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).

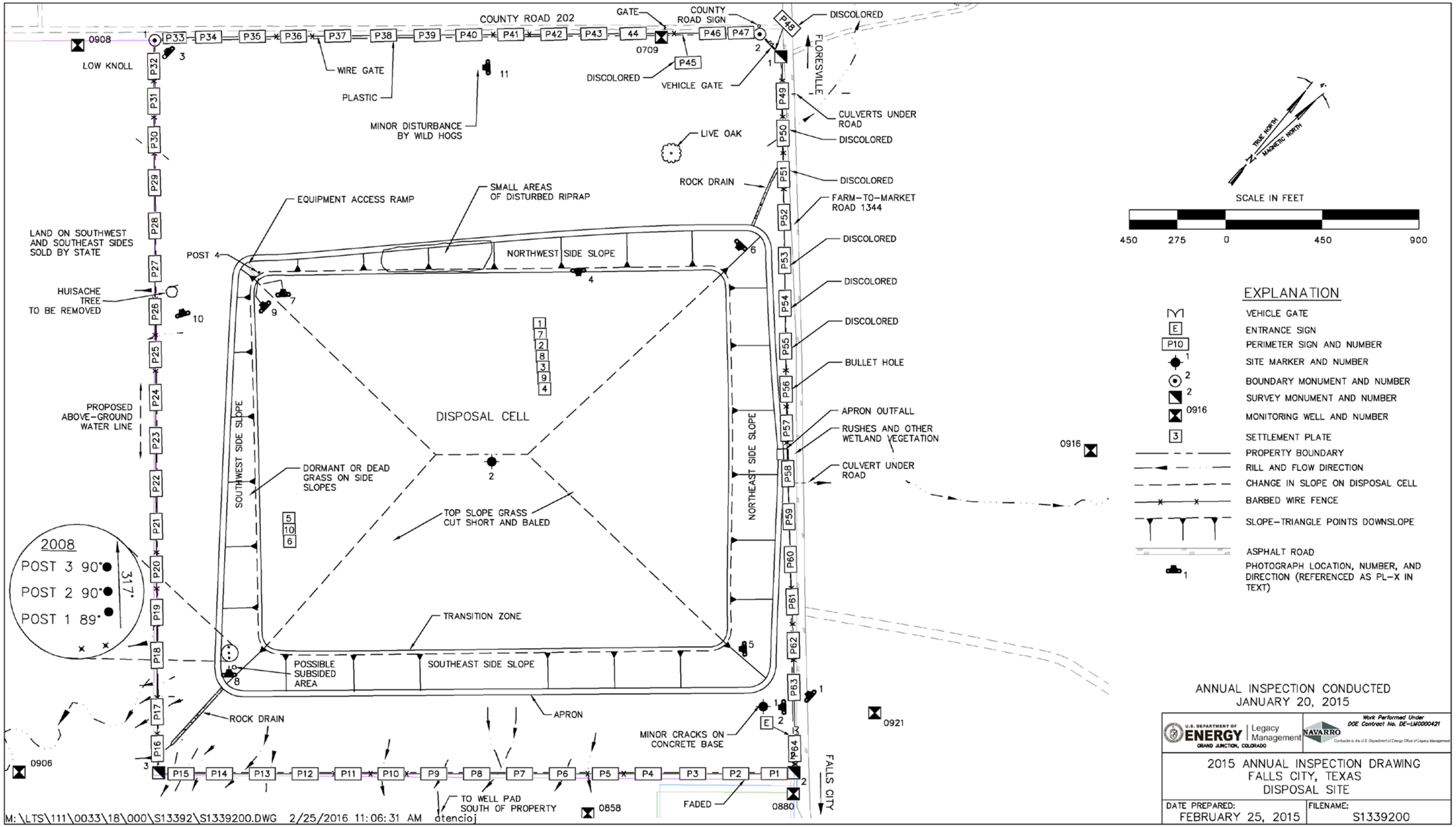

Figure 5-1. 2015 Annual Inspection Drawing for the Falls City Disposal Site

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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.

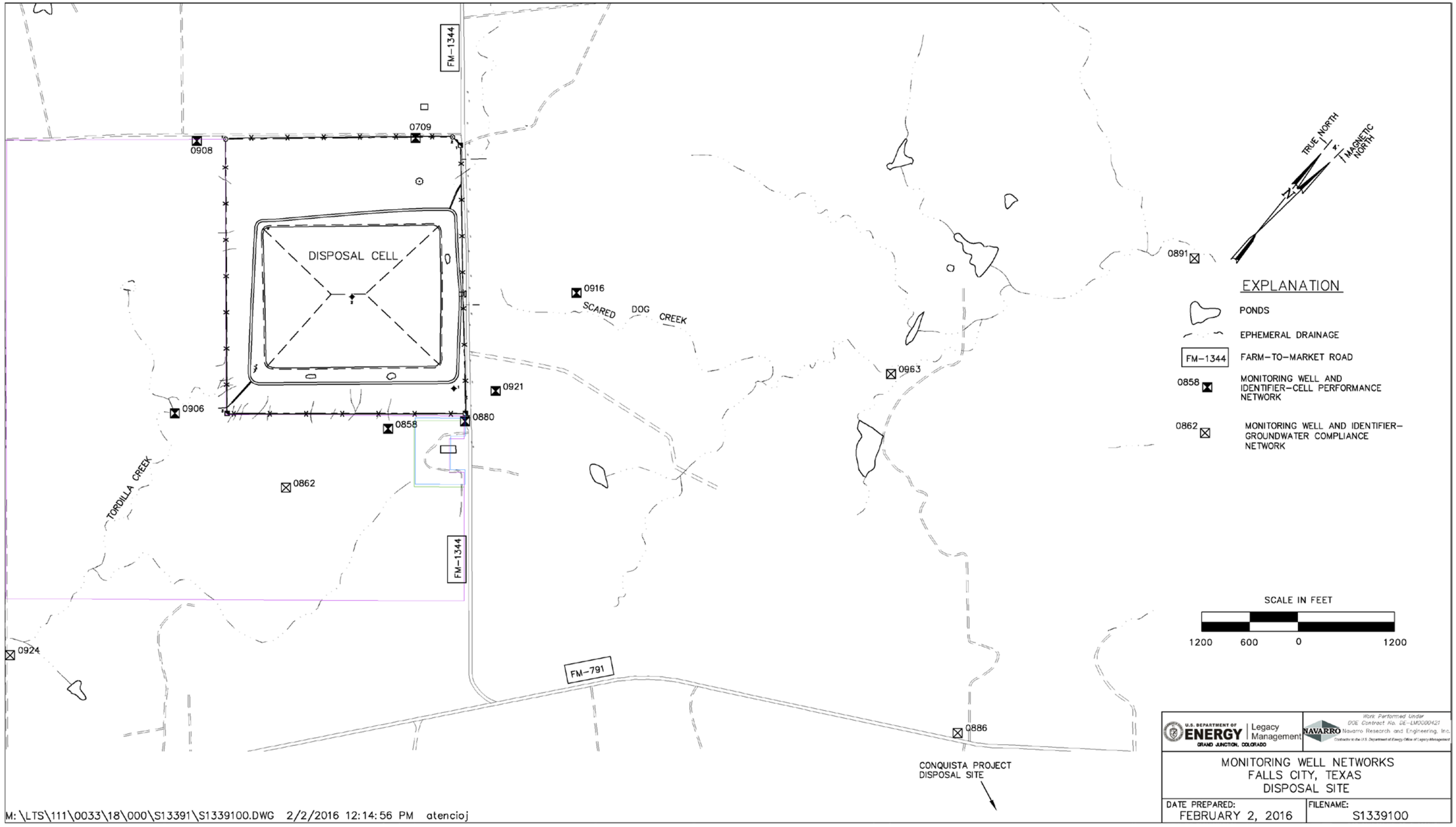

Figure 5-2. Combined Monitoring Well Network at the Falls City Disposal Site

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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]

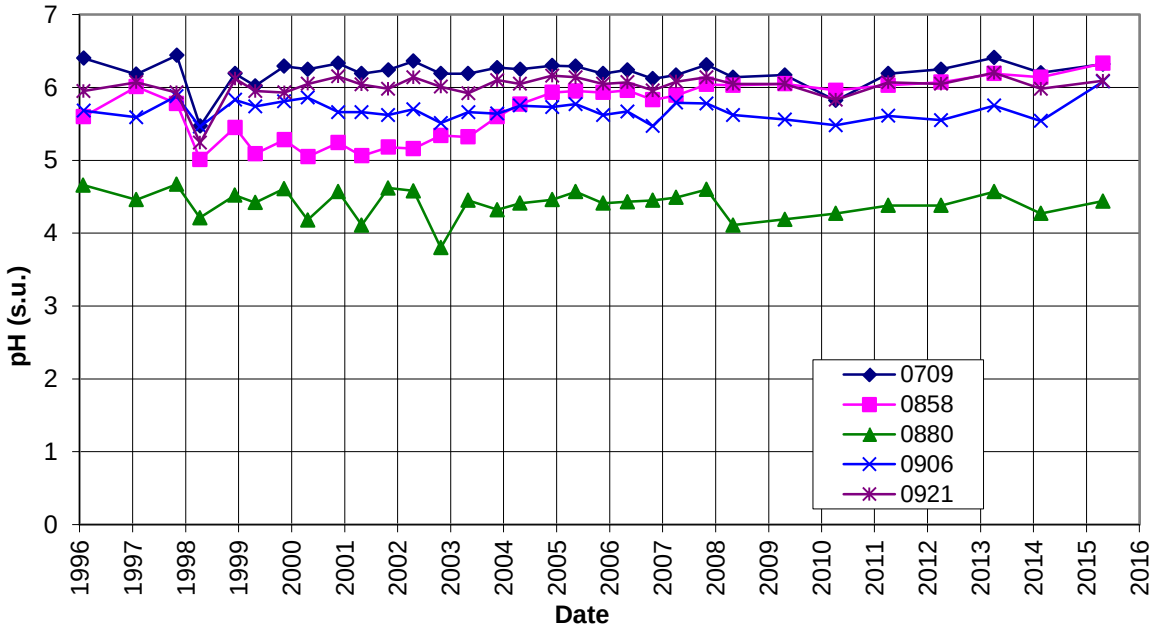

Figure 5-3. pH in Groundwater at Cell Performance Monitoring Locations at the Falls City Disposal Site

[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.

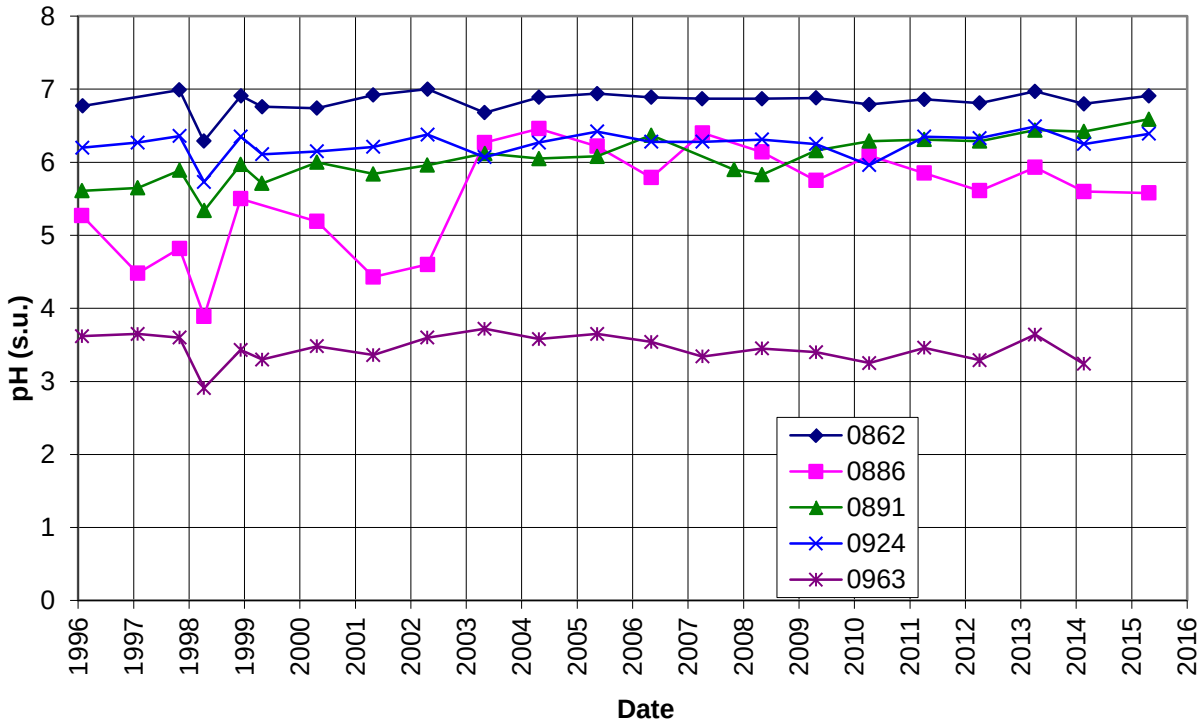

Figure 5-4. pH in Groundwater at Compliance Monitoring Locations at the Falls City Disposal Site

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).

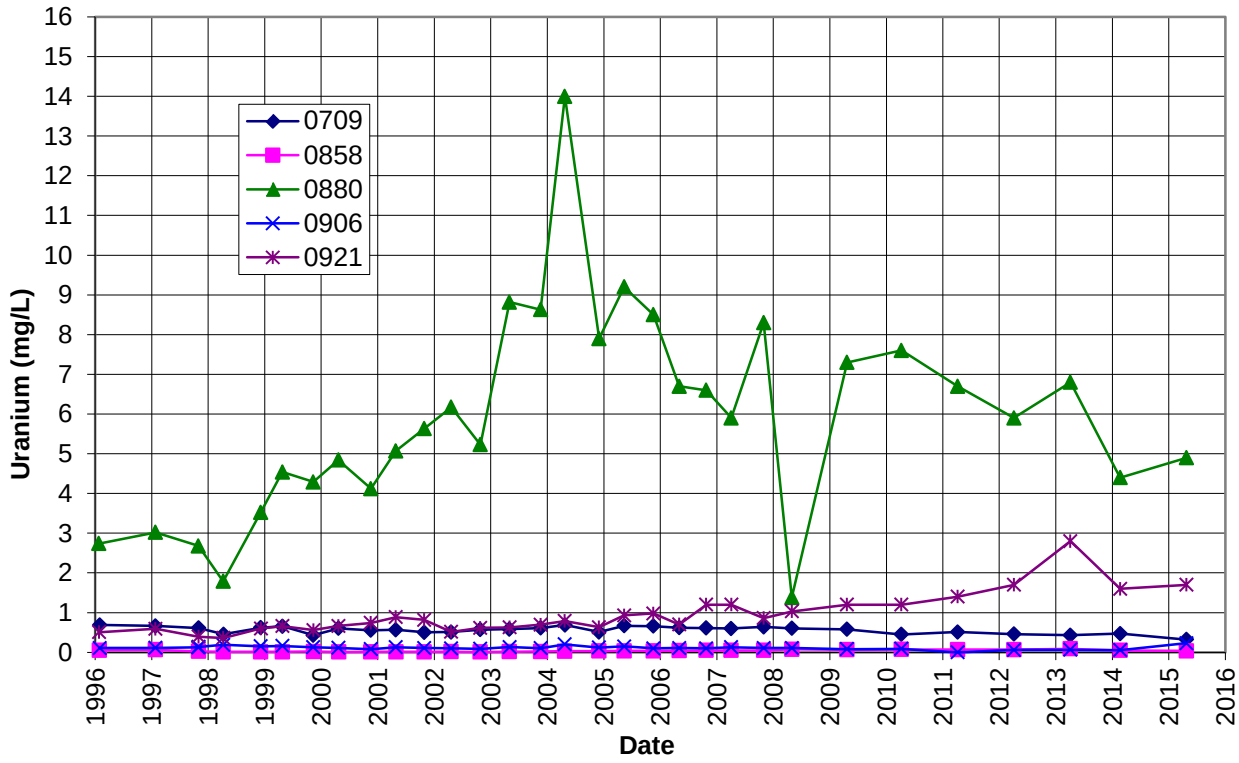

Figure 5-5. Uranium in Groundwater at Cell Performance Monitoring Locations at the Falls City Disposal Site

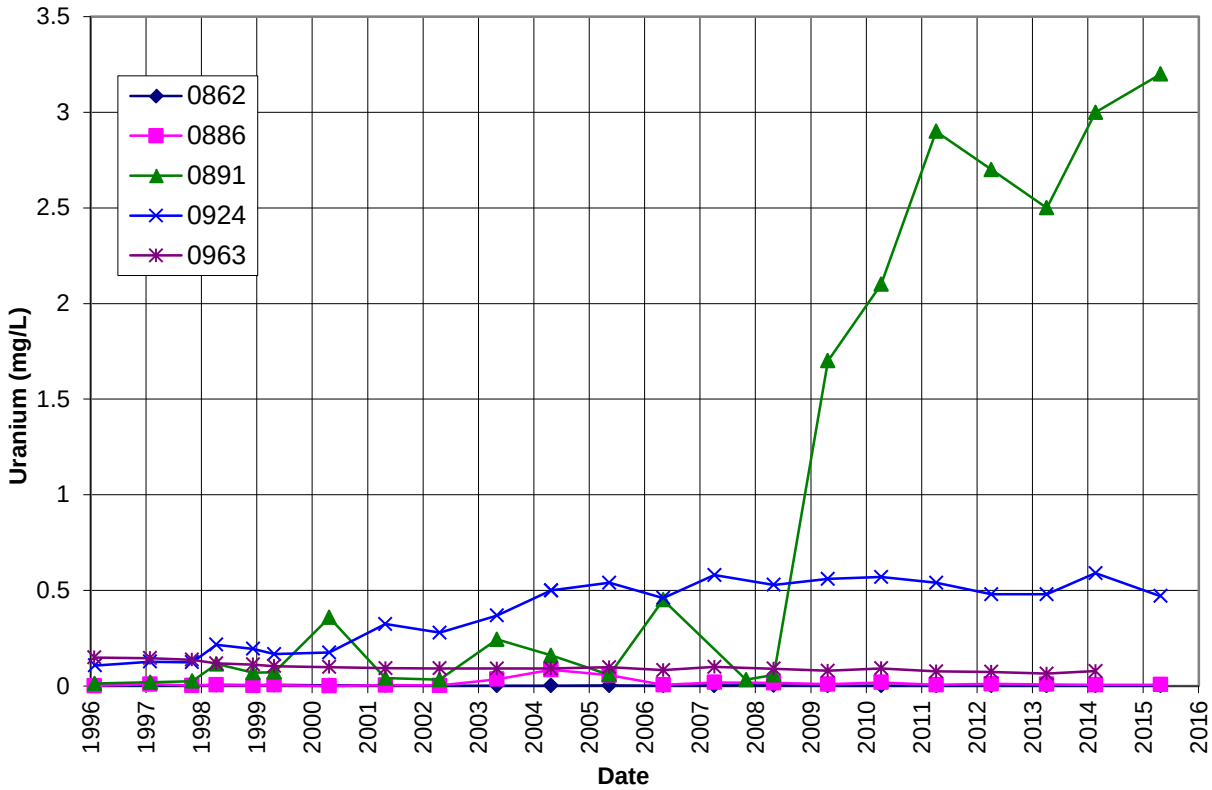

Figure 5-6. Uranium in Groundwater at Compliance Monitoring Locations at the Falls City Disposal Site

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.

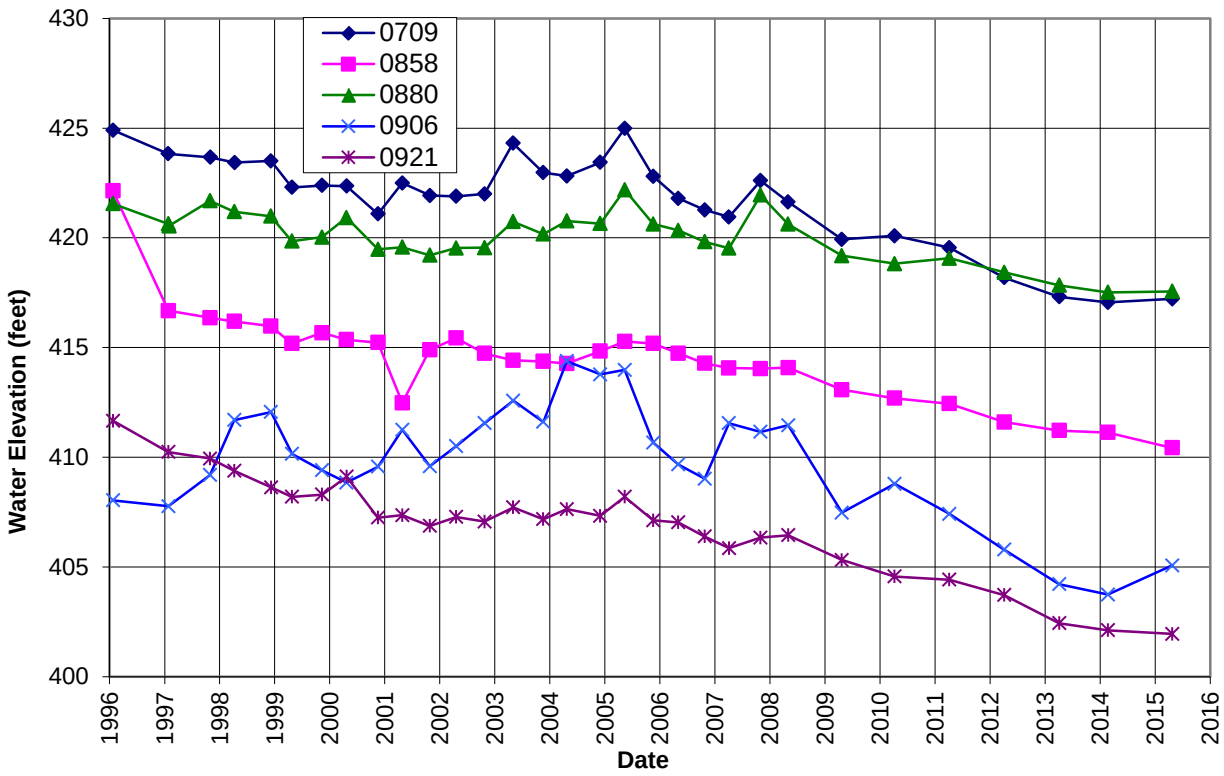

Figure 5-7. Water-Level Measurements at Cell Performance Monitoring Locations at the Falls City Disposal Site

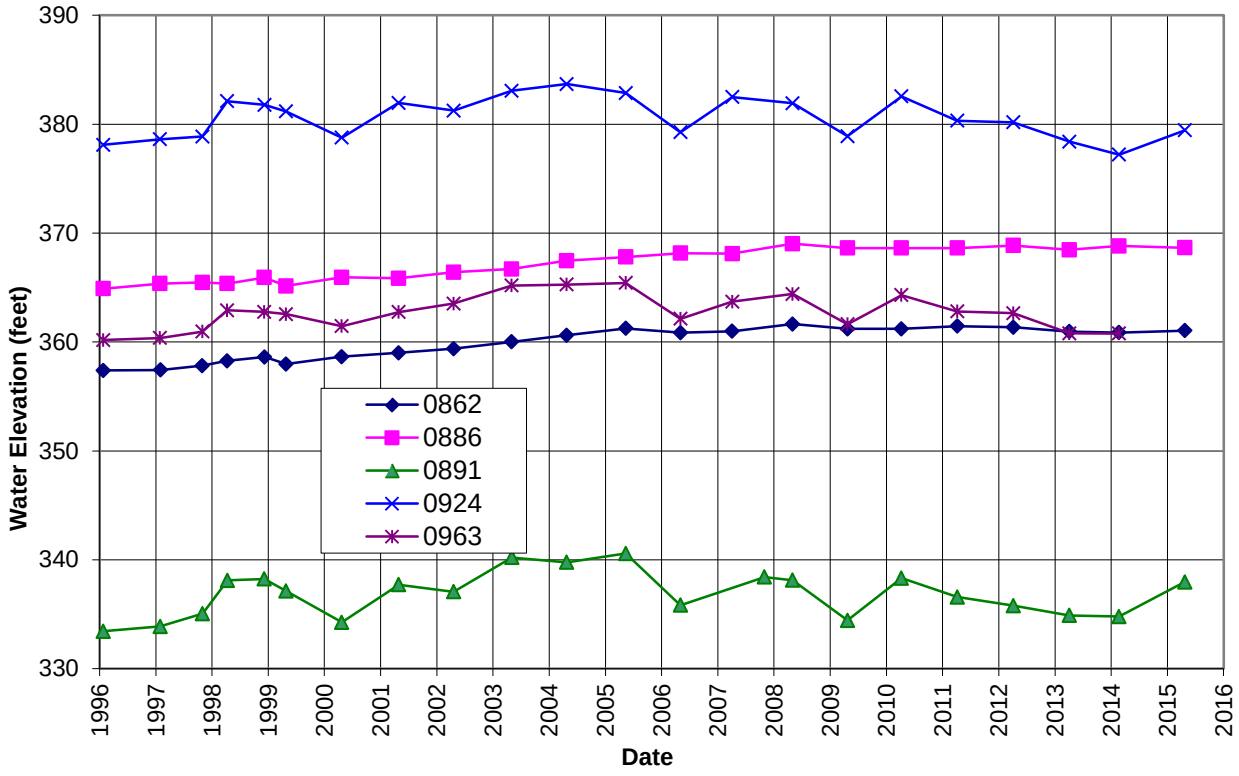

Figure 5-8. Water-Level Measurements at Compliance Monitoring Locations at the Falls City Disposal Site

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.