Appendix D

NRC Technical Evaluation Report on Revised LTSP

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

February 28, 2008

Ms. Jalena Maestas
Civil Engineer/Project Manager
US Department of Energy
2597 B¾ Road
Grand Junction, CO 81503

SUBJECT: REVIEW OF DRAFT REVISED LONG-TERM SURVEILLANCE PLAN FOR THE U.S. DEPARTMENT OF ENERGY FALLS CITY URANIUM MILL TAILINGS DISPOSAL SITE, FALLS CITY, TEXAS

Dear Ms. Maestas:

The U.S. Nuclear Regulatory Commission (NRC) has completed its review of the U.S. Department of Energy's *Draft Revised Long-Term Surveillance Plan (LTSP) for the U.S. Department of Energy Uranium Mill Tailings Disposal Site at Falls City, Texas* (January 2007). NRC staff has determined that the changes in the revised LTSP, including modification to the environmental monitoring program are appropriate. The enclosed Technical Evaluation Report contains a detailed discussion of the NRC's findings.

Please provide us with a copy of the revised LTSP when it is finalized. If you have any questions regarding this letter, please contact me at (301) 415-0724 or, by e-mail, at DTM1@nrc.gov.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records component of NRC's Agencywide Documents Access and Management System (ADAMS). ADAMS is accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html.

Sincerely,

Douglas Mandeville

Douglas Mandeville, Geotechnical Engineer
Uranium Recovery Branch
Decommissioning and Uranium Recovery
Licensing Directorate
Division of Waste Management
and Environmental Protection
Office of Federal and State Materials
and Environmental Management Programs

Docket No.: WM-65

Enclosure:
Technical Evaluation Report

copy to Jalena

FCT 505.15 (Roberts)

TECHNICAL EVALUATION REPORT
DRAFT REVISED LONG -TERM SURVEILLANCE PLAN
FOR THE U.S. DEPARTMENT OF ENERGY
FALLS CITY URANIUM MILL TAILINGS DISPOSAL SITE,
FALLS CITY, TEXAS

DATE: February 15, 2008

FACILITY: Falls City Uranium Mill Tailings Disposal Site, Falls City, Texas

TECHNICAL REVIEWER: Jon Peckenpaugh

PROJECT MANAGER: Paul Michalak

SUMMARY AND RECOMMENDATIONS

The U.S. Department of Energy (DOE) Office of Legacy Management submitted by letter dated January 23, 2007, a request for review and concurrence of a *Draft Revised Long-Term Surveillance Plan for the U.S. Department of Energy Falls City Uranium Mill Tailings Disposal Site, Falls City, Texas.* Based upon U.S. Nuclear Regulatory Commission (NRC) staff's review of this and supporting documents, the NRC concurs with the following DOE proposed revisions:

- The disposal cell performance monitoring of the ground water will be reduced from biannual to annual for the existing monitoring wells.
- The revised plan will incorporate requirements of the Ground Water Compliance Action Plan. Monitoring wells are sampled annually, which does not change from the current Long-Term Surveillance Plan (LTSP).
- The constituents analyzed for the monitoring wells in the disposal cell performance and in the Ground Water Compliance Action Plan monitoring will be reduced to total uranium and the field parameters.

In addition, the NRC staff has noted that Well 0891, located approximately 1.7 miles northeast of the Falls City Uranium Mill Tailings Disposal Site (the Site), has exhibited a significant increase in uranium ranging from 0.05 to 0.45 mg/L between May 2005 to May 2006. For the most recent sampling event (October 2007), the Well 0891 uranium concentration was 0.033 mg/L (slightly above U.S. Environmental Protection Agency's (EPA's) uranium drinking water standard of 0.03 mg/L). NRC staff acknowledges that Well 0891 is located within the Dilworth aquifer, which has a Class III designation in the vicinity of the Site (no current or potential ground water use due to widespread ambient contamination). However, Well 0891 is the furthest outlying well in the Falls City ground water compliance network. As a result, NRC staff believes DOE should continue to monitor uranium trends in Well 0891.

SITE HISTORY

The Site is located at a former uranium-ore processing facility in Karnes County, Texas, approximately 8 miles southwest of Falls City. Uranium deposits were discovered in the Eocene sedimentary rocks beneath the Site and surrounding area in the 1950s. Susquehanna Western Incorporated (SWI) started pit mining in this area in 1959. SWI built and operated a mill at this

Enclosure

site between 1961 and 1973. The mill used a sulfuric acid leach process to extract about 700 tons of uranium oxide (U_3O_8) from ore that averaged 0.16 percent U_3O_8. The milling operation generated more than 3.1 million tons of tailings that were deposited in three settling ponds and four former pit mines. The ponds/pits were 30 to 35 feet deep and unlined except for clay-rich horizons in the strata underlying the ore deposits (DOE, 2006a).

In 1975, SWI sold the mill and tailings to Tepcore, Inc., which sold the property to Solution Engineering, Inc. (SEI). Between 1978 and 1982, SEI conducted solution mining to extract uranium and molybdenum from the four former pit mines using injection and recovery wells. In 1982, these operations ceased; and SEI evaporated the active ponds except for Pond 6, which was recharged by natural seepage, filled these evaporation ponds with existing site materials, and re-contoured the tailing piles (ponds). The disturbed areas were covered with 1 to 2 feet of clay-rich soil and planted to native grasses (DOE, 2006a).

The Site was designated for cleanup under Title I of the Uranium Mill Tailings Radiation Control Act (UMTRCA). Remedial actions commenced in 1992 with two parcels of land (Figure 1). Parcel A (473 acres) included the former mill, one mill building, five tailings piles (Piles 1, 2, 4, 5, and 7), and one tailings pond (Pond 6). The Site now occupies the northern part of this parcel. Parcel B (120 acres) was about one mile east of Parcel A, and it enclosed Pile 3. The two parcels were connected by a corridor that contained a slurry line that carried waste materials from Parcel A to Pile 3 in Parcel B while the mill was in operation (DOE, 2006a).

The NRC issued a general license (under provisions in 10 CFR 40.27) to the DOE for long-term custody of the Site after the NRC concurred with the original LTSP in a letter dated July 8, 1997. On September 18, 1998, the NRC concurred with the DOE's Ground Water Compliance Action Plan (GCAP) dated April 8, 1998. The DOE was required to modify the LTSP to include ground water monitoring of an existing plume for 5 years (until 2003) in Wells 0862, 0886, 0891, 0924, and 0963 for the protection of beneficial water use. The NRC staff had decided that the GCAP and the Falls City Remedial Action Plan satisfied requirements set forth in UMTRCA and the regulations of 40 CFR 192, Subparts B and C.

GEOLOGY AND HYDROGEOLOGY

The Site is located within the coastal plain of the Gulf of Mexico. The main topographic element in Karnes County is a series of ridges that are sloping plains (cuestas) formed by resistant southeastward-dipping clastic sedimentary rocks that have northeast to southwest trends. Relief from the ridges to the intervening drainage is usually less than 100 feet. A surface water drainage divide cuts across the Falls City Disposal Cell with drainage to the west and northwest on one side and to the east to southeast on the other side of the divide (DOE, 1997a).

This Site is underlain by unconsolidated sand, silt, and clay sedimentary rocks that gently dip to the southeast, approximately 20 feet per 1,000 feet. The site also rests upon outcrops of the Dubose Clay, Deweesville Sandstone (Deweesville), and Conquista Clay (Conquista) members of the Whitsett formation. Tailings were placed in several old open pits excavated in the uranium ore-bearing Deweesville and Conquista members. Underlying the Conquista is the Dilworth Sandstone (Dilworth) member, which overlies the Manning Clay formation (DOE, 1997a).

The shallow ground water at the Site is found 5 to 30 feet below the land surface within the water-bearing units of the Deweesville and Conquista members. These adjacent water-bearing units are referred as one aquifer that is under unconfined conditions in the northern and western portions of the Site. Near the disposal cell this aquifer has been saturated primarily by the uranium mining and milling activities, including past uranium mining boreholes that may not have been properly abandoned in these units. In addition, the uranium mineralization associated with the uranium ore bodies has caused background water quality in these units to vary with depth and location. Due to the fact that the former tailing piles were located on the up dip surface of the Deweesville and the upper Conquista outcrops, it is not possible to install upgradient, background monitor wells screened in this aquifer (DOE, 1997a).

Both the Deweesville and Conquista aquifer and the underlying Dilworth water-bearing unit (aquifer) are low-yield aquifers. Seepage from the tailing disposed in the old pits and on the outcrop of the Deweesville and upper Conquista has resulted in a ground water mound in the Deweesville and Conquista aquifer (DOE, 1997a).

The Dilworth member, which is referred to as the Dilworth aquifer, outcrops north of the Falls City Disposal site. In this area, the Dilworth is recharged from precipitation and the water-bearing portion of this unit is unconfined. To the southeast, the Dilworth aquifer dips below younger rock strata. The depth to ground water in the Dilworth aquifer is approximately 100 feet below the ground level in the disposal cell area. Down dip to the southeast, ground water in the Dilworth aquifer becomes confined by the lower Conquista Clay. The Dilworth aquifer is separated from the Deweesville and Conquista aquifer by 30 to 50 feet of carbonaceous clay of the lower Conquista Clay subunit, which acts as an aquitard to downward seepage (DOE, 1997a).

A downward hydraulic conductivity (K) occurs between the Deweesville and Conquista aquifer and the Dilworth aquifer. The K between the Deweesville and Conquista aquifer and the Dilworth aquifer (determined by aquifer tests and single-packer pressure testing) ranges from 0.5 to 2.6 feet/day (1.8×10^{-4} cm/s) (DOE, 1997a).

Ground water movement occurs among these three water-bearing units because of improper well installation. Mining companies drilled about 370 boreholes in this area that have penetrated the Dilworth, and in some cases these boreholes were improperly abandoned (BEG, 1992). The Texas Bureau of Economic Geology has identified three discrete potentiometric highs as an indication of leakage from the Deweesville and Conquista aquifer into the Dilworth aquifer. These leakages were caused by mining companies exploring for uranium ore. DOE refers to the Deweesville and Conquista aquifer and Dilworth aquifer as the "uppermost aquifer" because of this ground water movement between these units (DOE, 1997a).

The likelihood of leakage of ground water naturally or by man's activities through the uppermost aquifer into the Manning Clay formation below the Dilworth member of the Whitsett formation is low because of the small number of boreholes drilled through these upper units into this lower formation. The Manning Clay formation is a 300 feet thick aquitard of carbonaceous clays and lignite seams (DOE, 1997a).

The ground water in the uppermost aquifer near the Site is unsuitable as a source of drinking water. This has occurred because of widespread contamination from naturally occurring uranium mineralization and degradation caused by uranium exploration and mining not related to onsite uranium-ore processing. For example, the disposal cell is located near former open pit uranium mines in an active geochemical environment (DOE, 2006a). Also, the Deweesville and Conquista aquifer has low yield units with poor quality (the total dissolved solids range from

7,000 to 9,000 mg/L near the disposal cell). The Dilworth aquifer is also a low yield unit where the ground water is not used as a source of domestic or drinking water within 2 miles of the site (DOE, 1998).

SURFACE WATER

The Site is situated on a drainage divide. Two ephemeral streams, Tordilla Creek and Scared Dog Creek originate or head on or near the disposal cell. Runoff from the northern half of the Site flows toward Scared Dog Creek, a tributary of the San Antonio River several miles to the northeast. Runoff from the southern half of the Site flows toward Tordilla Creek, a tributary of the Nueces River. Other small ephemeral streams are near the Site (for example, Conquista Creek); however, there are no significant lakes or ponds near the Site. Figure 1 delineates the location of Scared Dog and Tordilla Creeks within and nearby the Site (DOE, 2006a).

The water quality of Scared Dog and Tordilla Creeks is impacted by base flow from the uppermost aquifer. However, DOE states that the water chemistry of these creeks is unaffected by the regional ground water contamination (DOE, 2006a).

EXISTING LONG-TERM SURVEILLANCE PLAN

The LTSP, as approved in 1997, describes how the DOE will perform long-term care at this Site. The LTSP covers the requirements under 10 CFR 40.27 by addressing the following:

- Final site conditions,
- Legal description of the site,
- Long-term surveillance program,
- Follow-up inspections, and
- Maintenance and other actions (DOE, 2006 and DOE, 1997b).

Only the ground water monitoring program will be addressed in this section. The ground water monitoring program for the LTSP was modified by including the GCAP monitoring approved in 1998 (DOE, 2006a). Thus, the existing LTSP includes the performance cell monitoring and GCAP monitoring of the uppermost aquifer.

Both components of the ground water monitoring are impacted by classification of the ground water in the uppermost aquifer. DOE, NRC, and the State agreed that ground water monitoring for the disposal cell performance and for the GCAP would not be based upon concentration limits. Instead, a narrative supplemental standard was applied to the ground water, which does not include numerical concentrations limits or point of compliance {40 CFR 192.21(g)}. The Class III designation of the ground water results from no current or potential use of ground water in the area as a source of drinking water because it contains widespread ambient contamination that cannot be cleaned up using methods reasonably employed by public water supply systems. Background water quality varies by order of magnitude in the area since the aquifer is in an area of redistribution of uranium mineralization from ore bodies (DOE, 1997b).

DOE states that currently ground water from Deweesville and Conquista aquifer is not used as a source of domestic or drinking water because of low yield and poor water quality (total dissolved solids range from 7,000 to 9,000 mg/L near the disposal cell). Also, ground water from the Dilworth aquifer is not used as a source of domestic or drinking water within 2 miles of the site. This ground water may have been used for stock and to water gardens. For additional information on the ground water classification, consult Appendix A of the draft revision of the LTSP report (DOE, 2006a).

The performance cell monitoring and the GCAP monitoring wells are delineated in Figure 2. The performance cell monitoring network consists of 7 wells (0709, 0858, 0880, 0906, 0908, 0916, and 0921) surrounding the disposal cell and screened in the Deweesville and Conquista aquifer. Monitor wells 0908 and 0916 are located updip of the intersection of the typical water table and the bottom of the Deweesville and Conquista aquifer; therefore, these wells are usually dry. Ground water samples are collected biannually from these wells, and they are analyzed for the analytes listed in Table 1 (DOE, 1997b and DOE, 2006b).

Table 1. Analytes for Disposal Cell Performance and GCAP Monitoring of the Uppermost Aquifer (Based upon Table 5.6 from DOE, 1997b, Table 1 DOE, 2006b, and Attachment 3 from DOE, 2006b)

Analyte	**Analyte**
Field Measurements	Laboratory Measurements
Alkalinity	Gross Beta
Dissolved Oxygen	Iron
Redox Potential	Lead
pH	Magnesium
Specific Conductance	Manganese
Turbidity	Molybdenum
Temperature	Nickel
Laboratory Measurements	Nitrate +Nitrate as N ($NO_3 + NO_2$) - N
Aluminum	Potassium
Ammonia as N (NH_3-N)	Radium-226
Antimony	Radium-228
Arsenic	Selenium
Beryllium	Sodium
Bromide	Sulfate
Cadmium	Sulfide
Calcium	Total Dissolved Solids
Chloride	Thallium
Chromium	Tin
Cobalt	Uranium
Copper	Vanadium
Gross Alpha	Zinc

The ground water compliance network consists of 5 monitor wells (0862, 0886, 0891, 0924, and 0963) located downgradient from the identified affected areas (Figures 3 and 4). Monitoring wells 0886, 0924, and 0963 are screened in the Deweesville and Conquista aquifer, and monitoring wells 0862 and 0891 are screened in the Dilworth aquifer. Ground water samples are collected annually from these wells, and they are analyzed for the analytes in Table 1 (DOE, 1997b and DOE, 2006b).

PROPOSED REVISIONS IN THE LONG-TERM SURVEILLANCE PLAN

The proposed revised Long-Term Surveillance Plan includes the following:

- The disposal cell performance monitoring of the ground water will be reduced from biannual to annual for the existing monitoring wells.
- The revised plan will incorporate requirements of the GCAP. Monitoring wells are sampled annually, which does not change from the current LTSP.
- The constituents analyzed for the monitoring wells in the disposal cell performance and in the GCAP monitoring for the downgradient plumes will be reduced to only total uranium and the field parameters.
- The institutional controls imposed on the former State-owned portion of the processing site are described and included in inspection objectives.

The LTSP will also be revised to make it consistent with the structure and content of current LTSPs.

DOE proposes to continue monitoring the ground water through 2010 at the 12 locations currently sampled as discussed above. After the 2010 monitoring event, DOE plans to assess the monitoring results and recommend whether to continue, modify, or terminate the monitoring program.

EVALUATION AND RECOMMENDATIONS PERTAINING TO THE PROPOSED REVISION TO THE LONG-TERM SURVEILLANCE PLAN

Figures 3 and 4 delineate the pH in the Deweesville and Conquista aquifer and Dilworth aquifer, respectively. The pH isopleths on these figures are surrogates for uranium and some of the other metals listed in Table 1. Figure 3 shows that there are two areas of lower pH, which would represent uranium plumes in the Deweesville and Conquista aquifer. Figure 4 indicates that there is one area of lower pH, which would represent a uranium plume in the Dilworth aquifer.

The results of the analytical analyses and the ground water levels for the disposal cell performance and the ground water compliance monitoring wells are presented in "Data Validation Package" reports. A recent report is the May 2006 report (DOE, 2006b).

An evaluation of the ground water levels for the disposal cell performance and the ground water compliance monitoring wells from 1996 through May 2006 indicates that the water levels for monitoring wells of the disposal cell performance (0709, 0858, 0880, 0906, and 0921) have fluctuated, probability based upon variations in climatic conditions. Also, these ground water levels have an overall decreasing trend which may be caused by dewatering of the disposal cell. However, ground water levels for the ground water compliance monitoring wells (0862, 0886, 0891, 0924, and 0963) have changed very little over this same time period. This may be due to their generally greater distance from the disposal cell and in some cases deeper screened intervals from the land surface.

The NRC concurs with DOE's assessment that the analytical results of the disposal cell performance monitoring wells do not represent a health concern. For most of the wells, the concentrations of metals analyzed in the ground water have changed very little during the 1996 to May 2006 time period. Also uranium concentrations have changed very little for all the wells except for Well 0880 (DOE, 2006b). This well has the largest uranium concentration, and it has also increased from about 3 to 7 mg/L over this time period. This change is not a health concern because ground water in the Deweesville and Conquista aquifer is not used for human or stock use as previously discussed.

The analytical results of the ground water compliance monitoring wells from 1996 through May 2006 indicate that the concentrations of metals in the ground water from these wells have usually changed very little. However, Wells 0924 and 0891, which are screened in the Deweesville and Conquista aquifer and the Dilworth aquifer, respectively, do exhibit changes in gross alpha and uranium. Well 0924 has variable gross alpha values and an overall increasing trend for uranium. These changes are not a health concern because ground water in the Deweesville and Conquista aquifer is not used for human or stock use.

Well 0891 has variable gross alpha values and uranium concentrations with a significant increase in uranium from 0.05 to 0.45 mg/L from May 2005 to May 2006. It should be noted that due to overgrown vegetation, Well 0891 was not identified or sampled during DOE's April 2007 sampling event (Ransbottom, 2007); however, uranium in an October 2007 ground water sample of this well was 0.033 mg/L (Maestas, 2008). The earlier increase in uranium in Well 0891 presents a concern because this well is located along the front of the pH plume, the surrogate uranium plume (Figure 4). As discussed above, ground water from the Dilworth aquifer is not used as a source of domestic or drinking water within 2 miles of the site; however, Well 0891 is located about 1.7 miles from the site. Reportedly, use of the Dilworth aquifer downgradient of Well 0891 is for livestock watering or gardening.

Based upon NRC staff review of the revised draft LTSP and supporting documents, the NRC concurs with the DOE proposed revisions contained in the draft LTSP. In addition, based upon recent uranium concentration trends in Well 0891, the NRC staff believes that the DOE should continue to monitor uranium trends in Well 0891.

REFERENCES

BEG (Bureau of Economic Geology), 1992. Hydrogeology and Hydrochemistry of Falls City Uranium Mine Tailings Remedial Action Project, Karnes County, Texas. The University of Texas at Austin. [ADAMS Legacy Accession No. 9603140087]

DOE (U.S. Department of Energy), 1997a. Final Site Observational Work Plan for the UMTRA Project Site at Falls City, Texas. DOE/AL/62350-157 Rev.1. [ADAMS Legacy Accession No. 9706040234]

DOE (U.S. Department of Energy), 1997b. Long-Term Surveillance Plan for the U.S. Department of Energy Falls City Uranium Mill Tailings Disposal Site, Falls City, Texas. DOE/AL/62350-187, Rev.3. [ADAMS Legacy Accession No. 9704300263]

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Uranium Mill Tailing Sit at Falls City, Texas. Transmitted by letter dated April 8, 1998. [ADAMS Legacy Accession No. 9805220233]

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DOE (U.S. Department of Energy), 2006b. Data Validation package, May 2006 Falls City, Texas, Disposal Site. DOE-LM/1263-2006. [Adams Accession No. ML070710338]

Maestas, Jalena, 2008. E-mail titled "Falls City Well 0891 Results – October 2007." [Adams Accession Number No. ML080520397]

Ransbottom, Robert, 2007. E-mail titled "RE: Falls City Well Sampling." {Adams Accession Number No. ML080520396]

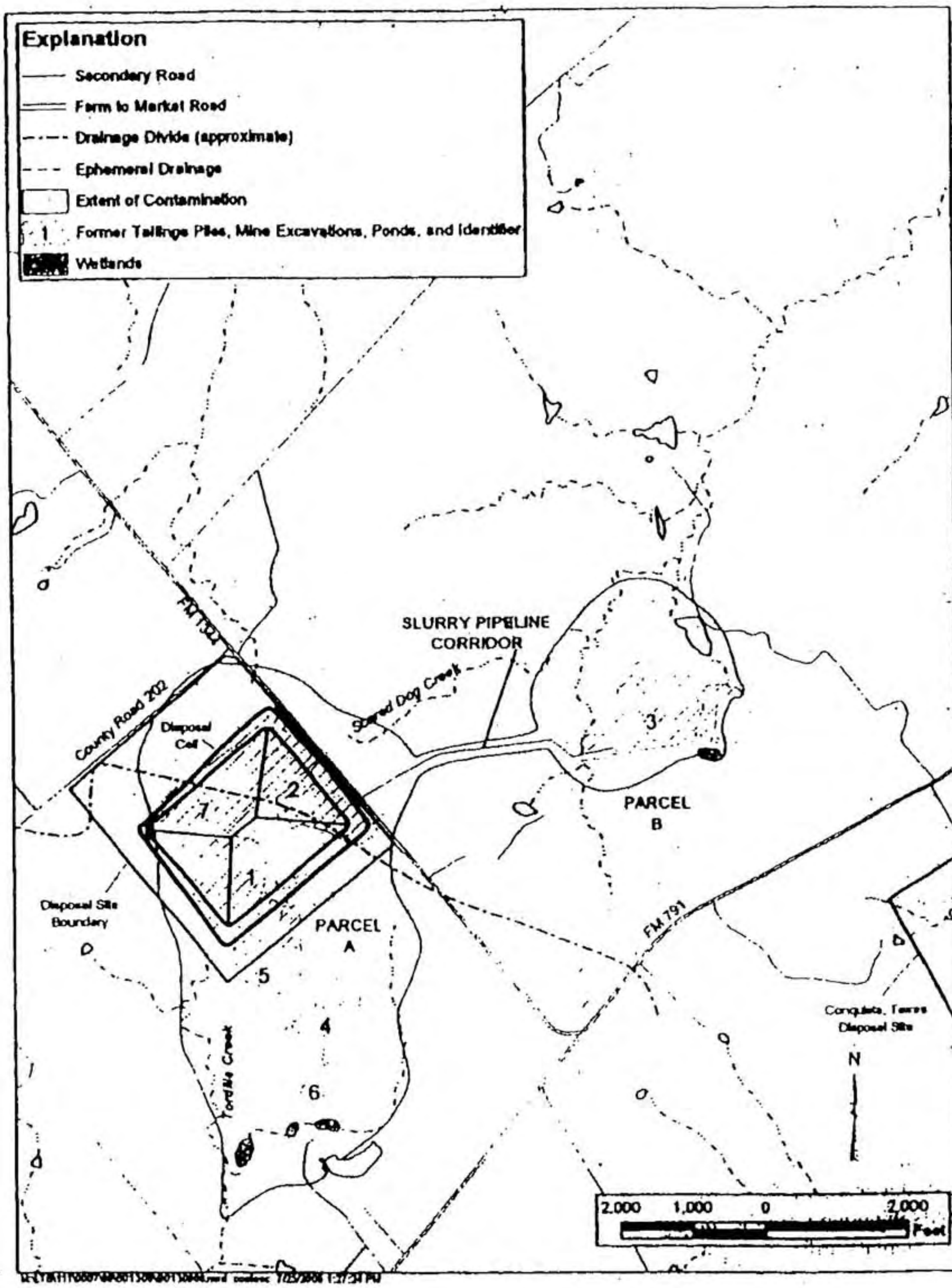

Figure 1. Contaminated Areas at Falls City Disposal Site, Before Remedial Action (Figure 2-1 from DOE, 2006a)

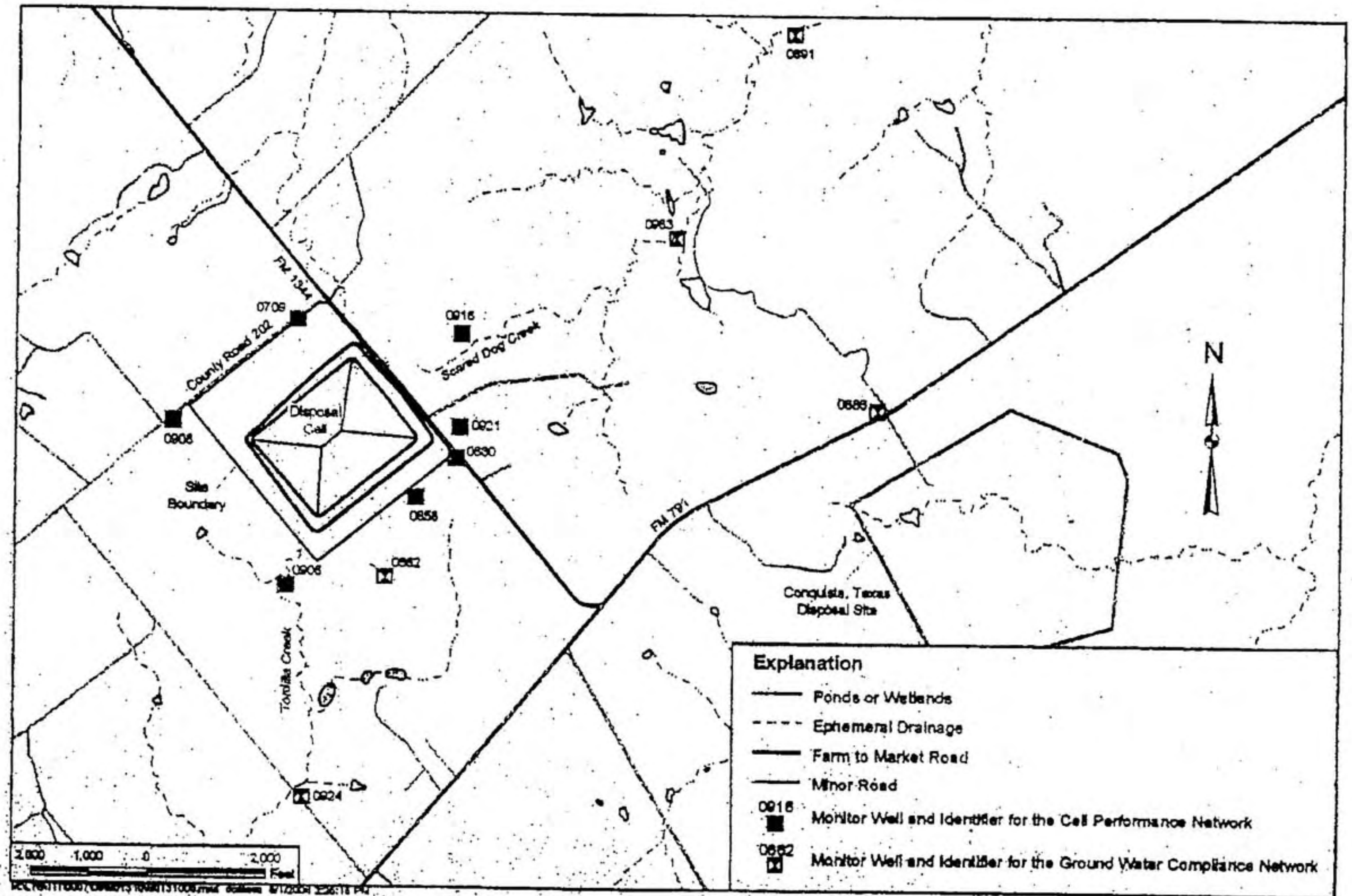

Figure 2. Ground Water Monitor Wells at the Falls City Disposal Site (Figure 2-5 from DOE, 2006a)

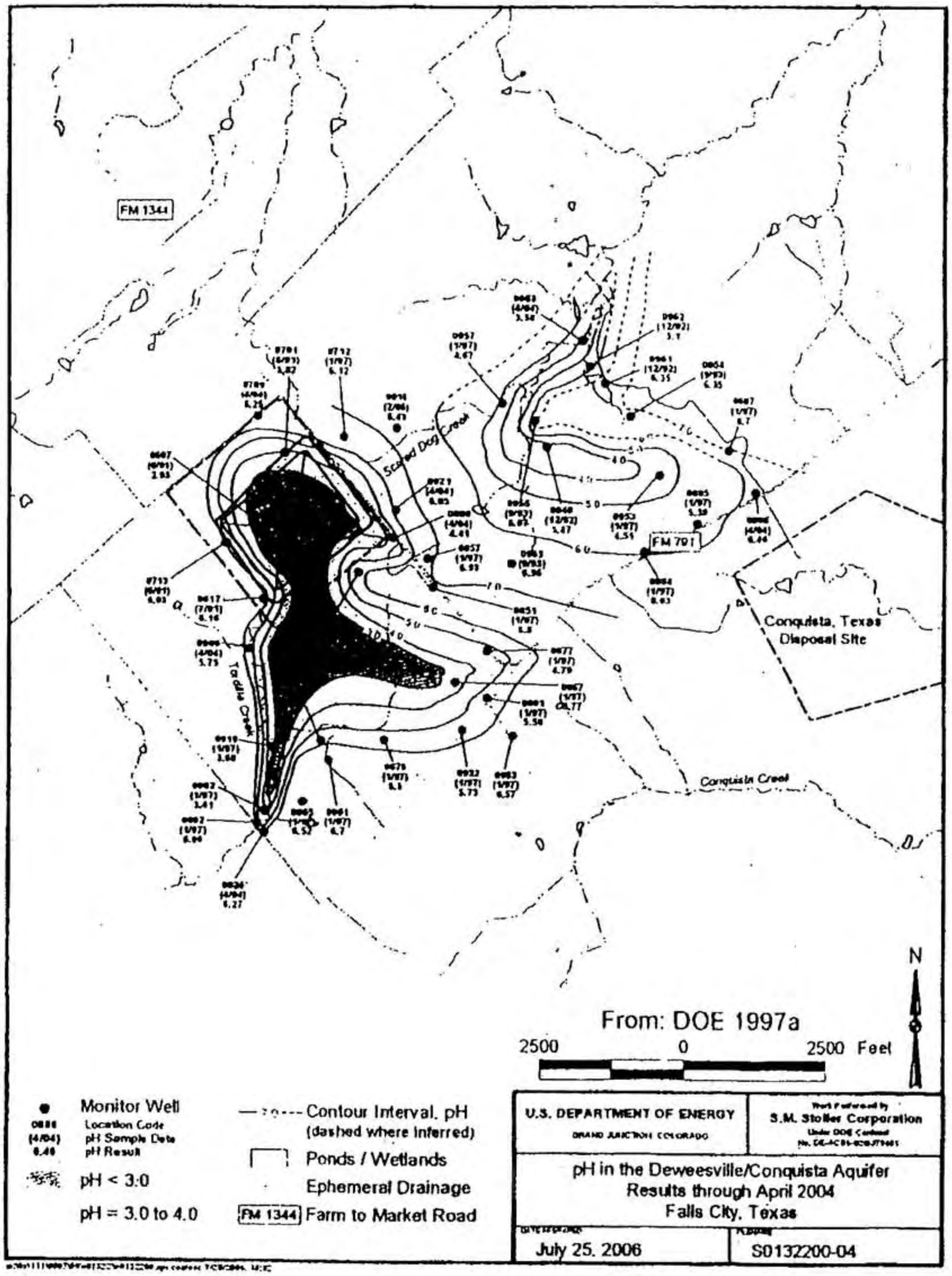

Figure 3. Ground Water pH in the Deweesville and Conquista Aquifer (Figure 2-7 from DOE, 2006a)

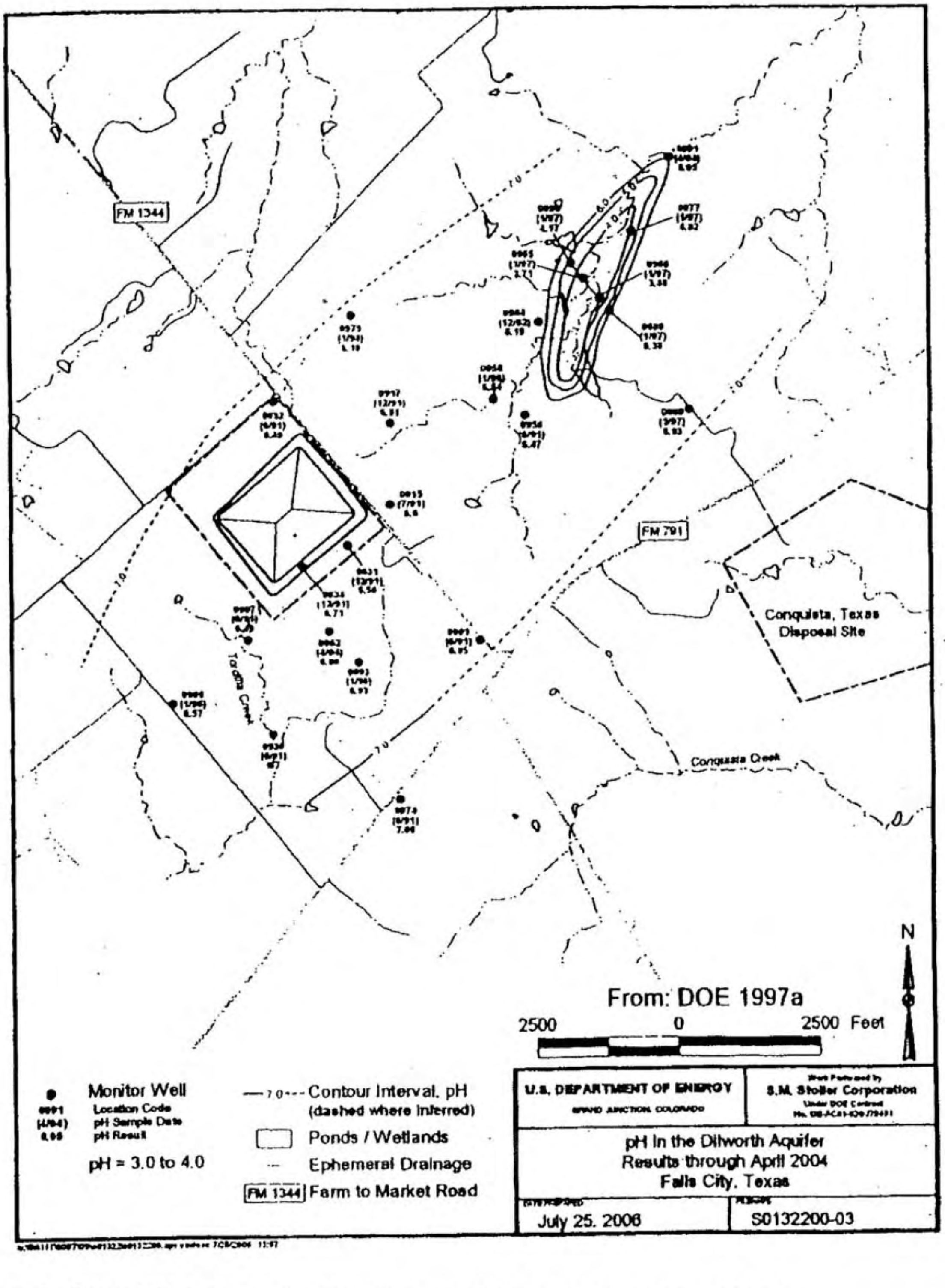

Figure 4. Ground Water pH in the Dilworth Aquifer (Figure 2-8 from DOE, 2006a)

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