DOE–LM/1602–2008

Long-Term Surveillance Plan for the U.S. Department of Energy Falls City Uranium Mill Tailings Disposal Site Falls City, Texas

March 2008

U.S. Department of Energy

Office of Legacy Management

Work Performed Under DOE Contract No. DE–AM01–07LM00060
for the U.S. Department of Energy Office of Legacy Management.
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U.S. Department of Energy
Falls City Uranium Mill Tailings Disposal Site
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for the U.S. Department of Energy Office of Legacy Management, Grand Junction, Colorado

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Acronyms, Abbreviations, and Units of Measure

BM	boundary monument
CFR	*Code of Federal Regulations*
DOE	U.S. Department of Energy
D_{50}	median diameter
EPA	U.S. Environmental Protection Agency
FM	Farm to Market Road
ft	foot or feet
GCAP	Ground Water Compliance Action Plan
LTSP	Long-Term Surveillance Plan
mg/L	milligram(s) per liter
MW	monitor well
NRC	U.S. Nuclear Regulatory Commission
SEI	Solution Engineering, Inc.
SM	survey monument
SMK	site marker
SWI	Susquehanna Western, Incorporated
TDS	total dissolved solids
UMTRCA	Uranium Mill Tailings Radiation Control Act of 1978 (Title 49 *United States Code* Section 7901, et seq.)

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1.0 Introduction

1.1 Purpose

This Long-Term Surveillance Plan (LTSP) explains how the U.S. Department of Energy (DOE), as long-term custodian, will comply with the requirements of the general license for custody and long-term care of the Falls City, Texas, uranium mill tailings disposal site.

The Falls City site was licensed on July 8, 1997, after the U.S. Nuclear Regulatory Commission (NRC) concurred in the original LTSP (DOE 1997b). This revised LTSP incorporates the requirements of the Ground Water Compliance Action Plan (GCAP) (DOE 1998) for the Falls City site into a comprehensive management plan for the site. The GCAP imposed monitoring requirements to ensure protection of human health and the environment from processing-related ground water contamination. The environmental monitoring program developed in the GCAP has been modified in this revised LTSP to reflect results obtained since the disposal cell was closed in 1994.

The modification to the environmental monitoring program for the Falls City disposal site is to continue monitoring the current network of wells annually for the next 5 years as a best management practice and reduce the analyte list to total uranium and field measurements of temperature, pH, conductivity, turbidity, alkalinity, dissolved oxygen, and oxidation-reduction potential.

1.2 Legal and Regulatory Requirements

The Uranium Mill Tailings Radiation Control Act (UMTRCA) of 1978 (Title 42 *United States Code* Section 7901, as amended) provides for the remediation and regulation of uranium mill tailings at uranium millsites addressed under Title I and Title II of UMTRCA. Title I sites, such as the Falls City site, are former uranium millsites unlicensed and essentially abandoned when UMTRCA was implemented on January 1, 1978. Title II of UMTRCA addresses reclamation of uranium millsites under specific license on January 1, 1978. NRC is the licensing agency for both Title I and Title II sites, although an Agreement State may elect to regulate a Title II site.

Federal regulations in Title 10 *Code of Federal Regulations* Part 40.27 (10 CFR 40.27) provide for the licensing, custody, and long-term care of uranium mill tailings disposal sites remediated under Title I of UMTRCA. NRC regulates a general license for the long-term custody and care of these sites. Long-term care includes institutional controls, inspection, monitoring, maintenance, and other measures to ensure that the sites continue to protect public health, safety, and the environment after remediation is completed.

The general license becomes effective when a site-specific LTSP receives NRC concurrence. The original LTSP for the Falls City site (DOE 1997b) received NRC concurrence on July 8, 1997 (Appendix A).

Table 1–1 lists the requirements in 10 CFR 40.27 for the LTSP and for the long-term custody and care of the Falls City site.

Table 1–1. Requirements for the Long-Term Surveillance Plan and the Long-Term Surveillance and Maintenance of the Falls City, Texas, Disposal Site

Requirements for the LTSP		
No.	*Requirement*	*This LTSP*
1.	Final site conditions	Section 2.0
2.	Legal description of the site	Section 2.3.1 and Appendix B
3.	Long-term surveillance program	Section 3.0
4.	Follow-up inspections	Section 3.4
5.	Maintenance and other actions	Section 3.5
Requirements for Surveillance and Maintenance		
No.	*Requirement*	*This LTSP*
1.	Changes to the LTSP	Section 3.1
2.	Permanent right-of-entry	Section 3.1
3.	Notification of inspections, significant problems, or actions	Sections 3.3, 3.4, 3.5, and 3.6

The plans, procedures, and specifications in this revised LTSP are based on the *Guidance for Implementing the Long-Term Surveillance Program for UMTRCA Title I and Title II Disposal Sites* (DOE 2000). That document and the current LTSP constitute DOE's operational plan for the long-term custody and care of the Falls City site.

1.3 Role of the U.S. Department of Energy

In 1988, DOE designated the office at Grand Junction, Colorado, to be the program office for the long-term surveillance and maintenance of all DOE remedial action project disposal sites, as well as other sites as assigned, and to be the common office for the surveillance, monitoring, maintenance, and institutional control of these sites. DOE established the Long-Term Surveillance and Maintenance Program to carry out this responsibility. In 2003, DOE created the Office of Legacy Management (LM) at DOE Headquarters. DOE–LM assumed the responsibilities of the long-term surveillance and maintenance activities and is responsible for implementing and revising this LTSP.

2.0 Final Site Conditions

2.1 Site History

In 1954, the first uranium deposits on the Gulf Coastal Plain were discovered in western Karnes County. These deposits were in the Eocene sedimentary rocks that underlie the Falls City disposal site and surrounding area. Discovery of these deposits led to extensive exploratory drilling by Susquehanna Western, Incorporated (SWI). Open pit mining began in 1959.

SWI built and operated a mill at the site between 1961 and 1973 (DOE 1991). The mill used a sulfuric acid leach process to extract more than 700 tons of uranium oxide (U_3O_8, or yellow cake) from approximately 2.5 million tons of ore. The ore averaged 0.16 percent U_3O_8. The yellow cake was sold to the U.S. Atomic Energy Commission. The milling operation generated more than 3.1 million tons of tailings. Tailings and waste solutions (acid raffinate) were impounded in seven settling ponds, four of which were formerly open pit mines. The ponds were 30 to 35 feet (ft) deep and unlined except for naturally occurring clay-rich horizons in underlying foundation soils and sedimentary rocks. Once the ponds were filled with tailings, they were called tailings piles. Some references cited use the terms ponds and tailings piles interchangeably.

In 1975, SWI sold the millsite and tailings to Tepcore, Inc. Tepcore in turn sold the property to Solution Engineering, Inc. (SEI) and its partner, Basic Resources, Inc. From late 1978 to early 1982, SEI conducted secondary recovery operations from four of the tailings piles. The recovery operation used a system of shallow injection and recovery wells and an ion exchange process to recover uranium and molybdenum from solution. Acid water from one of the ponds (Pond 7) was used in this operation, and wastewater was pumped back into the pond. All ponds were eventually evaporated except Pond 6, which was recharged by natural seepage.

In 1982, SEI re-contoured the tailings piles and filled the remaining ponds. The disturbed area was covered with 1 to 2 ft of local clay-rich soil and planted with native grasses.

The Falls City millsite was designated for cleanup under Title I of UMTRCA. At the start of remedial action in 1992, the processing site consisted of two parcels of land (Figure 2−1). Parcel A (473 acres) was northwest of the intersection of Farm to Market Road (FM)-1344 and FM-791. This parcel included the former millsite, one mill building, five tailings piles (Piles 1, 2, 4, 5, and 7), and one tailings pond (Pond 6). The Falls City disposal site now occupies the northern part of this parcel. Parcel B (120 acres) was approximately 1 mile east of Parcel A. Parcel B enclosed Pile 3. The two parcels were connected by a corridor that accommodated a slurry line. The slurry line carried waste materials from Parcel A to Pile 3 in Parcel B while the mill was in operation.

Windblown contamination was present on 298 acres associated with Parcel A and 80 acres associated with Parcel B. Thirteen vicinity properties were also contaminated with radioactive materials imported from the millsite. A total of 7,143,000 tons of radioactive materials from all sources were identified for remediation.

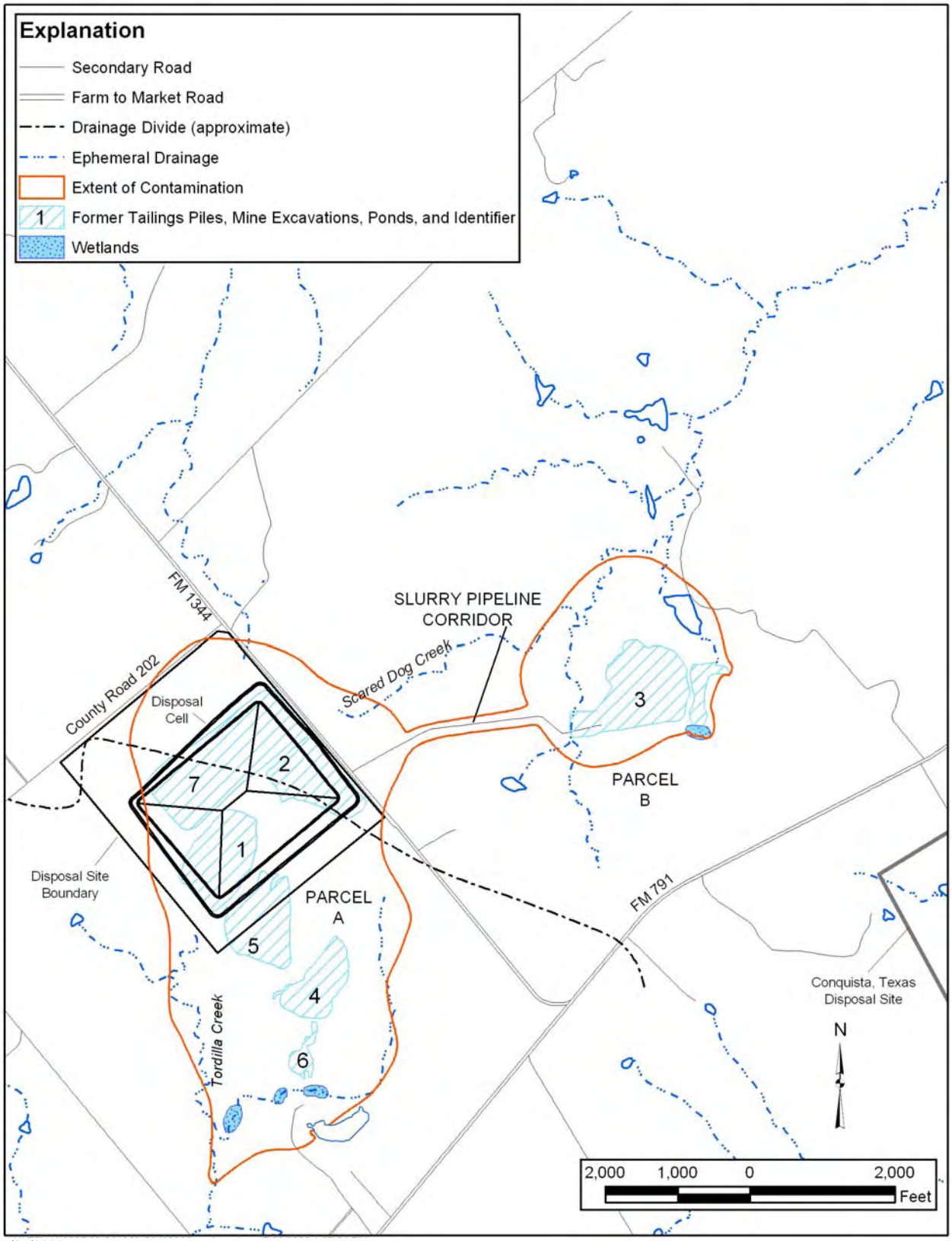

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Figure 2–1. Contaminated Areas at the Falls City, Texas, Disposal Site, Before Remedial Action

The approved site remediation strategy was to encapsulate tailings and other residual radioactive materials in an on-site engineered disposal cell. Most of the tailings in Piles 2 and 7 and all of the tailings in Pile 1 were left in place. The remainder of Piles 2 and 7 and all of Piles 3, 4, 5, and tailings in Pond 6, along with windblown and vicinity property materials, were placed within the area occupied by Pile 1 and most of Piles 2 and 7. Remedial action began in 1992 and was completed in 1994. Ford, Bacon, and Davis (1981) and DOE (1991, 1992) provide detailed information on site history and remedial action.

2.2 Area Description

The Falls City disposal site is in Karnes County, Texas, approximately 8 miles southwest of the town of Falls City and 46 air miles southeast of San Antonio (Figure 2−2).

The site is on the northern margin of the West Gulf section of the Gulf Coastal Plain Physiographic Province in an area of low hills underlain by Tertiary sedimentary rocks that dip gently southeast toward the Gulf of Mexico. Relief in the vicinity of the disposal site is 100 ft or less. The site is on a broad drainage divide between the San Antonio and Nueces Rivers at an elevation of approximately 450 ft above sea level.

The surrounding area is rural. Historically, the land has been used for dry-land grain and hay farming and cattle, swine, and dairy production. Before mining, the Falls City site was part of a large dairy farm. Although the area is sparsely populated, about 14 residences are within 1 mile of the disposal site. Former open pit uranium mines are scattered throughout the area.

Vegetation in the vicinity of the site consists of grasses in upland areas and dense woods along stream courses. Mesquite and large cactus are prominent in areas of overgrazing.

Climate is subtropical with hot humid summers and mild winters (DOE 1991). The average annual maximum temperature is 79 ^{o}F, and the average annual minimum temperature is 58 ^{o}F. Maximum summer temperatures are typically in the 90s and may exceed 100 ^{o}F. Winter temperatures below freezing are infrequent. Annual average precipitation is approximately 30 inches and typically ranges from 25 to 38 inches. The greatest rainfall occurs in late spring, summer, and early fall. Heavy rainstorms are not uncommon, and tropical storms (hurricanes) occasionally occur (Ford, Bacon, and Davis 1981).

2.3 Site Description

2.3.1 Legal Description

Pursuant to Section 104 of UMTRCA, the State of Texas, in 1990 and 1991, acquired 746.13 acres for remedial action (DOE 1997b). Upon completion of remedial action, 231.15 acres of land, including the disposal cell and land immediately adjacent, were transferred to DOE for long-term custody. Perpetual access to the site is from FM-1344 that runs along the northeast side of the site and County Road 202 along the northwest side of the site (Figure 2–1).

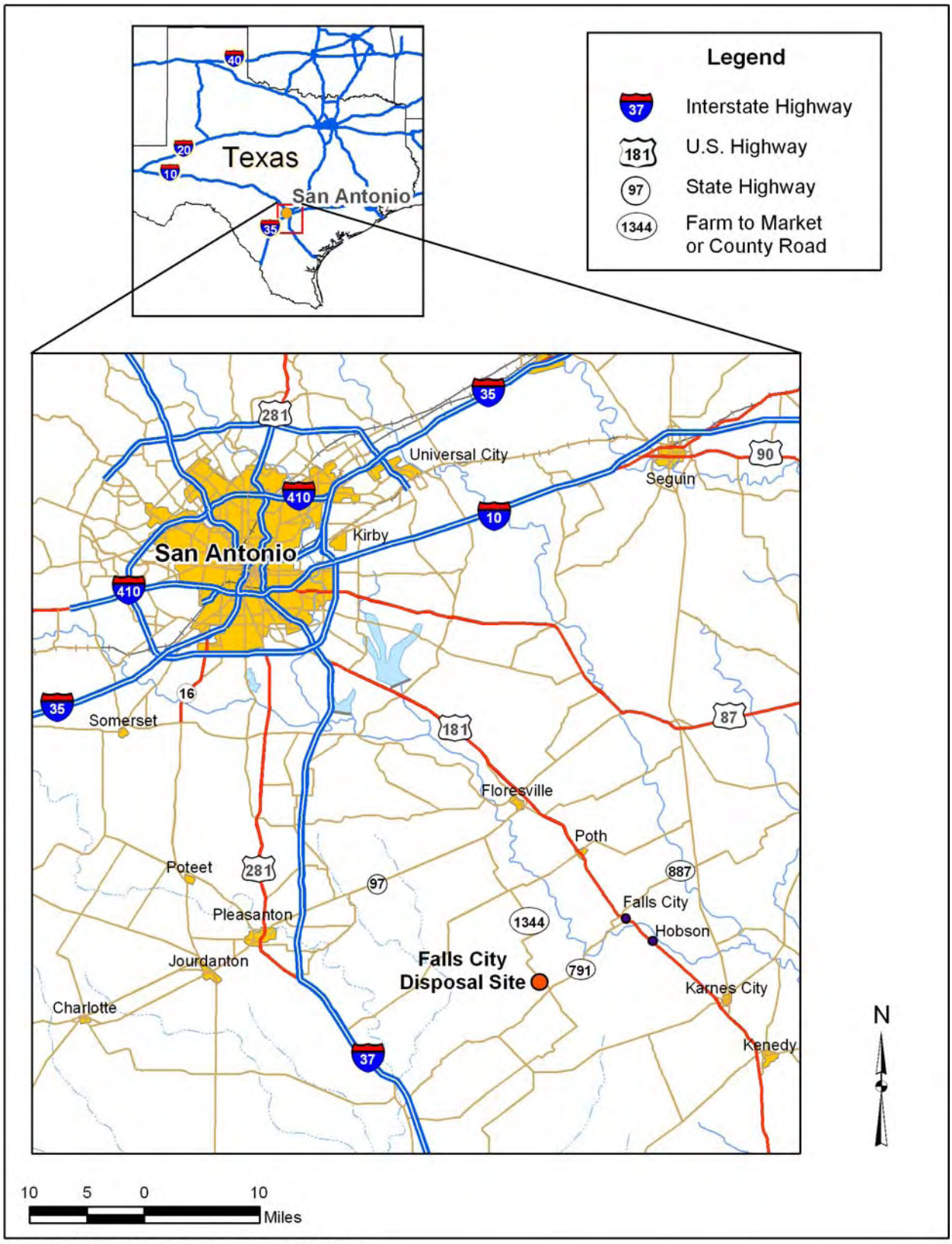

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Figure 2–2. Location Map, Falls City, Texas, Disposal Site

The legal description of the site and a brief history of land acquisition are in Appendix B. Site boundaries are shown on Figure 2−4.

Land surrounding the site is privately owned. The remainder of the land acquired by the State was sold in 2005.

2.3.2 Location and Access

Table 2–1 shows mileages and driving directions to the site. See also Figure 2−2.

Table 2–1. Driving Directions to the Falls City, Texas, Disposal Site

Mileage	Route
0.0	Intersection of Interstate Highway 37 South (I–37S) and U.S. Highway 181. Proceed southeast on Highway 181 through Floresville toward Falls City.
32.4	Junction with County Road 887 north of Falls City. Turn right (southwest).
33.6	Junction with Farm-to-Market Road (FM)–791. Turn right (southwest).
41.1	Junction with FM–1344. Turn right (northwest).
41.9	Access gate at the east corner of the site adjacent to FM–1344. At this location, the site is immediately west of FM–1344.

2.3.3 Site Description

Features described in this section are shown on Figure 2−4.

Disposal Site—The site comprises 231.15 acres, of which 127 acres are occupied by the disposal cell, including the apron. The disposal site is on top of a broad drainage divide. Runoff from the northern half of the site flows into natural drainages northeast and east of the site. These ephemeral drainages are tributaries of the San Antonio River. Runoff from the southern half of the site drains south and southwest into Tordilla Creek, an ephemeral tributary of the Nueces River.

Disposal Cell—The disposal cell contains 7,143,000 dry tons of residual radioactive materials. These materials consist of tailings, millsite debris, vicinity property materials, and windblown contamination. Total activity within the cell is 1,277 curies of radium-226.

The disposal cell is a rectangular, flat-topped mound that rises 30 to 40 ft above surrounding grade. It is a surface impoundment, but parts of it are below grade where it was constructed above pre-existing, backfilled, open-pit mines. The highest elevation on top of the cell is 487 ft above sea level. The base of the cell is approximately 2,500 ft long on the northwest and southeast sides, and 2,200 ft long on the northeast and southwest sides.

In the lower part of the cell, debris from the mill building was placed above pre-existing tailings and the surface of the ground. Organic materials such as woody debris and grubbed vegetation were distributed throughout the cell. Relatively clean, fine-grained, windblown material was placed above the other materials toward the top of the cell to restrict the release of radon to the

atmosphere (radon flux) (DOE 1996). Contaminated materials underlie the side slopes of the cell.

The tailings are encapsulated and protected by an engineered cover on the top and side slopes of the disposal cell. The component layers of the cover are designed to prevent erosion, limit radon flux, and restrict infiltration of rainwater (Figure 2−3). The disposal cell is designed to withstand a probable maximum precipitation event (defined as the largest storm that could hypothetically occur as a result of the most severe meteorological conditions possible occurring simultaneously over a watershed at a given time) of 19.2 inches of rainfall in 1 hour and a seismic event with horizontal ground acceleration of 0.1 g (g = standard acceleration of gravity) (DOE 1992).

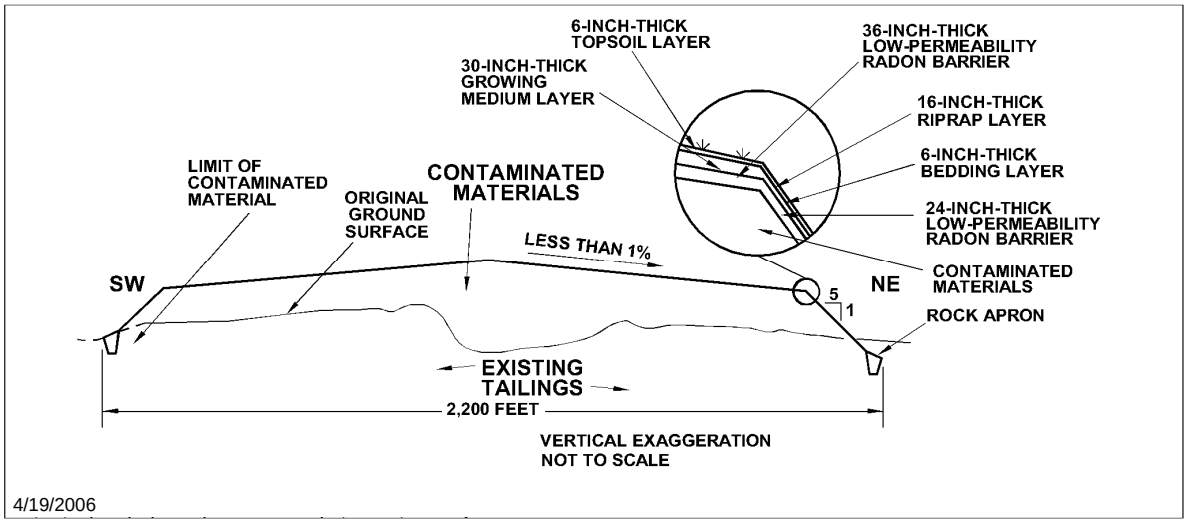

Figure 2–3. Disposal Cell Cross Section

On top of the disposal cell, the cover is 72 inches thick. It consists of a 36-inch-thick layer of highly compacted, clay-rich soil (radon barrier), a 30-inch-thick layer of soil suitable as a growing medium, and a 6-inch-thick layer of topsoil. The radon barrier is designed to limit radon flux to less than the U.S. Environmental Protection Agency (EPA) standard at 40 CFR 192.02 of 20 picocuries per square meter per second. The highly compacted, fine-grained radon barrier also serves to restrict the infiltration of rainwater into the tailings.

The 6-inch-thick layer of topsoil above the radon barrier supports a dense mixture of range grasses, primarily Kleingrass (Table 2–2). The grass provides erosion protection and removes moisture from the soil through evapotranspiration. The grass is cut several times each year, depending upon rainfall. The hay is bailed for feed (Section 3.5). Because of the mild climate, the radon barrier and soil cover are not subject to freeze-thaw cycles.

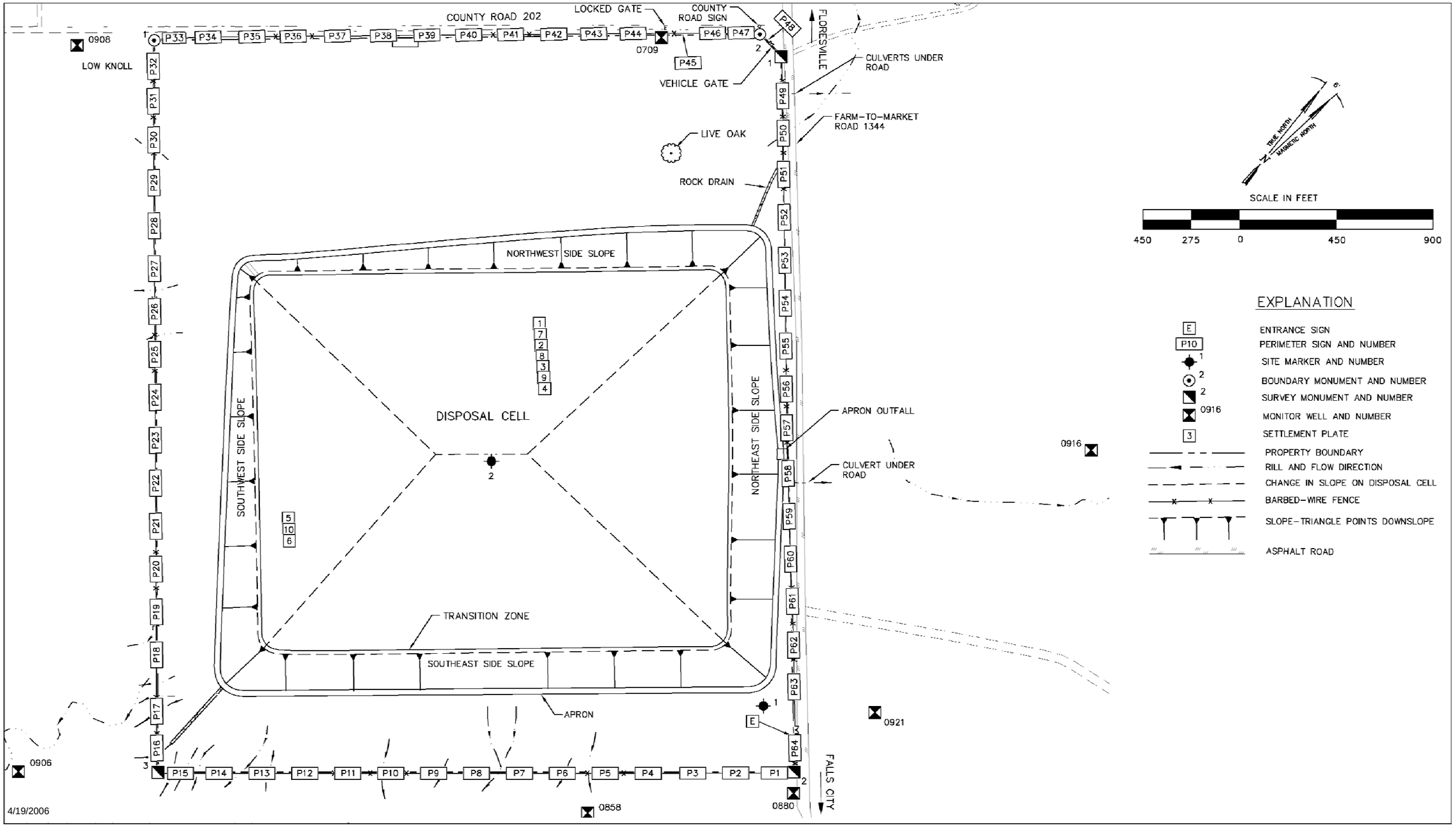

Figure 2–4. Site Map, Falls City, Texas, Disposal Site

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Table 2–2. Top Slope Seed Mixture, Falls City, Texas, Disposal Site

Species	Rate (pounds per acre)
Green sprangletop	1.90
Common Bermuda	10.20
Sideoats grama	0.96
Kleingrass	5.14
Total	18.20

The top of the disposal cell has a 100:1 (1 percent) slope to prevent standing water and minimize the velocity of runoff. The cover over the top of the disposal cell has a high water storage capacity. It stores water during periods when rainfall exceeds runoff and evaporation, and returns water to the atmosphere through evapotranspiration.

The cover on the side slopes is 46 inches thick. It consists of a 24-inch-thick radon barrier of the same compacted clay-rich soil used for the top slope. This layer is covered with 6 inches of bedding material and a 16-inch-thick layer of riprap. The riprap has a median diameter (D_{50}) of 7 inches (D_{50} is the diameter of rock such that 50 percent of the rock by weight is of that diameter or larger.) The bedding layer was placed over the radon barrier to protect it during placement of the riprap. The bedding layer also facilitates runoff following storms. The side slopes of the disposal cell have 5:1 (20 percent) slopes.

An apron of rock surrounds the base of the disposal cell on all sides. The apron is from 6 to 10 ft deep and extends 29 ft beyond the toe of the side slopes. Riprap in the apron has a D_{50} of 11 inches. The apron protects the side slopes of the disposal cell from erosion adjacent to the disposal cell and is graded to direct runoff away from the cell.

Rock drains at the north and south corners of the cell extend outward from the apron for a distance of 350 ft. An apron outfall, constructed of the same rock as the apron and rock drains, is midway along the northeast side of the disposal cell. The apron outfall and rock drains convey runoff away from the cell.

The side slopes, rock apron, rock drains, and apron outfall are designed to withstand a Probable Maximum Precipitation event.

2.3.4 Institutional Controls

Institutional controls at the site consist of federal ownership (withdrawal) of the land within the boundaries of the DOE-owned disposal site, which allows DOE full control of on-site land use.

DOE has imposed use restrictions in the form of deed restrictions on the portion of the former processing site acquired by the State of Texas but not incorporated into the disposal site (Appendix B). This parcel was sold to a private entity in 2005.

2.3.5 Specific Site Surveillance Features

Features described in this section are shown on Figure 2−4. Specifications for construction of these features are in the guidance document (DOE 2000).

Fence and Gates—A barbed-wire stock fence on the property line encloses the site. The entrance gate is a tubular metal gate at the eastern corner of the site adjacent to FM−1344. A second gate is at the north corner of the site between boundary monument BM−2 and survey monument SM−1. The second gate is a simple wire gate wide enough for vehicles. Another wire gate is on the northwest side of the property, adjacent to County Road 202. All gates are locked.

Boundary and Survey Monuments—There are two boundary monuments. BM−1 is near the west corner of the site, and BM−2 is near the north corner of the site. Both are Berntsen Model A-1 federal aluminum survey monuments. Boundary monuments extend about 12 inches above the ground.

There are three survey monuments. SM−1 is near the north corner of the site approximately 150 ft east of BM−2 where the property corner is truncated. SM−2 is near the east corner of the site, and SM−3 is near the south corner of the site. All survey monuments are Berntsen RT−1 survey monuments set in concrete. The concrete bases extend about 4 inches above the ground.

Each boundary and survey monument is set approximately 5 ft inside the property boundary.

Site Markers—Site markers are unpolished granite monuments embedded in concrete. SMK−1 is just inside the entrance gate at the east corner of the site. SMK−2 is at the crest of the disposal cell. The markers are identically inscribed with the following information: a diagram to show the site boundary and location of the disposal cell, the date of closure (February 9, 1994), the quantity of tailings (7,143,000 dry tons), and the level of radioactivity within the disposal cell (1,277 curies of radium-226).

Signs—Sixty-four perimeter (warning) signs are mounted on steel posts at 500-ft intervals around the edge of the site. The signposts are set back 5 ft from the site boundary and are set in concrete. The signs are numbered P1 through P64 on Figure 2−4.

The signs are metal or plastic placards, approximately 24 inches wide and 18 inches high. Information on the signs states that the site is a uranium mill tailings repository, U.S. Government property, no trespassing allowed. The international symbol for radioactive materials (trefoil) is on each sign to warn of the potential hazard, although there is no hazard as long as the engineered cover over the tailings remains intact. Signs have black lettering on a yellow background.

In addition to the perimeter signs, an entrance sign is on a post just inside and to the left of the entrance gate. This sign provides the same information as the perimeter signs and also a 24-hour telephone number ([970] 248-6070) for the public to contact DOE in case of an emergency or inquiry.

Settlement Plates—There are 10 settlement plates in two groups on top of the disposal cell. Settlement plates were used to monitor settlement during and immediately following

construction of the disposal cell. Settlement or movement, as measured, did not exceed 1 inch vertically or 0.7 inch laterally, and was determined to be insignificant. Monitoring of settlement plates was terminated soon after the disposal cell was completed. The settlement plates are artifacts of construction and are no longer monitored or maintained.

Monitor Wells—There are twelve DOE monitor wells remaining at the Falls City site (Figure 2–5). Wells are constructed to State of Texas specifications for monitor wells and are protected by locked steel covers. Completion diagrams are appended to the GCAP (DOE 1998).

2.4 Geology

The Falls City site is underlain by surficial deposits (soils) and clastic sedimentary rocks of the Eocene Whitsett Formation. The three members of the Whitsett Formation are, in descending order, the Deweesville Sandstone, Conquista Clay, and Dilworth Sandstone. The Conquista Clay is composed of three subunits: an oxidized upper clay/silt, a middle sandstone, and a lower clay. The Manning Clay underlies the Whitsett Formation. Both the Deweesville Sandstone and Conquista Clay are composed of poorly lithified, fine-grained sandstones and carbonaceous siltstones and claystones deposited in lagoonal to strand plain, barrier bar environments. The Dilworth Sandstone is predominantly fine-grained. Uranium ore occurs primarily in the sandstone units. Volcanic ash, abundant in some units, is the likely source of the uranium. The Whitsett Formation underlies the surficial soils at the Falls City site.

Geologic structure at the site is relatively simple. Strata dip uniformly one to four degrees southeast toward the Gulf of Mexico and are undeformed. The Falls City fault is one mile north, and the Fashing fault system is 5 miles south of the site (DOE 1991); these are typical gulf coast slump faults that parallel the coast. Neither is active or considered capable of generating sufficient seismic activity to threaten cell integrity. Minor seismic activity was reported on 12 occasions in Karnes and Atascosa Counties between 1973 and 1993. Only one report of seismic activity was in Karnes County; the other 11 were in adjacent Atascosa County. All 12 events were listed as “probably man-made” (i.e., attributed to oil and gas withdrawal) (University of Texas, undated).

2.5 Ground Water

2.5.1 Ground Water Occurrence

Two aquifers of interest underlie the site: the shallow Deweesville/Conquista aquifer and the deeper Dilworth aquifer. Because the two aquifers are hydraulically connected, they constitute the uppermost aquifer for regulatory purposes. The Dilworth aquifer is underlain by the Manning Clay, a 300-ft-thick aquitard that isolates the uppermost aquifer from better quality ground water in deeper aquifers.

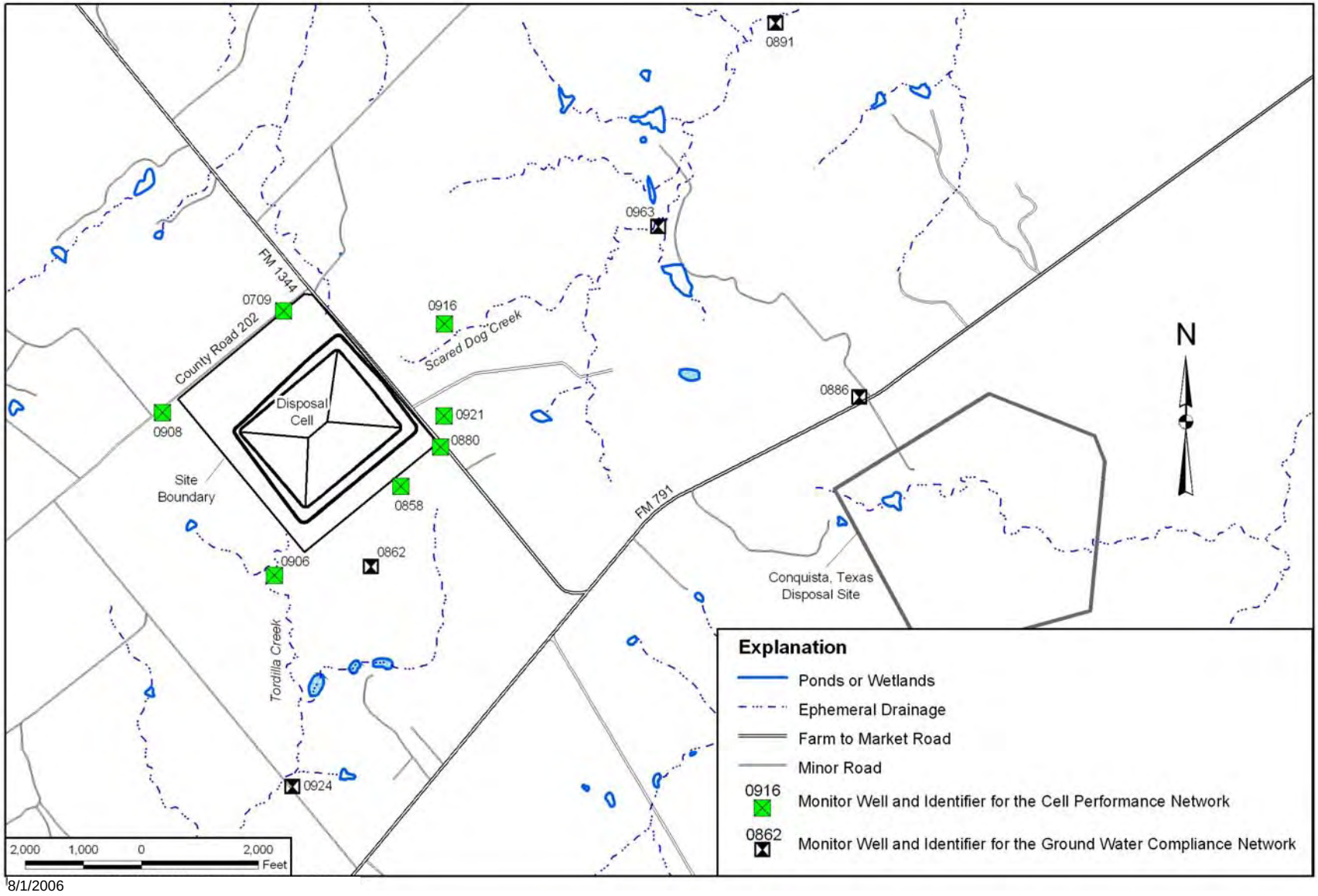

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Figure 2–5. Ground Water Monitor Wells, Falls City, Texas, Disposal Site

Ground water occurs in the Deweesville/Conquista aquifer under unconfined conditions at depths ranging from 5 to 30 ft (DOE 1997a). Recharge is primarily from precipitation falling on areas of outcrop and some seepage from other formations. When the tailings ponds were active (some consisted of open pit mines excavated into the ore-bearing Deweesville and Conquista units), they provided an additional component of recharge. Discharge in the downdip direction is to Tordilla Creek and an unnamed tributary southeast of the site. Discharge may also occur to Conquista Creek southeast of FM–791. North of Parcel B (Pond 3), discharge is to the Scared Dog Creek drainage. A downward hydraulic gradient exists between the Deweesville/Conquista aquifer into the Dilworth aquifer. No continuous impermeable strata separate the two aquifers.

Ground water occurs in the Dilworth aquifer at depths ranging from 30 to 100 ft beneath the site. Ground water is unconfined in the updip direction near the outcrop and is confined by 30 to 50 ft of carbonaceous clay in the lower part of the overlying Conquista Clay in the downdip direction beneath the disposal cell. This lower clay unit acts as an aquitard to downward seepage of ground water from the Conquista sandstone unit. However, some hydraulic connection between the overlying Deweesville/Conquista aquifer and the Dilworth aquifer is believed to occur because uranium exploration boreholes were drilled through both aquifers across the region. The boreholes probably were not properly decommissioned, as was a common practice of the time.

Before site remediation, the potentiometric surface of the Deweesville/Conquista aquifer defined a ground water mound beneath the former processing site that was created by infiltration of processing solutions (DOE 1997a). Literature research and historical data indicate the Deweesville/Conquista strata beneath the site were unsaturated before milling operations began (DOE 1995). Recent ground water monitoring results indicate that the ground water mound is dissipating. This is most likely the result of regional potentiometric equilibrium becoming reestablished after some local sources of recharge were eliminated (i.e., cessation of ore-processing activities and removal of tailings ponds during remedial action).

Aside from the lowering of water levels in some monitor wells near the disposal cell, ground water elevations measured in many of the existing DOE-owned monitor wells have remained relatively stable since completion of the disposal cell. Some monitor wells reflect a slight regional rise in water levels for the past 3 to 4 years. No significant deviations of the water level have been noted in the vicinity of the disposal site (Figure 2–6).

2.5.2 Ground Water Quality

Ground water in the Deweesville/Conquista and Dilworth aquifers in the vicinity of the Falls City site is of limited use and is unsuitable as a source of drinking water because of widespread ambient contamination (naturally occurring uranium mineralization) and degradation caused by associated human activities (uranium exploration and mining) not related to uranium-ore processing. The disposal cell is located near former open pit uranium mines in a geochemically active environment. Remnant uranium mineralization is being redistributed through recharge by oxidizing meteoric water at the formation outcrop immediately updip of the site.

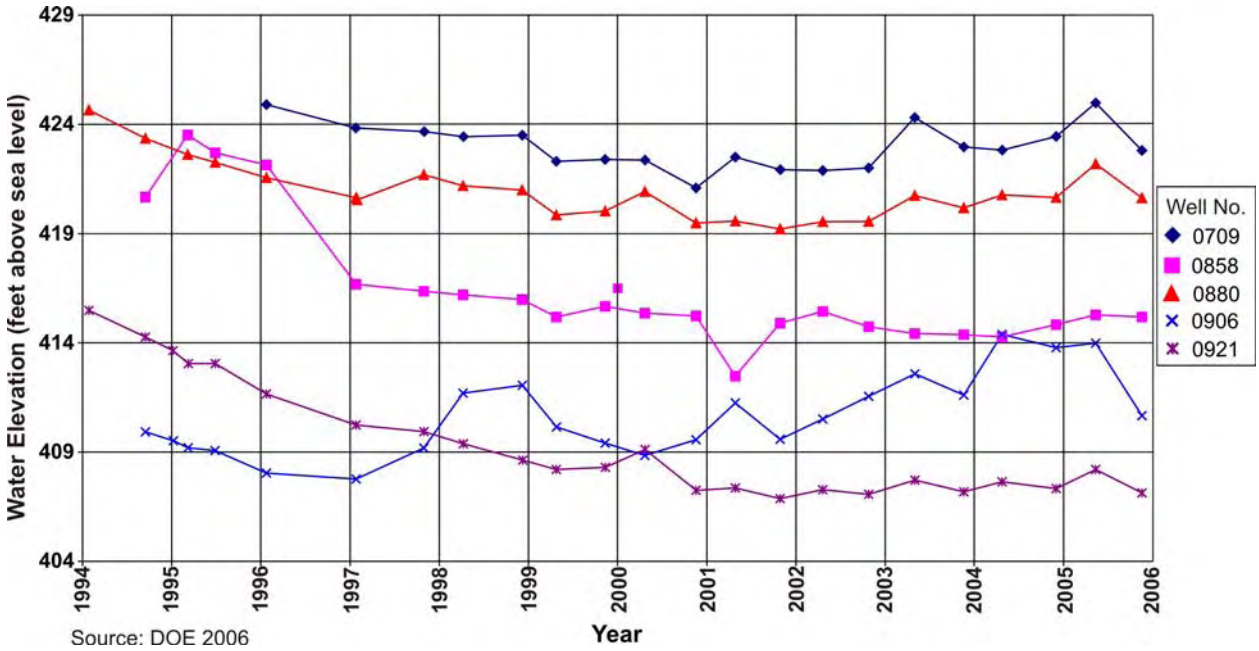

Figure 2–6. Static Ground Water Levels Near the Falls City, Texas, Disposal Site

DOE has monitored the ground water from 10 monitor wells at the Falls City disposal site as specified in the LTSP (DOE 1997b) and GCAP (DOE 1998). Ground water monitoring data are available in the DOE–LM SEEPro database, and analyses of results from the November 2005 sampling event are available in the Data Validation Package (DOE 2006). A summary of ground water quality measurements is presented in this section.

Background Ground Water Quality—The Deweesville/Conquista aquifer was unsaturated beneath the site before mining and milling activities began. Consequently, background ground water quality information for the former Falls City millsite does not exist (DOE 1997a). DOE obtained representative background ground water quality information from an area of the Deweesville/Conquista aquifer near Hobson, a small town about 3.5 miles south of Falls City, in an area removed from the effects of uranium-ore processing (DOE 1997a).

Ground water quality varies within the Deweesville/Conquista and Dilworth aquifers in the vicinity of the disposal site depending on oxidation state and length of time the ground water has been in contact with aquifer materials. The ground water chemistry in each permeable zone is distinct. Oxidizing conditions exist within the permeable zones beneath the millsite, and conditions become more reducing downdip. Table 2–3 shows typical water compositions for the various zones, determined during remedial action.

Ground Water Contamination—Ground water monitoring has identified milling-related contamination in the Deweesville/Conquista and Dilworth aquifers. Hazardous constituents in ground water that were derived from uranium milling operations at the Falls City site include arsenic, cadmium, molybdenum, radium, selenium, and uranium. These constituents have been detected at concentrations that exceed EPA maximum concentration limits in 40 CFR 192. In both aquifers, contamination in ground water generally coincides with pH values that are lower than typical background values. Typically, pH values for the tailings pore fluids were

approximately 3.0 standard units, and pH values in affected ground water in the Deweesville/Conquista and Dilworth aquifers range from 3.5 to 6.3 and 5.5 to 7.0 standard units, respectively. Because ground water pH initially has been shown to influence contaminant fate and transport, pH changes have been monitored as an indicator of ground water quality. The Deweesville/Conquista and Dilworth aquifers naturally buffer the low pH as ground water moves downgradient (DOE 1997a).

Table 2–3. Typical Background Water Quality Data for the Deweesville/Conquista and Dilworth Aquifers

Constituent	Tailings Fluid	Reduced Zone		Transitional Zone		Oxidized Zone (outcrop area)		
	0607[a]	0667	0668	0951	0969	0967	0968	0979
Alkalinity[b]	–	252	250	307	291	116	226	193
Calcium	510	335	405	364	495	278	90	258
Chloride	1,040	785	944	708	779	793	338	672
Iron	544	0.45	0.19	0.03	0.87	< 0.03	< 0.03	< 0.03
Magnesium	214	31.8	45.1	29	61	30.5	8.1	28.3
Manganese	22.6	0.21	0.78	0.21	2.94	0.02	< 0.01	0.07
Nitrate	< 1.0	4.9	3.5	4	1.3	10.2	12.4	4.4
pH	2.93	6.65	6.63	6.75	6.70	5.98	6.58	6.08
Potassium	2.38	43	29	45	43	30	18	36
Sodium	832	678	583	652	550	675	121	531
Sulfate	7,390	1,043	930	856	1,290	817	156	569
TDS[c]	11,900	3,120	3,310	2,291	3,650	2,750	6,224	2,210
Uranium	0.908	0.015	0.017	0.008	0.010	0.003	0.068	0.25

Notes: All concentrations are in milligrams per liter except pH.
Wells 0951, 0667, and 0668 are completed in the Deweesville/Conquista aquifer. Wells 0967, 0968, 0969, and 0979 are completed in the Dilworth aquifer.
Analytical results are from the June/July 1991 sampling.
Source: DOE 1997a.

[a]These are monitor well identifiers.
[b]Reported as milligrams per liter $CaCO_3$
[c]Total dissolved solids

Two areas have been identified in the Deweesville/Conquista aquifer on the basis of pH values that are lower than pH values in portions of the aquifer that were not affected by ore-processing activities. These areas are defined by the pH isopleths in Figure 2–7. The source appears to be the open pit mining operations that occurred on Parcels A and B and the processing solutions pumped to the pits and piles on Parcel A. One area has been delineated in the Dilworth aquifer beneath Parcel B (see Figure 2–8). Tailings pore fluids were also generally lower in pH than background ground water and are essentially indistinguishable from processing-related contamination.

Contaminant mobility generally increases as pH decreases. Recent pH values for ground water in all monitor wells were generally consistent with historical data, although slight increases were observed at some locations. Increasing pH most likely reflects equilibrating ground water chemistry as potentiometric surfaces adjust to elimination of some sources of recharge.

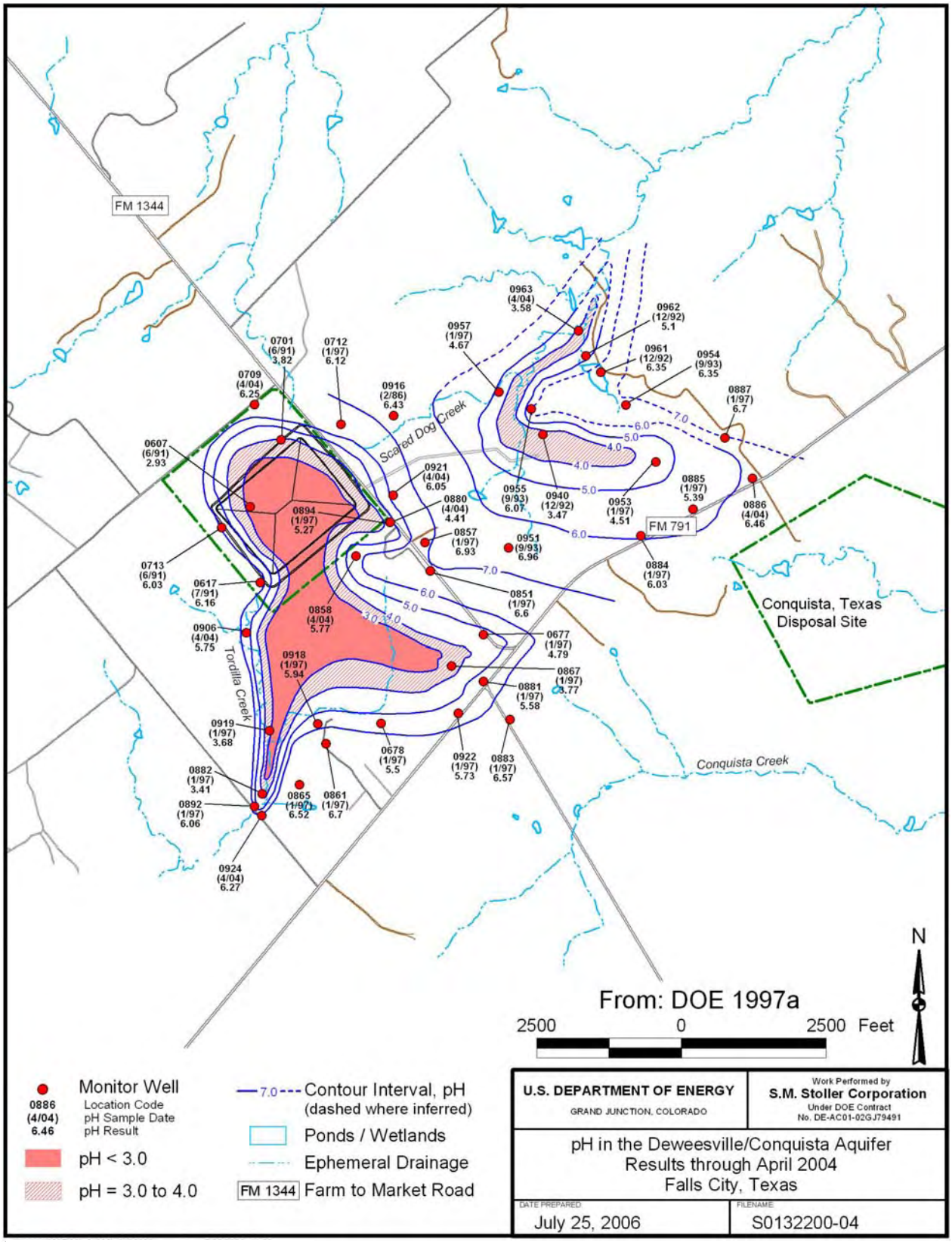

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Figure 2–7. Ground Water pH in the Deweesville/Conquista Aquifer

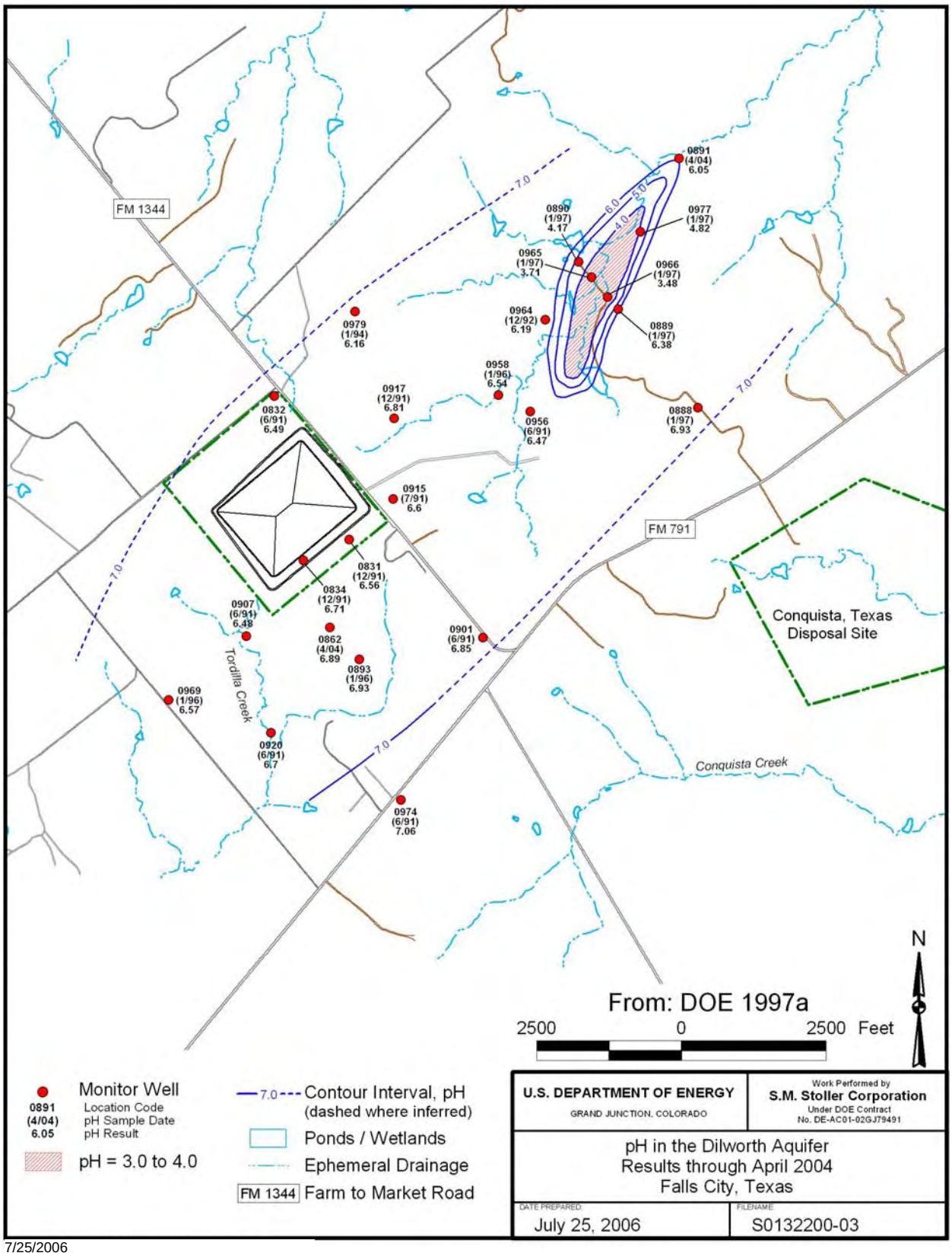

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Figure 2–8. Ground Water pH in the Dilworth Aquifer

Monitoring results indicate that pH is not necessarily an indicator of contaminant concentrations. For instance, at monitor well 0880, cadmium, radium, and gross alpha levels have historically been higher, and pH has generally been lower, than at the other wells in the monitoring network. Uranium concentration in monitor well 0880 has increased in recent years and is now decreasing; concentrations in the May 2005 and November 2005 samples were 9.2 and 8.5 milligrams per liter (mg/L), respectively. The overall increase in uranium in ground water at well 0880 may be an indication of seepage from the disposal cell, which might be expected since some of the tailings material was not completely dry at the time of disposal. However, the Remedial Action Plan (DOE 1992) states that "the distribution of other hazardous constituents…shows isolated points of elevated concentrations…[that] are contributed by the natural redistribution of mineralization rather than tailings seepage." These trends have persisted since before 1994 when the disposal cell was completed, and ground water at other monitor wells nearby does not show similarly elevated concentrations of analytes. Subsequent statistical analysis has indicated only moderate correlation between pH and uranium concentration in the affected portions of the uppermost aquifer beneath the Falls City site.

Uranium concentrations in ground water near the former tailings piles (several of which were located in the former open pit mines) were, in places, an order of magnitude higher than uranium concentrations in the tailings pore fluids from those piles, indicating that the source included remnant uranium mineralization at the site and was not solely related to ore-processing operations.

Health Risk—Ground water in the Deweesville/Conquista and Dilworth aquifers is classified as limited use. This ground water is unsuitable for agricultural or domestic use because of the widespread ambient contamination that results from elevated levels of naturally occurring constituents. Elevated concentrations of arsenic, cadmium, molybdenum, radium, selenium, and uranium are associated with oxidized ore deposits and open pit mining near the site. Ground water in the reduced portion of the Deweesville/Conquista aquifer is in direct contact with regional uranium mineralization and may contain locally elevated concentrations of lead, manganese, radium-226, sulfate, and uranium. Ground water in the Dilworth aquifer typically contains elevated concentrations of arsenic, manganese, and sulfate. These constituents occur naturally in the uppermost aquifer and render the water untreatable by methods used in public water systems in the region.

Currently, ground water from the Deweesville/Conquista aquifer is not used as a source of domestic or drinking water because of low yields (less than 150 gallons per day) and poor quality (total dissolved solids range from 7,000 to 9,000 mg/L in the vicinity of the disposal cell). Ground water from the Dilworth aquifer is not used as a source of domestic or drinking water within 2 miles of the site (DOE 1998). Because the ground water from the shallow aquifers is not used, ground water contamination does not pose an unacceptable risk to human health and the environment.

Potable (domestic) water is produced locally from the Carrizo Sandstone that lies 2,000 ft below the surface in the vicinity of the disposal site.

2.6 Surface Water

The Falls City site is situated on a drainage divide. There is no catchment above the site, so flooding is not a credible risk.

Two ephemeral drainages, Tordilla Creek and Scared Dog Creek, originate on the site. Runoff from the northern half of the site flows toward Scared Dog Creek, a minor headwater tributary to the San Antonio River many miles to the northeast. Runoff from the southern half of the site flows toward Tordilla Creek, a tributary to the Nueces River. Both San Antonio and Nueces Rivers eventually flow into the Gulf of Mexico.

Although both Scared Dog and Tordilla Creeks receive base flow from ground water, water chemistry data indicate that the surface water in the creeks is unaffected by regional ground water contamination.

There are no significant lakes or ponds near the site. There is a permanent fish pond on a farm about 0.6 mile south of the site. The pond is on the south side of a small tributary to Tordilla Creek and topographically above that tributary. This tributary lies between the disposal site and the farm (Figure 2−5).

End of current text

3.0 Long-Term Surveillance

3.1 General License for Long-Term Custody

With NRC concurrence in the original LTSP (DOE 1997b and Appendix A), the Falls City site was included under the general license for long-term custody established at 10 CFR 40.27(b).

Although sites remediated under UMTRCA are designed and constructed to last "for up to 1,000 years, to the extent reasonably achievable, and, in any case, for at least 200 years" (40 CFR 192, Subpart A, 192.02 [a]), there is no provision for the termination of the general license or DOE's responsibility for the long-term custody of these sites (10 CFR 40.27[b]).

An LTSP is a requirement of the general license. When DOE determines that revision of the LTSP is necessary, DOE will notify NRC. Changes to the LTSP may not conflict with the requirements of the general license (Section 3.2).

In addition, DOE must guarantee NRC permanent right-of-entry to the site so that NRC may conduct site inspections. The Falls City site is easily accessible from FM-1344, a public right-of-way (Section 2.3.2).

3.2 Requirements of the General License

Requirements of the general license are at 10 CFR 40.27 and 10 CFR 40, Appendix A, Criterion 12. Table 3–1 lists the requirements of the general license and the sections in this LTSP where each is addressed.

Table 3–1. Requirements of the General License and DOE Response

Requirement	This Revised LTSP
1. Annual site inspection	Section 3.3
2. Annual inspection report	Section 3.3.5
3. Follow-up inspections and follow-up inspection reports, as necessary	Section 3.4
4. Site maintenance, as necessary	Section 3.5
5. Emergency measures in the event of catastrophe	Section 3.6
6. Environmental monitoring, if required.	Section 3.7

3.3 Annual Site Inspections

3.3.1 Frequency of Inspections

At a minimum, sites must be inspected annually to confirm the integrity of visible features at the site and to determine the need, if any, for maintenance, additional inspections, or monitoring (10 CFR 40, Appendix A, Criterion 12).

To meet the inspection requirement, DOE will inspect the site once each calendar year. The date of the inspection may vary from year to year, but DOE will endeavor to inspect the site once every 12 months unless circumstances warrant variance. The variance will be explained in the inspection report. DOE will notify NRC of the annual inspection at least 30 days in advance.

3.3.2 Inspection Procedure

To ensure a thorough and uniform inspection, the site is divided into areas called transects (Table 3−2).

Table 3–2. Transects for the Annual Inspection of the Falls City, Texas, Disposal Site

Transect	Description
Disposal Cell	Top, side slopes, and apron of the disposal cell, apron outfall, and rock drains
Site Perimeter	Area between the disposal cell and boundary of the site, including the boundary fence
Outlying Area	Area within 0.25 mile of the site

Each transect inside the site is visually inspected by walking a series of random traverses across each transect so that the entire transect surface is inspected. Within each transect, inspectors examine specific site surveillance features, such as survey and boundary monuments, signs, site markers, rock drains, and other features listed in Sections 2.3.5 and 3.3.3 and on the Inspection Checklist (Appendix C).

Inspectors also examine each transect for success of previous maintenance, and for erosion, settling, slumping, plant or animal encroachment, human intrusion or vandalism, and other activity or phenomenon that might affect the safety, integrity, long-term performance, or institutional control of the site.

Inspectors note changes within 0.25 mile of the site. Changes in the surrounding area that might be significant include new development, changes in land use, and erosion or instability of slopes around the site.

Inspectors use photographs and measurements, as necessary, to support or supplement written observations.

3.3.3 Inspection Checklist

Inspectors are briefed, and the inspection checklist is reviewed before the annual inspection. A sample checklist is provided in Appendix C. The actual checklist may vary from year to year, depending on site conditions, and the format for the checklist is not prescribed.

The checklist includes

- Specific site surveillance features to be inspected.
- Routine observations to be made.
- Special issues or problems, if any, to be observed and evaluated.

The checklist is reviewed annually and revised as necessary to reflect changes or new conditions at the site.

3.3.4 Personnel

Typically, two inspectors will perform the annual inspections. Inspectors will be experienced engineers or scientists who have the required knowledge, skills, and abilities to evaluate site conditions and recognize imminent or actual problems.

Inspectors will be assigned for a given inspection of the Falls City Disposal Site on the basis of site conditions and inspector expertise. Areas of expertise include civil, geotechnical, and geological engineering, geology, hydrology, biology, and environmental science (e.g., ecology, soils, or range management). If conditions warrant, more than two inspectors specialized in specific fields may be assigned to the inspection to evaluate serious or unusual problems and make appropriate recommendations.

3.3.5 Annual Inspection Report

DOE will report results of the annual inspection to NRC within 90 days of the last Title I site inspection in the calendar year (10 CFR 40, Appendix A, Criterion 12). If the report cannot be submitted in accordance with 10 CFR 40, DOE will notify NRC. Annual reports are available to the public and other agencies.

3.4 Follow-up Inspections

Follow-up inspections are unscheduled inspections that are conducted in response to threatening or unusual site conditions.

3.4.1 Criteria for Follow-Up Inspections

Criteria for follow-up inspections are at 10 CFR 40.27(b)(4). DOE will conduct a follow-up inspection when:

- A condition is identified during the annual inspection (or other site visit) that requires personnel, perhaps with specific expertise, to return to the site to evaluate the condition; or
- DOE is notified by a citizen or outside agency that conditions at the site are substantially changed.

The public may use the 24-hour DOE telephone number posted prominently on the entrance sign to request information or to report a problem at the site (Section 2.3.5).

Once a new or changed condition is identified, DOE will evaluate the information and determine whether a follow-up inspection is warranted. Conditions that may require a follow-up inspection

include changes in vegetation, erosion, storm damage, wildfires, low-impact human intrusion, minor vandalism, or the need to evaluate, design, or perform maintenance projects. Conditions that threaten the safety of the site or the integrity of the disposal cell may require a more urgent follow-up inspection or emergency response. Slope failure, disastrous storm, major seismic event, and deliberate human intrusion are among these conditions. DOE may request the assistance of local agencies to confirm the seriousness of a condition before conducting a follow-up inspection or emergency response (Section 3.6.3).

DOE will use a graded approach with respect to follow-up inspections. Urgency will be proportional to the potential seriousness of the condition. For example, a follow-up inspection to investigate or control vegetation may be postponed until a particular time during the growing season.

In the event of "unusual damage or disruption" (10 CFR 40, Appendix A, Criterion 12), damage that may compromise or threaten the safety, security, or integrity of the site, DOE will:

- Notify NRC pursuant to 10 CFR 40, Appendix A, Criterion 12, or 10 CFR 40.60, whichever applies;
- Begin the DOE internal occurrence notification process (DOE Order 232.1A);
- Respond with an immediate follow-up inspection or emergency response team; and
- Implement emergency measures, as necessary, to prevent or contain exposure or release of radioactive materials (Section 3.6).

3.4.2 Personnel

DOE will assign inspectors to follow-up inspections on the same basis as the annual site inspection (see Section 3.3.4).

3.4.3 Reports

Results of follow-up inspections for incidents or conditions that do not threaten disposal cell integrity will be included in the annual inspection report to NRC (Section 3.3.5). Separate reports will not be issued unless DOE determines that is it advisable to notify NRC and other agencies of a potentially serious problem at the site.

If follow-up inspections are required for more urgent reasons, DOE will submit a preliminary report of the follow-up inspection to NRC within the 60-day period required by 10 CFR 40, Appendix A, Criterion 12.

3.5 Maintenance

Sites remediated under UMTRCA are designed and constructed so that "ongoing active maintenance is not necessary to preserve isolation" of radioactive material (10 CFR 40, Appendix A, Criterion 12). No "ongoing active" maintenance is required at the Falls City site, although the vegetation requires management, and minor repairs to as-built features are required from time to time.

Vegetation Management—The top of the disposal cell and the area around the disposal cell are covered with dense range grass. The grass is cut two to three times each year, depending on rainfall. The work is performed by a subcontractor, who provides appropriate equipment. The subcontractor cuts and bales the grass, removes the bales, and fertilizes the grass, as necessary. Frequent cutting of the grass reduces the danger of range fire and generally prevents the establishment of deep-rooted, woody species on top of the disposal cell. The minor deep-rooted vegetation that establishes within the grass-covered areas is spot sprayed with herbicide.

Access to the top of the disposal cell for grass cutting operations is at the west corner of the disposal cell where the distance from the bottom of side slope to the top is shortest. DOE installed a ramp constructed of aggregate at this location to prevent displacement of riprap by farming equipment.

Small trees and woody plants tend to propagate in the riprap on the side slopes of the disposal cell. This is a potential concern because tailings extend under the side slopes of the cell where the radon barrier over the tailings is only 24 inches thick. Encroaching species include bee bush, yerba de pasmo, rabbit brush, and mimosa. These plants are cut down, and the cuttings removed as necessary. Cut stumps are treated with herbicide.

Site Features—DOE will maintain site features such as the fence, entrance gate, perimeter, and entrance signs, as required.

Reports—Reports of maintenance during the previous 12 months will be summarized in the annual site inspection report (Section 3.3.5).

3.6 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 (10 CFR 40, Appendix A, Criterion 12).

3.6.1 Criteria for Emergency Response

Conceptually, there is a continuum in the progression from small-scale, minor, routine maintenance (Section 3.4) to large-scale intervention that might include reconstruction of the disposal cell following an unlikely disaster. Although required by 10 CFR 40.27(b)(5), criteria for initiating specific responses to progressively more serious problems are not easily established because the nature of all potential problems is unforeseeable and the threat of those that can be anticipated is highly scale dependent. The information in Table 3−3 is a guide to the actions DOE may make in response to increasingly serious problems.

The table shows that the difference between routine maintenance and different emergency responses is primarily one of risk or urgency. Priorities listed in the table are inversely related to the probability of the problem occurring. The highest priority responses are the least likely to be required.

Table 3–3. Criteria for Emergency Response

Priority	Event	Example	Response
1 Urgent	Breach of containment with release of contaminated materials.	Side slope of disposal cell fails. Radioactive materials are dispersed.	1. Notify NRC. 2. Conduct immediate follow-up inspection by DOE emergency response team. 3. Recover radioactive materials. 4. Repair side slope.
2	Breach of containment without release of contaminated materials.	Side slope of disposal cell fails or is threatened by erosion. Radioactive materials are not dispersed.	1. Notify NRC. 2. Conduct immediate follow-up inspection by DOE emergency response team. 3. Repair side slope.
3	Cover materials no longer meet design objectives.	Riprap deteriorates due to weathering. Grass cover is lost due to fire, climate, pest, or other cause.	1. Perform risk assessment. 2. If risk unacceptable, design for repair. 3. Complete repair.
4	Breach of site security with or without excavation or removal of materials.	Willful human intrusion or significant vandalism.	Restore security. Harden security as necessary.
5 Routine	Minor problems, small-scale changes.	Minor vandalism, fence repairs, undesirable changes in vegetation.	Routine maintenance.

3.6.2 Notification

In accordance with 10 CFR 40.60, DOE will notify the following organization within 4 hours of discovery of a Priority 1 or 2 (or similar) event (Table 3−3):

Fuel Cycle Facilities Branch
Division of Fuel Cycle Safety and Security
Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission
Telephone (301) 816-5100.

3.6.3 Procedure for Emergency Response

In the event of a Priority 1 or 2 event, a DOE emergency response team will assess the damage and decide whether evaluation of the problem is required or if immediate intervention is essential. This decision will be based on the emergency team's evaluation of the adequacy of the damaged feature to perform its intended function.

To make this decision, the emergency response team will evaluate the following:

- Adequacy of the design specifications for the damaged feature to control or accommodate the observed problems;
- Extent of the damage, degradation, or departure from the design (or as-built condition) of the damaged feature; and
- Ability of the feature, in its damaged condition, to withstand a design-basis event.

The evaluation may include assessment of risk. DOE will provide NRC with a clear, technical explanation for its decision to study and evaluate or intervene with additional remedial action (DOE 2000).

3.7 Environmental Monitoring

Environmental monitoring at the Falls City site has consisted of ground water monitoring to assess compliance with two regulations. DOE monitored initial disposal cell performance in accordance with 40 CFR 192.03. DOE also monitored ground water contaminated by historical ore-processing activities to comply with 40 CFR 192, Subpart B, as established in the GCAP (DOE 1998). This revised LTSP combines the requirements of both the initial LTSP (DOE 1997b) and the GCAP. The monitoring program reflects the results of the DOE evaluation of ground water quality data collected from 10 monitor wells at the Falls City site from 1996 through 2005 (Section 2.5.2). The conditions that were found to be protective in the initial LTSP and the GCAP prevail.

DOE has fulfilled the environmental monitoring requirements for disposal cell performance and ground water compliance as specified in the LTSP and the GCAP, respectively. In addition, monitoring results indicate that

- There are no unexpected trends and no indication of unacceptable risk to human health and the environment resulting from historical processing of uranium ore at the site.
- Except for uranium, contaminant concentrations in ground water are stable and no longer require monitoring. Uranium will continue to be present in ground water in varying concentrations where geochemical conditions favor mobilization of this constituent as it is released from naturally occurring uranium minerals in the uppermost aquifer.
- Because of widespread, naturally occurring contaminants, ground water in the uppermost aquifer will never be suitable for agricultural or domestic use.

However, to demonstrate that legacy contamination is not affecting downgradient ground water quality in the uranium milling district (including the Title II sites), DOE will continue monitoring the current network of wells annually during early spring through 2010. DOE will analyze ground water for uranium and field parameters (including pH) and will measure water levels. The two components of the revised monitoring program are described below in more detail. After the 2010 monitoring event, DOE will assess monitoring results and recommend whether to continue, modify, or terminate the monitoring program. DOE will recommend termination of monitoring if monitoring results do not vary significantly from current conditions, or if variances from current conditions can be shown to be attributable to naturally occurring processes in the site ground water systems.

3.7.1 Cell Performance Monitoring

DOE has conducted post-closure monitoring since cell closure in 1994 as a best management practice to assess the initial performance of the disposal cell. This monitoring was conducted to demonstrate that the encapsulation system is preventing ground water degradation by comparing ground water sample results to historical conditions and assessing if differences can be attributed to leachate escaping from the disposal cell.

The 1997 LTSP established a screening monitoring program using pH as the indicator parameter to evaluate disposal cell performance. This program was established because pH was expected to correlate to processing-related contamination. Tailings pore fluids were generally lower in pH than background ground water, and mobility of the contaminants of concern generally increases as pH decreases. The pH values for ground water in all monitor wells were generally consistent with historical data, although slight increases were observed at some locations. Increasing pH does not trigger a disposal cell performance evaluation and most likely reflects equilibrating ground water chemistry and potentiometric surfaces. A follow-on investigation and evaluation of disposal cell performance is triggered by pH results of two successive sampling events that fall below the lower 95th percentile (i.e., 2 standard deviations) of the baseline pH values established shortly after cell closure in 1994.

Using ground water chemistry as an indicator of disposal cell performance is problematic at the Falls City site. A comparison of the chemistry of tailings pore water and ground water suggests that contamination that might leach from the disposal cell, either through transient drainage or percolation of precipitation through the cover, would be chemically similar and most likely indistinguishable from site ground water (DOE 1992). Also, monitoring results demonstrate that pH does not co-vary with uranium levels in a statistically significant manner, as had been postulated in the initial LTSP, and results validate the earlier observation that water quality shows significant local variation (DOE 1992). Therefore, decreasing pH does not indicate that contamination originating within the disposal cell is affecting site ground water. Some analyte concentrations have varied with time (e.g., uranium at monitor well 0880). Water level monitoring has indicated dissipation of the legacy ground water mound, which will cause low-pH legacy contamination to move downgradient. This movement of legacy contamination occurs within the hydrologically active ground water system; in areas where reducing conditions prevail, uranium is removed from the ground water, and uranium minerals form. In oxidized zones, uranium remains in solution.

The disposal cell performance monitoring network consists of seven wells (0709, 0858, 0880, 0906, 0908, 0916, and 0921) surrounding the disposal cell and completed in the Conquista and Deweesville sandstone units, which together constitute the upper water-bearing units of the uppermost aquifer (Figure 2–5 and Table 3–4). Because the disposal cell is located on a ground water divide, ground water generally flows away from the area. Monitor wells 0908 and 0916 are located updip of the intersection of the water table and the bottom of the Deweesville/Conquista aquifer, and are usually dry. The remaining wells are completed in saturated permeable zones that underlie the disposal cell and the areas immediately adjacent. Ground water samples will be collected annually from these seven wells and analyzed for total uranium. Sampling will include field measurements of pH, ground water temperature, conductivity, turbidity, water levels, dissolved oxygen, and oxidation-reduction potential.

Table 3–4. Sample Locations for Disposal Cell Performance Monitoring at the Falls City, Texas, Disposal Site

Location	Hydrologic Relationship	Screened Interval[a]
0709	Conquista Sandstone downgradient from cell	13–33
0858	Conquista Sandstone, downgradient from cell	41–51
0880	Deweesville Sandstone, downgradient from cell	24–34
0906	Conquista Sandstone, downgradient from cell	13–28
0908[b]	Conquista Sandstone, unsaturated zone	38–57
0916[b]	Conquista Sandstone, unsaturated zone	13–33
0921	Conquista Sandstone, downgradient from cell	45–55

[a]Feet below ground surface.
[b]Water level measurement only, unless enough water is present to sample.

3.7.2 Ground Water Compliance Monitoring

As described in Section 2.4.1, ground water in the uppermost aquifer in the vicinity of the Falls City site is not suitable for use for any purpose because of naturally elevated levels of uranium. The compliance strategy for ground water protection at the Falls City site is no further remediation and application of supplemental standards (40 CFR 192.21[g]). This strategy is based on a classification of "limited use ground water," which means ground water that is not a current or potential source of drinking water because of widespread, ambient contamination not due to activities involving residual radioactive materials from a designated processing site (at the Falls City site, natural uranium mineralization and mining activities) exists that cannot be cleaned up using treatment methods reasonably employed in public water systems (40 CFR 192.11[e][2]). NRC and the State of Texas concurred with application of supplemental standards as the ground water compliance strategy for the Falls City site (Appendix A).

Numerical ground water quality standards are not applicable under the supplemental standards compliance strategy approved for the site, and ground water monitoring is not required. Neither compliance concentration limits nor points of compliance have been established. DOE will conduct ground water monitoring of the downgradient limit of the processing-related contamination as a best management practice to verify protection of human health and the environment (DOE 1998). This verification is accomplished by using monitoring results to determine if downgradient users might be at risk if they use the ground water in the Deweesville/Conquista and Dilworth aquifers.

The GCAP required monitoring downgradient of the affected areas of ground water through 2002 as a best management practice to ensure that existing or anticipated beneficial uses of ground water and surface water are not adversely affected (DOE 1996). DOE continued to monitor ground water to demonstrate that legacy ground water contamination is not degrading downgradient ground water. Two areas were identified: (1) east of the site in the Conquista/ Deweesville aquifer and the underlying Dilworth aquifer, and (2) an area underlying the cell and extending to the south in the Conquista/Deweesville aquifer. These areas were delineated where ground water pH dropped below 4.0 (Figures 2–7 and 2–8).

The ground water compliance monitoring network consists of five monitor wells (0862, 0886, 0891, 0924, and 0963) located downgradient from the identified affected areas (Figure 2–7 and Figure 2–8). Sample locations were selected on the basis of ground water flow direction from the

two areas. Ground water samples will be collected annually from these five wells and analyzed for total uranium. Sampling will include field measurements of pH, ground water temperature, conductivity, dissolved oxygen, oxidation-reduction potential, turbidity, and water levels.

Table 3–5. Ground Water Compliance Monitoring Locations at the Falls City Site

Location	Hydrologic Relationship	Screened Interval[a]
862	Dilworth aquifer beneath Parcel A.	120–130
886	Downgradient of the low pH plume in the Deweesville/Conquista aquifer, beneath Parcel B.	19–49
891	Downgradient of the low pH plume in the Dilworth aquifer, beneath Parcel B.	13–23
924	Downgradient of the low pH plume in the Deweesville/Conquista aquifer, south of Parcel A.	19–29
963	Downgradient of the low pH plume in the Deweesville/Conquista aquifer, beneath Parcel B.	8–18

[a]Feet below ground surface.

3.8 Records

DOE–LM maintains active records for the Falls City site that are accessible to the site custodian. These records contain information essential to the long-term care and custody of the site pursuant to applicable laws and regulations. These records include site characterization reports, remedial action plans, National Environmental Policy Act documents, engineering design and construction documents, as-built drawings, results of ground water monitoring, and annual inspection reports. Records are available for public inspection. Selected records are available online at http://lts1.gjo.doe.gov/lm_main.htm.

Records for the Falls City site are maintained in compliance with DOE requirements in DOE Order 200.1, *Information Management Program*, and 36 CFR Parts 1220–1238, "Records Management."

3.9 Quality Assurance

The long-term care of the Falls City site and all activities related to the annual surveillance, monitoring, and maintenance of the site comply with DOE Order 414.1C, *Quality Assurance*, and ANSI/ASQ E4-2004, *Quality Systems for Environmental Data and Technology Programs: Requirements with Guidance for Use* (American Society for Quality 2004).

Quality assurance requirements are transmitted to subcontractors through procurement documents when appropriate.

3.10 Health and Safety

Long-Term Surveillance and Maintenance activities are conducted in accordance with health and safety procedures established for DOE–LM and are consistent with DOE orders, regulations, codes, and standards.

Health and safety concerns specific to work at the Falls City site are in the *U.S. Department of Energy Office of Legacy Management Project Safety Plan* (DOE current version). This plan contains a list of emergency telephone numbers and addresses for local fire, hospital, ambulance, and police or sheriff agencies, as well as a map to the nearest emergency medical facility. Personnel are briefed on health and safety requirements before each annual inspection or site visit and carry a copy of the project safety plan.

DOE maintenance subcontractors are advised of health and safety requirements through appropriate procurement documents. Subcontractors are required to have a health and safety plan that complies with Occupational Safety and Health Administration requirements and the project safety plan. A Job Safety Analysis that addresses work-place hazards and mitigation measures will be developed by the subcontractor and will be subject to DOE approval.

End of current text

4.0 References

10 CFR 40.27. U.S. Nuclear Regulatory Commission, "General License for Custody and Long-Term Care of Residual Radioactive Material Disposal Sites," *Code of Federal Regulations,* January 1, 2006.

10 CFR 40, Appendix A, Criterion 12. U.S. Nuclear Regulatory Commission, "Long-Term Site Surveillance," *Code of Federal Regulations,* January 1, 2006.

10 CFR 40.60. U.S. Nuclear Regulatory Commission, "Domestic Licensing of Source Material: Reporting Requirements," *Code of Federal Regulations,* January 1, 2006.

36 CFR 1220–1238, Chapter 12, Subchapter B. National Archives and Records Administration, "Records Management," *Code of Federal Regulations,* July 1, 2005.

40 CFR 192.04. U.S. Environmental Protection Agency, "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings," Table 1 to Subpart A, "Maximum Concentration of Constituents for Groundwater Protection," *Code of Federal Regulations,* July 1, 2005.

42 U.S.C. 7901 et seq., as amended. Uranium Mill Tailings Radiation Control Act of 1978, *United States Code*.

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DOE (U.S. Department of Energy), 1997b. *Long-Term Surveillance Plan for the Falls City Disposal Site, Falls City, Texas*, DOE/AL/62350-187, Rev. 3, Albuquerque Operations Office, Albuquerque, New Mexico, July.

DOE (U.S. Department of Energy), 1998. Ground Water Compliance Action Plan (GCAP), *Subpart B, Ground Water Compliance Modification to the Remedial Action Plan of the Inactive Uranium Mill Tailings Site at Falls City, Texas*, letter report from D.R. Metzler, DOE-Grand Junction, to J.J. Holonich, NRC, Washington D.C., U.S. Department of Energy, Grand Junction Office, Grand Junction, Colorado, April 13.

DOE (U.S. Department of Energy), 2000. *Guidance for Implementing the Long-Term Surveillance Program for UMTRCA Title I and Title II Disposal Sites* (draft), U.S. Department of Energy, Grand Junction Office, Grand Junction, Colorado.

DOE (U.S. Department of Energy), 2006. Data Validation Package, November 2005 Falls City, Texas, Disposal Site, DOE-LM/GJ1124-2006, Office of Legacy Management, Grand Junction, Colorado, February.

Ford, Bacon & Davis Utah, Inc., 1981. *Engineering Assessment of Inactive Uranium Mill Tailings, Falls City Site, Falls City, Texas*, DOE/UMT-0111, Salt Lake City, Utah, October.

University of Texas, undated. "South Central Texas Earthquakes of Magnitude 3 or Greater," University of Texas Institute for Geophysics. Accessed June 7, 2006, on the Internet at http://www.ig.utexas.edu/research/projects/eq/compendium/DEM_s_central.htm.

Appendixes for the Long-Term Surveillance Plan for the Falls City, TX, Disposal Site can be accessed by selecting the links on the Contents page.