LMS/DUD/S06297-0.0

Long-Term Surveillance Plan for the Durango Disposal Site, Durango, Colorado

January 2011

U.S. DEPARTMENT OF ENERGY | Legacy Management

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Appendix A NRC Concurrence and Licensing Documentation
Appendix B Site Ownership/Custody Documentation
Appendix C Inspection Checklist and Photo Log
Appendix D Reuse Potential Impacts Matrix

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Abbreviations

ac	acre
BM	boundary monument(s)
CDPHE	Colorado Department of Public Health and Environment
CFR	*Code of Federal Regulations*
cm	centimeter(s)
DOE	U.S. Department of Energy
EA	Environmental Assessment
EMS	environmental management system
EPA	U.S. Environmental Protection Agency
ft	feet
ha	hectare(s)
km	kilometer(s)
LM	Office of Legacy Management
LTSP	Long-Term Surveillance Plan
m	meter(s)
m^3	cubic meter(s)
MCL	maximum concentration limit
mV	millivolt(s)
NEPA	National Environmental Policy Act
NRC	U.S. Nuclear Regulatory Commission
PMP	probable maximum precipitation
POC	point-of-compliance
POE	point-of-exposure
PRB	permeable reactive barrier
SM	survey monument
SMK	site marker
UMTRCA	Uranium Mill Tailings Radiation Control Act
VCA	Vanadium Corporation of America
yd^3	cubic yard(s)

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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 Durango, Colorado, uranium mill tailings disposal site.

The Durango disposal site was licensed on June 18, 1996. The U.S. Nuclear Regulatory Commission (NRC) concurred with the original LTSP in September 1996 (Appendix A).This revised LTSP incorporates the potential for beneficial reuse of some of the Durango Disposal Site property see Section 4.0 Beneficial Reuse Project for details.

1.2 Legal and Regulatory Requirements

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 the Uranium Mill Tailings Radiation Control Act (UMTRCA) of 1978 (Title 42 *United States Code* §7901 et seq.). 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 and the environment after remediation is completed (Table 1-1). Concurrence from NRC on the remedial action plan was received October 16, 1995 (Appendix A).

Table 1-1. Requirements for the Long-Term Surveillance Plan and the Long-Term Surveillance and Maintenance of the Durango, Colorado, Disposal Site

	Requirements for the LTSP	**Reference**
1.	Final site conditions	Section 2.0
2.	Legal description	Section 2.2.2
3.	Description of the long-term surveillance program	Section 3.0
4.	Criteria for follow-up inspections	Section 3.4.1
5.	Criteria for instituting maintenance or emergency measures	Section 3.5.1
	Requirements for Surveillance and Maintenance	**Reference**
1.	Notification to NRC of changes to the LTSP	Section 1.3
2.	NRC permanent right-of-entry	Section 3.1
3.	Notification to NRC of inspections, significant problems, or actions	Section 3.3–3.4

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 2001). The current version of the guidance document and this LTSP constitute DOE's operational plan for the long-term custody and care of the Durango, Colorado, Disposal Site.

1.3 Role of DOE

In 1988, DOE designated the Grand Junction, Colorado, facility, to be the program office for the long-term surveillance and maintenance of all Uranium Mill Tailings 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. LM assumed the responsibility for long-term surveillance and maintenance of remediated sites and is responsible for implementing and revising this LTSP.

2.0 Final Site Conditions

2.1 Site History

The Durango uranium-ore processing mill was located southwest of the Durango town limits, on the west bank of the Animas River (Figure 2−1), near the south end of a former lead smelter site that operated from 1880 to 1930. In 1942, U.S. Vanadium Corporation leased the property and constructed a vanadium-ore processing mill on the site. This mill operated until 1946, when the mill was shut down. In 1949, Vanadium Corporation of America (VCA) leased and subsequently purchased the processing site. VCA operated a uranium-ore processing mill and sold uranium to the U.S. Atomic Energy Commission until March 1963, when the mill shut down permanently. Ranchers Exploration and Development Corporation (Ranchers) purchased the mill in 1977. Hecla Mining Company acquired Ranchers in July 1984. The Durango mill produced an estimated 1.2 million cubic yards (yd^3) (0.92 million cubic meter [m^3]) of tailings. Other surface contamination included tailings transported to vicinity properties as fill material, contaminated earth, mill debris, slag, and windblown material. In March 1987, DOE initiated remedial action to relocate the approximately 2.5 million yd^3 (1.9 million m^3) of residual radioactive material in the form of tailings piles and contaminated soils from the processing site to the Durango disposal site in the Bodo Canyon area about 2 miles (3.2 kilometers [km]) to the southwest. Relocation of the contaminated material was comp1eted in the fall of 1990.

2.2 Description of the Disposal Site and Vicinity

2.2.1 Site Description

The disposal site comprises 120.6 acres (ac) (48.8 hectares [ha]) in La Plata County, Colorado, approximately 3.5 road miles (5.6 km) southwest of Durango, (Figure 2−2), in the eastern half of Section 36, Township 35 North, Range 10 West, and the western half of Section 31, Township 34½ North, Range 9 West, New Mexico Principal Meridian (Figure 2−2) (DOE 1993).

The disposal site is on a small, upland plateau in the upper west part of the Bodo Canyon area. The Bodo Canyon area is an ephemeral drainage basin of about 4.5 square miles (11.6 square km), bordered by Smelter Mountain on the north, Carbon Mountain on the south, and the Animas River on the east (Figure 2−2). Prior to receiving tailings and contaminated soils from the processing site, the Bodo Canyon area was used as pastureland and wildlife habitat. The land was managed by the U.S. Department of the Interior Bureau of Land Management. No mining, milling, or other industrial activities occurred in the valley before the disposal cell was established.

The disposal site lies at an elevation of approximately 7,100 feet (ft) (2,200 meters [m]) above mean sea level. Area elevations range from 7,725 ft (2,355 m) at the top of Smelter Mountain (approximately 0.85 mile [1.4 km] from the site) to about 6,600 ft (2,000 m) at the mouth of Bodo Canyon. At the north edge of the San Juan Basin, rock formations at the site are in the Mesaverde Group of Late Cretaceous age and dip to the south-southeast. The uppermost bedrock unit beneath the site is the Cliff House Sandstone, which is exposed on the hillside at the east end of the site. The Menefee Formation underlies the Cliff House Sandstone and is exposed only in a small area in the north part of the disposal site. Vegetation in much of the Bodo Canyon area consists of grasses and sagebrush (DOE 1993).

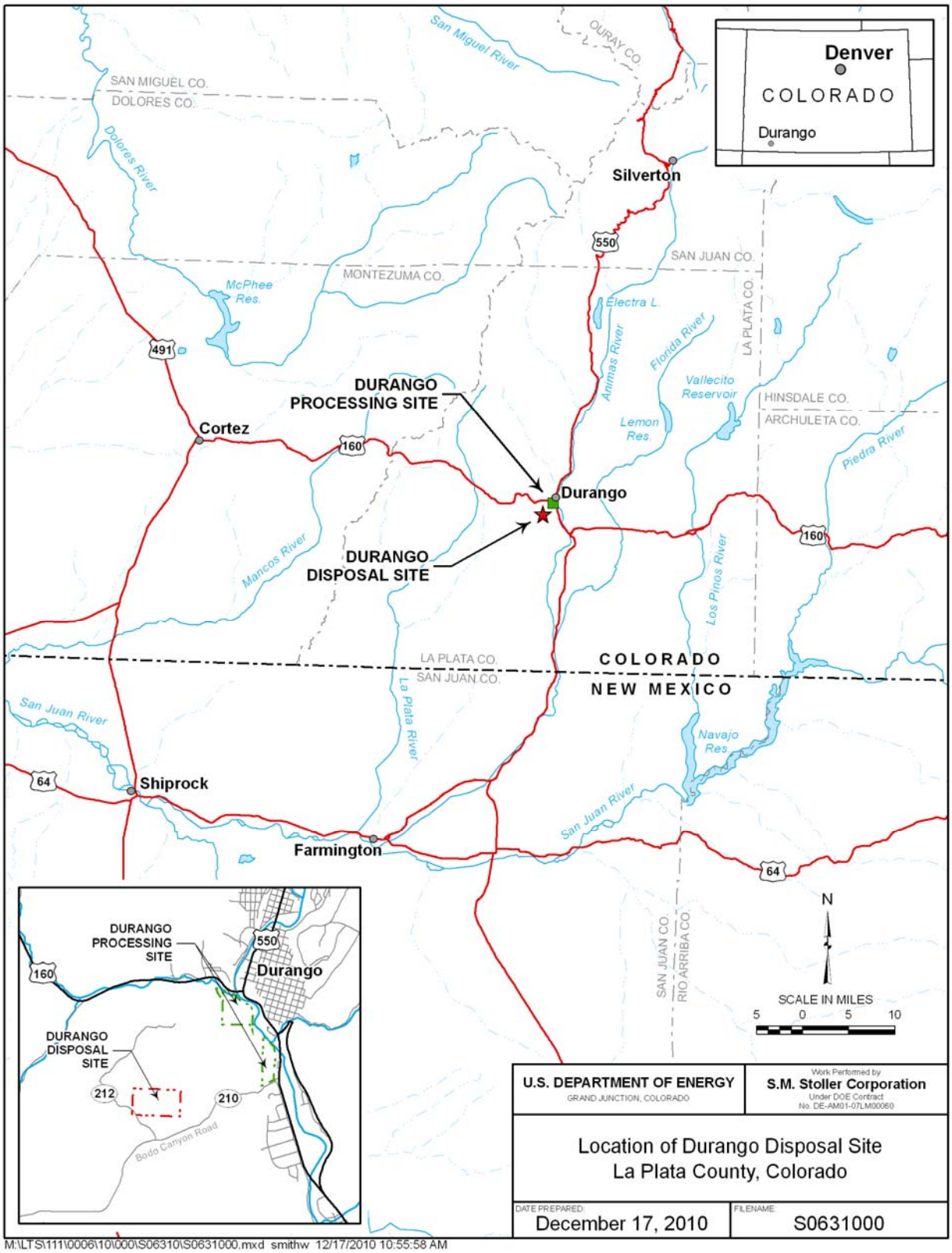

Figure 2−1. Location of the Durango Disposal Site, La Plata County, Colorado

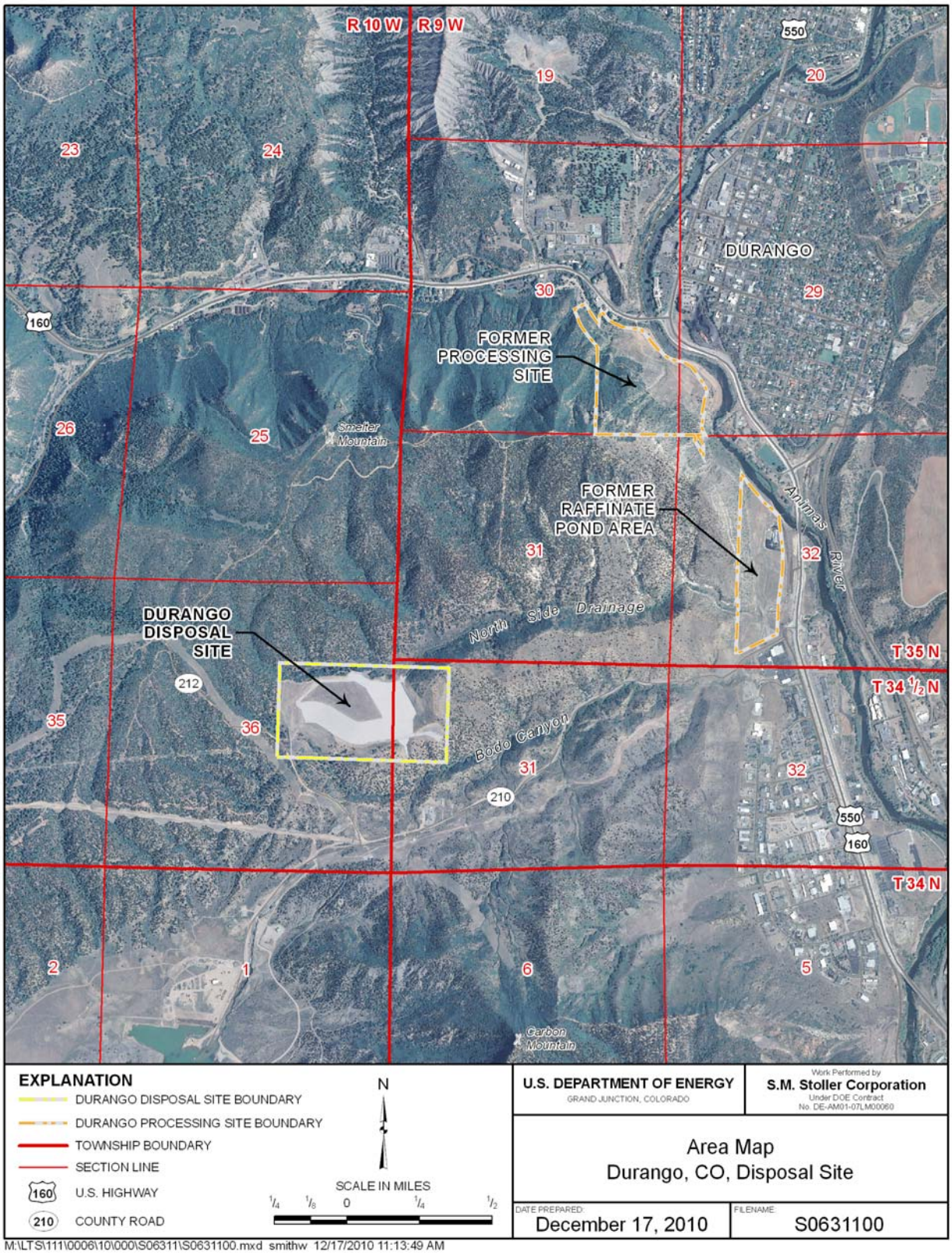

Figure 2−2. Area Map of the Durango, Colorado, Disposal Site

2.2.2 Legal Description

The disposal site consists of 120.6 ac that was acquired in two parcels, which were historically identified as Tracts 101 and 102. Both parcels were acquired by the Colorado Department of Public Health and Environment (CDPHE) and were deeded by quitclaim to the United States of America in August 1996. Tract 101 contains approximately 39 ac, and Tract 102 contains the remaining 81 ac. Appendix B provides copies of the quitclaim deeds and details the legal descriptions for both tracts.

2.2.3 Location and Access

Figure 2−2 is a map of the Durango, Colorado, area. The disposal site can be accessed using the following directions:

1. Where U.S. Highway 160 joins U.S. Highway 550 (US-550/160) just west of downtown Durango, proceed south on US-550/160.

2. Turn west (right) on County Road 210 (CR 210), known as Bodo Canyon Road, which soon becomes a dirt road.

3. Remain on CR 210, heading southwest.

4. An electrical substation is on the right side of the road. Remain on CR 210.

5. Turn northwest (right) onto CR 212. Proceed northwest.

6. Turn north (right) onto the entrance road.

The site entrance gate is at the southwest corner of the site.

2.2.4 Disposal Cell Description

The disposal cell is constructed partially below existing grade. It covers approximately 60 ac (24 ha), with maximum areal dimensions of 2,400 × 1,300 ft (730 × 400 m).

The radon barrier thickness was designed to be conservative, based upon radiological characterization of the contaminated materials obtained prior to and during construction. The radon emanation rate from the completed disposal cell meets the U.S. Environmental Protection Agency's (EPA) standard of 20 picocuries per square meter per second. The tailings were encapsulated with a compacted 2-ft (0.6-m)-thick radon barrier layer of uncontaminated silty clay and clay materials. On the side slope, the upper 18 inches (46 centimeters [cm]) of the radon barrier was amended with 7 percent bentonite to maintain a consistent radon barrier thickness on the top and sides of the cell. Additionally, the radon barrier on the top slope was constructed with a bentonite mat (bentonite sandwiched between two geotextile membranes) on the surface to restrict infiltration into the barrier. The radon barrier is further protected by a 6-inch (15-cm)-thick sand filter/drainage layer on the side slopes and top.

The top slope was completed with a 1.5-ft (0.5-m)-thick biointrusion layer, a 2.5-ft (0.8-m)-thick frost-protection layer of compacted soil, and a 6-inch (15-cm)-thick rock/soil matrix. The matrix has a 1.5 to 2.0 percent grade away from a drainage divide at the center of the cell. The cell top slope is covered with native grasses. The cover system for the embankment top slope is illustrated in Figure 2−3 and Figure 2−4.

The top slope was planted with the following seed mixture:

Smooth brome	4.1 lb/ac (4.6 kg/ha)
Kentucky bluegrass	3.4 lb/ac (3.8 kg/ha)
Western wheatgrass	3.9 lb/ac (4.4 kg/ha)
Blue grama	3.65 lb/ac (4.1 kg/ha)
Galleta	1.95 lb/ac (2.2 kg/ha)
Total	17.0 lb/ac (19.1 kg/ha)

The side slope was completed with a 6-inch (15-cm)-thick bedding layer, a 1.5-ft (0.5-m)-thick frost-protection layer, another 6-inch (15-cm)-thick bedding layer, and a 1.0-ft (0.3-m)-thick riprap layer. The riprap is keyed into the surrounding surface at the toe of the slope to prevent headcutting erosion at the cell boundary.

The drainage features of the embankment and general site grading ensure long-term embankment stability as required in 40 CFR 192.02(b) (Figure 2−5). Runoff from the embankment flows to the apron and then to the adjacent natural ground on the northern slope of the cell. All other side slopes of the cell drain to perimeter catchment ditches that channel the concentrated flows to outfall structures. Ditch No. 1 carries run off from the eastern slope and drains to an outfall structure into the North Side Drainage. Ditch No. 2 carries run off from the southern face of the cell eastward to an outfall structure that drains into Bodo Canyon. Ditch No. 3 captures a smaller drainage from the northwestern and western slopes of the cell and a small upland drainage area. The eastern part of this ditch drains to the North Side Drainage, and the western part drains to the South Side Drainage. The ditches have sufficient depth and rock protection to carry runoff from a probable maximum precipitation (PMP) event. Significant precipitation events can create velocities capable of moving sediment buildup in the ditches. Flows in the North and South Side Drainages off of the cell, produced from a PMP event in the upland drainage area, will not impact the toe of the disposal cell. Flows in both the North Side Drainage and Bodo Canyon go eastward to the Animas River (Figure 2−2).

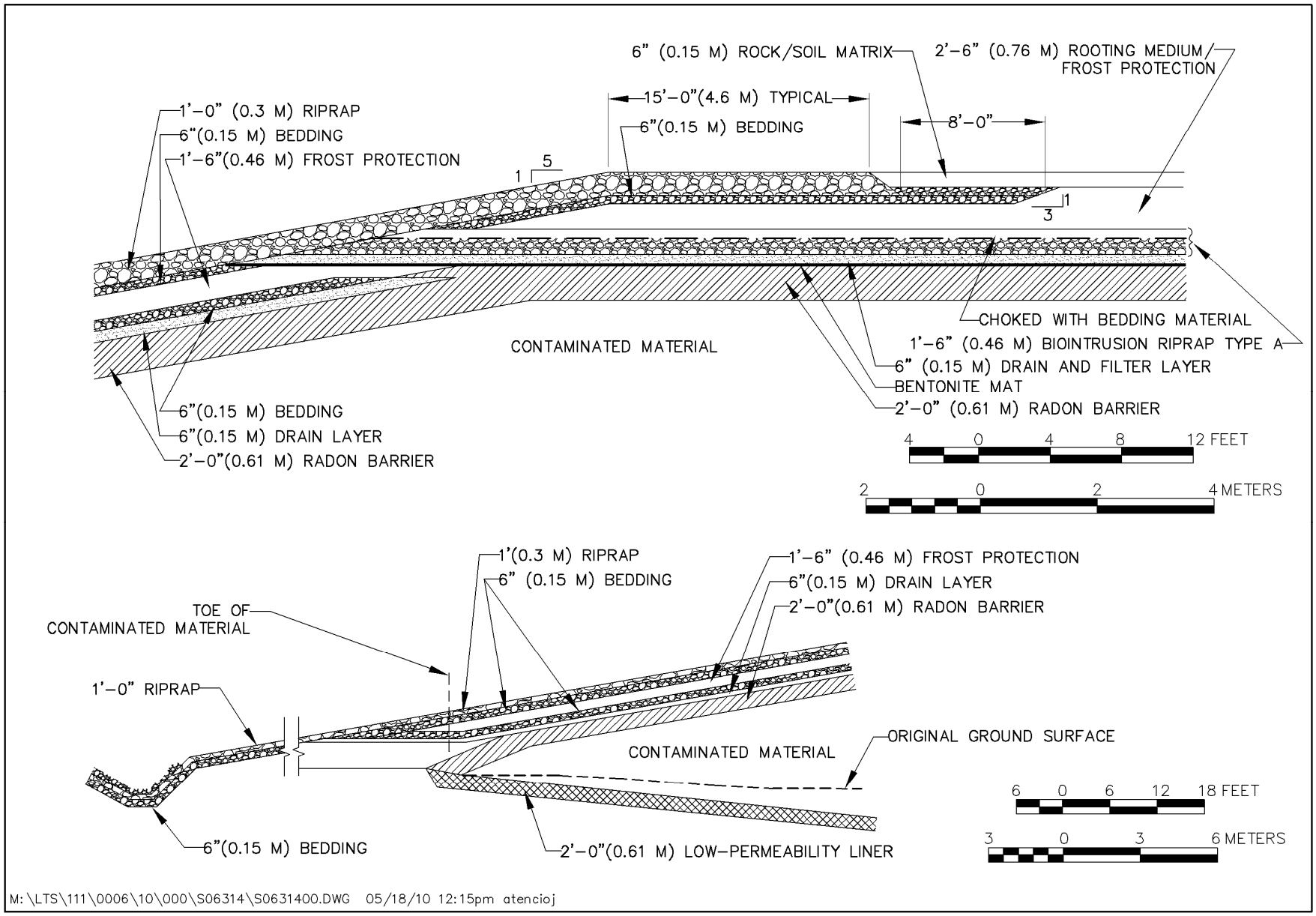

Figure 2–3. As-Built Cross Section of Cover System, Durango, Colorado, Disposal Cell

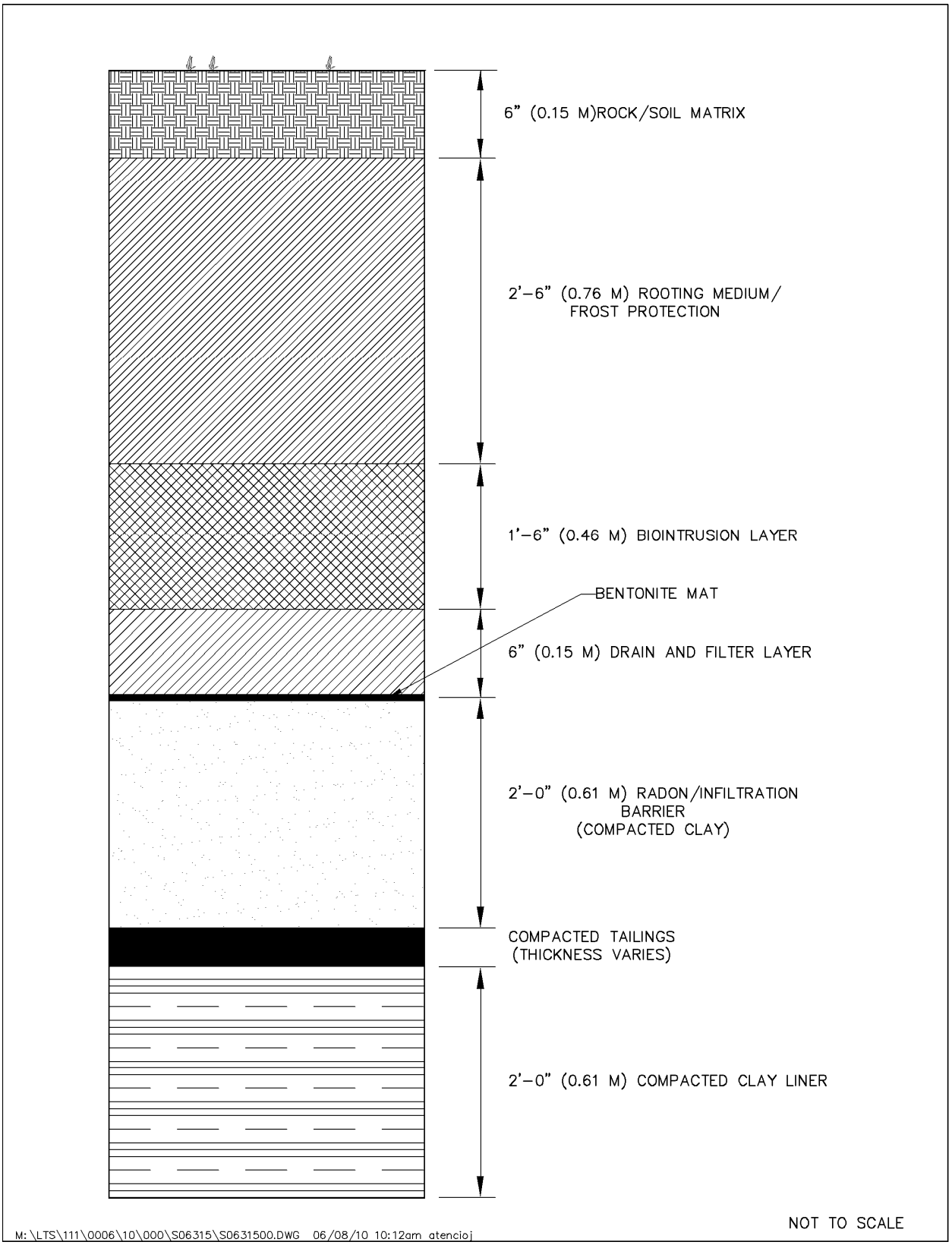

Figure 2–4. Top Slope Cover System, Durango, Colorado, Disposal Cell

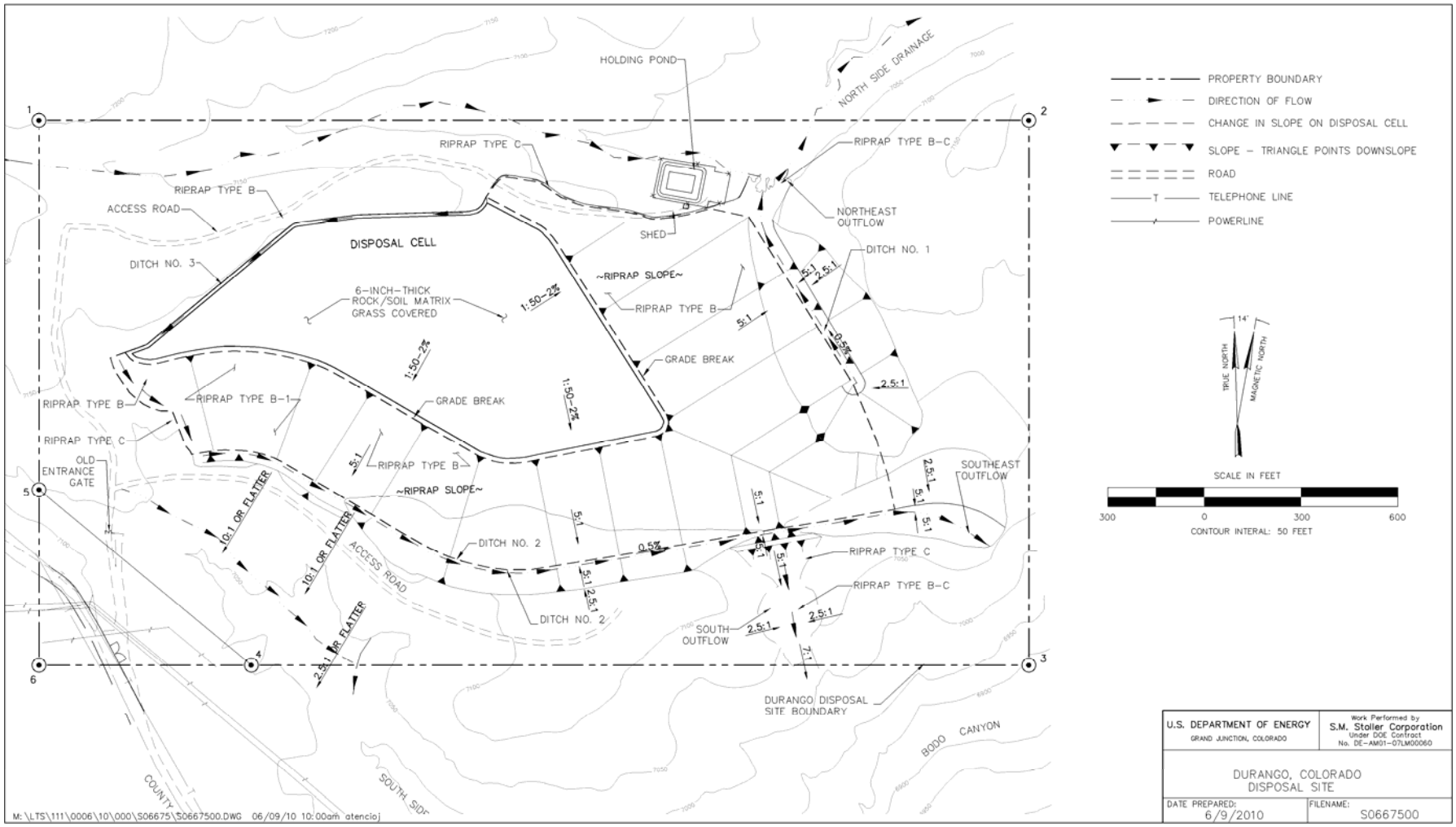

Figure 2–5. Embankment Features Durango, Colorado, Disposal Cell

The following major design features will mitigate potential groundwater contamination at the disposal site:

- A low-permeability liner on the sides and beneath the contaminated tailings (Figure 2−3).
- A compacted clay radon/infiltration barrier (with bentonite mat on top slope and bentonite amended clay on side slopes) above the tailings material (Figure 2−4).
- A high-conductivity sand drain/filter layer placed on the top of the radon barrier (Figure 2−4).

The low-permeability liner placed underneath the tailings material is composed of natural, recompacted silty clay and clay soils. These soils have high neutralization, adsorption, and ion exchange potential and thus provide a high attenuating capacity to restrict downward contaminant migration through the barrier.

2.2.5 Transient Drainage System

During disposal cell construction, seepage appeared on the eastern side slope of the cell. A toe drain and holding pond were required to manage transient drainage from the tailings. The drain system, consisting of a rock-filled drainage trench over a perforated 6-inch PVC pipe, was constructed on the east side of the cell in 1989. This transient drainage system gathered water and conveyed it to a double-lined holding pond. The seepage water collected in the pond was treated periodically and discharged to the north arroyo in accordance with a CDPHE Industrial Wastewater Treatment Facility discharge permit (Colorado Discharge Permit System Permit No. CO-0041548). In 1995, a permeable reactive barrier (PRB) test facility was installed with a fund from DOE's Office of Science and Technology, and the CDPHE discharge permit was modified to include the PRB facility. The toe drain valve was closed on June 4, 2004, the system was no longer being used for treatment and discharge and the CDPHE permit was allowed to expire on January 31, 2009. In September 2009 the toe drain valve was opened to allow water to drain to the holding pond. In October 2010 the PRB facility was decommissioned and remediated. All of the contaminated media associated with the PRB facility was transported to the Grand Junction, Colorado disposal site. DOE will inform NRC and CDPHE on the decommissioning and remediation of the remaining transient drainage system.

2.2.6 Institutional Controls

Institutional controls at the disposal site, as defined by DOE Policy 454.1, consist of federal ownership of the property, warning/no-trespassing signs (entrance and perimeter signs) along the property boundary, and a locked gate at the entrance to the site. The 120.6-ac (48.8-ha) disposal site is owned by the federal government and was accepted under the NRC general license (10 CFR 40.27) in 1996. DOE is the licensee and, in accordance with the requirements for UMTRCA Title I sites, is responsible for the custody and long-term care of the site.

2.2.7 Permanent Site Surveillance Features

Survey monuments (SM), boundary monuments (BM), site markers (SMK), and entrance and perimeter signs are the permanent surveillance features at the disposal site. Five boundary monuments define the corners of the unfenced perimeter of the disposal site. Eighty-two warning signs are placed around the perimeter of the disposal site (Figure 2−6).

Survey Monuments—SM-1 is in the northwest part of the site, SM-2 is south of the disposal cell, and SM-3 and SM-4 are to the east (Table 2−1 and Figure 2−6). The monuments, Berntsen RT-1 metal markers, were set into the top of a truncated cone of reinforced concrete set in concrete (DOE 2001).

Boundary Monuments—Five Berntsen federal aluminum survey monuments, Model A-1 (DOE 2001), were used for the site boundary monuments (BM-1 through BM-6) (Table 2−1 and Figure 2−6). BM-1, BM-2, and BM-3 mark the northwest, northeast, and southeast corners, respectively, of the site. BM-4 is at the west end of the proposed truncated south boundary, and BM-5 is at the south end of the truncated west boundary, however DOE retained the full area that is marked by BM-6 in the southwest corner (MK-F 1991).

Site Markers—Two unpolished granite site markers (SMK-1 and SMK-2) are within the restricted site boundary. SMK-1 is just inside the entrance gate, and SMK-2 is on top of the disposal cell revegetated area (DOE 2001). The markers identify the disposal site, the general location of the disposal cell, the date of closure (August 3, 1990), the mass of residual radioactive materials (3,460,000 dry tons [3,140,000 tonnes]), and the radioactivity (1,400 curies, radium-226) (Figure 2−7).

Entrance and Perimeter Signs—The site entrance sign (Figure 2−8) is at the entrance gate. In addition to the entrance sign, 82 perimeter signs (Figure 2−9) mark the boundary around most of the site (Table 2−1 and Figure 2−6). These signs display the international trefoil symbol indicating the presence of radioactive materials. They also state that the disposal site is U.S. Government property and that trespassing is forbidden. The entrance sign has the same information as the perimeter signs, plus the name of the site and the telephone numbers of DOE and CDPHE offices (Figure 2−8).

Settlement Plates—Fourteen settlement plates (DOE 2001) are located on the disposal cell, primarily on the south and east side slopes of the cell (Table 2−1 and Figure 2−6). The total long-term settlement of the disposal cell could be measured using the 14 settlement plates. The plates were installed after the disposal cell was completed.

2.2.8 Site Drawings and Photographs

At the completion of remedial action, disposal site as-built conditions were documented with as-built drawings and photographs (MK-F 1991). This information illustrates baseline conditions for comparison to future disposal site conditions.

A disposal site topographic map was prepared and is part of the permanent Durango site file. The topographic map, disposal site map drawings, and photographs may be further modified by LM, as necessary. LM is responsible for maintaining and archiving maps, drawings, and photographs in the permanent Durango disposal site file.

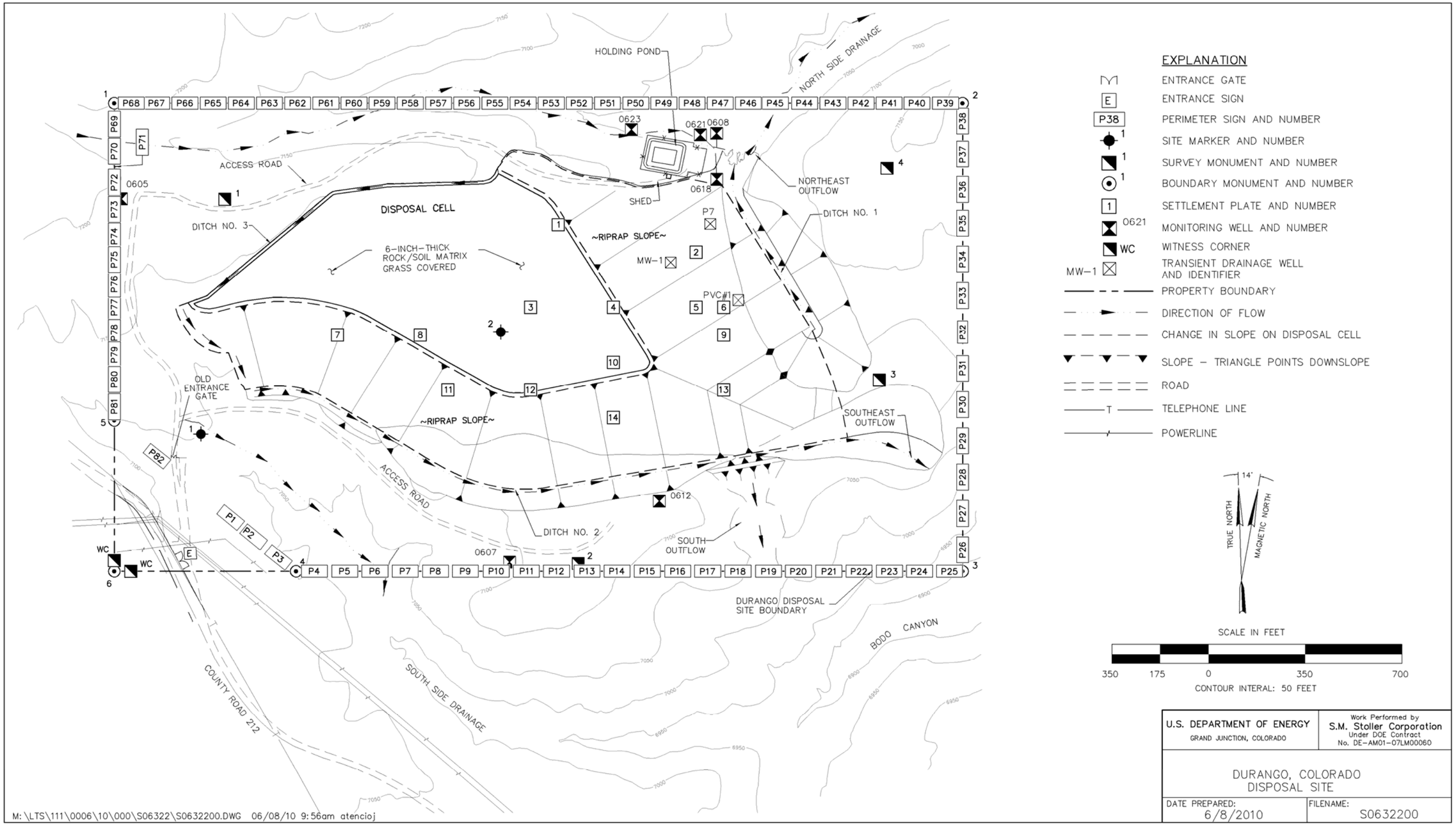

Figure 2–6. Map of the Durango, Colorado, Disposal Site

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Table 2−1.Site Surveillance Feature Location Coordinates

LOCATION COORDINATES FOR WELLS, MONUMENTS, AND SETTLEMENT PLATES			
SURVEY MONUMENTS			
SYMBOL 1	NORTHING	EASTING	
1	N42692.34	E44591.44	
2	N41370.10	E45872.37	
3	N42035.81	E46964.05	
4	N42804.37	E46991.91	
BOUNDARY MONUMENTS			
SYMBOL 1	NORTHING	EASTING	
1	N43,041.67	E44,190.57	
2	N43,041.67	E47,265.57	
3	N41,341.67	E47,265.57	
4	N41,341.76	E44,850.01	
5	N41,890.10	E44,190.74	
6	N41,341.66	N44,190.82	
MONITORING WELLS			
WELL ID NUMBER 0621	NORTHING	EASTING	
0605	N42693.8	E44216.4	
0607	N41375.0	E45623.4	
0608	N42879.1	E46374.2	
0612	N41595.3	E46165.7	
0618	N42859.6	E46369.6	
0621	N42876.7	E46365.2	
0623	N42944.3	E46064.6	
DISPOSAL CELL WELLS			
SYMBOL	NORTHING	EASTING	
P7	N42,602.62	E46351.12	
MW-1	N42,461.96	E46207.53	
PVC#1	N42325.57	E46452.34	
SETTLEMENT PLATES			
SYMBOL 1	NORTHING	EASTING	ELEVATION 12-6-90
1	N42,600	E45,800	7146.83
2	N42,500	E46,300	7072.57
3	N42,300	E45,700	7151.79
4	N42,300	E46,000	7144.58
5	N42,300	E46,300	7093.95
6	N42,300	E46,400	7076.93
7	N42,200	E45,000	7122.30
8	N42,200	E45,300	7147.30
9	N42,200	E46,400	7087.71
10	N42,100	E46,000	7146.98
11	N42,000	E45,400	7125.55
12	N42,000	E45,700	7144.15
13	N42,000	E46,400	7111.41
14	N41,900	E46,000	7112.43

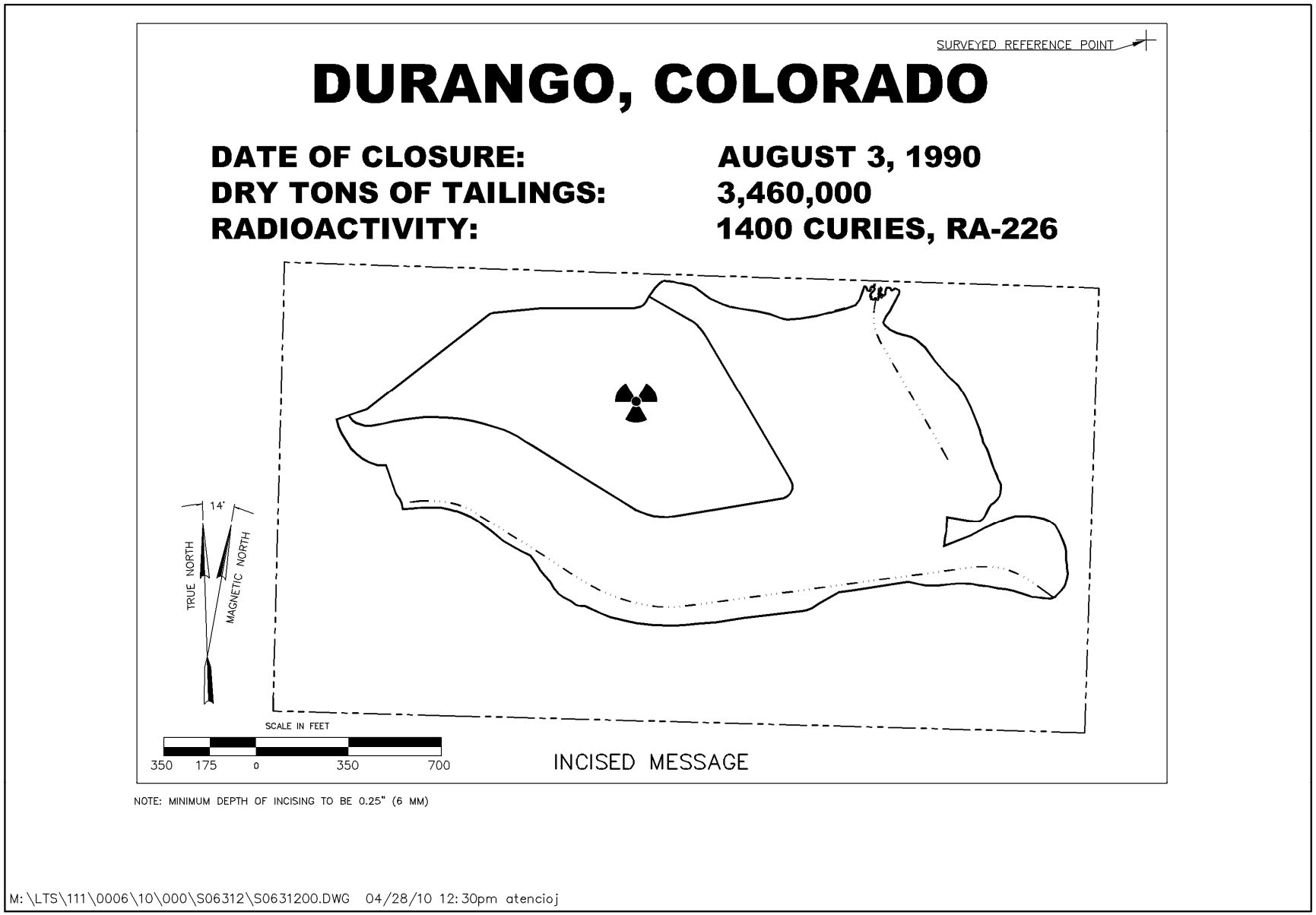

Figure 2–7. Site Marker, Durango, Colorado, Disposal Site

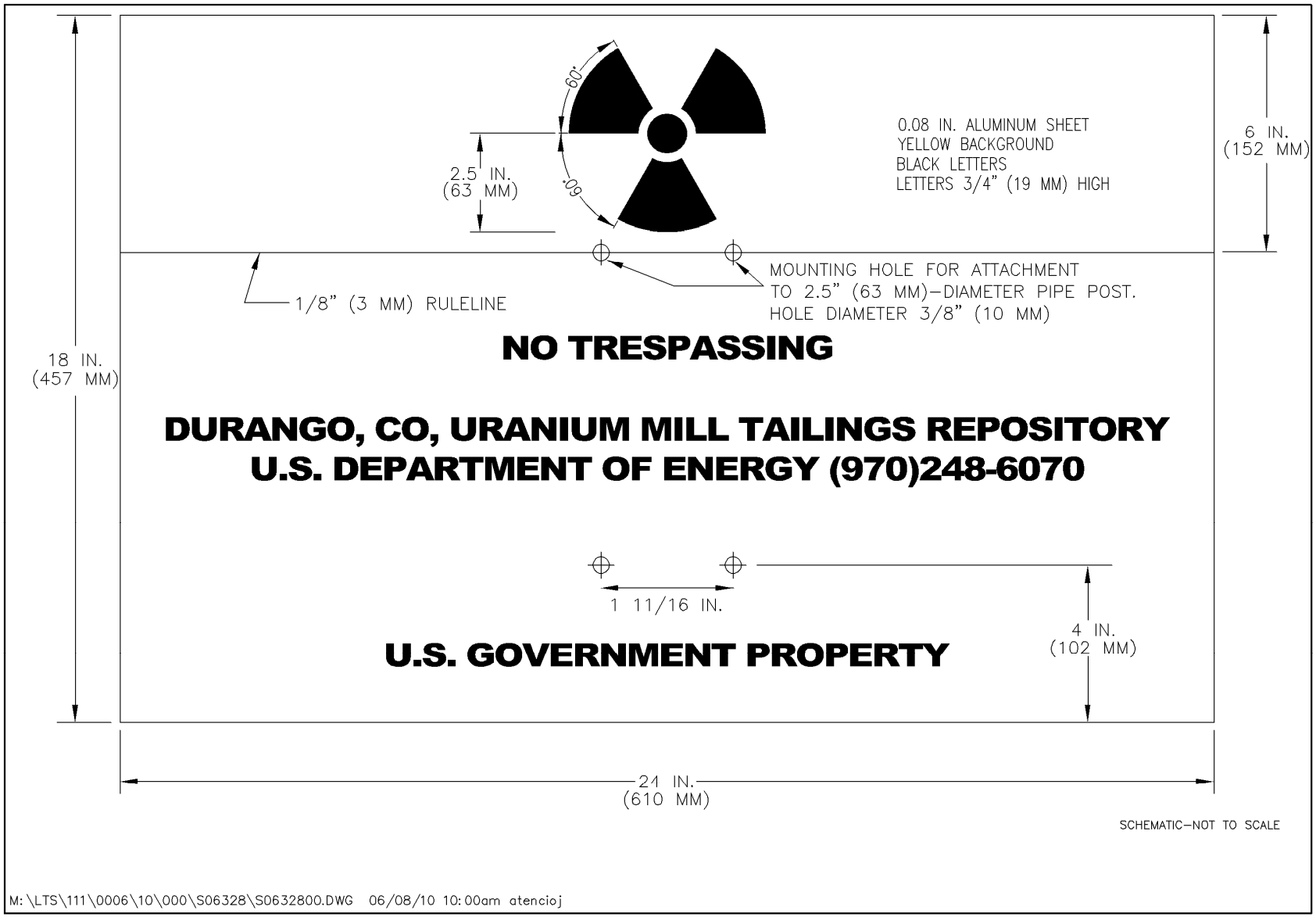

Figure 2–8. Entrance Sign, Durango, Colorado, Disposal Site

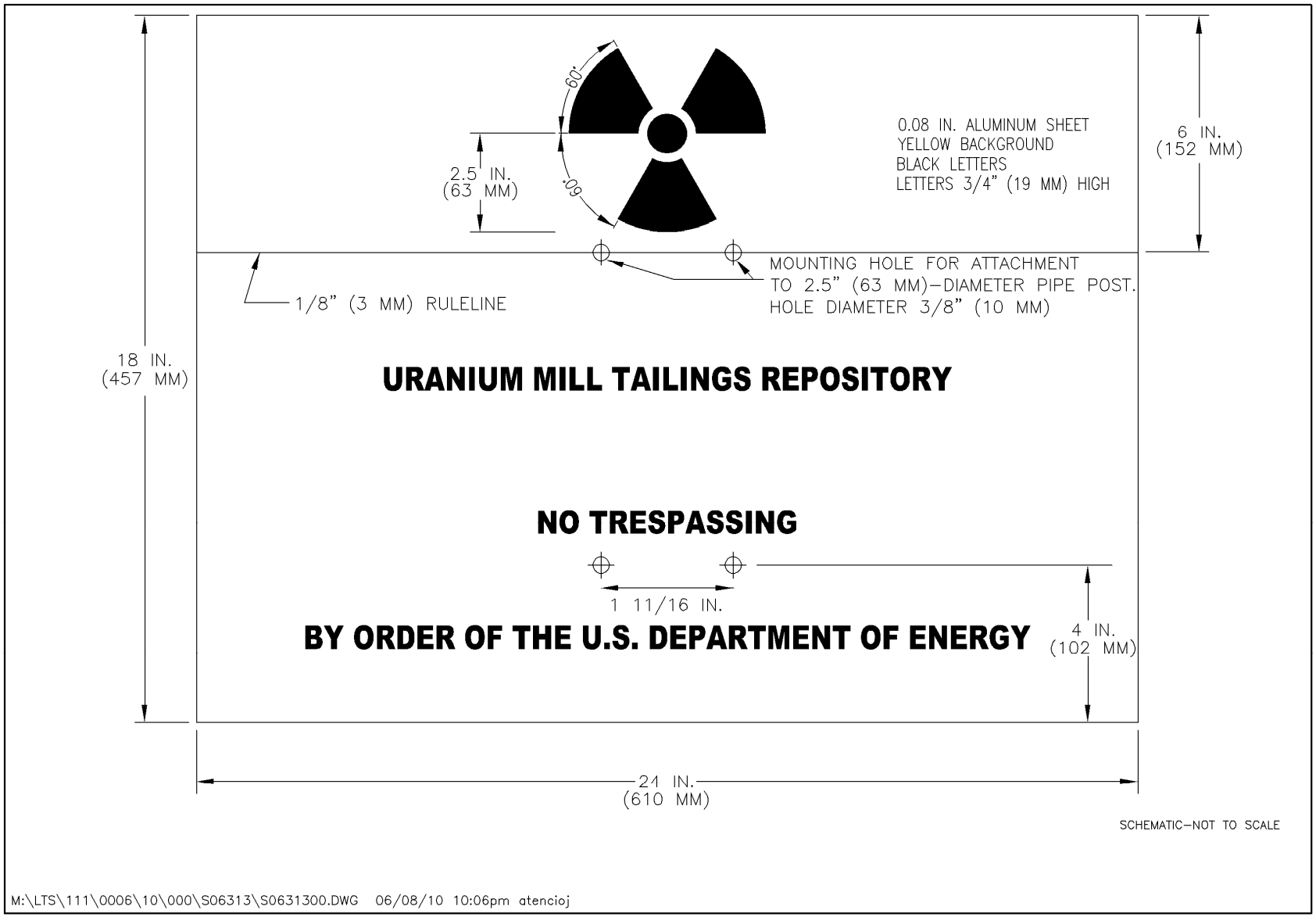

Figure 2–9. Perimeter Sign, Durango, Colorado, Disposal Site

Disposal Site Map

The Durango disposal site map (Figure 2−6) identifies the following site features:

- Disposal site, plus an area of 0 to 1,300 ft (0 to 400 m) around the site boundary
- Topographic features
- Permanent site surveillance features
- Entrance road and gate/barricade
- North and South Side Drainages and Bodo Canyon
- Disposal site boundary
- Disposal cell
- Groundwater monitoring wells

The Durango disposal site map (Figure 2−6) will serve as the base map for site inspections (Section 3.3.5). A new, separate inspection map will be prepared after each inspection. Each site inspection map will indicate the year and type of inspection.

The Durango disposal site base map and site inspection maps will become part of the permanent Durango disposal site file.

Disposal Site As-Built Drawings

A set of as-built drawings provided by Morrison Knudsen-Ferguson illustrates the final disposal cell construction and final disposal site conditions. These drawings were used to prepare the disposal site map. They may be used to document changes in physical site conditions or the disposal cell over time and to develop corrective action plans, if required. These drawings are filed and maintained in the permanent Durango disposal site file.

Site Baseline and Aerial Photographs

A photographic record of the final site conditions at the Durango disposal site is maintained in the permanent Durango disposal site file. This record consists of a series of aerial and ground photographs that provide a baseline visual record of site construction and final site conditions to complement the as-built drawings. The post-construction photographs provide an orientation tool for site inspections and a baseline record of surveillance features. Aerial photographs for the disposal site were taken throughout remedial action activities from 1987 to 1989 and in 1990 and 1991 after surface remedial action was completed. These photographs provide a record of site conditions, enabling inspectors to monitor changes in site conditions (e.g., erosion patterns, vegetation changes, and land use) over time. The photographs are a useful orientation tool for disposal site inspections.

2.3 Geology, Hydrology, and Groundwater

2.3.1 Site Geology

The disposal site is on the east-northeast striking Hogback Monocline, which separates the San Juan Basin to the southeast from the Four Corners Platform to the northwest. Bedrock dips to the south-southeast at variable amounts that generally decrease westward across the site, from about 13 degrees at the east to about 6 degrees at the west. The locations of four cross sections across the disposal site are shown on Figure 2−10. These cross sections (Figure 2−11 through Figure 2−14) show the geologic relationships of the dipping bedrock formations and Quaternary material below and adjacent to the disposal cell.

Bedrock underlying the disposal site consists of the upper two (Cliff House Sandstone and Menefee Formation) of three formations that compose the Mesaverde Group. The Cliff House Sandstone is approximately 400 ft (120 m) thick in this area and consists of an interbedded sequence of calcareous, yellow-brown sandstone and light-gray mudstone, siltstone, and silty shale (Kirkham and Navarre 2003). The contact between the Cliff House Sandstone and the underlying Menefee Formation is a minor disconformity. The Menefee Formation thickness ranges from 225 to 300 ft (70 to 92 m) and consists of interbedded gray, brown, and black carbonaceous shale and siltstone; gray, brown, and orange-brown cross-bedded sandstone; and coal (Kirkham et al. 1999).

Based on lithologic differences, the Cliff House Sandstone may be roughly divided into two informal units, lower and upper, which are approximately the same thickness. The lower unit consists mainly of interbedded siltstone and sandstone beds that range up to 3 ft (1 m) in thickness. The ridge just north of the disposal cell is supported by resistant sandstone beds in the lower unit (Figure 2−11). The upper unit contains more shale beds and fewer and thinner sandstone beds than the lower unit. Less resistant than the lower unit, beds of sandy siltstone in the upper unit support the ridge just south of the disposal cell (Figure 2−11).

The Menefee Formation is lithologically similar to the overlying Cliff House Sandstone. The main difference is that the Menefee contains coal beds and carbonaceous material in its shale and siltstone, making it a more drab color than the Cliff House rocks. A coal bed about 5 ft (1.5 m) thick in the upper part of the Menefee, approximately 80 ft (24 m) below the contact with the Cliff House Sandstone, occurs beneath the disposal site (Figure 2−12, Figure 2−13, and Figure 2−14). This coal bed was mined in the1890s and 1910s where it crops out about 0.1 mile (0.16 km) northeast of the disposal site property in the North Side Drainage (Kirkham et al. 1999). At the disposal site, outcrops of the Menefee Formation (only the uppermost part) are only in the extreme north part along the North Side Drainage.

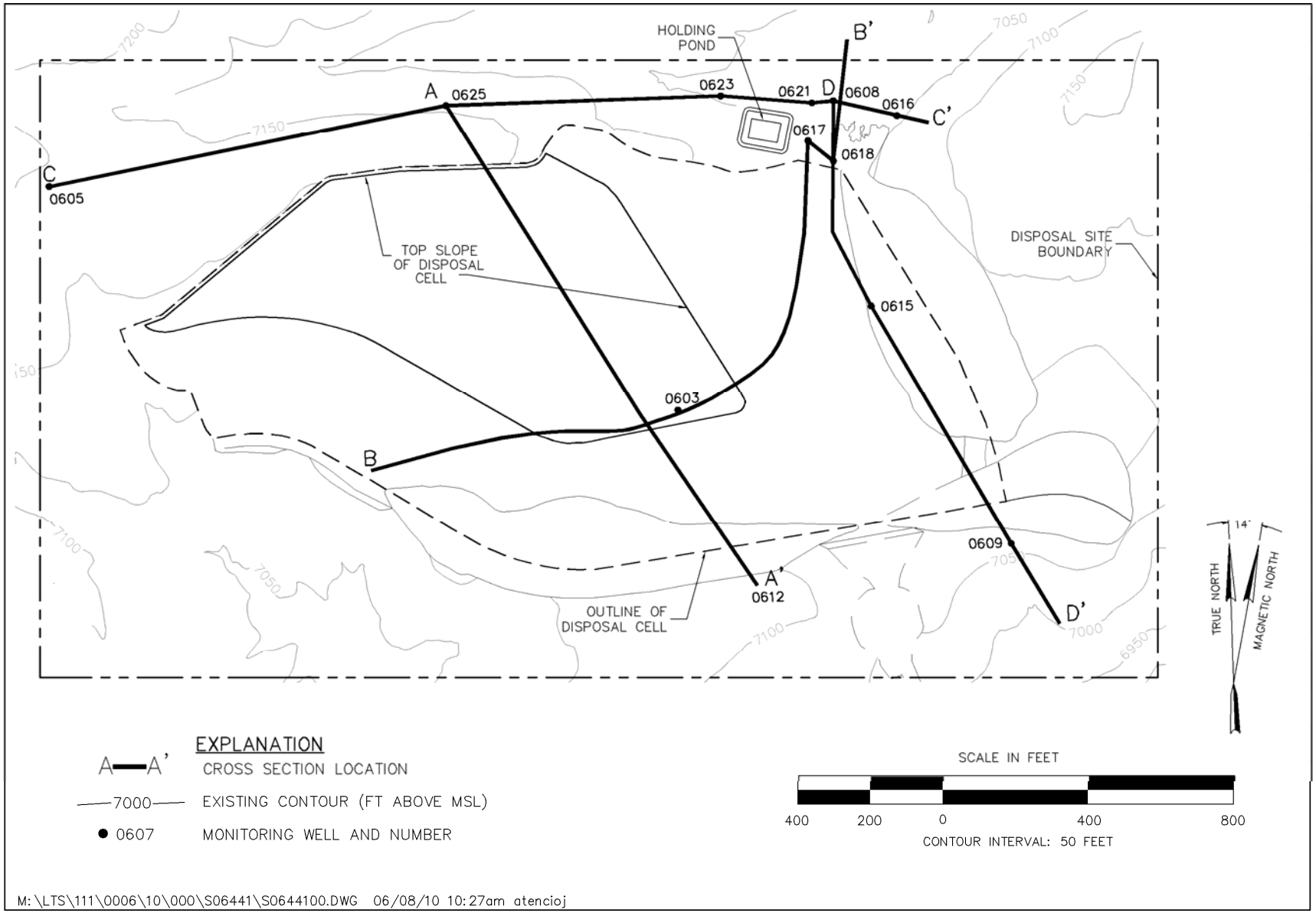

Figure 2−10. Locations of Monitoring Wells and Cross Sections, Durango, Colorado, Disposal Site

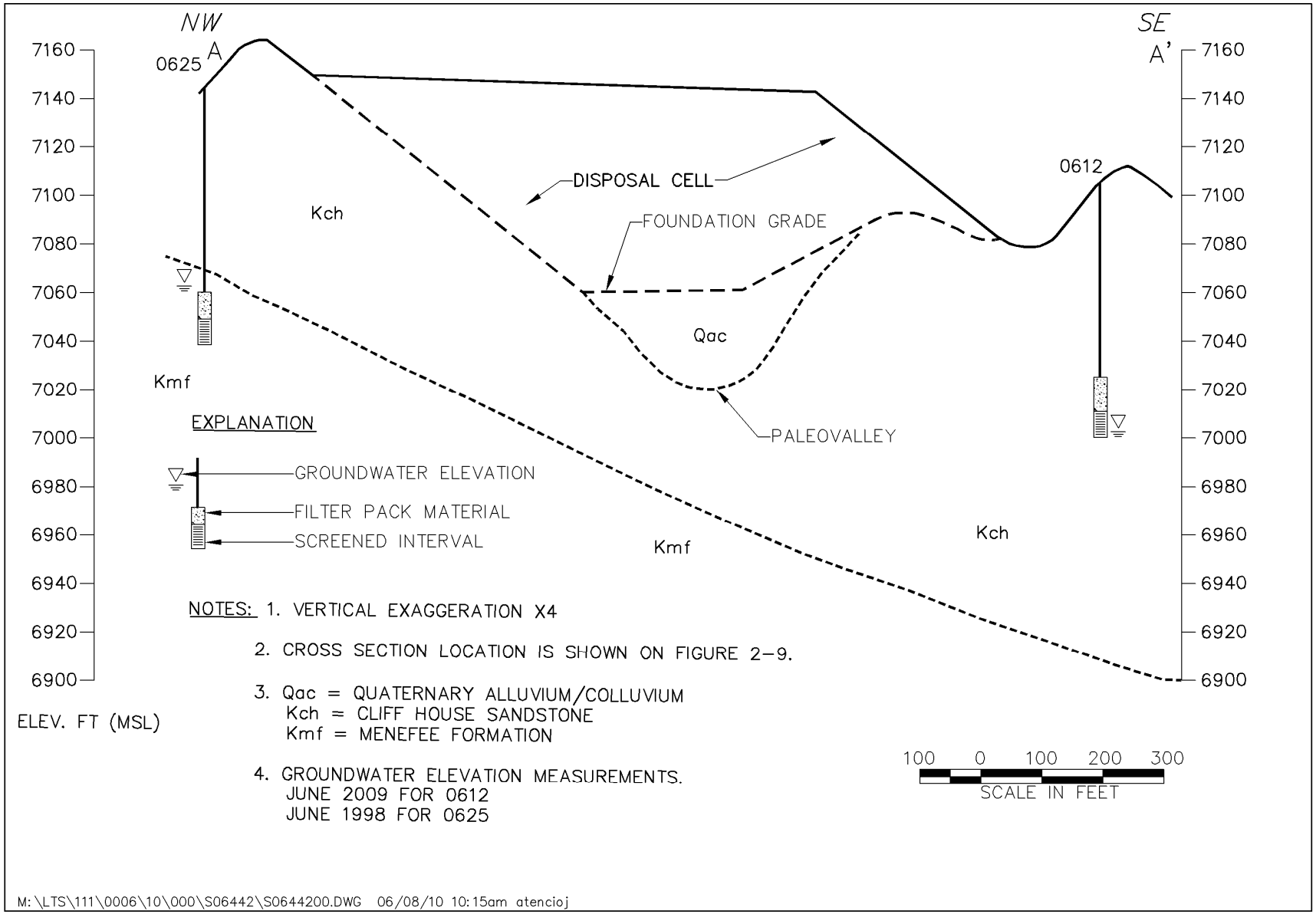

Figure 2–11. Cross Section A–A', Durango, Colorado, Disposal Site

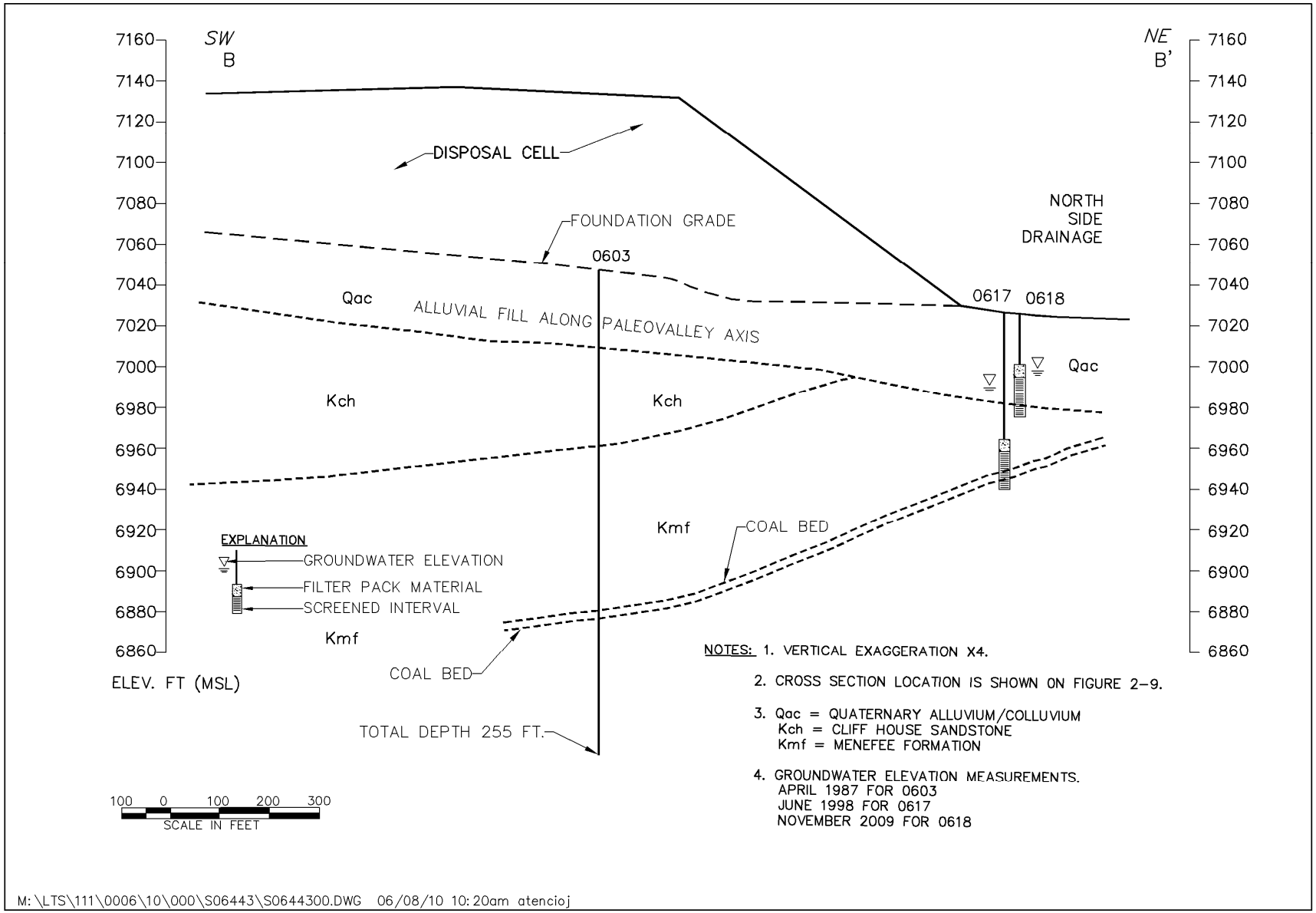

Figure 2−12. Cross Section B−B', Durango, Colorado, Disposal Site

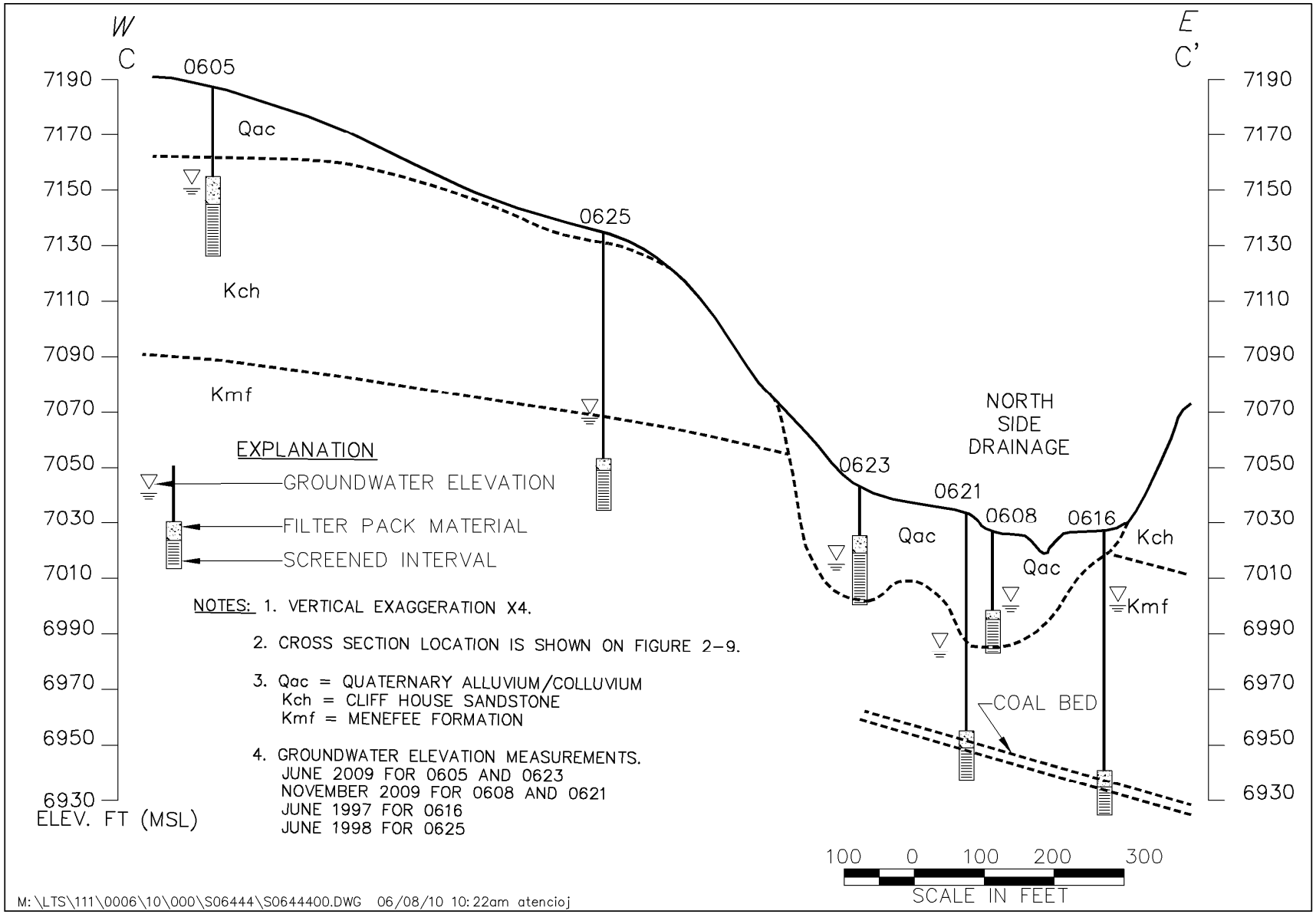

Figure 2-13. Cross Section C-C', Durango, Colorado, Disposal Site

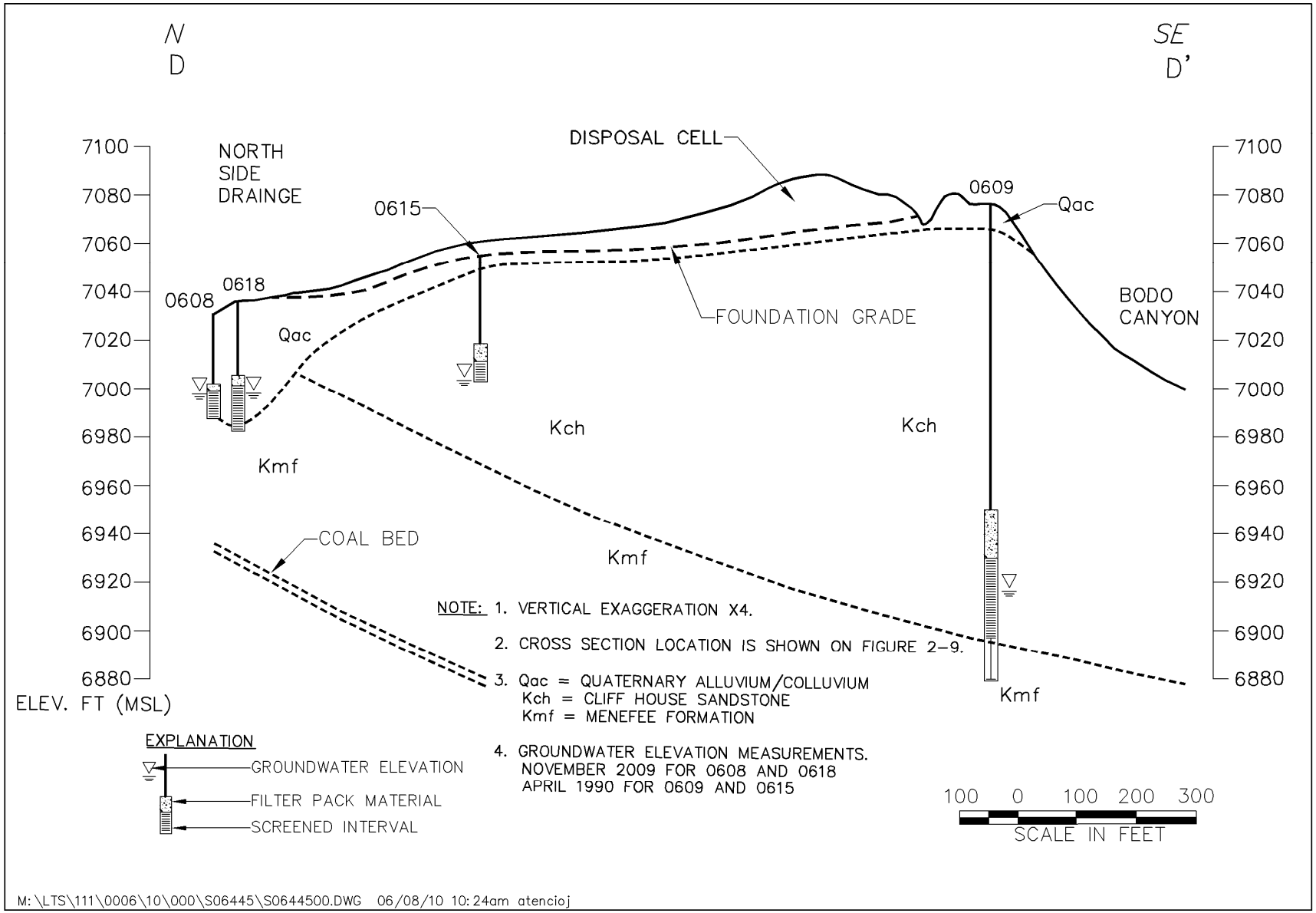

Figure 2−14. Cross Section D−D', Durango, Colorado, Disposal Site

The disposal cell sits on a small upland plateau. The plateau drained northeastward along a paleovalley into the North Side Drainage. Flow through the paleovalley was in a narrow channel, or paleochannel, that was filled with as much as 65 ft (20 m) of alluvium consisting of silty clay, silt, and sand, with some sandstone and shale fragments. The alluvium-filled paleovalley, as shown in cross section B-B′ (Figure 2−12) sits under the disposal cell on bedrock of the lower unit of the Cliff House Sandstone. Cross section A-A′ (Figure 2−11) crosses the paleovalley and provides information on the width of the valley. The base of the paleochannel at its confluence with the North Side Drainage has cut through the lower Cliff House into the upper part of the Menefee Formation (Figure 2−13). During remedial action, the alluvium in the paleovalley was shaped and compacted with additional imported silty clay and clay soil, forming a low-permeability base for the disposal cell, thereby restricting the downward migration of contaminants.

2.3.2 Bedrock Hydrology

Groundwater elevations measured in monitoring wells drilled into the bedrock beneath the cell before its construction, and into the bedrock north, south, and east of the cell, do not clearly identify a piezometric surface, flow direction, or gradient. Groundwater within 100 ft (30 m) below land surface apparently occurs in different layers within the bedrock, and these groundwater zones may have limited areal extent. Recharge of the near-surface groundwater in the bedrock is probably only from local precipitation and is unrelated to the deeper, regional flow regime. Groundwater in the shallow bedrock appears to flow both southeast, in the general direction of the dip of the bedrock, and northeast, down the trend of the North Side Drainage in the same direction as the groundwater in the alluvium.

Three hydraulic gradients were calculated from three-point solutions used to define the southeastern direction of potential groundwater flow in the bedrock. The average hydraulic gradient is 0.19 ft/ft (0.06 m/m). The average potential groundwater velocity was calculated using Darcy's Law, assuming a porosity of 0.15 and the geometric mean of hydraulic conductivity (0.07 ft [0.02 m] per day). The average potential groundwater linear velocity to the southeast is 32 ft (9.8 m) per year in the bedrock aquifer (DOE 1991).

2.3.3 Alluvium Hydrology

Shallow groundwater occurs locally within the alluvium filling the paleovalley beneath the disposal cell. The depth to groundwater prior to construction of the disposal cell varied seasonally, and several boreholes in the mid-gradient to upgradient areas beneath the disposal cell did not encounter water above the bedrock. Groundwater in the shallow alluvium was found mostly northeast of the disposal cell in the North Side Drainage, near well 0606. During the wet season, groundwater was at or near the ground surface. The hydraulic conductivity of the shallow alluvium in most of the paleovalley averages approximately 0.13 ft (0.04 m) per day, although an aquifer test performed at the confluence of the paleovalley and the North Side Drainage gave a value of 32 ft (10 m) per day. Assuming a porosity of 0.25 and a gradient of 0.003 down the center of the paleovalley, the rate of movement to the northeast will vary from approximately 0.6 ft (0.2 m) per year to about 140 ft (40 m) per year. This amount of variability is not unusual for alluvium-filled valleys. For calculations of potential downward movement of groundwater, the vertical conductivity is assumed to be one-third of the horizontal hydraulic conductivity.

2.3.4 Background Groundwater Quality

Because of the limited area of alluvial system saturation under natural conditions beneath the disposal cell (confined to the paleovalley), the bedrock aquifer (also called the Cliff House/Menefee aquifer) is considered the uppermost aquifer at the Durango disposal site (DOE 1991).

Background groundwater quality in the bedrock aquifer has been determined from samples from 10 monitoring wells completed in the bedrock aquifer (Table 2−2). These wells are located both upgradient and downgradient of the disposal cell. Data collected from 1987 through 1994 were used to characterize background water quality (DOE 1996). Data collected since that time from one bedrock background well has been consistent with this data set and has been reported in Title I Annual Reports. These reports are available to the public on the LM website.

Background groundwater quality in the bedrock aquifer varies between wells, primarily because the amount of dissolved sulfate salts varies between wells. These salts are thought to be derived from the dissolution of natural gypsum in the aquifer. Total dissolved solids range from 932 to 7,440 milligrams per liter (mg/L). Major anions include sulfate and/or bicarbonate. Sodium is generally the major cation. The groundwater is generally oxidizing; however, measured oxidation-reduction potentials vary in individual wells from reducing (-353 millivolts [mV]) to oxidizing (768 mV). Groundwater pH in the bedrock aquifer also ranges from alkaline (average pH of 8.9 in well 0609) to acidic (average pH of 4.9 in well 0621). The acidic water in well 0621 and in adjacent well 0616 is thought to be due to the natural oxidation of pyrite (iron sulfide) in the aquifer. The naturally acidic water is associated with high amounts of dissolved iron (as much as 452 mg/L), manganese (as much as 6.04 mg/L), sulfate (as much as 4,000 mg/L), and sulfide (as much as 16 mg/L). Trace constituents that have been detected at least once in background samples include antimony, arsenic, beryllium, cadmium, chromium, lead, mercury, molybdenum, nickel, radium-226, radium-228, selenium, silver, thallium, uranium, and vanadium (Table 2−2).

The variation in background water quality within the bedrock aquifer probably reflects local variations in lithology and perhaps changes in oxidation-reduction conditions related to the natural movement of dissolved oxygen and groundwater through the aquifer. It is possible that changes in water quality in individual wells will occur in response to future natural variations in groundwater flow and oxidation-reduction conditions. To reduce the chance that future naturally occurring variation will be mistaken for contamination from the disposal cell, a single broad definition of background water quality has been developed. This definition combines all data from sampled bedrock wells in the disposal cell area.

Table 2−2. Summary of Background Groundwater Quality, Durango, Colorado, Disposal Site

Parameter	Frequency of Detection	Minimum[a]	Median[a]	Maximum[a]
Alkalinity	94/94	2	694	2,032
Calcium	88/88	2	161	545
Chloride	85/85	6	36	428
Iron	80/88	0.02	0.33	452
Magnesium	88/88	1.2	143	458
Manganese	84/92	<0.01	0.06	6.0
pH	97/97	4.72	6.88	11.14
Oxidation-reduction potential	43/43	–353 mV	204 mV	768 mV
Potassium	88/88	3.4	7.2	40
Sodium	88/88	105	336	1,370
Sulfate	79/79	23	925	4,000
Total dissolved solid	79/79	932	2,750	7,440
Antimony	9/46	<0.003	<0.003	0.027
Arsenic	12/92	<0.001	<0.01	0.03
Barium	27/72	<0.01	<0.10	0.90
Beryllium	5/52	<0.005	<0.01	0.023
Cadmium	14/92	<0.001	<0.001	0.019
Chromium	6/72	<0.01	<0.01	0.12
Cyanide	1/30	<0.01	<0.01	0.18
Lead	9/88	<0.001	<0.01	0.02
Mercury	4/68	<0.0002	<0.0002	<0.0004
Molybdenum	25/92	<0.01	<0.01	0.22
Net gross alpha	48/82	0.0	2.9	35
Nickel	7/58	<0.01	<0.04	0.07
Nitrate	28/87	<0.1	<1.0	43
Radium-226	12/90	<0.1	<1.0	2.0
Radium-228	20/90	<0.9	<1.0	15
Selenium	18/92	<0.001	<0.005	0.042
Silver	2/68	<0.01	<0.01	0.03
Thallium	1/35	<0.01	<0.01	0.01
Uranium	53/89	<0.001	0.001	0.077
Vanadium	27/79	<0.01	<0.01	0.06

As reported in DOE 1996 data from bedrock monitoring wells 0605, 0607, 0609, 0611, 0612, 0613, 0616, 0617, 0621, and 0625 collected from 1987 through 1994.
[a] Units in milligrams per liter except Radium-226, Radium-228, and net gross alpha, which are in picocuries per liter.

2.3.5 Hazardous Constituents

Hazardous constituents were identified by characterizing tailings pore fluids sampled from monitoring wells completed within the Durango disposal cell and comparing the results with those of background well samples. Concentrations measured in tailings wells were statistically compared to concentrations measured in bedrock background wells to determine which of the hazardous constituents listed in Table 1 to Subpart A and Appendix I to 40 CFR 192 are present in the tailings pore fluids at levels above ambient background. Additionally, analyses of effluent from the disposal cell toe drain (Section 2.2.5) were compared to analyses of tailings solutions to

provide further information about the levels of hazardous constituents derived from the tailings. In general, the toe drain results and disposal cell well results were in agreement. Concentrations of arsenic, cadmium, molybdenum, radium-226, selenium, uranium, and vanadium were significantly elevated in tailings pore fluids, the median concentration from tailings pore fluids exceeded the median background level by at least 1 order of magnitude.

A second group of hazardous constituents, including beryllium, chromium, mercury, nickel, and silver, were found to be statistically elevated in tailings pore solution compared to background, although in more than half the tailings samples, they were below detection limits. Furthermore, the detected concentrations from tailings solutions were not remarkably higher than the detection limits or than observed background levels. The statistical significance of these constituents is attributable primarily to their greater frequency of detection in tailings samples than in background samples. These constituents were retained as hazardous constituents at the Durango disposal site but are not expected to be reliable indicators of potential groundwater contamination, because they occur infrequently in the tailings solutions and are below detection limits in the toe drain effluent. They occur at levels near background and likely will be attenuated by reactions with the clay liner and alluvial material. These reactions will reduce concentrations to background levels before the bedrock aquifer is reached.

Several constituents listed in Table A or Appendix I of 40 CFR 192 either were not detected in the tailings or toe drain effluent (antimony, barium, cyanide, net gross alpha, and thallium) or occurred at levels equal to or less than levels found in background groundwater based on statistical testing (lead, nitrate, and radium-228). These constituents are not designated as hazardous constituents at the Durango disposal site.

2.3.6 Concentration Limits for Hazardous Constituents

Concentration limits in point-of-compliance (POC) wells for long-term monitoring of the disposal cell (Table 2−3) were established following EPA guidance (EPA 1992). In this guidance, EPA endorsed the use of tolerance intervals for detecting contamination above background in one or more downgradient wells. Updated guidance (EPA 2009) is consistent with this earlier recommendation. A tolerance interval is designed to contain all but a small percentage of future measurements from wells accessing uncontaminated water. Therefore, repeated exceedances of the upper tolerance limit present statistical evidence of contamination.

Because of inherent uncertainties at the Durango disposal site concerning the geographic and statistical distribution of naturally occurring constituents in the groundwater, a nonparametric approach was used to determine a tolerance interval for the hazardous constituents. The upper tolerance limit is the maximum observed concentration in bedrock well samples collected between 1987 and 1994. At the Durango site, the maximum concentrations are based on analytical results ranging from 52 measurements for beryllium to as many as 92 measurements for cadmium, chromium, and selenium. There is 95 percent confidence that the maximum observed concentration of each constituent represents a level that will exceed background no more than 5 percent of the time. Therefore, using the maximum observed concentration as a concentration limit for long-term groundwater monitoring produces reasonable protection against false positive results from random background variation.

Table 2−3. Concentration Limits for Hazardous Constituents in Tailings Solutions, Durango, Colorado, Disposal Site

Constituent	MCL[a,b]	Tailings Pore Fluid Median[a,c]	Observed Maximum Background[a]	Approved Concentration Limit[a] in POC Wells[d]
Arsenic	0.05	0.19	0.03	0.05
Cadmium	0.01	0.037	0.019	0.019
Chromium	0.05	<0.01	0.12	0.12
Mercury	0.002	<0.0002	0.0004	0.002
Molybdenum	0.1	1.73	0.22	0.22
Radium-226 Radium -228	5.0	10.1	15.0	15.0
Selenium	0.01	0.13	0.042	0.042
Silver	0.05	<0.01	0.03	0.05
Uranium	0.044	4.5	0.077	0.077
Beryllium	None	<0.01	0.023	0.023
Nickel	None	0.04	0.07	0.07
Vanadium	None	11	0.06	0.06

[a] Concentrations in milligrams per liter except radium-226 and radium-228, which are in picocuries per liter.
[b] MCL = maximum concentration limit established in 40 CFR 192
[c] From monitoring wells 0200 through 0204 completed in disposal cell. Data collected 1987 through 1990.
[d] POC wells for the Durango disposal site are wells 0607, 0612 and 0621.

EPA regulations allow the concentration limits for hazardous constituents to be set at the background value or the maximum concentration limits (MCLs) established in 40 CFR 192, whichever is greater. Therefore, the concentration limits for hazardous constituents listed in Table 2−3 represent the larger of the maximum observed concentration or the MCL for constituents with established MCLs.

3.0 Long-Term Surveillance Program

3.1 General License for Long-Term Custody

With NRC concurrence in the original LTSP (DOE 1996 and Appendix A), the Durango disposal site was included under the general license for long-term custody established at 10 CFR 40.27(b). Although engineered disposal cells constructed under UMTRCA are designed to "be effective 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.

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	Reference
Annual site inspection	Section 3.3
Annual inspection report	Section 3.3.6
Follow-up inspections and follow-up inspection reports, as necessary	Section 3.4
Site maintenance, as necessary	Section 3.5
Emergency measures in the event of catastrophe	Section 3.6
Environmental monitoring, if required.	Section 3.7

3.3 Annual Site Inspections

3.3.1 Inspection Frequency

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 Durango disposal 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 would be explained in the inspection report. DOE will notify NRC of the annual inspection at least 30 days in advance.

3.3.2 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 Durango 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.

3.3.3 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 Durango, Colorado, Disposal Site

Transect	Description
1	Top of the Disposal Cell
2	Side Slopes of the Disposal Cell
3	Drainage Ditches
4	Holding Pond
5	Site Boundary
6	Outlying Areas

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, drainage ditches, and other features listed 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 phenomena that might affect the safety, integrity, long-term performance, or institutional control of the site.

Inspectors note changes within 0.25 mile (0.40 km) 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.

3.3.4 Inspection Checklist

Inspectors are briefed, and the inspection checklist is reviewed before the annual inspection. A sample checklist is provided in Appendix C.

The checklist includes

- Specific site surveillance features to be inspected;
- Routine observations to be made; and
- 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.

3.3.5 Site Inspection Map

A new site inspection map will be prepared after each annual inspection using the disposal site map (Figure 2−6) as a base. This map will include at a minimum the following:

- Photograph locations;
- Locations and descriptions of new, anomalous, or unexpected features;
- Features identified during previous inspections for observation or monitoring; and
- Inspection date.

3.3.6 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 made 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 found 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 on the entrance sign to request information or to report a problem at the site (Figure 2−8).

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, vandalism, elevated concentrations of analytes in groundwater, 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, severe 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 3.5).

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 231.1A).
- Respond with an immediate follow-up inspection or emergency response team.
- Implement emergency measures, as necessary, to prevent or contain exposure or release of radioactive materials (Section 3.5).

3.4.2 Personnel

DOE will assign inspectors to follow-up inspections on the same basis as the annual site inspection (see Section 3.3.2).

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. 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.

3.4.4 Beneficial Reuse Inspections

The need for additional inspections may be required if any type of reuse activities are initiated, to ensure that reuse of the site does not interfere with the site integrity or protectiveness. DOE would increase the frequency of site inspections from yearly to monthly as well as additional inspections following severe rainfall events, to ensure that potential erosion or any other negative impacts are identified and remedied before they become significant. Less frequent inspections may be approved as appropriate. These inspections will be conducted following the annual site

inspection procedure with focus on the added site features and issues associated with the reuse activities including evaluating the condition of the diversion channels to ensure that they remain functional as engineered.

3.5 Routine Site Maintenance and Emergency Measures

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).

3.5.1 Criteria for Routine Site Maintenance and Emergency Measures

Site intervention measures, from minor routine maintenance to large-scale reconstruction following potential disasters, lie on a continuum. Although 10 CFR 40.27 (b)(5) requires that increasingly serious levels of intervention trigger particular DOE responses, the criteria for those responses are not easily defined because the nature and scale of all potential problems cannot be foreseen. The information in Table 3−3 serves as a guide for appropriate DOE responses. The table shows that the primary differences between routine maintenance and an emergency response is the urgency of the activity and the degree of threat or risk. DOE's priority level, in column 1 of Table 3−3, bears an inverse relationship with DOE's estimate of probability; the highest-priority response is believed to be the least likely.

Table 3−3. DOE Criteria for Maintenance and Emergency Measures

Priority	Description	Example	Response
1	Breach of disposal cell with dispersal of radioactive material.	Seismic event that exceeds design basis and causes massive discontinuity in cover.	Notify NRC. Immediate follow-up inspection by DOE emergency response team. Emergency actions to prevent further dispersal, recover radioactive materials, and repair breach.
2	Breach without dispersal of radioactive material.	Partial or threatened exposure of radioactive materials.	Notify NRC. Immediate follow-up inspection by DOE emergency response team. Emergency actions to repair the breach.
3	Maintenance of specific site surveillance features.	Deterioration/ vandalism of signs, markers.	Repair at first opportunity.
4	Minor erosion or undesirable changes in vegetation.	Erosion not immediately affecting disposal cell, invasion of undesirable plant species.	Evaluate, assess impact, respond as appropriate to address problem.

Other changes or conditions will be evaluated and treated similarly on the basis of perceived risk.

3.5.2 Reporting Maintenance and Emergency Measures

Routine maintenance completed during the previous 12 months will be summarized in the annual inspection report.

In accordance with 10 CFR 40.60, within 4 hours of discovery of any Priority-1 or -2 event such as those listed in Table 3−3, DOE will notify the following group at NRC:

Decommissioning and Uranium Recovery Licensing Directorate,

Division of Waste Management and Environmental Protection,

Office of Federal and State Materials and Environmental Management Programs.

The phone number for the required 4-hour contact to the NRC Operations Center is (301) 816-5100.

3.6 Environmental Monitoring

3.6.1 Groundwater Monitoring

Groundwater is monitored at the Durango disposal site to verify the initial performance of the disposal cell. The monitoring network consists of seven wells (Table 3−4 and Figure 3−1). Four wells are completed in the uppermost aquifer (bedrock of the Cliff House Sandstone and the Menefee Formation), including one upgradient background well (0605) and three downgradient point-of-compliance wells (0607, 0612, and 0621). Wells 0607 and 0612 are downdip of the disposal cell in the direction of bedrock groundwater flow. Well 0621 is installed in the bedrock in the vicinity of the paleochannel alluvium in the direction of surface water flow. It monitors bedrock that could be affected by infiltration of groundwater from the alluvium.

Table 3−4. Groundwater Monitoring Requirements for the Durango Disposal Site

Well Number	Purpose	Unit and Screened Interval (ft bgs[a])	Monitored Parameters
0605	Background	Bedrock; 36–56	Analytes: molybdenum, selenium, uranium Field parameters: alkalinity, oxidation-reduction potential, pH, specific conductance, turbidity, temperature
0607	POC based on bedrock dip direction	Bedrock; 37–57	
0608	BMP[b]	Alluvium; 29–39	
0612	POC based on bedrock dip direction	Bedrock; 98–108	
0618	BMP; supplements 0608	Alluvium; 30–50	
0621	POC based on surface drainage	Bedrock; 78–88	
0623	BMP	Alluvium; 19–39	

[a] bgs = below ground surface
[b] BMP = best management practice

The alluvium and the groundwater it contains are of very limited extent and are not considered to be a true aquifer. There are no discharge points of alluvial groundwater to the surface. However, it is possible that some alluvial groundwater may infiltrate into the bedrock aquifer; therefore, the alluvium is monitored as a best management practice (BMP). Three BMP wells are completed in the alluvium, one upgradient (0623) and two downgradient (0608 and 0618) of the disposal cell. Well 0618 (screened to the bottom of the alluvium) was installed adjacent to well 0608 (screened to within several feet of the base of the alluvium) and added to the monitoring network in 2002 because it intercepts the full saturated thickness of the alluvium.

Figure 3−1. Existing Wells at the Durango, Colorado, Disposal Site

No wells at the Durango disposal site are explicitly designated as point-of-exposure (POE) wells. The POE would be considered to be any location outside of the site boundary where no restrictions on groundwater use apply. The approved concentration limits for the site are based on either MCLs or background and must be met at the POC wells.

During the established groundwater monitoring period, routine monitoring is conducted to observe possible changes in groundwater quality and to assess compliance with the groundwater protection standards. Indicator parameters were selected from the list of hazardous constituents identified for the site (Table 2−2 and Table 2−3). Indicator parameters are those that (1) are known to be present in the tailings solutions at concentrations statistically greater than background levels, (2) are present at much higher concentrations in the tailings solutions than in background, (3) display low variability in background, and (4) are mobile in the groundwater environment. The parameters that best meet the first three criteria are arsenic, molybdenum, selenium, uranium, and vanadium. Of these, attenuation batch experiments indicate that subsurface sediments beneath the Durango disposal cell will adsorb all the vanadium and most of the arsenic in solution, some selenium and uranium, and a small amount of molybdenum (DOE 1991). Therefore, molybdenum, selenium, and uranium are the most reliable indicator parameters of groundwater contamination at the Durango disposal site and were selected as representative hazardous constituents for routine monitoring.

Routine monitoring consists of collecting groundwater samples annually at approximately the same time each year to minimize variation due to seasonal effects. Samples are analyzed for the three indicator parameters. In addition, routine monitoring has included parameters that are indicative of general water quality. General water quality indicators monitored for are: pH, electrical conductivity, temperature, alkalinity, oxidation-reduction potential, turbidity (Table 3−4). Monitoring requirements (both frequency and analytical parameters) will be reevaluated every 5 years. Changes to monitoring requirements may be recommended based on site-specific conditions and will be concurred by NRC prior to implementation.

The site-specific standards used for the three indicator parameters—molybdenum, selenium, and uranium—are the maximum observed background concentrations of these analytes reported in groundwater samples collected from wells completed in the bedrock aquifer as identified in Table 2−3. Exceedances of the site-specific standards are evaluated on a well-by-well basis. If a limit listed in Table 2−3 is exceeded at a POC well (0607, 0612, 0621), the well will be resampled within 1 year for all routine monitoring parameters (Table 2−2 and Table 3−4). If the resampling indicates a second exceedance of concentration limits for an indicator parameter, data will be evaluated to determine if a cause for the exceedance can be identified. If a limit listed in Table 2−3 is exceeded at a BMP well (0608, 0618, 0623), no further action is required, however DOE may investigate the exceedance as a best management practice.

When resampling does not eliminate the disposal cell as the cause for a water-quality exceedance in a POC well, evaluative groundwater monitoring will be required. Evaluative groundwater monitoring may include analysis of additional hazardous constituents, direct or indirect measurements of the disposal cell cover, or other activities that are determined to be appropriate.

The EPA standards (40 CFR 192.04 [c]) require implementation of a corrective action program within 18 months of verification of an established concentration limit exceedance for one or more of the monitored constituents in a POC well. The goal of the corrective action program is to restore the disposal cell to its design specifications. If corrective action is determined necessary,

DOE will prepare and submit a corrective action plan for NRC review, and a copy of the plan also will be transmitted to CDPHE. The plan will include a monitoring plan to demonstrate the effectiveness of the corrective action, which DOE will implement after consultation with NRC and CDPHE.

3.6.2 Vegetation Monitoring

A plant specialist or other qualified person will periodically participate in site inspections. If the inspection does not coincide with the general growing season, the plant specialist may conduct a separate inspection at a more favorable time.

Volunteer plant growth: Volunteer plant growth includes plants growing where none were planned, such as in rock-lined drainage ditches, or unwanted plant species growing on the vegetated top slope of the disposal cell.

Based on results of a 1995 biointrusion study (DOE 1995), a volunteer plant root-to-shoot ratio of 1:1 should be used unless site-specific plant data indicate otherwise. Based on a root-to-shoot ratio of 1:1, an unwanted plant species must be removed when its shoot height equals or exceeds 3.5 ft (1.1 m) from the base of the plant. Unwanted plant species may be eliminated from the cover by selective spraying or mechanical removal.

3.7 Records

LM receives and maintains selected records to support post-closure site maintenance. Inactive records are preserved at a federal records center. Site records contain critical information required to protect human health and the environment, manage land and assets, protect the legal interests of DOE and the public, and mitigate community impacts resulting from the cleanup of legacy waste.

The records are managed in accordance with the following requirements:

- Title 44 *United States Code* Chapter 29 (44 USC 29), “Records Management by the Archivist of the United States and by the Administrator of General Services”; 44 USC 31, “Records Management by Federal Agencies”; and 44 USC 33, “Disposal of Records.”
- 36 CFR 1220 through 1238, Subchapter B, “Records Management.”
- DOE Order 243.1, *Records Management Program*.
- *Office of Legacy Management Information and Records Management Transition Guidance* (DOE 2004).

3.8 Quality Assurance

The long-term care of the Durango disposal site and all activities related to the annual surveillance, monitoring, and maintenance of the site comply with DOE Order 414.1C, *Quality Assurance*, Applicable requirements of 10 CFR 830 Subpart A, “Quality Assurance Requirements;”, and ANSI/ASQ E4-2004, *Quality Systems for Environmental Data and Technology Programs: Requirements with Guidance for Use* (American Society for Quality 2004).

3.9 Health and Safety

Health and safety requirements and procedures for LM and Legacy Management Support (LMS) contractor activities are consistent with DOE orders, federal regulations, and applicable codes and standards. The DOE Integrated Safety Management System serves as the basis for the LMS contractor's health and safety program.

4.0 Beneficial Reuse Project

DOE has an initiative to increase the number of LM custody and control sites in beneficial reuse by fiscal year 2015. The Durango disposal site is one of the sites identified as a potential location for a beneficial reuse project.

4.1 Scope

DOE would consider two models for the type of beneficial reuse at the disposal site:

- DOE would make land available for lease to private industry or electric utilities. An example of this would be placement of solar photovoltaic panels on top of the disposal cell cover or on previously disturbed areas west of the cell for the generation of electricity.
- DOE would not lease access to the site but would coordinate with other government agencies in management of site activities. An example of this would be coordinating site activities with state agencies to enhance site resources to the benefit of the local wildlife population. Another example would be coordinating with government agencies in planning hiking trails that could use some of the Durango Disposal Site perimeter land.

Any potential reuse of the site will not be allowed without the concurrence of CDPHE and NRC.

4.2 National Environmental Policy Act

For any proposed reuse project, DOE will prepare National Environmental Policy Act (NEPA) documentation suitable to the scope of the proposed reuse project. Public involvement or notification through meetings or electronic media is a required part of the NEPA process and would be conducted in accordance with the level of community interest and scope of a proposed action. An Environmental Assessment is an expected level of NEPA documentation that would be associated with a renewable energy project, whereas a lower level of NEPA documentation (e.g., an Environmental Checklist leading to application of a Categorical Exclusion) may be appropriate for a small-scale project such as upgrading wildlife habitat with no impacts to the disposal site.

4.3 Long-Term Lease Requirements

DOE will always maintain ownership of the disposal site and will not transfer or dispose of any real property interest without NRC concurrence. If DOE enters into a lease on the Durango site, all realty interest in the form of a lease shall be revocable, and the term of the lease shall be limited. Any lease shall require the lessee to restore the site to preexisting conditions at the end of reuse activities.

The minimum lease requirements and restrictions will include the following:

- Bonding and insurance;
- Duration and cost of lease;
- Site access, security, and fencing;
- Vendor requirements for utility coordination;

- Permitting;
- Vendor water source and infrastructure requirements;
- Roles and responsibilities for compliance with environmental laws;
- NRC and CDPHE approval and potential associated time requirements;
- Disposition and restoration; and
- Additional restrictions and requirements that will ensure the proposal will not negatively impact disposal cell maintenance and performance are described in Section 4.5, "Minimum Technical Requirements."

4.4 Potential Reuse Impacts

Despite any reuse, DOE will ultimately be responsible for ensuring the integrity of the Durango disposal cell and for ensuring that it remains protective of human health and the environment.

To ensure that any potential reuse does not have a negative impact on the cell, DOE would increase the frequency of site inspections. The increased frequency of inspections will depend on the type of reuse activity.

Appendix D presents a listing of potential reuse impacts related to a solar installation project on the cell, based on requirements for the annual inspection, along with mitigation measures. This type of evaluation will be required for any reuse activity. Additional inspections related to reuse activities will include a review of the initial anticipated impacts and verification that mitigation of those impacts remains effective as reuse activities progress.

4.5 Minimum Technical Requirements

To ensure that reuse of the site does not interfere with the long-term care, the following minimum technical requirements will be required for reuse activities. In the case of a reuse activity with a lease to a private entity, these requirements will be imposed on the lessee through the lease.

4.5.1 Disposal Cell Cover

- Overall integrity of the disposal cell cover must remain intact;
- No grading can be done on the disposal cell cover;
- Rock armor on the channels and side slopes shall not be disturbed. An access road to the cell cover can be built across the northern diversion channel (Ditch No. 3) near its high point by using geotextiles and free-draining aggregate to bridge over the riprap;
- Erosion protection: The project must not concentrate runoff to create a new runoff pattern across the cell cover. Runoff cannot cause erosion of the surface. Lessee must repair any surface erosion resulting from reuse;
- Infrastructure cannot anchor into the soils; electrical conduits must be placed aboveground;
- Infrastructure cannot be within 5 ft of the site markers or monuments.
- Clear paths need to be maintained for all-terrain-vehicle access;

- If utility trenching for high-voltage lines or small foundations is required, the depth of excavation is limited to a maximum of 24 inches, and shall not exceed the total area of disturbance specified in the lease. The top 6 inches of material (soil/rock matrix) must be separated from deeper excavated soils. Soils must be placed back with 90 percent standard Proctor compaction;
- Settlement: Loads shall not exceed 300 pounds per square foot bearing pressure on the ground;
- Machinery used on the cover shall have rubber tires, be considered low ground pressure equipment, and not cause rutting. Nothing shall be allowed within 5 ft of the site marker (SMK-2) on the cover; and
- Existing grasses within the project footprint are to remain growing as much as practicable. Any grasses disturbed at the end of project shall be reseeded with approved seed mixture.

4.5.2 Entire Site

- Lessee shall use their own lock on the entrance gate for continual access and "daisy chain" with DOE's lock. DOE shall have access to facility for spraying of noxious weeds, inspections, and maintenance of cell cover, as necessary. Lessee will determine if security fencing is required. Improvements to the entrance gate and installing some new perimeter fence, as needed, should be considered as an alternative. The gate must be locked at all times.
- Lessee can only access the site using designated routes and can only conduct operations and place project structures in areas designated by DOE.
- DOE must have access to the solar facility for spraying noxious weeds, conducting inspections, and maintaining the cell cover.
- There is not water currently available on the site. No wells can be drilled within the property boundaries.
- Lessee is responsible for all improvements required for connections to the local grid or substations. As much of the infrastructure as possible shall be placed off of the cover.
- During the installation and reclamation of the panels and infrastructure, if traffic congestion occurs temporary traffic control measures may be required.
- All maintenance areas, including sheds, shall be off of the cover in areas designated by DOE. Any hazardous materials required for construction or maintenance must be approved by DOE before they are brought on site. Any hazardous material approved for use or storage shall have a Material Safety Data Sheet on site. Any spills shall be properly cleaned up and reported to DOE and any other required agencies. Fuel for equipment cannot be stored on site. Vehicles and machinery can only be fueled off of the disposal cell.
- Delivery and staging of construction materials shall also occur off of the cover and side slopes and in areas designated or approved by DOE.
- Cut slopes required as part of grading on areas off of disposal cell cover shall not be steeper than 4H:1V. Natural drainage channels cannot be disturbed. All disturbed areas will be revegetated with approved seed mixture after installation and after infrastructure is removed.
- No activity would be allowed within 150 ft of the cultural site. Additionally, the lessee would be responsible for informing all persons associated with the project that they would

be subject to prosecution for knowingly disturbing cultural sites or collecting artifacts of any kind.

- If fencing is required for site security, CDOW has requested that wildlife-exclusion fencing or wildlife-friendly fencing be installed.
- Overhead electrical lines may only be installed with advanced approval by DOE. If an overhead electrical line is required, CDOW would require that a raptor-proof system be installed.
- After end of the lease, all equipment, fencing, electrical infrastructure, and other associated improvements shall be removed from the site. Except for approved grading changes, site shall be restored to preexisting condition.

5.0 References

10 CFR 40. U.S. Nuclear Regulatory Commission, "Domestic Licensing of Source Material," *Code of Federal Regulations*, January 1, 2009.

10 CFR 830. U.S. Department of Energy, "Subpart A—Quality Assurance Requirements," *Code of Federal Regulations*, January 1, 2009.

36 CFR 1220–1238. National Archives and Records, National Archives and Records Administration, Subchapter B, "Records Management," *Code of Federal Regulations*, July 1, 2008.

40 CFR 192. U.S. Environmental Protection Agency, "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings," *Code of Federal Regulations*, July 1, 2009.

42 USC 7901 et seq. Uranium Mill Tailings Radiation Control Act, *United States Code*, November 8, 1978.

American Society for Quality, 2004. *Quality Systems for Environmental Data and Technology Programs: Requirements with Guidance for Use*, ANSI/ASQ E4-2004.

DOE Order 231.1A, *Environment, Safety and Health Reporting*, Change 1, June 3, 2004.

DOE Order 243.1, *Records Management Program*, February 3, 2006.

DOE Order 414.1C, *Quality Assurance*, June 17, 2005.

DOE Order 430.2B, *Departmental Energy, Renewable Energy and Transportation Management*, February 27, 2008.

DOE Order 450.1A, *Environmental Protection Program*, June 4, 2008.

DOE Policy 450.2A, *Identifying, Implementing, and Complying with Environment, Safety, and Health Requirements*, May 15, 1996.

DOE Policy 454.1, *Use of Institutional Controls*, April 9, 2003.

DOE (U.S. Department of Energy), 1991. *Remedial Action Plan and Site Design for Stabilization of the Inactive Uranium Mill Tailings Site at Durango, Colorado*, UMTRA-DOE/AL-050503.0000, UMTRA Project Office, Albuquerque Operations Office, Albuquerque, New Mexico.

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DOE (U.S. Department of Energy), 1995. *UMTRA Project Disposal Cell Cover Biointrusion Sensitivity Assessment*, DOE/AL/62350-200, Rev. 1, prepared for the U.S. Department of Energy, Environmental Restoration Division, UMTRA Project Team, Albuquerque, New Mexico.

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DOE (U.S. Department of Energy), 2001. *Guidance for Implementing the Long-Term Surveillance Program for UMTRA Title I and Title II Disposal Sites*, GJO-2001-215-TAR, UMTRA Project Office, Grand Junction Office, Grand Junction, Colorado.

DOE (U.S. Department of Energy), 2004. *Office of Legacy Management Information and Records Management Transition Guidance*, Office of Legacy Management, March.

EPA (U.S. Environmental Protection Agency), 1992. *Addendum to Interim Final Guidance Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities*, Office of Solid Waste Management Division, U.S. Environmental Protection Agency, Washington, D.C.

EPA (U.S. Environmental Protection Agency), 2009. *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance*, EPA 530-R-09-007, March.

Executive Order 13423. *Strengthening Federal Environmental, Energy, and Transportation Management*, January 24, 2007.

Kirkham, R.M., and A.K. Navarre, 2003. *Geologic Map of the Basin Mountain Quadrangle, La Plata County, Colorado*, Colorado Geological Survey Open-File Report 01-4, 42 pp., scale 1:24,000.

Kirkham, R.M., M.L. Gillam, T.D. Loseke, J.C. Ruf, and C.J. Carroll, 1999. *Geologic Map of the Durango West Quadrangle, La Plata County, Colorado*, Colorado Geological Survey Open-File Report 99-4, 34 pp., scale 1:24,000.

Lehmann, E.L., 1975. *Nonparametrics—Statistical Methods Based on Ranks*, prepared by the University of California–Berkeley, with special assistance from H. J. M. D'Abrera of the University of California–Berkeley, Holden-Day, Inc., San Francisco, California.

MK-F (Morrison Knudsen-Ferguson), 1991. *Durango Draft Completion Report*, prepared by Morrison Knudsen-Ferguson for the U.S. Department of Energy, UMTRA Project Office, Albuquerque Operations Office, Albuquerque, New Mexico.

Appendix A

NRC Concurrence and Licensing Documentation

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

September 16, 1996

Mr. Richard Sena, Acting Director
Environmental Restoration Division
Uranium Mill Tailings Remedial Action
Project
U.S. Department of Energy
2155 Louisiana NE, Suite 4000
Albuquerque, NM 87110

SUBJECT: ACCEPTANCE OF THE LONG-TERM SURVEILLANCE PLAN FOR THE BODO CANYON URANIUM MILL TAILINGS REMEDIAL ACTION PROJECT SITE, DURANGO, COLORADO

Dear Mr. Sena:

The U.S. Nuclear Regulatory Commission staff hereby accepts the U.S. Department of Energy's (DOE's) Long-Term Surveillance Plan (LTSP), dated September 1996, for the Bodo Canyon Uranium Mill Tailings Remedial Action Project site at Durango, Colorado. This action establishes the Durango site under the general license in 10 CFR Part 40.27.

Based on its August 12, 1996, review of the final LTSP, the NRC staff closed the three open hydrology issues that had been identified during NRC's review of the draft LTSP. By letter dated August 29, 1996, the DOE transmitted the final page changes responding to the NRC staff's comment on the erosion near Drainage Ditch #1, which closed the remaining open issue. On September 13, 1996, DOE submitted final document required for NRC approval, the "Real Estate Documentation", which confirmed that the Bodo Canyon disposal site had been transferred from the state of Colorado to DOE on September 10, 1996. The NRC staff has reviewed the land transfer material and finds it to be acceptable.

NRC staff has determined that the revised LTSP satisfies the requirements set forth in the Uranium Mill Tailings Radiation Control Act of 1978 for long-term surveillance of a disposal site, and all requirements in 10 CFR Part 40.27 for an LTSP. In accordance with DOE's guidance document for long-term surveillance, all further NRC/DOE interaction on the long-term care of the Durango site will be conducted with the DOE's Grand Junction Project Office.

If you have any questions concerning this subject please contact the NRC Project Manager, Janet Lambert, at (301) 415-6710.

Sincerely,

Daniel M. Gillen, Acting Chief
Uranium Recovery Branch
Division of Waste Management
Office of Nuclear Material Safety
and Safeguards

cc: J. Evett DOE Alb
S. Hamp, DOE Alb
E. Artiglia, TAC Alb
J. Virgona, DOE GJPO

LT DUR 3

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

June 18, 1996

Mr. Richard Sena, Acting Director
Environmental Restoration Division
Uranium Mill Tailings Remedial
Action Project
U.S. Department of Energy
2155 Louisiana NE, Suite 4000
Albuquerque, NM 87110

SUBJECT: FINAL COMPLETION REVIEW REPORT FOR THE DURANGO, COLORADO, URANIUM MILL TAILINGS REMEDIAL ACTION PROJECT SITE

Dear Mr. Sena:

The U.S. Nuclear Regulatory Commission staff has completed its review of the U.S. Department of Energy's (DOE's) Final Completion Report for the Uranium Mill Tailings Remedial Action Project inactive uranium mill tailings site at Durango, Colorado, submitted on October, 16, 1995. The review considerd pertintent documents associated with this site including revised Completion Report pages transmitted by letters dated November 9, 1995, May 9, 1996, and May 23, 1996. The NRC staff's review of the Completion Report is documented in the final Durango Completion Review Report (Enclosure 1), which discusses the staff's evaluation of the completed remedial action.

Based on its review of the Completion Report, NRC staff concurs that DOE has performed remedial action at the Durango site in accordance with the approved plans and specifications, with the exception of the selection and performance of a groundwater cleanup program. DOE, with NRC approval, has deferred this aspect of the remedial action to a separate groundwater restoration program. The signed DOE Certification Summary providing official NRC concurrence in completion of the Durango remedial action (other than groundwater cleanup), is enclosed.

JUL 1996
RECEIVED

If you have any questions concerning this subject letter or the enclosures, please contact the NRC Project Manager for the Durango site, Janet Lambert, at (301) 415-6710.

Sincerely,

Joseph J. Holonich, Chief
Uranium Recovery Branch
Division of Waste Management
Office of Nuclear Material Safety
and Safeguards

Enclosures: As stated

cc: J. Evett, DOE Alb
S. Hamp, DOE Alb
E. Artiglia, TAC Alb

CERTIFICATION SUMMARY
for the
Durango, Colorado, Disposal Site

The Environmental Restoration Division Acting Director and the Contracting Officer for the U.S. Department of Energy certify the Durango, Colorado, processing and disposal sites are complete and meet all design criteria, technical specifications, and the surface Remedial Action Plan required under Public Law 95-604. The undersigned request that the U.S. Nuclear Regulatory Commission concur in this certification.

Juan D. Williams
Contracting Officer
Major Programs Team
Field Management Branch
Contracts and Procurement Division

DATE: 10-16-95

Richard F. Sena
Acting Director
Environmental Restoration Division

DATE: 10-16-95

The U.S. Nuclear Regulatory Commission's Chief of High-Level Waste and Uranium Recovery Projects Branch hereby concurs with the U.S. Department of Energy's completion of surface remedial action at the Durango, Colorado, processing and disposal sites.

Joseph J. Holonich, Chief
~~High-Level Waste and~~ Uranium Recovery
~~Projects~~ Branch
Division of Waste Management
Office of Nuclear Materials Safety
and Safeguards
U.S. Nuclear Regulatory Commission

DATE: June 18, 1996

Appendix B

Site Ownership/Custody Documentation

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REAL ESTATE DOCUMENTATION
LONG-TERM SURVEILLANCE PLAN
DURANGO, CO, DISPOSAL SITE
DURANGO, COLORADO

GENERAL

Pursuant to Section 106 of the Uranium Mill Tailings Radiation Control Act, 42 U.S.C. §7901 et seq., Public Law 95-604, the Colorado Department of Public Health and Environment acquired two parcels of property that would become the Durango Disposal Site. The first tract, Tract 101 was acquired from the Colorado Department of Natural Resources, Division of Wildlife, through a quitclaim deed dated August 4, 1987. This tract consisted of 38.7 acres (15.7 ha). The second tract, Tract 102, was acquired from the State Land Board and consisted of 81.36 acres (32.93 ha).

A portion of the land for the site was conveyed in 1975 to the State of Colorado, Division of Wildlife from the Nature Conservancy with the agreement the land would be used for the express purpose of a wildlife habitat, would have uses consistent with sound game management, and would have no commercial uses. The 1975 conveyance stated that should a breach of the agreement occur, the affected land may revert to the Nature Conservancy. The Nature Conservancy quitclaimed all rights to the property in August 1994 to the State of Colorado.

The State of Colorado could thereby quitclaim both Tracts to the United States of America with clear title in August 1996. The quitclaim deeds were duly recorded in La Plata County, Colorado in December 1996.

LEGAL DESCRIPTIONS

The legal descriptions are provided on the attached quitclaim deeds.

REPOSITORY

Real estate correspondence and related documents are maintained in the real property portion of project records and working copies can be easily accessed by contacting DOE's Office of Legacy Management realty staff or contractor realty staff.

The Colorado Department of Public Health and Environment formerly known as The Colorado Department of Health, whose address is 4300 Cherry Creek Drive South, Denver

STATE DOCUMENTARY FEE
DATE 9-10-96
$ .50

TRACT 101
102890

City and County of Denver, and State of Colorado, for the consideration of

Ten ($10.00)*********************** Dollars, in hand paid,

hereby sell(s) and quit claim(s) to The United States of America of Washington, D.C., and its assigns,

NO DECLARATION OK

UMTRA BODO CANYON, CO
TRACT 101

, the following real property, in the County of La Plata, and State of Colorado, to wit:

A Tract of Land in Section Thirty-one (Sec. 31), Township Thirty-four and one-half North (T. 34 1/2 N.) Range Nine West (R. 9 W.) of the New Mexico Principal Meridian (N.M.P.M.) in La Plata County, State of Colorado, being more particularly described as follows:

Beginning at a point on the West line of said Section 31, whence the Northwest corner of said Section 31 bears North 00° 39' 08" West a distance of 130.00 feet;
Thence East a distance of 1,000.00 feet;
Thence South a distance of 1,700.00 feet;
Thence West a distance of 980.65 feet to the West line of said Section 31;
Thence North 00° 39' 08" West a distance of 1,700.11 feet to the point of beginning;
Said Tract contains 38.7 acres more or less.
Also
Including all rights presently owned by the Grantor to any and all minerals, ore and metals of any kind and character and all coal, asphaltum, oil, gas, geothermal resources or other substances in, on or under the above-described tract being conveyed, along with all right, title and interest which the Grantor may have in the banks, beds, and waters of any streams bordering the above-described tract of land, and all interest in alleys, roads, streets, ways, strips, gores, or railroad rights-of-way abutting or adjoining said land and in any means of ingress or egress appurtenant thereto,

with all its appurtenances subject to existing easements for public roads and highways, public utilities, railroads, pipelines and reservations or exceptions of record, The land herein conveyed to United States of America by and through the Department of Energy.

Signed this 28th day of August, 1996

Colorado Department of Public Health and Environment FKA- Colorado Department of Health
By: Patti Shwayder-Coffin
Patti Shwayder-Coffin, Acting Executive Director

STATE OF COLORADO,
County of Denver } ss.

The foregoing instrument was acknowledged before me this 28th day of August, 1996, by Patti Shwayder-Coffin

My commission expires 12-9-96
Witness my hand and official seal

L-11C415

FROM : RealEstate Div Acqn Br   FAX NO. : 402 221 7760   Apr. 14 2000 01:50PM P4

David Kreutzer, Assistant Attorney General

No. 898. QUIT CLAIM DEED—Short form—

—Bradford Publishing Co., 1721-41 Stout Street, Denver, Colorado —5-76

Return: Joy Vondrasek, Dept. of Army, Corps of Engineers, 215 North 17th St., Omaha, NE 68102

FROM : RealEstate Div Acqn Br FAX NO. : 402 221 7760 Apr. 04 2000 01:50PM P3

.....Recorder.

The Colorado Depar at of Public Health and Environment, formerly known as The Colorado Department of Health, whose address is 4300 Cherry Creek Drive South, Denver

City and County of Denver, and State of Colorado, for the consideration of

Ten ($10.00)********** Dollars, in hand paid,

hereby sell(s) and quit claim(s) to The United States of America of Washington, D.C., and its assigns

STATE DOCUMENTARY FEE
DATE 9.10.96
$ .50

TRACT 102

the following real property, in the County of La Plata, and State of Colorado, to wit:

TOWNSHIP THIRTY-FIVE NORTH (T.35 N.), RANGE TEN WEST (R 10 W.) NEW MEXICO PRINCIPAL MERIDIAN (N.M.P.M.) LA PLATA COUNTY

In the East One-half (E 1/2) of Section Thrity-six, (Sec. 36), La Plata County, Colorado, more particularly described by metes and bounds as follows:

Beginning at a point on the east line of said Sec. 36, which point bears South 00° 39' 08" East a distance of 130.00 feet from the Northwest corner of Section Thirty-one (Sec. 31), Township Thirty-four and One-half North (T. 34 1/2 N.), Range Nine West (R. 9W.);

Thence West a distance of 2075.00 feet to a point;

Thence South a distance of 1700.00 feet to a point;

Thence East a distance of 2094.35 feet to the east line of said Sec. 36;

Thence North 00° 39' 08" West a distance of 1700.00 feet to the point of beginning.

Containing 81.36 acres, more or less, along with all right, title and interest which the grantor may have in the banks, beds, and waters of any streams bordering the above-described tract of land, and all interest in alleys, roads, streets, ways, strips, gores, or railroad rights-of-way abutting or adjoining said land and in any means of ingress or egress appurtenant thereto,

with all its appurtenances subject to existing easements for public roads and highways, public utilities, railroads, pipelines and reservations or exceptions of record. The land herein conveyed to United States of America by and through the Department of Energy.

Signed this 28th day of August, 19 96

Colorado Department of Public Health and Environment -FKA Colorado Department of Health
By: Patti Shwayder-Coffin
Patti Shwayder-Coffin, Executive Director

NO DECLARATION

UMTRA BODO CANYON, CO
TRACT 100

STATE OF COLORADO,
County of Denver } ss.

The foregoing instrument was acknowledged before me this 28th day of August, 19 96, by Patti Shwayder-Coffin

My commission expires 12/9/96
Witness my hand and official seal

LINDA L. HOLLAND

TITLE CO.

FROM : RealEstate Div Rcgn Br FAX NO. : 402 221 7760 Apr. 04 2000 01:49PM P2

Appendix C

Inspection Checklist and Photo Log

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2009 INSPECTION CHECKLIST
DURANGO, COLORADO, DISPOSAL SITE

Status of Site Inspections

Date of This Revision:	May 27, 2009
Last Annual Inspection:	May 28, 2008
Inspectors:	M. Kastens (lead) and L Sheader
Next Annual Inspection (Planned):	May 28, 2009
Scheduled Inspectors:	M. Kastens (lead) and L. Sheader

No.	ITEM	ISSUE	ACTION
1	Access	There are no access protocols.	
2	Participants	Contact Wendy Naugle of CDPHE at (303) 692-3394.	Wendy Naugle of CDPHE will meet the inspectors at the site at 1:00 p.m. on 5/28/09. We will have copies of the 2008 trip report and extra inspection maps available. Conduct tailgate safety meeting. Tripping, ticks and rattlesnakes hazards will be discussed.
3	Specific Site Surveillance Features	See attached list.	Inspect.
4	Vandalism	Vandalism is an ongoing problem at this site. The entrance sign and several perimeter signs are repeatedly stolen or damaged by bullets and shotgun shot. Several perimeter signs have been reinforced with steel frames. Determine if the entrance sign and perimeter signs P1 and P82 were replaced in 2008. Perimeter sign P2 is missing and will not be replaced. Entrance site marker SMK–1 has been damaged in the past. Trash is sometimes illegally dumped near the site entrance.	Record evidence of vandalism at the site. Check entrance, P1, and P82 signs; replace damaged signs if necessary. Check legibility of SMK–1. Check for illegal dumping.
5	Top slope	The top of the cell was in excellent condition in 2008. The top slope was seeded with grasses. Vegetation was healthy in 2008 (yellow sweet clover was a minor component, unlike previous years). Small infestations of musk thistle, a noxious weed, were found in several areas on the cell cover in previous years; these were treated with herbicide. No deep-rooted woody species greater than 3 ft in height were found in 2008. Dryland alfalfa, a deep-rooted forb species, has been found on the cell and treated with herbicide. Inspectors questioned whether this plant species should be controlled, as its aboveground height will never exceed the 3.5-foot criterion listed in the LTSP. DOE determined that it should be controlled. Since 2006, alfalfa plants on the cell top have been treated with herbicide Small mammal burrows have been observed near site marker SMK-2.	Check for evidence of settling, slumping, or erosion. Evaluate condition of the vegetation and record noxious weed locations. Check top slope for sagebrush and other deep-rooted shrubs and trees; these will be treated with herbicide by a subcontractor. (LTSP states that an unwanted plant species must be removed when its shoot height equals or exceeds 3.5 ft from the base of the plant.) Check cell top for alfalfa plants. Mark with orange flagging if found. Continue to check for burrowing and evaluate if it affects the integrity of the cell cover.

No.	ITEM	ISSUE	ACTION
6	Side Slopes	Riprap cover was in good condition in 2008. Minor ruts, apparently caused by the herbicide applicator, were observed on the southern sideslope. Numerous small shrubs and trees are encroaching on the side slopes. Deep-rooted, woody vegetation was cut and treated in September 2006. Herbicide has been applied to noxious weeds (Canada thistle, musk thistle, bull thistle, houndstongue) since 2002. There are three transient drainage piezometer wells with data loggers (MW–1, P–7, and NVP) and a drainage system vent well (PVC–1).	Check for subsidence, rock deterioration, or slope failure. Continue checking for ruts; it may become necessary to regrade riprap. Evaluate condition of the vegetation. If present, note location of deep-rooted shrubs and trees. The deep-rooted shrubs and trees and noxious weeds will be treated with herbicide by a commercial applicator in 2009. Check condition.
7	Drainage ditches	Headward erosion has occurred at the outfalls of Ditches No. 1 and No. 2. The outflow of Ditch No. 1 was designed to erode back and self-armor in the process. Several of the slopes above Ditches No. 1 and No. 2 are loose and steep, and have been a source of talus. Small talus deposits have accumulated at places on top of the riprap along the base of these slopes. Some talus deposits in Ditch No. 1 hold moisture and support small patches of vegetation, including willows. There was no evidence of recent slope erosion or talus accumulations in 2008.	Check condition of the outfalls. There has been no significant movement of the knickpoint since it was surveyed in 1999. Evaluate condition of the ditches and the surfaces above the ditches, and whether they are blocked to the extent that storm water flow is impeded.
8	Site boundary	Two gullies along the southern side of the site on the north-facing slope, just north of perimeter sign P3 were eroding in 2004 but were deemed stable in 2005. New headcutting within two gullies northeast of SMK-1 was documented in 2006. No threat to the cell is occurring at this time. A guardrail and a hardened gate were installed along the county road at the site access in 2000 and have prevented vehicular trespassing from the county road. In 2006, inspectors noted an increased number of small rodent burrows in the northwest corner of the site. These may reflect a local, and possibly a natural cyclic, increase in rodent population but do not pose a threat to the cell.	Check condition of rill and gully erosion. Check condition of the gate and effectiveness of access controls and for possible vehicular access to the site from other locations. Monitor.
9	Weed control	Seven species of noxious weeds occur on the site: Canada thistle, musk thistle, scotch thistle, bull thistle, Russian knapweed, spotted knapweed, and houndstongue. Russian knapweed has not been found on the site for several years, but all the other species continue to be well represented, although weed populations have declined significantly since 2003. Herbicide has been applied to known locations of weeds annually since 2002.	Refer to Weed Location Map for noxious weed locations and areal extent of identified species. Herbicide was applied to all noxious weeds in June and September of the previous year. Evaluate weed control efforts.
10	Retention Pond and Drain Pipes	Drainpipes have been broken for several years; however, no water discharges have been occurring or are expected to occur. June 2006 was the last time water levels in the cell were monitored. Decommissioning of these facilities is expected to occur in the future.	Check security and condition of shed, pond, and surrounding fence.

No.	ITEM	ISSUE	ACTION
11	Outlying area	The Animas/La Plata Reservoir is under construction, and a new utility corridor was built near the west side of the site. Boundary monument BM-6 was destroyed when a pipeline was laid during construction. It was decided not to replace it, as the nearby witness corners are still in place. In 2006, inspectors noted that the northern witness corner was becoming overgrown with oak brush.	Check for activities that could affect site security and integrity. If possible, remove the oak brush obscuring the view of the BM-6 witness corner.

Specific Site Surveillance Features—Durango, Colorado, Disposal Site

FEATURE	**COMMENT**
Entrance Sign (1)	Could be defaced or missing.
Perimeter Signs (81)	Several could be defaced or missing. P2 is missing and will not be replaced. P44 is being undercut by erosion—monitor.
Site Markers (2)	SMK-1 (near the entrance gate) is pockmarked from bullets.
Survey Monuments (4)	
Boundary Monuments (6)	BM-3 and two of its associated reference markers are exposed to erosion. BM-6 is missing due to pipeline construction; it was not replaced because two witness monuments near this property corner are intact and will be used to identify the SW corner of the site. Cut oakbrush away from northern BM-6 witness corner.
Monitor Wells (7)	MW-0605 (upgradient background) MW-0607 (downgradient POC) MW-0608 (downgradient alluvium) MW-0612 (downgradient POC) MW-0618 (companion well to MW-0608 added to network because screen placement is more appropriate than designated well) MW-0621 (downgradient POC) MW-0623 (upgradient alluvium)
Settlement Plates (14)	Do not need to be checked.
Retention Pond	Check condition of retention pond and surrounding fence. Check for leaks in the shed (beware of rodent infestation).

Field Photograph Log

Site: Purpose of Visit:

Date of Visit: Photo Type: Digital

File Name	Azimuth	Field Inspection Photo No.	Trip Report PL No.	Post on Web	Photo Caption

Lead Inspector: ; Assistant Inspector:
Remarks:
Electronic File Location:

Appendix D

Reuse Potential Impacts Matrix

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Aspects of the Durango LTSP Inspection and Potential Impacts Related to a Solar Reuse Project

Inspection Requirement	Impact	Mitigation Measures
Adjacent off-site features (within 0.25 mi) of the site boundary		
Changes in use of adjacent areas	No impacts are anticipated to adjacent off-site features.	None required.
New roads or trails		
Change in the position of nearby stream channels		
Headward erosion of nearby gullies		
New drainage channels		
Access roads and paths, fences, gates, and signs		
Break in the fence	No impact. The disposal cell area is not fenced.	None required.
Posts damaged or their anchoring weakened		
Evidence of erosion or digging beneath the fence		
Gate tampering or damage	Gate damage is possible.	The lease will include the following technical requirements: (1) Security—Lessee shall use its own lock on front gate for continual access and “daisy chain” with DOE’s lock. (2) Improvements to access gate and perimeter fence, as needed, should be considered as an alternative. (3) The site needs to remain locked at all times.
Human intrusion	Because the site is not fenced, human and large animal intrusions already occur.	DOE will designate areas that are restricted and where access is allowed on a site map included with the lease. DOE will maintain the current No Trespassing signs along the site perimeter.
Large animal intrusion		
Access roads and paths passable	Access could be restricted.	DOE will require in the lease that access roads and paths not be blocked.
Monuments and other permanent features		
Survey or boundary monuments defaced or disturbed	No impact.	None required.
Site markers disturbed by man or natural processes	Possible damage to markers on top of the cell.	DOE will not allow solar infrastructure to be installed within 5 feet of the site markers.
Natural processes threatening the integrity of any monument or site marker	No impact.	None required.
Crest		
Uneven settling (depressions, scarps)	Potential settling could occur if unrestricted infrastructure is allowed.	The lease will include the following technical requirements: (1) Settlement—Loads from the panels shall not exceed 300 pounds per square foot bearing pressure on the ground. (2) Machinery used on cover shall have rubber tires, be considered low ground pressure equipment, and not cause visible rutting.
Crest cracking		

Inspection Requirement	Impact	Mitigation Measures
Outer cover layer breached	It is anticipated that some trenching and shallow foundations in the frost barrier of the cover layer may occur.	The lease will include the following technical requirements: (1) Utility trenching or small foundations are limited to a maximum depth of excavation into the cover of 24 inches. The top 6 inches of material (soil/rock matrix) must be separated from deeper excavated soils. Soils must be placed back with 90% standard Proctor compaction. (2) No grading can be performed on the disposal cell cover. (3) Overall integrity of the disposal cell cover must remain intact
Evidence of erosion (1) By water (2) By wind	Solar infrastructure could create a situation in which water running off panels might lead to minor erosion. There would be no increase in the potential for wind erosion.	The lease will include the following technical requirement: (1) Erosion Protection—Panels must not concentrate runoff to create a new runoff pattern across the cell cover. Water running off panels cannot cause erosion of the surface. Lessee must repair any erosion that occurs on the surface. Additionally, DOE will increase the frequency of site inspections to ensure that potential erosion or any other negative impacts are identified and remedied before they become significant.
Evidence of animal burrowing	No impact.	None required.
Slopes		
Evidence of gradual down slope movement or creep (terraces, deflection of plants)	Down slope movement and/or cracking could potentially occur if the rock armor of the side slopes is not protected.	The lease will include the following technical requirement: (1) Rock armor on the channels and side slopes shall not be disturbed.
Slope cracking		
Depressions or bulges on the slope	Depressions or bulges could occur on the slopes with excessive loading or changes to the rock armor.	The lease restrictions requiring the rock armor not be disturbed (above), and the minimal load allowances on top of the cell will be protective of the side slopes of the cell.
Outer cover layer breach	No impact.	The proposed lease language will not allow any breach of the cover layer on the slopes.
Evidence of erosion: (1) By water (2) By Wind	There will be no erosion impact due to wind. Erosion or channeling due to increased or preferential water flow could occur.	The lease will include language that would require that any site infrastructure include a method for moving excess water away from the slopes to prevent erosion or channeling. DOE will increase the frequency of site inspections to ensure that potential erosion, or any other negative impacts are identified and remedied before they become significant.
Channelized water runoff (rivulets, gullies)		
Evidence of seepage (moisture, color, vegetation)	No impact.	None required.
Evidence of animal burrowing	No impact.	None required.

Inspection Requirement	Impact	Mitigation Measures
Evidence of deterioration of riprap or gravel cover	No impact.	None required.
Periphery (within site boundaries)		
Evidence of seepage, such as wet areas or localized change of vegetation	No impact.	None required.
Evidence of sediment transport from the uranium mill tailings by water or wind	No impact.	None required.
Vegetation remains as described in the as-builts	No impact.	DOE will continue to inspect the periphery vegetation as a part of annual inspections.
Drainage remains as described in the as-builts	No impact.	The lease will include the following language: (1) Cut slopes required as part of grading on areas off of disposal cell cover shall not be steeper than 4:1. Natural drainage channels cannot be disturbed. All disturbed areas will be revegetated with approved seed mixture after installation of the panels and after removal of solar panels/infrastructure.
Diversion Channels		
Evidence of bank erosion	No impact.	None required
Evidence of channel erosion		
Disturbance of integrity of riprap structures due to people or natural processes	Potential impact due to people.	The lease restrictions requiring that the rock armor not be disturbed will be inclusive of the diversion channels.
Evidence of sedimentation in the channel	No impact.	None required.
Channel obstruction	The possibility exists that obstructive material could be placed in the channel.	The lease will include language that requires the channel not be disturbed. However the lease will allow an access road to be built on the northern end (high point of the diversion channel) by using geotextile and roadbase.
Evidence that diversion channels are not performing their function	No impact.	DOE will continue to inspect the diversion channels to ensure they are performing their functions as part of annual inspections.
Monitoring Wells		
Disturbance of monitoring wells by man or natural processes	No impact.	None required.
Monitoring well integrity threatened by natural processes		
Monitoring wells capped and locked		

Inspection Requirement	Impact	Mitigation Measures
Other (not identified in the LTSP as requiring specific inspection)		
Maintenance of existing grasses on top of the disposal cell.	If water is more limiting to the plant growth than light, the panels will shade the surface and reduce evaporation loss. Greater near-surface water storage will enhance plant growth, diffuse light will be adequate for plant growth, and overall the water balance won't change significantly. The solar panel infrastructure may also restrict grazing by local wildlife populations, resulting in enhanced growth of the existing grasses.	The drainage layer, Claymax bentonite mat, and compacted clay layer buried 4.5 feet in the cover are the primary barriers for radon release and water infiltration. Evapotranspiration is a secondary measure to limit percolation; thus, any impact of the solar panels on plant growth would be minor. Solar panels are considered temporary and are not part of the long-term design. The lease will include the following language: (1) Existing grasses within solar panel footprint are to remain undisturbed and growing as much as practicable. Any grasses disturbed at end of project shall be reseeded with approved seed mixture.
Removal of noxious weeds and woody plant species.	The LTSP requires that DOE remove unwanted plant species when shoot height equals or exceeds 3.5 feet from the base of the plant. Closely spaced solar panels may inhibit DOE's ability to perform this action.	The lease will include the following language: (1) Panels shall be placed in rows not exceeding 10 feet in width, and have a clear path between the panels to allow access by an all terrain vehicle. Material Safety Data Sheets for herbicides used by DOE for spraying weeds will be given to Lessee to determine compatibility with solar panels. (2) DOE shall have access to solar facility for spraying of noxious weeds, inspections, and maintenance of cell cover.