed in heavily grazed areas downslope of the fence line onto the private property and were identified during previous inspections. One area, just north of perimeter sign P7, where a small drainage appeared to be forming on the DOE site in this area was noted for the first time during this inspection (Figure 9-1). None of these gullies or the small drainage pose a threat to cell integrity. Minor erosion maintenance work is planned for the on-site features.

Small gullies were identified in past years along the southern side of the site inside the fence. These gullies are located downhill of a west-sloping road just south of the fence line. The gullies likely represent overflow along the road during rain events. This area has not shown evidence of recent erosion. No maintenance is required in this area.

Several small rills and shallow gullies were observed onsite in the area north of the cell, where grass reestablishment has been limited, but appear unchanged from the previous inspection. No maintenance is required in this area, but the area will continue to be monitored.

9.5 Follow-Up or Contingency Inspections

DOE will conduct follow-up or contingency inspections if (1) an annual inspection or other site visit identifies a condition that requires a return to the site to evaluate the condition, or (2) a citizen or outside agency notifies DOE that conditions at the site or in the vicinity of the site are substantially changed. No need for a follow-up or contingency inspection was identified.

9.6 Maintenance and Repairs

No maintenance was conducted in 2015. Minor repairs to the perimeter fence, removal of vegetation from the fence, and some minor preventive on-site erosion maintenance along the west property fence are planned.

9.7 Groundwater Monitoring

9B DOE monitors groundwater quality in the uppermost aquifer at this site once every 5 years to demonstrate that the disposal cell is not leaching contaminants into the aquifer. The most recent sampling event was performed in May 2014.

Nine monitoring wells are in the groundwater monitoring network. Eight POC wells (four monitoring well pairs: 0602/0609, 0603/0608, 0604/0607, and 0605/0606) are east and south of the cell. Upgradient well 0515 is west of the disposal site. Monitoring wells 0602, 0603, 0604, and 0605 continued to be dry and could not be sampled.

Seven additional DOE-owned monitoring wells (0513, 0514, 0516, 0520, 0521, 0522, and 0523) exist on privately owned property near the site but are not sampled because they are not part of the groundwater compliance monitoring network.

Constituents analyzed every 5 years include arsenic, cadmium, and uranium. Their maximum concentration limits (MCLs), established by the U.S. Environmental Protection Agency in Table 1 to Subpart A of 40 CFR 192, are 0.05 milligram per liter (mg/L) for arsenic, 0.01 mg/L for cadmium, and 0.044 mg/L for uranium. Concentrations of these constituents continued to remain significantly below their respective limits in 2014. Arsenic concentrations were similar to the 2009 results (Figure 9-2), and all but one cadmium concentration result were below the laboratory detection limit of 0.00012 mg/L (Figure 9-3), and uranium concentrations remained stable or slightly increased (Figure 9-4). Based on the monitoring results to date, there is no indication of any degradation of groundwater near the site. The next cell performance monitoring is scheduled for 2019.

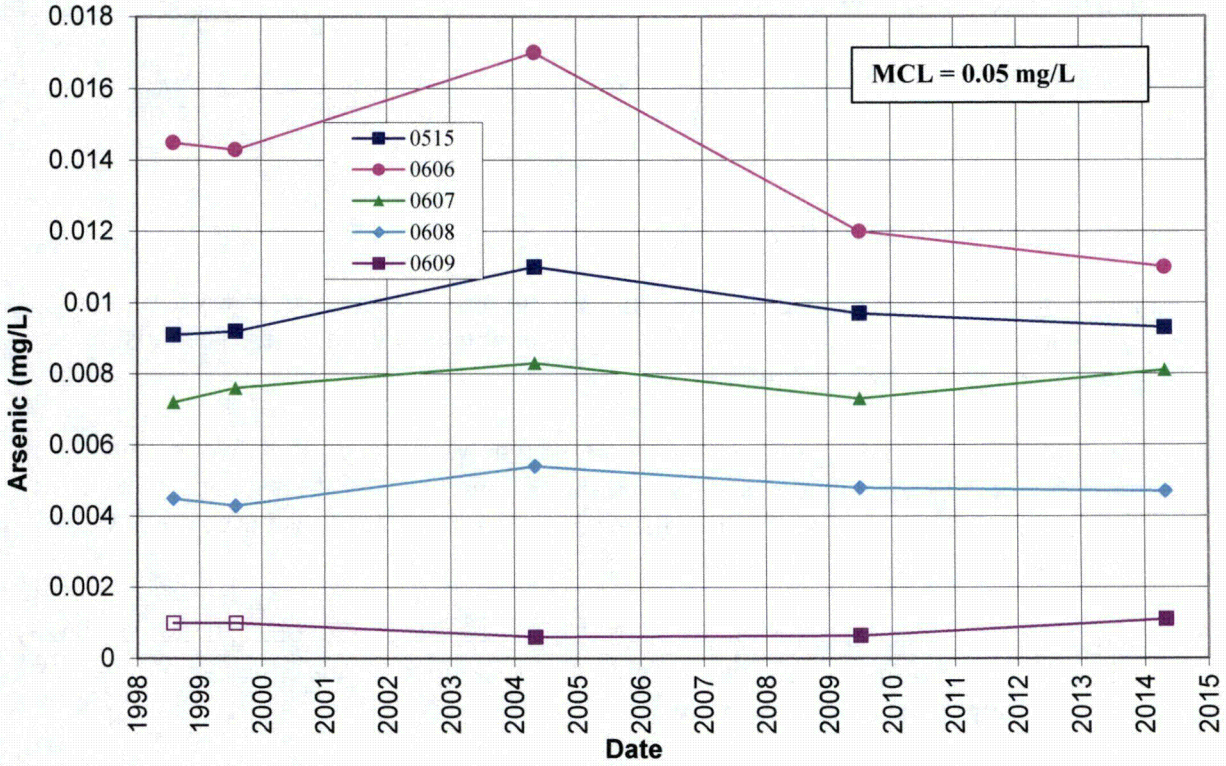

Figure 9-2. Time-Concentration Plot of Arsenic in Groundwater at the Lakeview Disposal Site

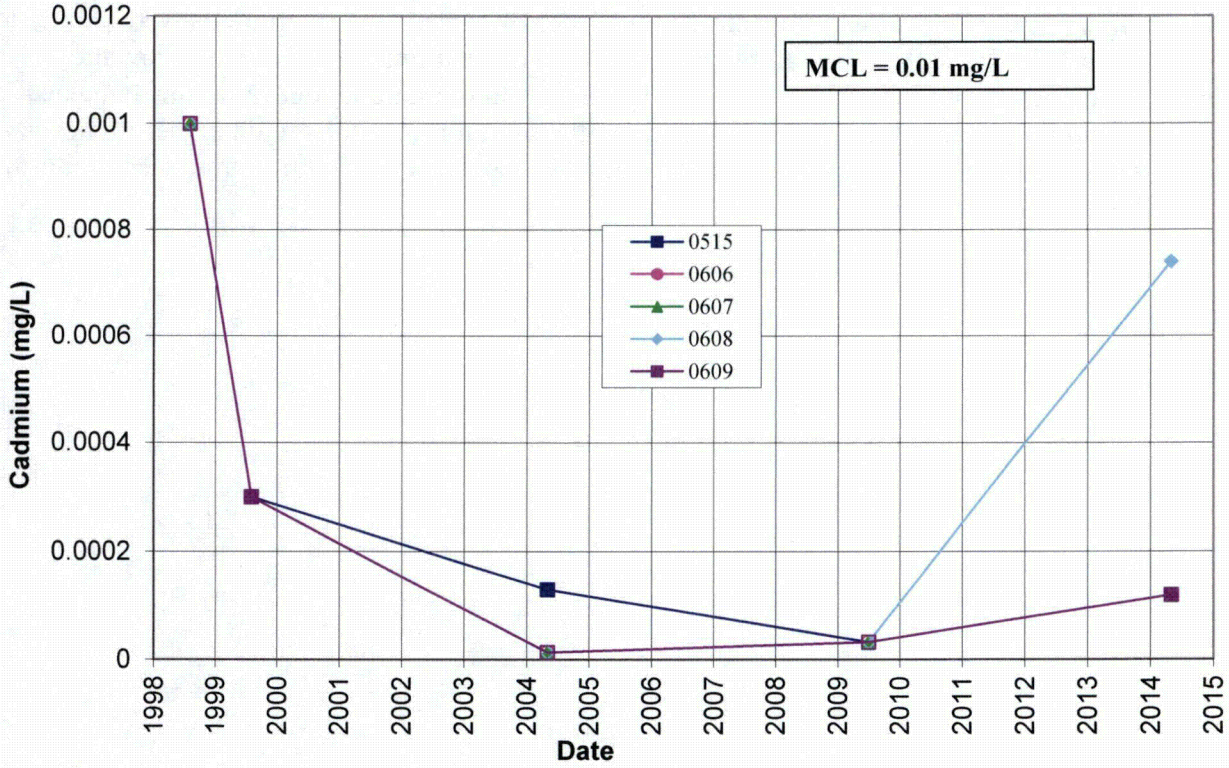

Figure 9-3. Time-Concentration Plot of Cadmium in Groundwater at the Lakeview Disposal Site

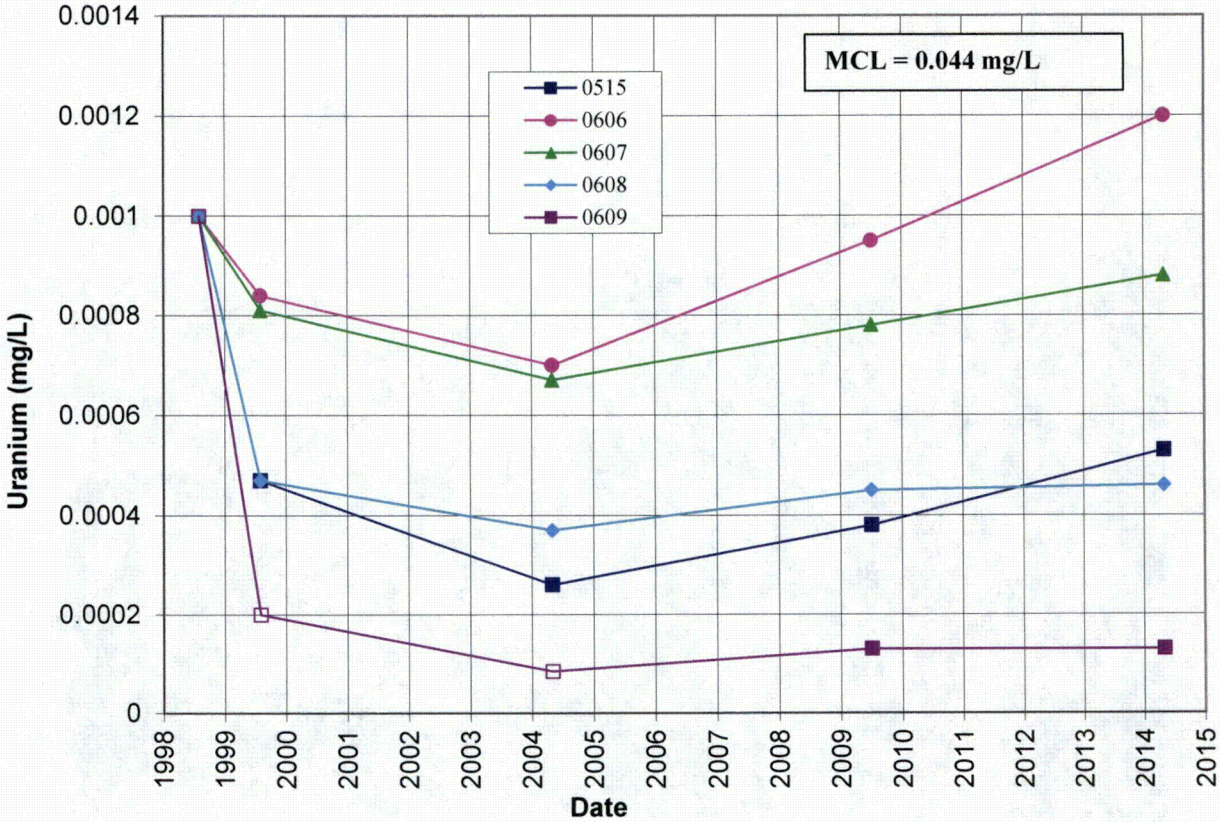

Figure 9-4. Time-Concentration Plot of Uranium in Groundwater at the Lakeview Disposal Site

9.8 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.

9.9 Photographs

Photograph Location Number	Azimuth	Photograph Description
PL-1	25	View north-northeast of vegetation growth along fence.
PL-2	215	Well 0515.
PL-3	185	View south of disposal cell top and west side slope.
PL-4	0	View north along transition zone from cell top to west side slope.
PL-5	65	View northeast of shallow rill along transition zone.
PL-6	150	View southeast of inspectors, a Geo-Smith Engineering representative, and a State of Oregon representative performing rock monitoring at monitoring location 13.
PL-7	NA	Riprap photo-monitoring location 12 in the EDA.

LKD 9/2015. PL-1. View north-northeast of vegetation growth along fence.

LKD 9/2015. PL-2. Well 0515.

LKD 9/2015. PL-3. View south of disposal cell top and west side slope.

LKD 9/2015. PL-4. View north along transition zone from cell top to west side slope.

LKD 9/2015. PL-5. View northeast of shallow rill along transition zone.

LKD 9/2015. PL-6. View southeast of inspectors, a Geo-Smith Engineering representative, and a State of Oregon representative, performing rock monitoring at monitoring location 13.

LKD 9/2015. PL-7. Riprap photo-monitoring location 12 in the EDA.

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