LMS/PKB/S11796-0.0

Long-Term Surveillance Plan for the Parkersburg, West Virginia, Disposal Site

September 2014

U.S. DEPARTMENT OF ENERGY | Legacy Management

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Abbreviations

AEC	U.S. Atomic Energy Commission
AMAX	AMAX Inc.
B&O	Baltimore and Ohio
CFR	*Code of Federal Regulations*
cm	centimeters
DOE	U.S. Department of Energy
ft	feet
ha	hectares
km	kilometers
LM	Office of Legacy Management
LTSP	Long-Term Surveillance Plan
m	meters
MW	monitoring well
NRC	U.S. Nuclear Regulatory Commission
pCi/L	picocuries per liter
UMTRA	Uranium Mill Tailings Remedial Action
USACE	U.S. Army Corps of Engineers
USC	*United States Code*

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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 fulfill its responsibility for the custody and long-term care of the radioactive material storage area formerly owned by AMAX Inc. (AMAX) at the Parkersburg, West Virginia, Disposal Site. The LTSP describes the long-term surveillance and maintenance activities that are necessary to fulfill the requirements of the site ownership, which was conveyed to DOE on March 4, 1994. DOE assumed ownership of the radioactive materials storage area (Parkersburg site) under the terms of Subtitle D, Section 151(c), of the Nuclear Waste Policy Act of 1982.

1.2 Legal and Regulatory Requirements

Regulations that govern the transfer of ownership of the Parkersburg site to DOE are solely in Subtitle D, Section 151(c), of the Nuclear Waste Policy Act of 1982 (see Title 42 *United States Code* Section 10171(c) [42 USC 10171(c)]). The text of Subtitle D of the Act (enacted on January 7, 1982) is presented in Appendix A. General federal license requirements under the Uranium Mill Tailings Radiation Control Act of 1978 do not apply to this site. Also, no state laws are applicable to the construction of the disposal cell at the site.

1.3 Role of the U.S. Department of Energy

In 1988, DOE designated the Grand Junction, Colorado, office to be the program office for the long-term surveillance and maintenance of all DOE remedial action project disposal sites, as well as other sites as assigned. It was also designated as the common office for the surveillance, monitoring, maintenance, and institutional control of these sites. DOE established the Long-Term Surveillance and Maintenance Program at Grand Junction to carry out this responsibility.

In 2003, DOE established the Office of Legacy Management (LM), which assumed responsibility for all closed DOE sites, including the Parkersburg site. The DOE office in Grand Junction, Colorado, is part of the LM organization. LM is responsible for the implementation and revision of this LTSP.

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2.0 Site Description and History

2.1 Site Location and Description

The Parkersburg site is located in Wood County, West Virginia, about 7 air miles (11 kilometers [km]) west-southwest of Parkersburg, the county seat, and is in the Lubeck magisterial district. Near the site are the villages of Washington and Lubeck about 1 mile (1.6 km) to the northeast and 3 miles (5 km) to the east-southeast, respectively. The center of the 15.16-acre (6.14-hectare [ha]) site containing the stabilization mound is about 2,000 feet (ft) (610 meters [m]) east of the Ohio River in Washington Bottom. The general location of the site is shown in Figure 1.

The Parkersburg site, at latitude 39°15′N and longitude 81°41′W, is in Washington Bottom, an area on the east bank of the Ohio River that contains both agricultural and industrial developments. The site appears on two U.S. Geological Survey 1:24,000-scale topographic maps: the extreme south part of the Little Hocking, Ohio-West Virginia map, and the extreme north part of the Lubeck, West Virginia-Ohio map. Driving directions to the site from downtown Parkersburg are provided in Table 1.

Table 1. Route and Mileage to Parkersburg Site

Mileage	Route
0.0	Junction of State Highway 68 and U.S. Highway 50 in downtown Parkersburg. Proceed south on State Highway 68.
0.2	Start of bridge over Little Kanawha River.
3.0	Junction of State Highway 68 and State Highway 892 (DuPont Road). Turn right on DuPont Road.
6.15	Large facility of the E.I. du Pont de Nemours Company to the right.
6.5	DuPont facility entrance to the right.
6.8	Post Office for the village of Washington to the left.
7.2	Entrance to the large General Electric Plastics facility to the right.
7.7	Turn right (west) on Foster Drive (Secondary State Route No. 34/2).
7.8	About 150 ft (46 m) after crossing the tracks of the Baltimore and Ohio Railroad, turn left (south) on the gravel site access right-of-way road that goes southward for about 750 ft (229 m), crosses two railroad tracks of the spur into the Northwest Pipe Company, and ends near the northeast corner of the Parkersburg site.
7.95	Entrance gate in the security fence surrounding the Parkersburg stabilization mound

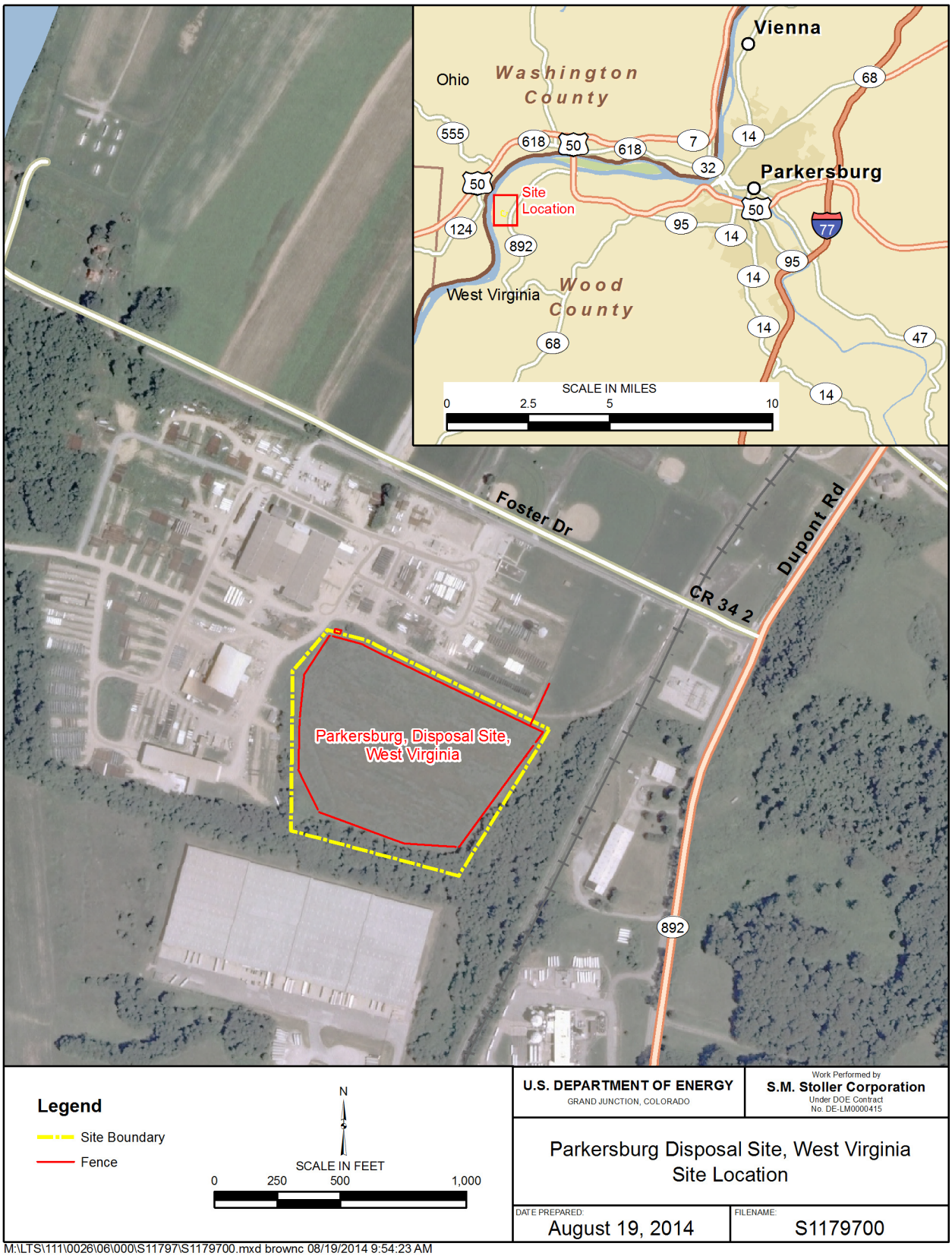

Figure 1. Parkersburg, West Virginia, Disposal Site Location

The Northwest Pipe Company, with several operating buildings, a water tower, a soccer field, and foundations of former buildings, is immediately west and north of the site. North of Foster Drive, agricultural and grazing land extends for about 2,500 ft (762 m) north to the industrial properties of General Electric Plastics and E.I. du Pont de Nemours Company. Land immediately to the east, south, and southwest of the site is used for grazing. Tracks of the Baltimore and Ohio (B&O) Railroad are about 250 to 300 ft (76 to 91 m) east of the site boundary, which they roughly parallel. Just east of the B&O Railroad tracks and south of Foster Drive is an electric power substation. South of the substation and directly east of the site are several buildings housing the insulation contracting and sales business of Nitro Industrial Coverings Inc. Farther to the south and about 700 ft (213 m) southeast of the site are buildings that house the air separation plant of AGA Burdox Inc., which produces oxygen and nitrogen. The large east-striking building is the DuPont Blennerhassett Warehouse, which is only about 150 ft (46 m) south of the site.

Figure 1 shows the boundary of the roughly pentagonal-shaped 15.16-acre (6.14 ha) site property that contains the stabilization mound. A legal description of the site property is provided in Appendix B, which contains the description as stated in the General Warranty Deed of AMAX Land Transfer for Tract 101 on July 8, 1993. This boundary description differs from the May 1987 description by AMAX in its license application to the U.S. Nuclear Regulatory Commission (NRC), mainly in that the azimuth directions had changed slightly to reflect a 1993 resurvey by the U.S. Army Corps of Engineers. Tract 101 is held as fee simple property by DOE. Also in Appendix B is the legal description of Tract 101E, which is the 20-foot-wide permanent access road easement through AMAX-owned property from Foster Drive to the DOE-owned Tract 101 that contains the stabilization mound. Tract 101E contains approximately 0.34 acre (0.14 ha).

The stabilization mound area is enclosed by a security fence that is 6 ft (1.8 m) high. It has one entrance gate and four walk gates (Figure 2), and all the gates are kept locked.

The fence around the stabilization mound was constructed in late 1982 and replaced in 2007. It is set inside the property boundary by a distance that varies from 15 to 100 ft (4.6 to 30 m). The galvanized security fence is approximately 2,900 ft (884 m) long and is of chain-link construction. The entrance gate near the northeast corner of the site property is a 16 ft (5 m) wide double gate. The four walk gates (about 3 ft [0.9 m] wide) are located at the west end of the north fence, midway along the west fence, at the south end of the west fence, and at the east end of the south fence (Figure 2).

Sixteen perimeter/warning signs are posted on the security fence around the site to inform the public of the function and ownership of the site and that trespassing is forbidden. The signs are spaced no more than 200 ft (61 m) apart around the site security fence. Because the site is in an active industrial and agricultural area, human intrusion/vandalism could become a problem. Scheduled site inspections will monitor the effectiveness of these security measures. The DOE 24-hour telephone number on the warning signs provides an additional security measure.

The Parkersburg site was developed in 1957 to produce high-grade zirconium metal for the Naval Reactor Program under a U.S. Atomic Energy Commission (AEC) contract. Zirconium ore was processed until 1970, zirconium and hafnium metal sponge was produced until 1974, and experiments were conducted on baddeleyite ore in 1975 as operations concluded at the site. NRC estimates that 2 million pounds (900,000 kilograms) of zirconium ore, mainly from

Nigeria, were processed at the AMAX-owned site. Residual soil contamination areas on the site were identified in 1977, and in 1978 several fires and explosions were caused by the uncovering of pyrophoric material on the site. Radiologic, geologic, and hydrologic studies of the site commissioned by AMAX resulted in a plan for remedial action provided in the initial stabilization plan (AMAX 1980). Remediation consisted of consolidating the waste material into one area and capping it with clay and topsoil; this was accomplished in the summer and fall of 1982. Details of the construction of the stabilization mound and of two additional groundwater monitoring wells installed on the site are in the Stabilization Plan, Construction, and Final Survey report (AMAX 1984). A more detailed discussion of the history of the site is provided in Section 2.3.

2.2 Site Geology and Climate

The Parkersburg site is in the unglaciated Allegheny Plateau section of the Appalachian Plateaus physiographic province. Although not glaciated, the site is at an elevation of about 630 ft (192 m) on a high terrace that formed from outwash material deposited by the Ohio River during early Wisconsinan glaciation about 65,000 to 75,000 years ago. Most of Washington Bottom consists of this high terrace surface situated about 60 ft (18 m) above the low water level of the Ohio River. West of the site is a narrow low terrace at an elevation of about 600 ft (183 m) that is adjacent to the Ohio River. This low terrace formed from late Wisconsinan glacial outwash and is also part of Washington Bottom. About 700 to 1,000 ft (213 to 305 m) east of the site, just east of DuPont Road, low hills abruptly rise up about 200 ft (61 m) and border Washington Bottom. These hills are formed on bedrock of the Dunkard Group of Pennsylvanian and Permian age (Cardwell et al. 1968). Rocks of this group consist of a cyclic nonmarine sequence of sandstone, siltstone, shale, limestone, and coal. Some of the coal has been removed by strip mines (now abandoned) scattered through the hills. Bedrock at the site, beneath approximately 100 ft (30 m) of glacial outwash sand and gravel, is also the Dunkard Group.

The site location in Washington Bottom at an elevation of about 630 ft (192 m) is higher than the highest recorded Ohio River floodwater level of 616.5 ft (187.9 m) in 1913 (NRC 1982). Because of the nearly flat terrain on the terraces of Washington Bottom, surface-water drainage in the area is poor in places, but generally is through small creeks and ditches that drain westward or southward into the Ohio River. Elevation over the 15.16-acre (6.14 ha) stabilization mound portion of the site property varies only about 30 ft (9 m) from about 644 ft (196 m) at the top of the stabilization mound to about 614 ft (187 m) in the drainage at the southwest corner of the property. Surface water at the site drains generally toward the south through an unnamed creek about 200 ft (61 m) east of the property and a ditch along the west property boundary. Both of these drainages empty into the south-flowing Ohio River within 1 mile (1.6 km) of the site.

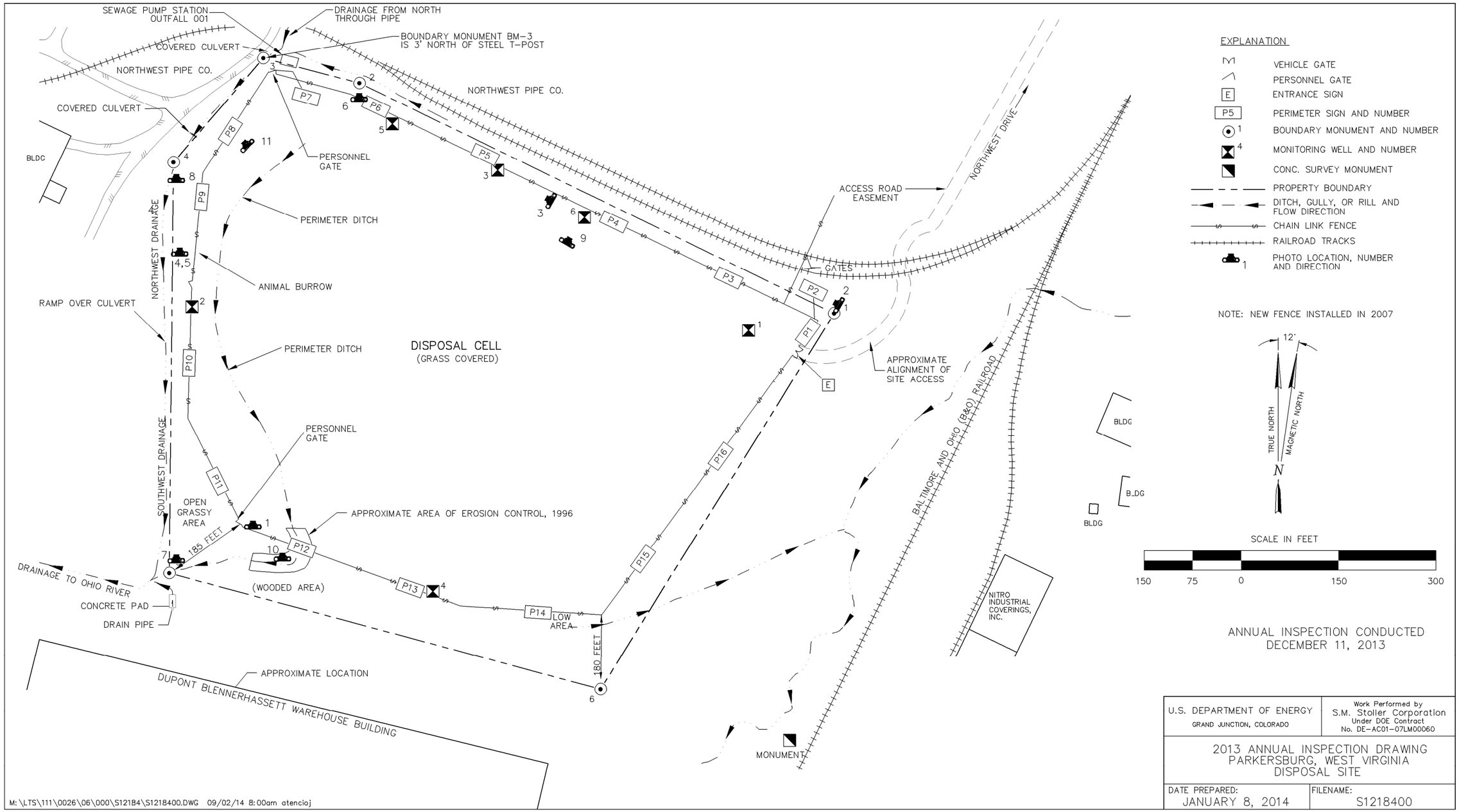

Figure 2. 2013 Annual Inspection Drawing, Parkersburg Site

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Soils in the site area are generally classified as the Huntington-Ashton-Wheeling association, according to the "Soil Survey of Wood and Wirt Counties, West Virginia" (Ellyson et al. 1970). These soils are deep, well-drained, silty, and occur on bottom lands and terraces along the Ohio River on level or gently sloping terrain. More specifically, soil at the site before the stabilization mound was constructed consisted of the Wheeling, Lakin, and Sciotoville series. Wheeling soil is deep, well-drained silt loam that is moderately permeable; it occurs in the west part of the site. Lakin soil is highly permeable loamy sand that developed on deep, sandy (possibly windblown sand) material on low ridges; it occurs in the central and southeast parts of the site. Sciotoville soil is a deep silt loam, moderately well drained, and of moderately low permeability; it occurs in a small area in the northeast part of the site.

The fenced area of the stabilization mound and most of the immediately adjacent area is open and grass-covered. Dense stands of trees are present along the unnamed south-draining creek that is east of the site, and trees are adjacent and south of a small section of the security fence along the south edge of the stabilization mound.

Climate at the Parkersburg site is humid and continental, as inferred from data from the nearby town of Parkersburg (Ellyson et al. 1970). Annual average precipitation is approximately 40 inches (102 centimeters [cm]). Heaviest rainfall is in June, July, and August; lightest precipitation is in September, October, and November. Annual average snowfall is about 24 inches (61 cm). Winter is usually moderated by warm air that flows up along the Ohio River Valley. However, cold and snow can occasionally be severe, as experienced during January 1994 when 40 inches (102 cm) of snow fell. Large diurnal temperature differences are rare; the average daily temperature range is between 15 and 20 °F (8 and 11°C). The lowest average temperature of 33 °F (0 °C) is in January and the highest average temperature of 75 °F (24 °C) is in July. Highest temperatures in summer usually reach into the upper 90s °F (35–38 °C) and lowest winter temperatures are about 0 °F (−18 °C). Prevailing winds are from the southwest. Fog commonly occurs along the Ohio River bottom at night and early morning in the summer and fall.

2.3 Site History

In 1957, the Carborundum Company built a facility to produce high-grade zirconium metal by processing zirconium ore ($ZrSiO_4$), which came mainly from Nigeria. The site of the processing facility included the present area of the stabilization mound and adjacent areas to the west and to the north as far as Foster Drive. The high-grade zirconium metal was produced under an AEC contract for use in the construction of nuclear reactors for the U.S. Navy. The designed capacity for this plant was 600 tons (544 tonnes) of zirconium annually and was an expansion from the company's smaller pilot zirconium-processing facility in Akron, New York.

The zirconium and hafnium (a constituent in the zirconium ore) processing method used at the Parkersburg facility was developed by W.J. Kroll for the U.S. Bureau of Mines. Zirconium ore is first converted to zircon carbonitride and hafnium carbonitride by mixing it with graphite or coke and fusing the mixture. The carbonitrides are chlorinated in a furnace, and the gaseous chlorides of zirconium ($ZrCl_4$, zirconium tetrachloride) and hafnium are collected in a condenser. The zirconium and hafnium chlorides are reduced to their respective metals using the Kroll method, which involves reacting the chlorides with magnesium metal under pressure. In addition to the

magnesium chloride produced in this reaction, another waste product that can become pyrophoric under certain conditions is "sidewall material." The final product, zirconium sponge, contains about 2 percent hafnium and is used in non-nuclear applications. Reactor-grade zirconium (which contains about 0.3 percent hafnium) is produced by dissolving zirconium sponge using methyl isobutyl ketone, and the hafnium is solvent extracted to hafnium thiocyanate. The resulting zirconium sponge is crushed, compacted into electrodes, and vacuum melted to ingots.

From 1959 to 1962, the Carborundum Company processed Nigerian zirconium ore under AEC surveillance and under several licenses. In addition to zirconium, this ore contained about 3 percent hafnium oxide, up to 8 percent thorium (ThO_2), and about 2 percent uranium oxide (UP_8) (NRC 1982). All the ore and the residual materials were stored in drums on the site. The use of this highly radioactive Nigerian ore ended in April 1962, and until January 1964 plant operations were limited to reprocessing and upgrading the zirconium oxide and sponge inventory. In January 1964, plant operations switched to processing Australian zirconium ore, which contained low levels of radioactivity compared to the Nigerian ore.

From June 1965 to May 1967, the site facility was operated under the name of Carborundum Metals Climax Inc., which was a joint venture of Carborundum Metals Company Division and AMAX Specialty Metals Co. Inc. In May 1967, AMAX (a totally owned division of American Metals Climax Inc.) became the sole owner of the facility. By 1968, some of the drums containing the radioactive Nigerian ore and residual materials had deteriorated and spilled on the soils in the storage area. High radioactivity in the contaminated soils exceeded approved levels and it became necessary to move the soils and drums from the site. In September 1968, approximately 3,000 drums of zirconium ore, residual material, and soil were transported from the site to the AEC low-level radioactive waste site at Maxey Flats, near Morehead, Kentucky.

In late 1969, AMAX began purchasing zirconium tetrachloride and discontinued processing zirconium ore. Production of zirconium and hafnium metal sponge continued until November 1974, when all production at the site ended. In November 1974, AMAX obtained a license from NRC to conduct laboratory-scale experiments on baddeleyite ore (ZrO_2), which contained less than 0.5 percent total thorium and uranium. Test material and process residuals were contained in one building. The tests were concluded in late 1975 and all remaining baddeleyite ore and its process materials were transported to Northern Abrasives, a site in Ontario, Canada.

In March 1977, AMAX sold the 375-acre (152 ha) property (only 125 acres [51 ha] of which had been involved with the zirconium-processing operations) and buildings to the L.B. Foster Company, a steel pipe manufacturing business. In September and October 1977, NRC conducted site inspections (associated with the closeout of AMAX's baddeleyite license) and found areas of residual soil contamination associated with Nigerian ore processing. The following cleanup program resulted in 70 drums of contaminated soil being transported to an NRC-approved disposal site in late 1977. During building construction activities by L.B. Foster Company in March 1978, a backhoe excavation encountered pyrophoric waste material that caused several fires and explosions. Investigation of the causes of the explosions determined that AMAX had not adequately terminated its license with the NRC. As a result, AMAX repurchased the property from L.B. Foster Company and began radiological, geological, and hydrological surveys to evaluate the site for cleanup. The first surveys completed were for a radiological assessment of

the site conducted from July through October 1978 (ATCOR Inc. 1978) and an aerial radiological survey flown in August 1978 (EG&G Inc. 1979). During 1979, AMAX leased part of the property found to be free of radiological contamination back to L.B. Foster Company, and L.B. Foster Company pipe manufacturing operations resumed in late 1979 in buildings to the northwest of the present stabilization mound.

In addition to the initial site studies, AMAX started in 1979 a comprehensive series of technical studies to develop a stabilization plan. Soil test pits and two monitoring wells (MW-1 and MW-2) were installed in June 1980 as part of a hydrogeologic evaluation of the of the AMAX site that was completed in August 1980 (Williams, R.E., and Associates 1980). A geotechnical investigation report (Woodward-Clyde Consultants 1980) completed in September 1980 located borrow material, recommended placement and compaction procedures for earthwork in stabilization mound construction, and presented tests of topsoil material in the area. The radiological survey conducted in 1980 by Chem-Nuclear Systems Inc. identified an unrestricted area in which the radiation dose levels were above the acceptable limits found in Title 10 *Code of Federal Regulations* Section 20.105 (10 CFR 20.105) (i.e., NRC regulations for licensed facilities). This survey was presented in the report completed in September 1980 entitled *Radiological Assessment and Stabilization Scenarios* (Chem-Nuclear Systems Inc. 1980). With these technical study report results, AMAX proposed a site stabilization plan to NRC in September 1980 (AMAX 1980). The stabilization plan proposed to consolidate the waste site into one area (which had previously been occupied by the zirconium processing operations), protect public health, and restore much of the property to unrestricted use. The consolidated waste material would be capped with clay and protective topsoil so that radionuclide leaching would be minimized, radon emissions would be reduced, erosion and dispersion would be prevented, and the potential for contact with pyrophoric wastes would be eliminated.

In April 1982, NRC completed an Environmental Impact Appraisal (NRC 1982) that evaluated the environmental impact of the proposed stabilization plan. This document determined that preparation of an Environmental Impact Statement for the proposed action was not necessary. Also in the document the NRC gave its approval with certain provisions for the proposed stabilization plan. The Environmental Impact Appraisal was submitted to EPA for its review and concurrence, but the EPA declined to review the document.

In June 1981, AMAX applied to NRC for a source material license. In June 1982, after the NRC's completion of the Environmental Impact Appraisal, NRC granted AMAX a license authorizing "the collection, stabilization, and storage of the contaminated soil and rubble which is present at and adjacent to the AMAX site." After receipt of the license, AMAX proceeded with stabilization of the site from July to November 1982. During construction of the stabilization mound, Chem-Nuclear Systems Inc. provided radiological data. Two additional monitoring wells (MW-3 and MW-4) were installed in the fall of 1982 during the stabilization mound construction. Details of the radiologically contaminated material removed and of the construction of the stabilization mound where the material was placed are in the Stabilization Plan, Construction, and Final Survey report prepared by AMAX in March 1984 (AMAX 1984). In late 1983, some minor post-construction adjustments were made to the stabilization mound and the adjacent area to facilitate water drainage away from the mound. These adjustments included regrading the slope between the railroad spur and the north edge of the stabilization mound, installing a 120 ft (37 m) section of 42-inch (l07 cm) diameter steel culvert at the north end of the west drainage ditch, installing a 50 ft (15 m) section of 60-inch (152 cm) diameter steel culvert under the ramp over the west drainage ditch, regrading the banks of the west

drainage ditch, and constructing a drainage furrow (perimeter ditch) along the west side of the stabilization mound (AMAX 1984).

The NRC requested that the Oak Ridge Associated Universities Radiological Site Assessment Program conduct a survey to evaluate the effectiveness of remedial action at the AMAX property. This study was completed as a *Radiological Survey of the AMAX Site* and issued in January 1985 (Frame and Berger 1985). Objectives of the survey were to (1) evaluate the adequacy and accuracy of the soil sampling and analytical techniques used by Chem-Nuclear Systems Inc., (2) evaluate the effectiveness of decontamination operations, and (3) determine the radiological status of the site following cleanup, backfilling, and stabilization mound construction.

The requirements of the license issued by NRC to AMAX included a stipulation that biannual inspections of the stabilization mound be conducted and a report submitted to the NRC. In addition, water samples were to be obtained from the four monitoring wells and analyzed for gross alpha and gross beta. The first inspection occurred in December 1982, and two inspections per year were conducted during most years through 1993. All inspections and sampling, except the initial sampling in 1982, were completed by personnel of the West Virginia Department of Health. All water-sample results for alpha and beta activity were below the NRC license criteria of 15 picocuries per liter (pCi/L) for gross alpha and 50 pCi/L for gross beta.

In January 1986, AMAX requested that (1) its contract license be amended to delete the area outside the stabilization mound and (2) the outside area that no longer contained radioactive material be released for unrestricted use. In March 1987, NRC released an Environmental Assessment (NRC 1987) that approved the contract license amendment subject to two conditions. In May 1987, AMAX applied for a renewal of its license to store radioactive contaminated soil and rubble in the stabilization area. This license application include a legal description of the 15.16-acre (6.14 ha) area containing the stabilization mound.

After its license was renewed, AMAX sent a letter to DOE in November 1987 requesting that DOE assume title and custody of the stabilization area. This license termination request was submitted pursuant to Subtitle D, Section 151(c), of the Nuclear Waste Policy Act of 1982, which describes the conditions for such a transfer. AMAX fulfilled the terms for the transfer and DOE was obligated to assume long-term ownership and responsibility for the site. However, under DOE Order 5440.1E, "National Environmental Policy Act Compliance Program," and DOE Order 5400.1, "General Environmental Protection Program," it was DOE's responsibility to (1) assess the potential liabilities the agency might incur as a result of its acceptance of title to the site and (2) determine if the site, as remediated, conformed to applicable state and federal environmental regulations. To answer these concerns, particularly in respect to groundwater flow direction and contamination, radon flux, and erosion potential, DOE collected additional characterization data on the stabilization area in 1994 and 1995.

Rust Geotech, the prime contractor for DOE, conducted the additional site characterization tasks according to the *Work Plan for Confirmation of Waste Containment at the AMAX Radioactive Material Storage Area* (DOE 1993), which was completed in December 1993. Two associated documents, a Sampling and Analysis Plan/Quality Assurance Project Plan (DOE 1994b) and a Health and Safety Plan (DOE 1994a), were prepared in early 1994. To adequately characterize groundwater conditions and movement, two additional monitoring wells (MW-5 and MW-6)

were installed by Rust Geotech along the north edge of the stabilization mound in May 1994. Rust Geotech made radon-flux measurements on the surface of the stabilization mound in August 1994 and prepared a report of the results in September 1994 (Rust Geotech 1994b).

The report on Site Characterization Results (DOE 1995), completed in September 1995, contains results of groundwater and radon sampling and concluded that the buried wastes were properly contained within the AMAX stabilization mound. Groundwater beneath the site complies with State of West Virginia groundwater standards and with federal Safe Drinking Water Act standards. Radon emissions were found to comply with the National Emission Standards for Hazardous Air Pollutants codified at 40 CFR 61, Subpart Q. On the basis of computer modeling results of hydrologic conditions downgradient from the stabilization mound, it was recommended that additional groundwater sampling at MW-5 and MW-6 sometime from 1997 to 2002 (15 to 20 years after site closure) might detect slow-moving contamination that has migrated downgradient (north to northeast) from the stabilization mound.

As part of the preparation for transfer of site ownership from AMAX to DOE, the U.S. Army Corps of Engineers (USACE), Huntington District, conducted surveys of the site and of an access road to the site. In February 1993, USACE surveyed the site security fence and its nine corners and determined that the fence enclosed an area of 12.098 acres (4.896 ha). USACE also surveyed a 20 ft (6 m) wide right-of-way easement for a site access road from Foster Drive to the entrance gate near the northeast corner of the security fence around the stabilization mound. The area of this right-of-way was determined to be approximately 0.34 acre (0.13 ha). On July 8, 1993, a General Warranty Deed (Appendix B) transferred title for Tracts 101 (the stabilization mound area) and Tract 101E (the permanent access road easement) from AMAX to DOE. However, ownership of the site was not formally assumed by DOE until March 4, 1994. As a result of the ownership transfer, on June 7, 1994, the NRC cancelled AMAX's license for the site. Additional characterization work in 1994 at the site created the need for another survey, which Rust Geotech subcontracted to a private surveyor. This survey was conducted in May 1995 and consisted of the following determinations: elevations of all six monitoring wells, horizontal coordinates of the two new monitoring wells (MW-5 and MW-6), and horizontal and vertical coordinates for the six new boundary monuments.

An initial or baseline inspection of the Parkersburg site was conducted by Rust Geotech in March 1994 (Rust Geotech 1994a). This inspection found the site to be in good condition; the main recommendations were to control the headward erosion of the gully near the southwest corner of the site and to set boundary monuments delineating the site property. Six boundary monuments were set on the property corners in late 1994. The second annual inspection of the site was conducted by Rust Geotech in March 1995 (Rust Geotech 1995). This inspection found the site to be in good condition; the main recommendations were to control the headward erosion of the gully near the southwest corner of the site and to install warning signs on the security fence. The signs were installed on the site security fence in the summer of 1995, and a design for the control of erosion in the gully near the southwest corner of the site was implemented in 1996.

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3.0 Final Site Conditions

3.1 Disposal Cell Design

The stabilization mound inside the security fence at the site covers an area of about 12 acres (4.9 ha). The mound was constructed from July to November 1982 by Chem-Nuclear Systems Inc. under contract to AMAX. Radioactive soil and other debris were removed from other parts of the AMAX property and placed on grade. Part of the existing grade included concrete pad foundations of two buildings (i.e., a fabrication shop to the west and a weld shop to the east) that L.B. Foster Company had started to build in 1978. Construction activities on the buildings had been halted because of explosions resulting from encounters with pyrophoric material, believed to be zirconium and magnesium metal. During construction of the mound, an effort was made to place the most contaminated soil on the concrete pads for the buildings (AMAX 1984). The resulting grass-covered, gently-sloping stabilization mound rises to a maximum height of only about 9 ft (3 m).

Because the mound is gently sloping, surface drainage off the mound is not well defined. To improve surface drainage, in late 1983, about a year after the mound was constructed, a shallow drainage furrow (perimeter ditch in Figure 2) was constructed in the west side of the mound to channel water to the south off the mound. To protect the stabilization mound from horizontal movement of offsite shallow subsurface groundwater, a 2 ft (0.6 m) wide barrier trench from 4 to 7 ft (1.2 to 2.1 m) deep was dug around the perimeter of the mound and backfilled with compacted clay (AMAX 1984).

Radioactive soil and pyrophoric material in the stabilization mound are capped by clay and protective topsoil. Information on the construction of the stabilization mound is in the Stabilization Plan, Construction, and Final Survey report (AMAX 1984). A conceptual schematic section of the component layers of the stabilization mound is shown in Figure 3.

Radiologically contaminated soil and debris placed on grade was compacted by D8 bulldozers and tandem truck wheels. An inorganic clayey soil obtained from the field west of the site was spread over the contaminated material and compacted to a dense 6-inch (15 cm) thick layer using a flat drum vibrator roller. A low permeability clay cap layer 12 inches (30 cm) thick was constructed over the clayey soil layer to protect the waste material from leaching. The clay material, classified as CL and with a high percentage of inorganic clay, was selectively borrowed from the floodplain (a low terrace) just east of the Ohio River to the west of the site. Water was added as necessary to maintain optimum moisture content (about 20 percent) of the clayey material as it was spread by scrapers and compacted using a flat drum vibrator compactor. The clay material in compaction tests exceeded 90 percent density, and permeability of the layer was less than 1×10^{-7} cm/second.

A 30-inch (76 cm) thick layer of topsoil was placed over the clay cap to protect it from weathering and erosion and to provide a soil base for growth of grass cover. The topsoil was obtained from borrow areas just west of the site and was compacted by a smooth drum vibrating compactor after being placed on the mound. The final 6 inches (15 cm) of topsoil was not compacted to allow for seeding of grass. Construction of the topsoil layer allowed surface drainage from all directions off the stabilization mound by limiting the final grade to between 1 and 5 percent over areas where the contaminated material had been placed. The final surface

grade exceeded 5 percent at the southwest edge of the mound, which is outside the area where contaminated material was deposited. In late fall 1982, fertilizer, grass seed, and mulch were spread by a hydromulch system over the final grade of the mound surface. The mixture of grasses seeded on the mound included winter wheat, Kentucky 31 Fescue (bluegrass), rye, and red clover.

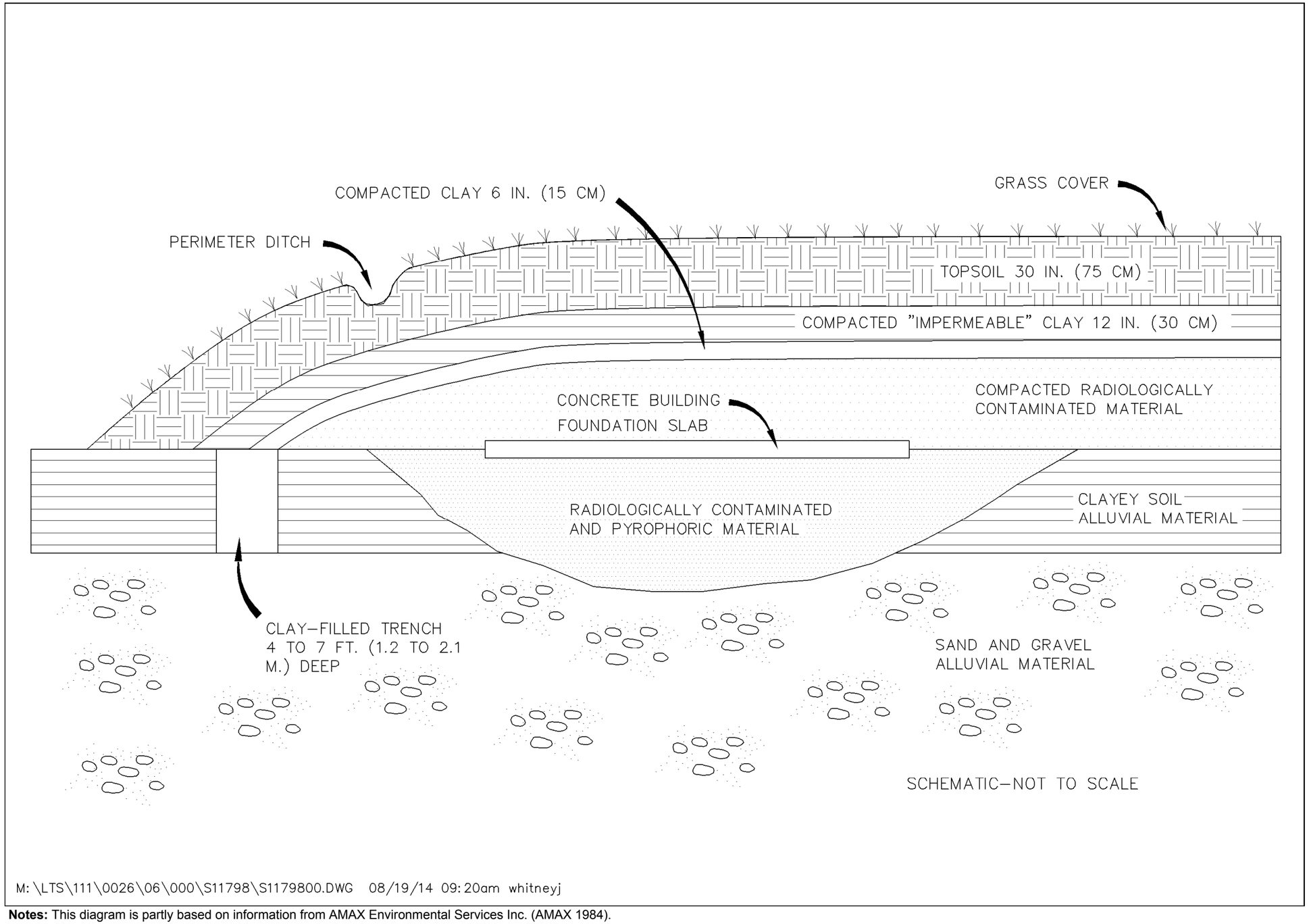
The surface condition of the stabilization mound are monitored during annual inspections to determine if the mound and erosion protection measures are functioning as designed.

3.2 Site Drawings

At the completion of remedial action, certain as-built conditions of the stabilization mound and adjacent area were documented by drawings, maps, and aerial photographs. This information is mainly in the Stabilization Plan, Construction, and Final Survey report (AMAX 1984) and the *Radiological Survey of the AMAX Site, Parkersburg, West Virginia* (Frame and Berger 1985). Conditions at the site just before the termination of AMAX's license are documented in a 1994 Annual Site Inspection report about the inspection conducted in March 1994 (Rust Geotech 1994a). Site conditions soon after the site was transferred to DOE are described in a 1995 Annual Site Inspection report conducted in March 1995 (Rust Geotech 1995). The baseline conditions provided by these reports are the basis against which future conditions at the site can be compared.

3.3 Permanent Site Surveillance Features

Permanent surveillance features at the Parkersburg site consist of boundary monuments, warning or perimeter signs, and monitoring wells. Six boundary monuments define the six corners of the legal boundary of the site property. Sixteen warning signs are placed on the security fence at spaced intervals around the perimeter of the site so that one or more of the signs is visible in daylight to a person approaching the site from any direction. The construction and emplacement of the boundary monuments and warning signs was accomplished according to specifications in DOE's *Guidance for Implementing the UMTRA Project Long-Term Surveillance Program* (DOE 1992). Six groundwater monitoring wells are around the perimeter of the stabilization mound and inside the security fence; wells are located in the north (three wells), west-central, south-central, and northeast parts of the site.



Notes: This diagram is partly based on information from AMAX Environmental Services Inc. (AMAX 1984).

Figure 3. Conceptual Schematic Section of Stabilization Mound

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3.3.1 Boundary Monuments

Berntsen Federal aluminum survey monuments, Model A-1, were used for the six boundary monuments (Figure 4). Ceramic magnets are epoxied into the cap and base of each monument and are vertically oriented so that the monument can easily be found if it becomes buried. Each 4 ft (1.2 m) long monument is set with the cap within several inches above the ground surface. All the monuments are set exactly on the property line. Because thick grass covers the stabilization mound and adjacent area, the boundary monuments may become difficult to locate with time. For this reason, a steel "T" bar fence post that stands 5 ft (1.5 m) above the ground surface was set beside each boundary monument as a reference post to aid in location of the boundary monument. Survey coordinates and elevation for each of the six boundary monuments are given in Table 2.

Table 2. Survey Coordinates and Elevations for Boundary Monuments and Monitoring Wells at Parkersburg Site

Feature	Coordinates[a]		Elevation (ft)	
	North (N)	East (E)	Ground[b]	Measuring Point
Boundary Monument 1	280,769.373	1,381,610.297	631.99	
Boundary Monument 2	281,125.097	1,380,878.172	629.11	
Boundary Monument 3	281,163.526	1,380,730.015	626.75	
Boundary Monument 4	281,002.681	1,380,591.266	618.45	
Boundary Monument 5	280,367.203	1,380,584.925	611.66	
Boundary Monument 6	280,188.014	1;381,250.134	634.50	
Monitoring Well 1			636.8	638.65
Monitoring Well 2			631.7	633.44
Monitoring Well 3			636.2	638.19
Monitoring Well 4			637.3	639.58
Monitoring Well 5	281,062.002	1,380,928.770	636.0	638.65
Monitoring Well 6	280,917.444	1,381,225.080	635.4	638.05

[a] Coordinates for the older monitoring wells, MW-1 though MW-4, were not determined in this 1995 survey.
[b] Elevation shown for the boundary monuments is that of the survey cap.

In 2011, Boundary Monument 2 was replaced because the original boundary marker had been damaged by grounds maintenance equipment, and Boundary Monument 4 was raised in order to make it more visible.

3.3.2 Perimeter Signs

Sixteen perimeter (warning) signs are mounted on the security fence around the site. The signs are metal or plastic, approximately 24 inches (61 cm) wide and 18 inches (46 cm) high. Perimeter signs state that the site is U.S. Government property, and that no trespassing is allowed. The international symbol for radioactive materials (trefoil) on the signs warns of the potential hazard, although there is no hazard as long as the engineered cover over the disposal mound remains intact and disposal site groundwater is not used.

An entrance sign is posted on the entrance gate. This sign provides the same information as the perimeter signs and also has the site name and a 24-hour telephone number for emergencies or inquiry.

3.3.3 Monitoring Wells

Six monitoring wells (MWs) are around the edge of the stabilization mound, just inside the site security fence. The wells are numbered in the chronological order in which they were drilled and installed and are shown on Figure 2. MW-1 through MW-4 were drilled and installed by AMAX; MW-1 and MW-2 in June 1980 and MW-3 and MW-4 in the fall of 1982. MW-5 and MW-6 were drilled and installed by Rust Geotech in May 1994.

The well heads of the first four wells are protected by rusting steel casings about 2 ft (0.6 m) in diameter that rise 2 to 3 ft (0.6 to 0.9 m) above the ground surface. The casing for MW-3 leans about 15 degrees to the east, is loose, and apparently is not cemented to the subsurface well casing. The top of each steel well casing is closed by a steel cap, which is locked by a padlock. Well construction and completion records are incomplete for these four wells. Completion information for MW-1 and MW-2 is in a report on the hydrogeology of the AMAX property (Williams, R.E., and Associates 1980). Scant information on MW-3 and MW-4 is in the Stabilization Plan, Construction, and Final Survey report (AMAX 1984).

The last two wells (MW-5 and MW-6) in the north part of the site have their well heads protected by a steel casing of about 8 inches (20 cm) diameter that rises about 18 inches (46 cm) above a concrete pad resting on the ground surface. Three steel posts set in each concrete well pad provide further protection for the well head. The top of each steel well casing is covered by a steel cap, which is secured by a padlock. Well completion and lithologic information are in the report on Site Characterization Results (DOE 1995).

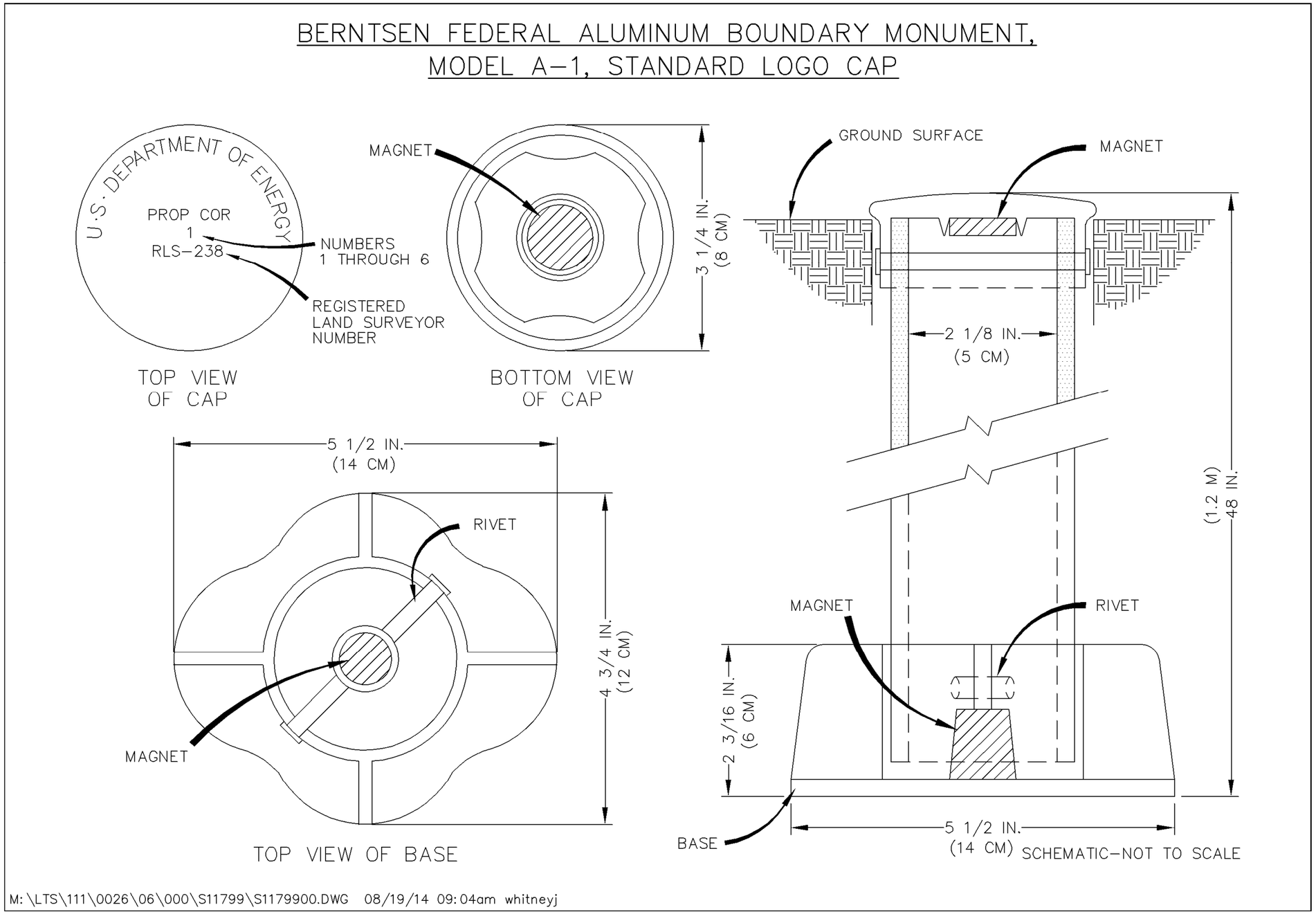

Figure 4. Boundary Monument at Parkersburg Site

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4.0 Long-Term Surveillance and Maintenance Program

4.1 Site Inspections

Inspections of the Parkersburg site will be conducted to confirm the integrity of visible features and to determine the need, if any, for maintenance, additional inspections, or monitoring. The principal objective of a site inspection is to identify potential problems before extensive maintenance, corrective action, or repairs are needed. Identification and documentation of progressive change caused by slow-acting natural processes are a fundamental part of the inspections. Findings from these inspections will be compared to initial baseline conditions to provide a basis for future inspections. Two types of site inspections exist: (1) scheduled inspections and (2) follow-up inspections.

Each site inspection is documented in a report that identifies the findings of the inspection. Inspection reports are maintained by LM and are posted to the LM website for access by the public.

No prior notification or permission is necessary for access to the Parkersburg site. However, personnel working onsite are advised to inform the Northwest Pipe Company (which occupies land north and west of the site) of their presence on or adjacent to the site.

4.1.1 Scheduled Inspections

DOE will inspect the Parkersburg site once each calendar year. The date of the inspection may vary from year to year, but DOE will endeavor to inspect the site once every 12 months unless circumstances warrant variance. The variance will be explained in the inspection report.

Late summer and fall are preferred times for inspections at the Parkersburg site. This is a relatively dry time of year and insect nuisances tend to be at a minimum. In addition, it is near the end of the growing season so the effect of vegetative growth on and around the stabilization mound can be assessed.

During the fiscal year 2015 inspection (in the fall of 2014), an assessment will be made to determine whether a less frequent inspection frequency is warranted. Any recommendation to change the sampling frequency will be based on previous inspection findings, how well the vegetation is being maintained, and how well institutional controls are being maintained. Because general federal license requirements under the Uranium Mill Tailings Radiation Control Act of 1978 do not apply to the Parkersburg site, NRC approval of a change to the scheduled inspection frequency is not required.

4.1.2 Inspection Procedure

To ensure a thorough and uniform inspection, the site is divided into areas called transects. Each transect is visually inspected during a walkover. Within each transect, inspectors examine specific site surveillance features, such as monitoring wells, survey monument, boundary monuments, and perimeter signs. These features are listed on the site inspection checklist, and posted on the site inspection map (Figure 2). Inspectors also examine each transect for the success of previous maintenance and for erosion, settling, slumping, plant or animal

encroachment, human intrusion or vandalism, and other activity or phenomenon that might affect the safety, integrity, long-term performance, or institutional control of the site. Inspectors may use photographs to support or supplement written observations.

For the Parkersburg site, the following two transects are identified: (1) stabilization mound and (2) site perimeter and outlying area.

- **Stabilization mound:** Inspectors will walk over the entire area of the stabilization mound inside the security fence. The objective is to achieve thorough visual coverage of the surface condition of the mound. Inspectors will search for evidence of differential settling or depressions in the mound surface that could affect drainage and cause ponding of water. The presence of vehicle ruts, from water-sampling or grass-mowing activities conducted during times of wet/soft ground conditions, also can affect drainage and create areas of ponded water. Evidence of erosion, slumping, and seepage will be sought along the steeper-sloping southwest edge of the stabilization mound. Wet areas on the mound surface and areas where running water has cut drainage pathways (rills) will be noted. The condition and composition of the grass cover (density and health of grass, discolored or dying grass, and mowed height of grass) will be noted. The mound surface will be examined for disturbances by animals (woodchuck burrows and mice/gopher holes). Trash deposited by wind from nearby industries will be noted and removed from the mound. Inspectors will walk along the length of the perimeter ditch to determine whether drainage is occurring and the ditch is functioning as designed. Included in this transect are the six monitoring wells, and their conditions will be noted.
- **Site perimeter and outlying area:** This transect includes the security fence, gates, and warning signs; the six boundary monuments; the area around the perimeter of the stabilization mound, generally from the security fence outward about 200 ft (61 m); and the site access road. Inspectors will note any damage to the security fence, gates, and warning signs (and whether any are missing). Emphasis in the area outside the fence will be on the progress of gully erosion in the southwest corner of the site property that is advancing headward toward the edge of the stabilization mound. Erosion rills should be noted, along with an evaluation of whether they are extensions of rills formed on the stabilization mound. Progress of erosion in the drainage with respect to Boundary Monuments 3 through 5 will be noted. Seep areas and other indications of seeps, such as discolored grass or soils, will be noted. Animal burrow location and frequency will be noted so their activities and movements in relation to the stabilization mound can be determined. The condition of the grass cover and the extent of woodland along the south edge of the site property will be noted. The presence and evidence of grazing animals will be noted. Wind-transported trash will be removed from the site property (from the security fence to the property boundary). The condition of the site access road will be noted along with any adjacent land uses that might restrict use of the road. Other changes in the outlying area that might be significant include new development, changes in land use, improvements or adjustments along the railroad right-of-way, and changes adjacent to the site.

4.1.3 Inspection Checklist and Map

Before each inspection, inspectors are briefed, and the inspection checklist is reviewed and revised as necessary to reflect changing site conditions. A sample checklist is provided in Appendix C. The checklist includes the following:

- Specific site surveillance features to be inspected
- Routine observations to be made
- Special issues or problems to be evaluated

Inspectors also will carry site inspection maps. The base map, represented in Figure 2, will be annotated to reflect recent observations, issues, and photograph locations. Inspectors will annotate the map, sign and date it, and submit it to the inspection case file. Map information will be processed for inclusion in the inspection report and will constitute the basis for the following year's inspection map.

4.1.4 Personnel

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

Inspectors will be assigned to a given inspection of the Parkersburg site on the basis of the 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 can be assigned to the inspection to evaluate serious or unusual problems and to make appropriate recommendations.

4.1.5 Inspection Report

After each scheduled inspection, a site inspection report will be completed that includes the following information:

- A narrative that describes the inspection, including results and recommendations.
- An inspection map (Figure 2) that will show photograph locations, locations of new or anomalous features, locations of features identified during previous inspections for observation or monitoring, and the inspection date.
- Photographs and an inspection photograph log that describes each photograph.
- Descriptions of any new conditions discovered during the inspection that require monitoring or immediate action, along with any recommendations for a follow-up inspection (if required) or custodial maintenance or repair.

4.1.6 Follow-Up Inspections

Follow-up inspections are unscheduled inspections conducted to investigate and quantify specific problems found during a scheduled inspection, groundwater sampling event, or special study.

They determine whether processes that are active at or near the site threaten site security or stability, and they evaluate the need for custodial maintenance, repair, or corrective action.

A follow-up inspection begins with an onsite visit to assess the need for definitive tests or studies. Additional visits may be scheduled if more data are needed to form conclusions and recommend corrective action.

After completion of the follow-up inspection, the information will be analyzed and a follow-up inspection report will be prepared within 60 days of the follow-up inspection date. The report will include at least the following:

- A description of the problem
- A preliminary assessment of any maintenance, repair, or corrective action required
- Conclusions and recommendations
- Assessment data, including field and inspection data, and photographs
- Names and qualifications of the field inspectors

4.1.7 Custodial Maintenance or Repair

Custodial maintenance will be performed as needed at the Parkersburg disposal site. The need to conduct unscheduled maintenance or repair will be based on the results of annual site inspections and follow-up inspections.

Planned maintenance at the site consists of cutting the grass on the stabilization mound and within the site boundary, keeping vegetation off of the site perimeter fence, and controlling noxious and evasive plant species. Grass cutting occurs at least once per year; a second cutting may occur if conditions warrant.

Unscheduled maintenance or repairs that might be required at the Parkersburg disposal site include the following:

- Repairing the security fence and gates
- Replacing perimeter warning signs
- Reestablishing boundary monuments or establishing reference boundary monuments
- Repairing the site access road
- Building erosion control structures in drainages on the west and southwest edges of the site
- Removing trees and brush from the security fence along the south side of the site
- Controlling burrowing animals on and near the stabilization mound

Any maintenance work will be conducted through a prepared statement of work (including subcontractor qualifications) and a purchase order to authorize the types of repair. The annual inspection report will include a summary of the work that was necessary to remediate an unscheduled maintenance or repair item. After work completion, the subcontractor must submit verification of the completed work and/or a written report if the action is considered significant. DOE will inspect the site, as necessary, and review the report before certifying that all work is

completed in accordance with all required specifications. Copies of all records, documentation, and certifications will be maintained by LM.

4.1.8 Environmental Monitoring

Groundwater monitoring is the only environmental monitoring taking place at the Parkersburg site. Water levels are monitored in six wells (MW-1 through MW-6), and water quality is monitored in two wells (MW-5 and MW-6). Well locations are shown in Figure 2.

The need for groundwater monitoring at the Parkersburg disposal site was evaluated in accordance with DOE Order 5440.1E, "National Environmental Policy Act Compliance Program," and DOE Order 5400.1, "General Environmental Protection Program." Groundwater sampling and analysis of the sample data, as part of additional characterization at the site during 1994 and 1995 (DOE 1995), determined that the groundwater complied with State of West Virginia groundwater standards and with Federal Safe Drinking Water Act standards.

As part of the site characterization (DOE 1995), a hydrologic assessment and computer modeling were performed to estimate the number of years a contaminant plume would take to reach downgradient wells MW-5 or MW-6 just north of the stabilization mound under “worst case,” “most-likely case,” and “best case” scenarios. The computer modeling was programmed to begin in 1982 (the year that stabilization was completed). The results of the three scenarios are shown in Table 3.

Table 3. Groundwater Model Predictions

Scenarios	Number of Years	Dates
Worst Case	15–20	1997–2002
Most-Likely Case	35–40	2017–2022
Best Case	95–100	2077–2083

The worst-case scenario assumed that the cover of the stabilization mound allowed water to infiltrate and saturate the buried radiologically contaminated material, forming a contaminant plume that would migrate about 60 ft (18 m) downward through alluvial material to the alluvial aquifer.

Based on the site characterization results (DOE 1995), sampling of groundwater at the Parkersburg site takes place in MW-5 and MW-6. Analysis of groundwater includes metals (antimony, barium, beryllium, cadmium, chromium, lead, mercury, nickel, selenium, and thallium), hafnium, zirconium, thiocyanate, major cations and anions (calcium, magnesium, potassium, sodium, chloride, sulfate, and nitrate+nitrite), radionuclides (radium-226, radium-228, and uranium), gross alpha, and gross beta. Analytical results are compared with results of samples collected in 1994 and 1995 (published in a report on Site Characterization Results [DOE 1995]) to determine if changes in groundwater quality have occurred.

An initial sampling period was defined from 1997 to 2002 to correspond to the model-predicted “worst case” scenario. Because modeling results indicated that contamination of the aquifer would occur relatively slowly, it was recommended that groundwater quality would be

monitored once every 5 to 10 years after the initial sampling time period (1997 to 2002). Up until 2014, sampling was conducted on a 5-year schedule.

A groundwater monitoring assessment was conducted for the Parkersburg Disposal Site in 2014 (DOE 2014). The recommendation made in that assessment was to transition the monitoring frequency from once every 5 years to once every 10 years. The assessment is attached as (Appendix D).

In August 2014, DOE approved the assessment recommendation to implement the 10 year groundwater monitoring frequency that was envisioned and approved by NRC in the previous issued LTSP (1995). The next scheduled sampling event at Parkersburg is scheduled to take place in 2023, and then every 10 years following.

4.1.9 Corrective Action

If natural or unpredictable events threaten the stability of the stabilization mound, corrective action appropriate to the problem could include temporary emergency measures. In addition, the factors that caused the problem would be evaluated to ensure that recurrence is minimized or avoided. A report of the evaluation would be prepared.

4.1.10 Records and Data Management

To support post-remediation maintenance of the Parkersburg site, LM maintains records at the LM office in Grand Junction, Colorado, and at the LM Business Center in Morgantown, West Virginia. These 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. Site historical records about the environmental remediation and stewardship are included in their site record holdings. All LM records will be managed in accordance with the following requirements:

- 44 USC 29, "Records Management by the Archivist of the United States and by the Administrator of General Services," *United States Code*, available online at http://www.law.cornell.edu/uscode/text/44/chapter-29
- 44 USC 31, "Records Management by Federal Agencies," *United States Code*, available online at http://www.law.cornell.edu/uscode/text/44/chapter-31
- 44 USC 33, "Disposal of Records," *United States Code*, available online at http://www.archives.gov/about/laws/disposal-of-records.html
- 36 CFR 1220–1239, Chapter 12, Subchapter B, "Records Management"
- DOE Order 243.1B Chg 1, *Records Management Program*, U.S. Department of Energy, Washington, D.C., available online at https://www.directives.doe.gov/directives-documents/200-series/0243.1-BOrder-b-admchg1
- LM Records Management Program procedures

4.1.11 Emergency Notification and Reporting

Notification agreements have not been established with local (county), state, and federal government agencies for notification of DOE in the event of human intrusion or unusual or catastrophic natural events in the vicinity of the Parkersburg site. However, the site is equipped with warning signs posted on the security fence that display a 24-hour DOE telephone number, which the public can use to report problems at the site.

4.1.12 Quality Assurance

All activities related to the surveillance, monitoring, and maintenance of the Parkersburg site will be in compliance with the LM *Quality Assurance Manual* (LMS/POL/S04320).

4.1.13 Health and Safety

Work at the Parkersburg site is performed in accordance with safety regulations promulgated by DOE and the Occupational Health and Safety Administration, including the provisions found in 10 CFR 851. Prior to the initiation of work, a job safety analysis is developed by the supervisor responsible for the work activity and the assigned workers, and it is then approved by a Health and Safety representative in accordance with the five core functions of the Integrated Safety Management System. Site-specific information related to known hazards and emergency information can be found in the *Comprehensive Emergency Management System* (LMS/POL/S04326).

All personnel assigned to a work activity or visiting the site are briefed to the approved job safety analysis and are required to have the proper personal protective equipment and communication equipment available for their immediate use.

Maintenance subcontractors are required to follow this same process in accordance with the requirements of 10 CFR 851, which are found in their specific contract documents.

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Appendix A

Subtitle D of Nuclear Waste Policy Act

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U.S. Department of Energy
Office of Civilian Radioactive
Waste Management
Washington, D.C. 20585

March 2004

Nuclear Waste Policy Act AS AMENDED

WITH APPROPRIATIONS
ACTS APPENDED

THE NUCLEAR WASTE POLICY ACT OF 1982[1]

An Act to provide for the development of repositories for the disposal of high-level radioactive waste and spent nuclear fuel, to establish a program of research, development, and demonstration regarding the disposal of high-level radioactive waste and spent nuclear fuel, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SHORT TITLE AND TABLE OF CONTENTS

Section 1. This Act may be cited as the "Nuclear Waste Policy Act of 1982".

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[1] This reproduction of the Act consists of the Act of Jan. 7, 1983 (Public Law 97-425; 96 Stat. 2201), as amended by P.L. 100-203, Title V, Subtitle A (December 22, 1987), P.L. 100-507 (October 18, 1988), and P.L. 102-486 (The Energy Policy Act of 1992, October 24, 1992). The Act is generally codified at 42 U.S.C. 10101 and following. Bracketed notes at the end of each section indicate the United States Code citation for the reader's convenience.

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shall apply to the State, to affected Indian tribes and to affected units of local government in the case of a monitored retrievable storage facility in the same manner as for a repository.
[42 U.S.C.10169]

SUBTITLE D—LOW-LEVEL RADIOACTIVE WASTE
FINANCIAL ARRANGEMENTS FOR LOW-LEVEL RADIOACTIVE WASTE SITE CLOSURE

Sec: 151. (a) Financial arrangements.

(1) The Commission shall establish by rule, regulation, or order, after public notice, and in accordance with section 181 of the Atomic Energy Act of 1954 [42 U.S.C. 2231 et seq.], such standards and instructions as the Commission may deem necessary or desirable to ensure in the case of each license for the disposal of low-level radioactive waste that an adequate bond, surety, or other financial arrangement (as determined by the Commission) will be provided by a licensee to permit completion of all requirements established by the Commission for the decontamination, decommissioning, site closure, and reclamation of sites, structures, and equipment used in conjunction with such low-level radioactive waste. Such financial arrangements shall be provided and approved by the Commission, or, in the case of sites within the boundaries of any agreement State under section 274 of the Atomic Energy Act of 1954 [42 U.S.C. 2021], by the appropriate State or State entity, prior to issuance of licenses for low-level radioactive waste disposal or, in the case of licenses in effect on the date of the enactment of this Act [enacted Jan. 7, 1983] prior to termination of such licenses.

(2) If the Commission determines that any long-term maintenance or monitoring, or both, will be necessary at a site described in paragraph (1), the Commission shall ensure before termination of the license involved that the licensee has made available such bonding, surety, or other financial arrangements as may be necessary to ensure that any necessary long-term maintenance or monitoring needed for such site will be carried out by the person having title and custody for such site following license termination.

(b) Title and custody.

(1) The Secretary shall have authority to assume title and custody of low-level radioactive waste and the land on which such waste is disposed of, upon request of the owner of such waste and land and following termination of the license issued by the Commission for such disposal, if the Commission determines that—

(A) the requirements of the Commission for site closure, decommissioning, and decontamination have been met by the licensee involved and that such licensee is in compliance with the provisions of subsection (a);

(B) such title and custody will be transferred to the Secretary without cost to the Federal Government; and

(C) Federal ownership and management of such site is necessary or desirable in order to protect the public health and safety, and the environment.

(2) If the Secretary assumes title and custody of any such waste and land under this subsection, the Secretary shall maintain such waste and land in a manner that will protect the public health and safety, and the environment.

(c) Special sites. If the low-level radioactive waste involved is the result of a licensed activity to recover zirconium, hafnium, and rare earths from source material, the Secretary, upon request of the owner of the site involved, shall assume title and custody of such waste and the land on which it is disposed when such site has been decontaminated and stabilized in accordance with the requirements established by the Commission and when such owner has made adequate financial arrangements approved by the Commission for the long-term maintenance and monitoring of such site.
[42 U.S.C. 10171]

SUBTITLE E—REDIRECTION OF THE NUCLEAR WASTE PROGRAM
SELECTION OF YUCCA MOUNTAIN SITE

Sec. 160. (a) In general.

(1) The Secretary shall provide for an orderly phase-out of site specific activities at all candidate sites other than the Yucca Mountain site.

(2) The Secretary shall terminate all site specific activities (other than reclamation activities) at all candidate sites, other than the Yucca Mountain site, within 90 days after the date of enactment of the Nuclear Waste Policy Amendments Act of 1987 [enacted Dec. 22,1987].

(b) Effective on the date of the enactment of the Nuclear Waste Policy Amendments Act of 1987 [enacted Dec. 22, 1987], the State of Nevada shall be eligible to enter into a benefits agreement with the Secretary under section 170 [42 U.S.C. 14173].
[42 U.S.C.10172]

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Appendix B

Legal Description of Site

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Legal Description

The Parkersburg site consists of two tracts (101 and 101E), which together comprise a 15.50-ac (6.27-ha) parcel of land at approximately 39° 15' N and 81° 41' W in the Washington Bottom area of Wood County, West Virginia. Only Tract 101 is held by the DOE as fee simple property; Tract 101E is a permanent access road easement through AMAX-owned property. The boundary of each tract is described in the following two paragraphs and is shown in Plate 1.

TRACT NO. 101

Beginning at an iron pin on the westerly right-of-way line of the Baltimore and Ohio Railroad Company at its intersection with the northerly line of Lot 2 of the Francis Keene Lewis Partition, a plat of which is of record in the Office of the Clerk of the County Commission of Wood County, West Virginia, in Deed Book 124, Page 313, which beginning point is further described as being located N 66° 38' 40" W 2564.68 ft from an iron pipe at the northeasterly corner of said Lot 2; thence, S 26° 23' 39" W along said westerly railroad right-of-way line a distance of 709.73 ft to a point on the southerly line of said Lot 2; thence running with said southerly lot line, N 74° 55' 26" W, passing a concrete monument at 10.20 ft, in all, a distance of 300 ft to the True Point of Beginning; thence, running with the said southerly line of Lot 2,

N 74° 55' 26" W 688.92 ft; thence, leaving said southerly lot line and severing said Lot 2,

N 00° 34' 18" E 635.51 ft
N 40° 46' 55" E 212.42 ft
S 75° 27' 33" E 153.06 ft
S 64° 05' 09" E 813.97 ft
S 31° 46' 54" W 683.89 ft to the True Point of Beginning, and contains 15.16 ac, more or less.

TRACT NO. 101E

Beginning at an iron pin on the westerly right-of-way line of the Baltimore and Ohio Railroad Company at its intersection with the northerly line of Lot 2 of the Francis Keene Lewis Partition, a plat of which is of record in the Office of the Clerk of the County Commission of Wood County, West Virginia, in Deed Book 124, Page 313, which beginning point is further described as being located N 66° 38' 40" W 2564.68 ft from an iron pipe at the northeasterly corner of said Lot 2; thence,

S 84° 26' 31" W 277.63 ft to the True Point of Beginning on the eastline of U.S.A. Tract 101 and has the approximate coordinate value of N280,718.85 E1,381,579.02; thence, running with the centerline of a proposed access road which has a right-of-way width of 20 ft, 10 ft on each side of the herein described centerline,

N 75° 21' 19" E 89.96 ft [88.27 ft][a]
N 30° 36' 39" E 156.11 ft

N 29° 55' 48" E 485.36 ft [493.14 ft][b] to a point on the south edge of West Virginia Secondary State Route No. 34/2, there terminates, and contains 0.34 ac, more or less.

---

[a]Distance in brackets is measured distance shown in Plate 1.
[b]Distance in brackets is measured distance to the center of Route No. 34/2 (Foster Drive) shown in Plate 1.

Appendix C

Inspection Checklist

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ANNUAL INSPECTION CHECKLIST
PARKERSBURG, WEST VIRGINIA, NWPA 151(c) DISPOSAL SITE

Status of Site Inspections

Date of This Revision: _____

Last Annual Inspection: _____
Inspectors: _____

Next Annual Inspection: _____
Inspectors: _____

No.	ITEM	ISSUE	ACTION
1	Access	From Dupont Road (State Route 892) to Northwest Drive (formerly named Foster Drive), then left along the DOE right-of-way to the site (see Figure 1-1 and Table 2-1 of LTSP). Road may be rutted along soccer fields, and overgrown from lack of use closer to the site Gravel was placed next to the RR tracks along the access road to fill in low spots in 2010.	Check status of access road, note any concerns. Be alert of operations on neighboring Northwest Pipe property (e.g., heavy equipment operation, movement of large pipe sections, etc.) and take appropriate safety precautions. Inspect access road along RR tracks and check for new low-spots.
2	Specific site surveillance Features	See attached table.	
		Grass covered disposal cell (essentially the area inside the security fence) Spraying and mowing has been taking place since 2003 to control Poison Hemlock infestations. This has allowed teasel to take hold in its place, especially in the NW corner of the site.	Evaluate vegetation management efforts, report concerns and progress. Note condition of the grass cover. Also check for; erosion, settling, biointrusion (animal burrows), or other modifying process.
		Site Entrance Sign *No current issues*	Verify presence and note condition of the site entrance sign.

No.	ITEM	ISSUE	ACTION
		Site Perimeter Fence and 15 Perimeter signs *No current issues* • Fence was replaced in 2007. • Sixteen perimeter signs are installed on the fence. In the past perimeter signs have been vandalized by shotgun blasts. • In the past some locks were rusted and difficult to use. An area of several animal burrows is present under the west perimeter fence. A couple of the burrows are large, and present a tripping hazard.	Note the presence of any vegetation on or around base of the fence that might impact integrity of the fence. Verify presence and note the condition of all 16 site perimeter signs. Have a few replacement locks available. Be aware of this area and proceed with caution to avoid tripping hazards.
		Boundary Monuments (6-total) Some boundary monuments are difficult to locate • BM-3 is often covered with shrubby vegetation • BM-5 and BM-6 are in wooded areas and difficult to find. Distances from perimeter fence are noted on the inspection map.	Verify presence and condition of all 6 boundary monuments. Clear vegetation and/or unbury if needed (may need a small shovel).
		Survey Monument Located along railroad track, southeast of Boundary Monument 6.	Verify presence and condition of survey monument.
3	Area between the security fence and the property boundary	Fence fabric should be free of vegetation.	Note effectiveness of mowing and herbicide treatments around the fence in keeping vegetation from encroaching onto the fence fabric.

No.	ITEM	ISSUE	ACTION
4	Outlying area	A drainage channel is located along the west side of the site and is lined with concrete and energy dissipation baffles near the southwest corner of the site. Site is located in a developed industrial area.	Evaluate the condition of the drainage channel. Check for signs of erosion. Check for indications of development or change in adjacent land-use that could threaten site integrity or security.
5	Monitor Wells Groundwater monitoring	Ground water is sampled every 10 years. Six monitor wells on site: • MW-5 and MW-6 (installed by DOE) are suitable for sampling. • MW-1 thru MW-4 (from AMAX) are only suitable for water level measurements. *Identified Minor Well Maintenance Issues* . • The protective casings at MW-2 and MW-4 are leaning and need to be straightened. They are not leaning enough to impact the riser of the monitor well. • Several monitor wells contain old sampling equipment that is no longer serviceable and should be removed • The bollard located at MW-6 needs to be repaired. • Outside casings on the AMAX wells are rusting.	Wells will be inspected as they are sampled. Verify that the wells are properly locked and secured. Minor Well Maintenance Issues are considered to be low priority.

BEWARE OF POISON IVY, TICKS, AND EXCESSIVE POPULATIONS OF MOSQUITOS!

Site-Specific Surveillance Features— Parkersburg West Virginia, NWPA 151(c) Disposal Site

FEATURE	COMMENT
Access Road	Leads through soccer fields from Northwest Drive.
Entrance Gate	Replaced in 2007.
Entrance Sign (1)	No comment
Perimeter Signs (16)	No comment
Site Markers	BM-2 Replaced in 2011 BM-4 Raised in 2011.
Security Fence	Replaced in 2007
Boundary Monuments (6)	Located at the property corners. Marked by T-posts. BM–4 may be buried in sediment BM-3, 5, and 6 may be covered by vegetation.
Monitor Wells (6)	Located inside the security fence around the edge of the cell. MW-1 through MW-4: installed by AMAX, water level only. MW-5 and MW-6: installed by DOE, sampled every 5 years.

Appendix D

2014 Groundwater Monitoring Assessment

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LMS/PKB/S11932

Groundwater Monitoring Assessment Parkersburg, West Virginia, Disposal Site

June 2014

U.S. DEPARTMENT OF ENERGY | Legacy Management

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LMS/PKB/S11932

Groundwater Monitoring Assessment
Parkersburg, West Virginia, Disposal Site

June 2014

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Attachments

Attachment 1 *Long-Term Surveillance Plan for the Parkersburg, West Virginia, Disposal Site*
Attachment 2 *NRC/DOE Agreement in Principle for Transfer of NRC Restricted Release Sites to DOE as Authorized Under Section 151(b) of the Nuclear Waste Policy Act*

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1.0 Purpose and Scope

The purpose of this assessment is to document the groundwater quality and elevation data collected since 1994 at the Parkersburg, West Virginia, Disposal Site, and to determine if the data support transitioning from a sampling frequency of once every 5 years to a frequency of once every 10 years. If a transition to sampling once every 10 years is deemed appropriate, the optimal timing for this transition is also to be considered.

The Long-Term Surveillance Plan (LTSP) for the Parkersburg site defines an initial groundwater sampling period from 1997 to 2002. The LTSP further explains that groundwater modeling results indicate that contamination of the aquifer would occur relatively slowly and that groundwater quality should be monitored once every 5 to 10 years following the end of the initial sampling period in 2002 (Attachment 1).

Since the initial sampling period ended 12 years ago, this assessment of the water quality will determine the optimum time frame for reducing the monitoring frequency. Transitioning the frequency from 5 years to 10 years is consistent with ongoing efforts to streamline stewardship costs at U.S. Department of Energy (DOE) Office of Legacy Management (LM) sites if such change is without risk to human health and the environment.

As this assessment details, the optimum time frame to move from a 5-year sampling frequency to a 10-year frequency is after the sampling event of 2013. The data support transitioning the sampling frequency now, and the timing aligns with the time frames stated in the model, which predict outcomes of disposal cell performance.

2.0 Introduction

The controlling document for groundwater monitoring at the Parkersburg disposal site is the *Long-Term Surveillance Plan for the Parkersburg, West Virginia, Disposal Site* (DOE 1995a). The Parkersburg LTSP prescribes that current groundwater quality data be compared to water quality data reported in 1994 and 1995 to determine if changes in groundwater quality have occurred. This report summarizes groundwater monitoring data (quality and elevation) collected at the Parkersburg disposal site in 1998, 2003, 2008, and 2013 and compares results to data collected in 1994 and 1995.

Figure 1 is a site map that shows the location of the six monitoring wells located at the site, identified as MW-1 through MW-6. Monitoring wells MW-1 through MW-4 are only used for measuring water elevations (and not water quality), since well construction and completion records for these wells are incomplete, making them unsuitable for analyzing water quality. Table 1 provides an analyte list for samples collected from MW-5 and MW-6. Groundwater is analyzed for 13 metals, 7 major cations and anions, and 5 radionuclides every 5 years.

Legend

- Monitoring Well
- Site Boundary
- Fence

SCALE IN FEET
100 50 0 100 200 300

N

U.S. DEPARTMENT OF ENERGY GRAND JUNCTION, COLORADO	Work Performed by S.M. Stoller Corporation Under DOE Contract No. DE-AM01-07LM00060
Well Location Map Parkersburg Site, West Virginia	
DATE PREPARED: August 6, 2013	FILENAME: S1052000

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Figure 1. Well Location Map

Table 1. Analyte List for the Parkersburg Site

Metals	Major Cations and Anions	Radionuclides
Antimony	Calcium	Radium-226
Barium	Magnesium	Radium-228
Beryllium	Potassium	Uranium
Cadmium	Sodium	Gross alpha
Chromium	Chloride	Gross beta
Lead	Sulfate	
Mercury	Nitrate/Nitrite	
Nickel		
Selenium		
Thallium		
Hafnium		
Zirconium		
Thiocyanate		

3.0 Regulatory Framework

Between 1957 and 1975, the privately owned Parkersburg site processed zircon ore (1957 to 1970), produced zirconium and hafnium metal sponge (1957 to 1974), and was used to conduct experiments with baddeleyite (a zirconium oxide [1975]). The site was transferred to the federal government in 1994 and is governed in accordance with Subtitle D, Section 151(c), "Special Sites," of the Nuclear Waste Policy Act of 1982 (Title 42 *United States Code* [USC] Section 101719[c]). Section 151(c) of the Nuclear Waste Policy Act states that if the low-level radioactive waste results from a licensed activity recovering zirconium, hafnium, and rare earth metals from source material, then the Secretary of Energy, upon request by the owner of the site, shall assume title and custody of the radioactive waste and the land on which it resides. This transfer of ownership occurs when the site has been decontaminated and stabilized in accordance with the U.S. Nuclear Regulatory Commission (NRC) requirements and when the owner has made financial arrangements approved by NRC for the long-term maintenance and monitoring of the site.

DOE assumed ownership of the Parkersburg site on March 4, 1994, following NRC termination of the site license. In accordance with the *NRC/DOE Agreement in Principle for Transfer of NRC, Restricted Release Sites to DOE as Authorized Under Section 151(c) of the Nuclear Waste Policy Act* (Attachment 2), DOE is authorized to maintain the waste and land in a manner that will protect the public health and safety and the environment. The governing document for managing the Parkersburg site is the Parkersburg LTSP that was prepared by DOE and issued in 1995.

The groundwater monitoring strategy established in the Parkersburg LTSP is to sample groundwater once every 5 years until 2002, then once every 5 to 10 years after 2002. The transition to once every 5 to 10 years is based on groundwater modeling results that indicate that if contamination of the aquifer took place, it would occur relatively slowly. The groundwater monitoring schedule has remained at once every 5 years through 2013. Groundwater data collected through 2013 support transitioning to a sampling schedule of once every 10 years. Since the strategy for transitioning sampling to once every 10 years is already in the approved LTSP, no notification to site stakeholders is required.

Groundwater quality results are compared to standards of the Safe Drinking Water Act (42 USC 300[f] et seq.) and the State of West Virginia groundwater quality standards, and made available to the public on the LM website: http://www.lm.doe.gov/parkersburg/Documents.aspx. Although groundwater monitoring requirements in the LTSP are not being changed, the LTSP requires a revision to reflect the findings of this assessment. The revised LTSP will also be posted on the LM website so that it is available to site stakeholders (e.g., NRC Division of Waste Management and Environmental Protection, West Virginia Department of Environmental Protection, and the interested public).

4.0 Historical Background

This section presents a brief summary of the site history to provide background on when monitoring wells were installed and why certain constituents of the groundwater are being analyzed.

From 1957 to 1970, zircon ore was processed at the Parkersburg site. Zirconium and hafnium metal sponge were produced until 1974, and experiments with baddeleyite were conducted in 1975. In 1977, the property that had been involved with the zirconium-processing operations was sold. Site inspections by NRC in 1977 found areas of residual soil contamination associated with the ore processing. Pyrophoric material was also found. In 1979, studies were conducted to develop a stabilization plan. Two groundwater monitoring wells (MW-1 and MW-2) were installed as part of the evaluation of the hydrogeology.

In 1982, NRC granted a license authorizing the collection, stabilization, and storage of contaminated soil and rubble. During the construction of the stabilization mound, two additional groundwater monitoring wells (MW-3 and MW-4) were installed. The stabilization work was completed in 1982.

Additional site characterization work was conducted in 1994 in preparation for DOE assuming responsibility for the site. Two additional groundwater monitoring wells were installed (MW-5 and MW-6) as part of a site characterization study that was published in 1995. Groundwater data collected at the site in 1994 and 1995 as part of the *AMAX Radioactive Material Storage Area, Parkersburg, West Virginia, Site Characterization Results* (DOE 1995b) showed that the groundwater complied with State of West Virginia groundwater quality standards and with federal Safe Drinking Water Act standards.

5.0 Site Hydrology

In descending order, the stratigraphy beneath the site consists of 1 to 10 feet of clayey silt/silty clay soils overlying 90 feet of interbedded sand and gravel alluvium. Sandstone bedrock is present at approximately 100 feet below the ground surface. An alluvial aquifer is present in the lower 40 feet of the interbedded sand and gravel alluvium (DOE 1995b). Slug test data are available from monitoring wells MW-5 and MW-6. Hydraulic conductivities of 1.8×10^{-2} inches per second and 1.3×10^{-3} inches per second were calculated for MW-5 and MW-6, respectively, based on the slug test results. Water level maps constructed in 1994 and 1995 indicate that the

groundwater flow direction is to the northeast at a relatively flat hydraulic gradient that ranged from 1×10^{-3} inches per second to 3×10^{-3} inches per second. The relatively flat gradient indicated that changes in flow direction are not uncommon for the area (DOE 1995b).

Computer modeling was conducted in 1995 to estimate the number of years that it might take for contaminated groundwater to reach monitoring wells MW-5 and MW-6 if the disposal cell cover allowed precipitation to infiltrate and saturate the buried waste, resulting in the formation of a contaminant plume. The modeling estimated the length of time that it would take for the contaminant plume to travel through unsaturated alluvium to reach the water table and then through the saturated alluvium to reach the downgradient wells. The modeling was programmed to begin in 1982 (the year that the stabilization was completed). The results for three scenarios (worst case, most likely case, and best case) are provided below.

Groundwater Model Predictions

Scenarios	Number of Years	Dates
Worst Case	15–20	1997–2002
Most Likely Case	35–40	2017–2022
Best Case	95–100	2077–2083

It should be noted that the Parkersburg LTSP defines an initial sampling period from 1997 to 2002, which corresponds to the modeled "worst case."

6.0 Groundwater Monitoring Results

Groundwater sampling is scheduled to correspond to the model-predicted time periods presented above. Following an initial sampling period (1997 to 2002) a 5-year or 10-year schedule is recommended in the LTSP. A 5-year schedule has been followed since 1998.

Since 1995, sampling has taken place four times: in 1998, 2003, 2008, and 2013. Analytical results are summarized in Table 2 for monitoring well MW-5 and in Table 3 for monitoring well MW-6.

As shown in Tables 2 and 3, with the exception of nitrate/nitrite at monitoring well MW-6 in 2013, water quality remains in compliance with both State of West Virginia groundwater quality standards and federal Safe Drinking Water Act standards. The data also indicate that the water quality has remained essentially the same compared to the water quality reported in 1994 and 1995. Based on the results provided in Tables 2 and 3, the worst-case model-predicted scenario did not occur.

As shown in Table 3, the nitrate/nitrite concentration in monitoring well MW-06 was slightly above both state and federal standards in 2013 (14 milligrams per liter [mg/L] versus a standard of 10 mg/L). Given that all other monitored parameters are consistent with historical results, the 2013 nitrate/nitrite water quality exceedance is attributed to adjacent property improvements and the use of fertilizers in the area rather than to disposal cell performance.

Table 2. Monitoring Well MW-5, Water Quality, 1994 Through 2013

Analyte	Units	1994		1995		1998		2003		2008		2013		EPA[f] MCL	WV[g] Standard
Metals															
Antimony	µg/L	3.1	B	U		U		0.3	B	U		U		6	
Barium	µg/L	90.4	B	86.6	B	73.9	B	74.5	B	63		92		2000	2000
Beryllium	µg/L	U		U		U		U		0.5	B	U		4	4
Cadmium	µg/L	U		U		U		U		0.076	B	U		5	5
Chromium	µg/L	U		U		U		U		U		U		100	100
Lead	µg/L	U		U		U		U		0.55		0.26	B	15[e]	15
Mercury	µg/L	U		U		U		U		U		U		2	2
Nickel	µg/L	U		U		U		U		1.8	B	U			
Selenium	µg/L	U		U		U		U		0.015	B	U		50	50
Thallium	µg/L	U		U		U		U		0.028	B	U		2	2
Hafnium	µg/L	U		U		U		U		[a]		[a]			
Zirconium	µg/L	1.1	B	U		U		U		U		U			
Thiocyanate	µg/L	U		U		U		U		U		U			
Major Cations and Ions															
Calcium	mg/L	110		107		99.5		110		110		160			
Magnesium	mg/L	16.2		15.4		12.6		13.4		14		21			
Potassium	mg/L	4.31	B	3.65	B	3.14		3.48		3.2		3.3			
Sodium	mg/L	10.6		7.74		9.85		10.9		16		11			
Chloride	mg/L	25.9		23		20.6		42.2		54		79			
Sulfate	mg/L	53.8		54.1		52.4		58.9		62		64			
Nitrate/nitrite[b]	mg/L	3.88		3.34		2.54		3.08		2.7		7.3		10	10
Radionuclides															
Radium-226	pCi/L	0.15		0.15		U		U		U		U		5[c]	5[c]
Radium-228	pCi/L	U		U		U		U		U		U		5[c]	5[c]
Uranium	µg/L	U		U		U		0.29	B	0.3	E	0.38		30	30
Gross alpha	pCi/L	U		U		U		U		U		U		15	15
Gross beta	pCi/L	U		U		U		U		3.45[h]		2.79[h]		4[d]	4[d]

Notes:
Max Value reported for 1994, 1995, 1998, 2003, and 2008
[a] Zirconium used as proxy for hafnium
[b] Nitrate/nitrite as nitrogen
[c] Radium-226 and radium-228 combined
[d] mrem = millirem (rem=roentgen equivalent man)
[e] Action limit
[f] U.S. Environmental Protection Agency (EPA) federal Safe Drinking Water Act standard
[g] State of West Virginia groundwater quality standards
[h] Screening level of concern for gross beta is 50 pCi/L. Data from 2008 and 2013 indicate that beta is from potassium.

Abbreviations:
B = Result is between instrument detection limit and contract-required detection limit
E = Result is an estimate
MCL = maximum contaminant level
µg/L = micrograms per liter
pCi/L= picocuries per liter
U = Result was below detection limit

Table 3. Monitoring Well MW-6, Water Quality, 1994 Through 2013

Metals														EPA[f] MCL	WV[g] Standard
Analyte	**Units**	**1994**		**1995**		**1998**		**2003**		**2008**		**2013**			
Antimony	µg/L	1.1	B	1	B	U		0.95	B	U		0.44		6	
Barium	µg/L	89.3	B	88.9	B	92.9	B	85	B	82		160		2000	2000
Beryllium	µg/L	U		U		U		U		0.33	B	U		4	4
Cadmium	µg/L	U		U		U		U		U		U		5	5
Chromium	µg/L	U		U		U		U		0.57	B	U		100	100
Lead	µg/L	U		U		U		U		0.14	B	0.24	B	15[e]	15
Mercury	µg/L	U		U		U		U		U		U		2	2
Nickel	µg/L	U		U		U		U		1	B	U			
Selenium	µg/L	U		U		U		U		0.046	B	U		50	50
Thallium	µg/L	U		U		U		U		0.029	B	U		2	2
Hafnium	µg/L	1.1	B	U		U		U		[a]		[a]			
Zirconium	µg/L	1.5	B	U		U		U		U		U			
Thiocyanate	µg/L	U		U		U		U		U		U			
Major Cations and Ions															
Calcium	mg/L	133		122		114		99.7		100		190			
Magnesium	mg/L	14.8		13.2		12.4		11.4		11		24			
Potassium	mg/L	2.34		1.78		1.83		1.76		2.1		3.3			
Sodium	mg/L	13.9		12.9		14.6		14.4		19		32			
Chloride	mg/L	31.6		26		24.5		52.5		38		120			
Sulfate	mg/L	101		81		58.8		48.6		70		91			
Nitrate/nitrite[b]	mg/L	10		9.71		6.37		1.9		1.7		14		10	10
Radionuclides															
Radium-226	pCi/L	0.25		0.1		U		U		U		U		5[c]	5[c]
Radium-228	pCi/L	U		U		U		U		U		U		5[c]	5[c]
Uranium	µg/L	U		U		U		0.44	B	0.44		0.64		30	30
Gross alpha	pCi/L	U		U		U		U		U		U		15	15
Gross beta	pCi/L	U		U		U		U		U		3.37[h]		4[d]	4[d]

Notes:
Max Value reported for 1994, 1995, 1998, 2003, and 2008
[a] Zirconium used as proxy for hafnium
[b] Nitrate/nitrite as nitrogen
[c] Radium-226 and radium-228 combined
[d] mrem = millirem (rem=roentgen equivalent man)
[e] Action limit
[f] EPA federal Safe Drinking Water Act standard
[g] State of West Virginia groundwater quality standards
[h] Screening level of concern for gross beta is 50 pCi/L. Data from 2008 and 2013 indicate that beta is from potassium.

Abbreviations:
B = Result is between instrument detection limit and contract-required detection limit
MCL = maximum contaminant level
µg/L = micrograms per liter
pCi/L= picocuries per liter
U = Result was below detection limit

7.0 Groundwater Elevations

Groundwater elevation measurements collected in 1994, 1998, 2003, 2008, and 2013 are graphed in Figure 2. The data indicate that water levels have been rising since 2004. In 2013, water levels were approximately 5.5 to 6.5 feet higher than in 2004. Although the water levels have been rising, the water level data indicate that the groundwater flow direction has remained generally to the north-northeast. Figure 3 through Figure 6 are water table maps for 1998, 2003, 2008, and 2013, respectively. As shown in the figures, the water table gradient has also remained fairly flat and consistent.

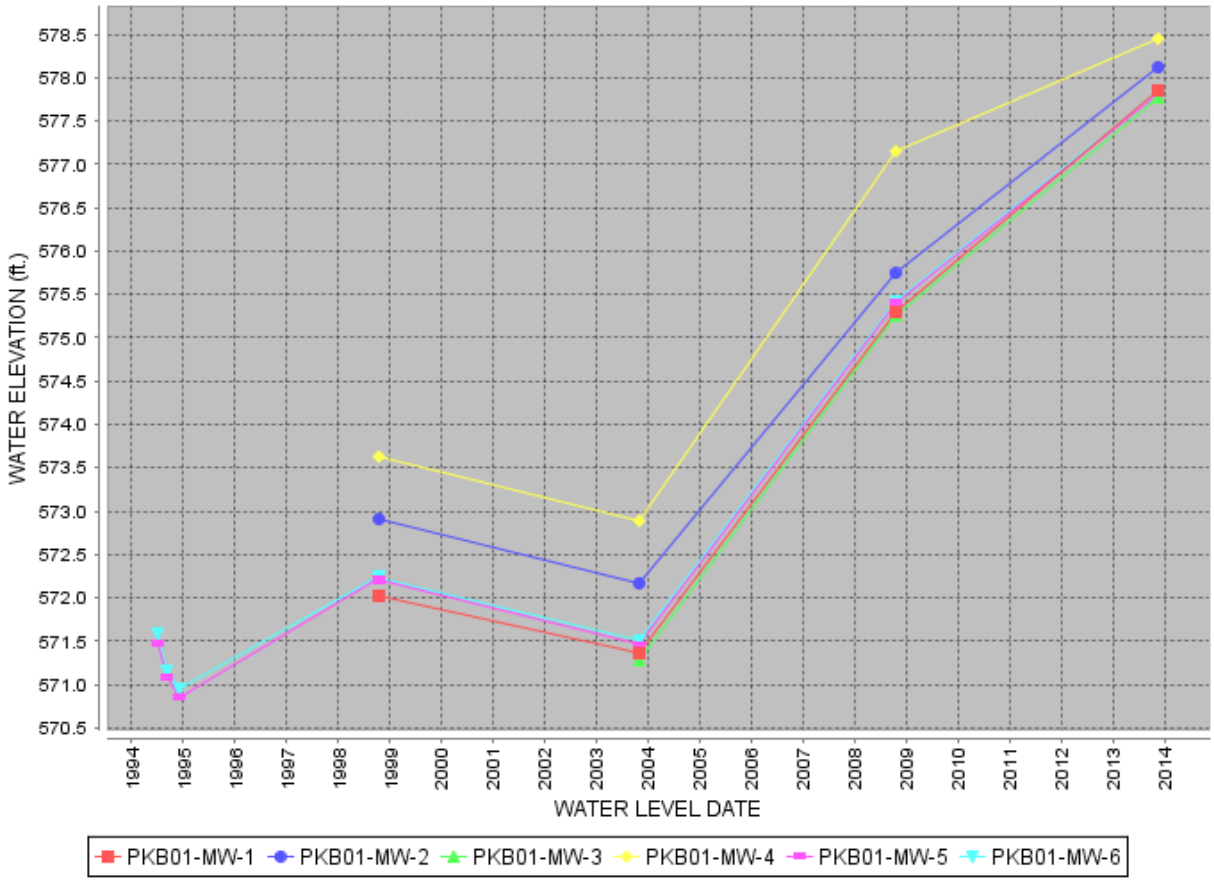
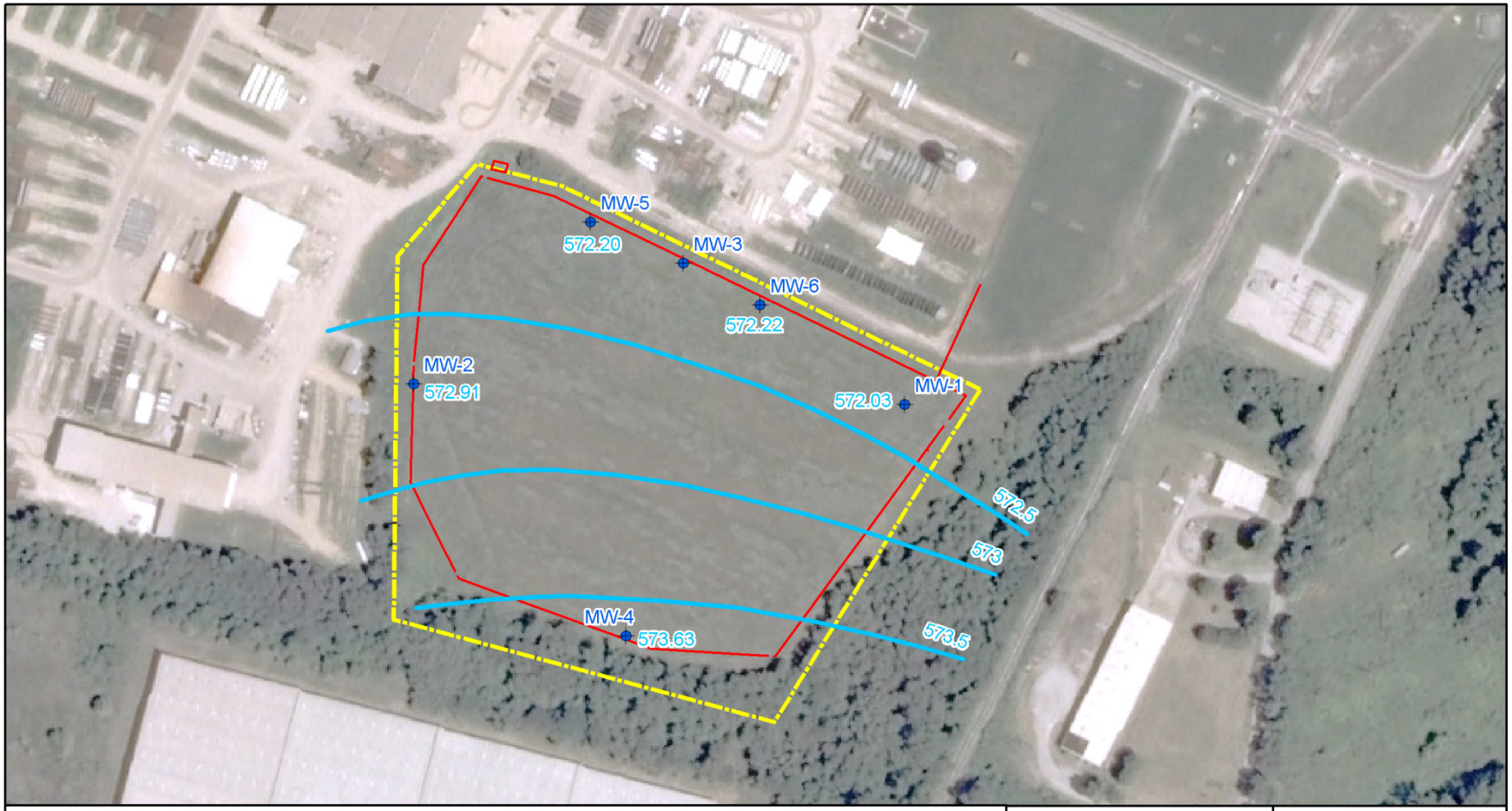


Figure 2. Static Water Levels by Location



Legend

- Monitoring Well
- Groundwater Elevation Contour
- Site Boundary
- Fence

SCALE IN FEET
100 50 0 100 200 300

N

U.S. DEPARTMENT OF ENERGY
GRAND JUNCTION, COLORADO

Work Performed by
S.M. Stoller Corporation
Under DOE Contract
No. DE-AM01-07LM00060

Groundwater Levels, October 1998
Parkersburg Site, West Virginia

DATE PREPARED: August 6, 2013

FILENAME: S1052100

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Figure 3. Groundwater Levels—October 1998

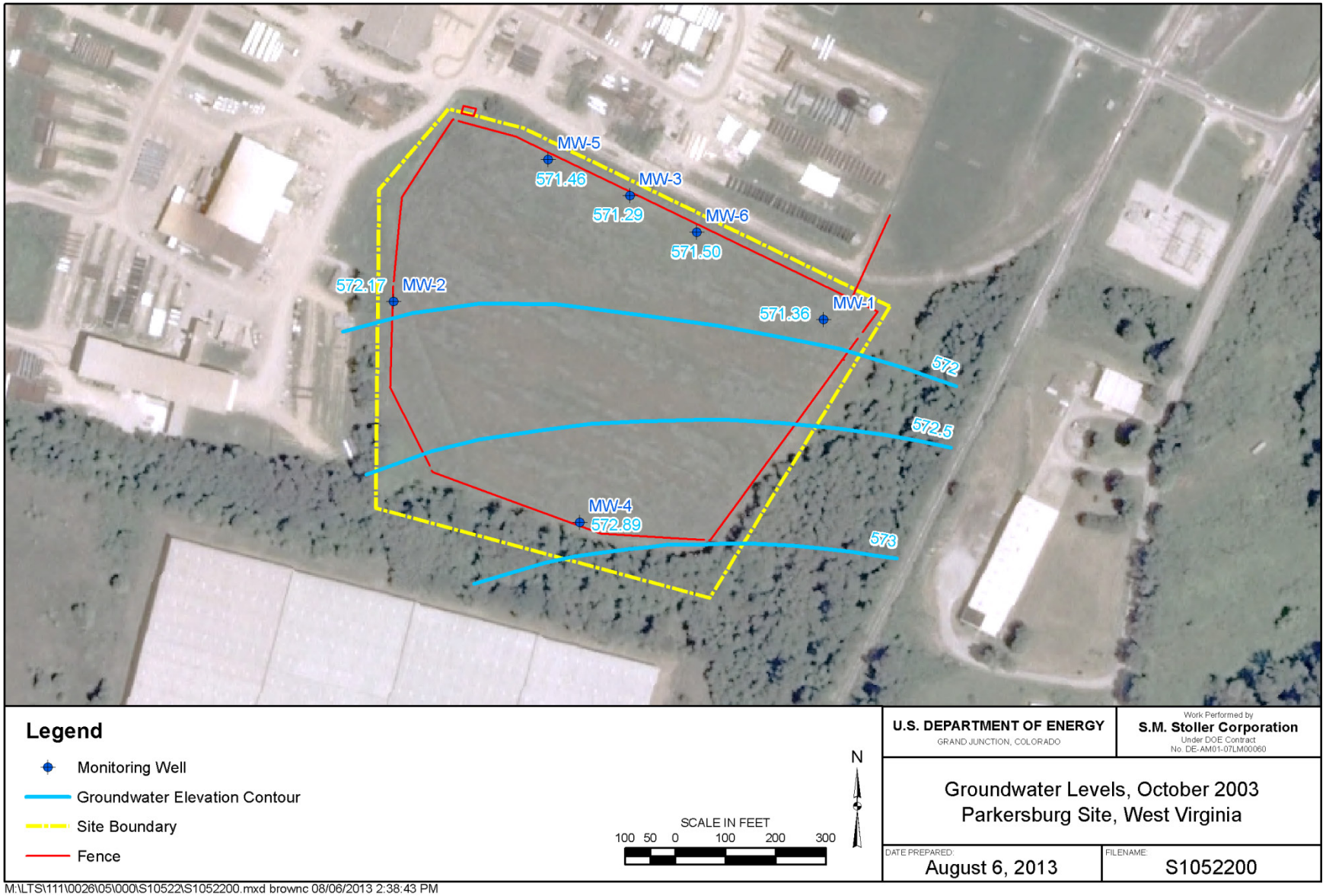
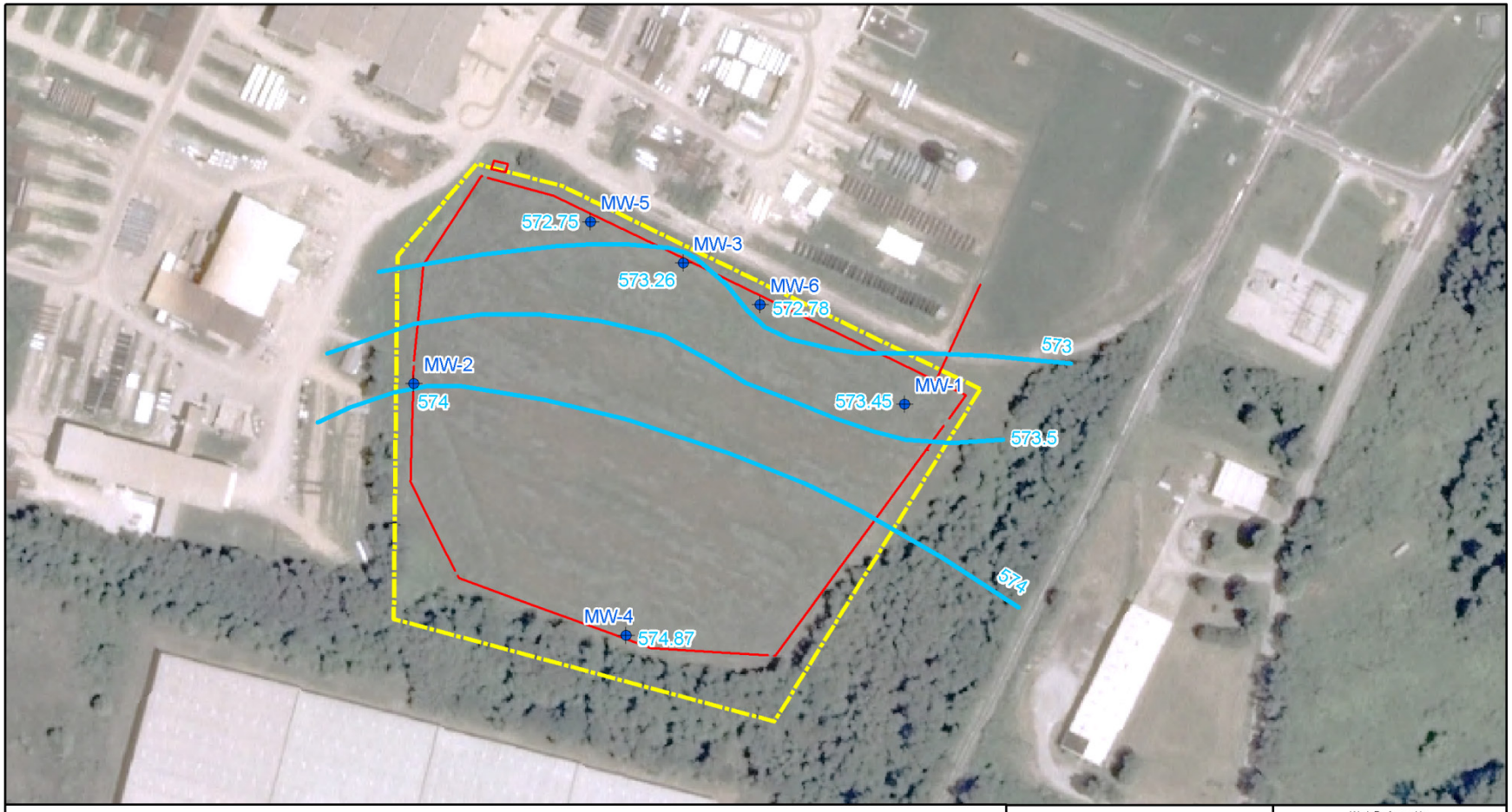


Figure 4. Groundwater Levels—October 2003



Legend

- Monitoring Well
- Groundwater Elevation Contour
- Site Boundary
- Fence

SCALE IN FEET
100 50 0 100 200 300

N

U.S. DEPARTMENT OF ENERGY GRAND JUNCTION, COLORADO	Work Performed by S.M. Stoller Corporation Under DOE Contract No. DE-AM01-07LM00060
Groundwater Levels, October 2008 Parkersburg Site, West Virginia	
DATE PREPARED: August 6, 2013	FILENAME: S1052300

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Figure 5. Groundwater Levels—October 2008

Legend

- Monitoring Well
- Groundwater Elevation Contours
- Site Boundary
- Fence

SCALE IN FEET
100 50 0 100 200

N

U.S. DEPARTMENT OF ENERGY GRAND JUNCTION, COLORADO	Work Performed by **S.M. Stoller Corporation** Under DOE Contract No. DE-AM01-07LM00060
Groundwater Levels, November 2013 Parkersburg Disposal Site, West Virginia	
DATE PREPARED: March 18, 2014	FILENAME: S1161100

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Figure 6. Groundwater Levels—November 2013

8.0 Conclusions

Data collected in 1998, 2003, 2008, and 2013 indicate the following:

- The water quality data indicate that the disposal cell is operating as designed.
- Although water levels are increasing, the increase has had no adverse impact on cell performance.
- With the exception of a nitrate/nitrite exceedance of water quality standards in 2013, water quality beneath the Parkersburg site remains in compliance with both State of West Virginia groundwater quality standards and federal Safe Drinking Water Act standards.
- The water quality exceedance for nitrate/nitrite in 2013 at one monitoring well is attributed to adjacent property improvements and the use of fertilizers rather than to cell performance.
- The "worst-case" modeling scenario for detecting a potential contaminant plume at monitoring wells MW-5, MW-6, or both did not occur.
- Groundwater flow directions have remained in a general north-northeast direction from 1998 through 2013, even though water levels have increased.
- The water quality and water level data support transitioning from a sampling frequency of once every 5 years to a frequency of once every 10 years. The optimum timing for a transition to a sampling frequency of once every 10 years is the present, since the 2013 sampling results have been assessed. A 10-year sampling frequency (with a start year of 2013) will correlate well with model-predicted scenario dates presented in Section 5.0 for the "most likely case." On a 10-year schedule, the next sample would be collected in 2023 (the end of the model-predicted "most likely case") and in 2083 (the end of the model-predicted "best case").
- If a decision is made to continue sampling on a 5-year frequency to collect additional data to verify cell performance, the next logical year for considering a transition to a sampling frequency of once every 10 years would be 2023, in order to have the monitoring schedule correlate with model predictions of cell performance.

9.0 Recommendations

It is recommended that the sampling frequency transition to once every 10 years. The next scheduled sampling event would then be in 2023 (corresponding to the end of the model-predicted "most likely case"). Transitioning to a 10-year sampling frequency now aligns the sampling schedule with the end of the model-predicted "best case" in 2083.

10.0 References

DOE (U.S. Department of Energy), 1995a. *Long-Term Surveillance Plan for the Parkersburg, West Virginia, Disposal Site*, Grand Junction Projects Office, Colorado, September.

DOE (U.S. Department of Energy), 1995b. *AMAX Radioactive Material Storage Area, Parkersburg, West Virginia, Site Characterization Results*, Grand Junction, Colorado.

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Attachment 1

Long-Term Surveillance Plan for the Parkersburg, West Virginia, Disposal Site

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UNCONTROLLED IF PRINTED

Long-Term Surveillance Plan for the Parkersburg, West Virginia, Disposal Site

September 1995

Prepared for
U.S. Department of Energy
Albuquerque Operations Office
Grand Junction Projects Office

Prepared by
Rust Geotech
Grand Junction, Colorado
Work Performed Under DOE Contract No. DE–AC04–94AL96907

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(in pocket in back)

Plate 1. Parkersburg Disposal Site Survey Map
Plate 2. Parkersburg Disposal Site Map

1.0 Introduction

1.1 Purpose

This Long-Term Surveillance Plan (LTSP) is a technical plan that explains how the U.S. Department of Energy (DOE) will fulfill its responsibility for the custody and long-term care of the radioactive material storage area, formerly owned by AMAX, Inc., (AMAX) near Parkersburg, West Virginia. The LTSP describes the long-term surveillance and maintenance activities that are necessary to fulfill the requirements of the site ownership, which was conveyed to the DOE on March 4, 1994. DOE assumed ownership of the radioactive materials storage area (Parkersburg site) under the terms of Subtitle D, Section 151(c), of the Nuclear Waste Policy Act of 1982.

1.2 Background

The Parkersburg site is in Wood County, West Virginia, about 7 air miles (mi) (11 kilometers [km]) west-southwest of Parkersburg, the county seat, and is in the Lubeck magisterial district. Near the site are the villages of Washington and Lubeck about 1 mi (1.6 km) to the northeast and 3 mi (5 km) to the east-southeast, respectively. The center of the 15.16-acre (ac) (6.27-hectare [ha]) site containing the stabilization mound is about 2,000 feet (ft) (610 meters [m]) east of the Ohio River in Washington Bottom. The general location of the site is shown in Figure 1–1.

The site was developed in 1957 to produce high-grade zirconium metal for the Naval Reactor Program under an Atomic Energy Commission (AEC) contract. Zircon ore was processed until 1970, zirconium and hafnium metal sponge was produced until 1974, and experiments were conducted on baddeleyite ore in 1975 as concluding operations at the site. It is estimated by the U.S. Nuclear Regulatory Commission (NRC) that 2 million pounds (lb) (900,000 kilograms [kg]) of zircon ore, mainly from Nigeria, were processed at the AMAX-owned site. Residual soil contamination areas on the site were identified in 1977, and in 1978 several fires and explosions were caused by the uncovering of pyrophoric material on the site. Radiologic, geologic, and hydrologic studies of the site commissioned by AMAX resulted in a plan for remedial action provided in the "Stabilization Plan" (AMAX 1980). Remediation consisted of consolidating the waste material into one area and capping it with clay and topsoil; this was accomplished in the summer and fall of 1982. Details of the construction of the stabilization mound and of two additional ground water monitor wells installed on the site are in the *Stabilization Plan, Construction and Final Survey* (AMAX 1984).

1.3 Regulatory Requirements

Regulations that govern the transfer of ownership of the Parkersburg site to the DOE are solely in Subtitle D, Section 151(c), of the Nuclear Waste Policy Act of 1982 [42 U.S.C. 10171(c)]. The text of Subtitle D of the Act (enacted on January 7, 1982) is presented in Appendix A. General Federal license requirements under the Uranium Mill Tailings Radiation Control Act of 1978 do not apply to this site. Also, no State laws are applicable to the construction of the disposal cell at the site.

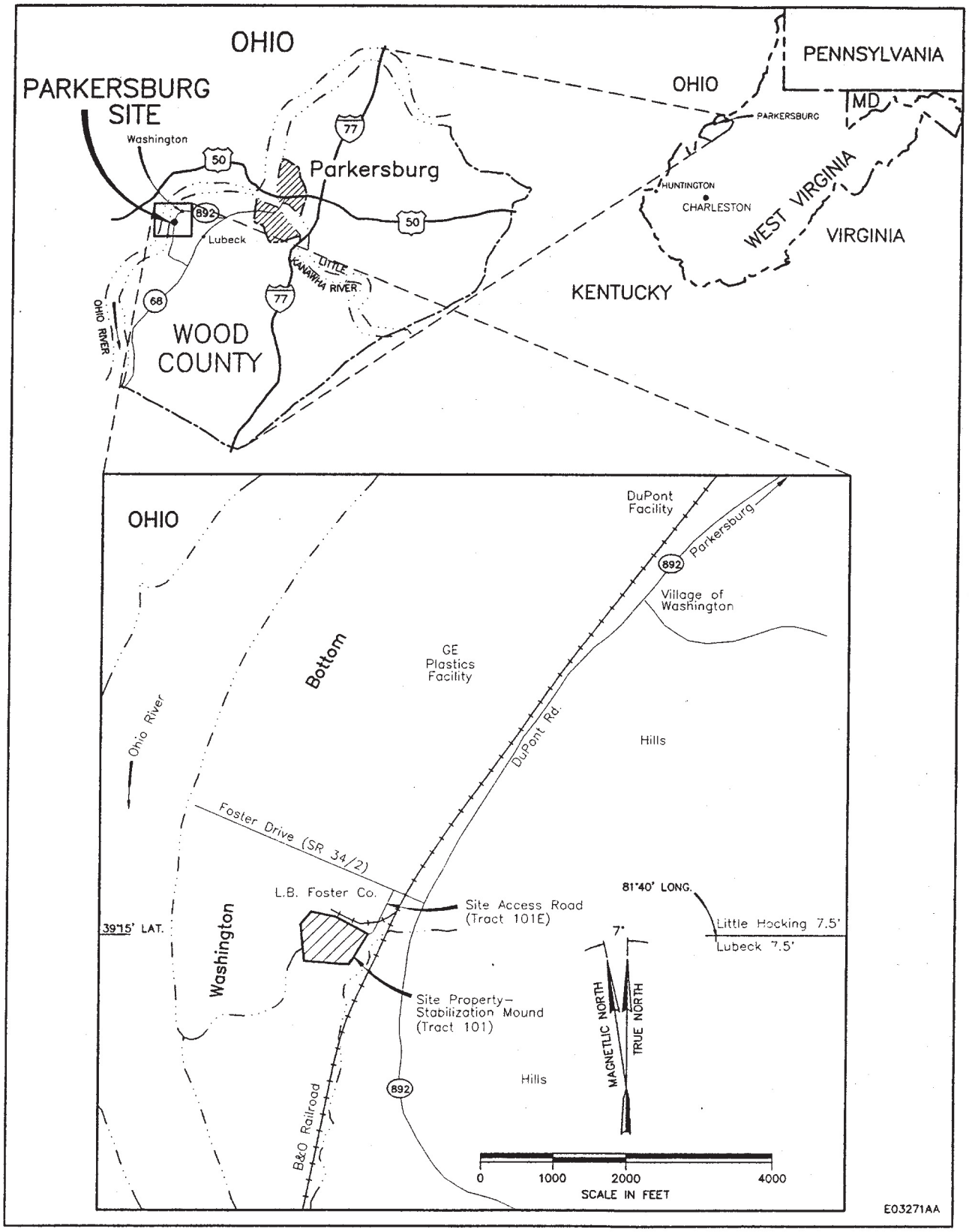

Figure 1–1. Location of Parkersburg, West Virginia, Site

2.0 Site Description and History

2.1 Site Location and Description

The Parkersburg site at 39° 15' N and 81° 41' W is in Washington Bottom, an area on the east bank of the Ohio River that contains both agricultural and industrial developments (Figure 1–1). The site is on two U.S. Geological Survey 1:24,000-scale topographic maps: the extreme south part of the Little Hocking, Ohio-West Virginia, and the extreme north part of the Lubeck, West Virginia-Ohio. Access to the site from downtown Parkersburg is shown in Table 2–1.

The L.B. Foster Company facility with several operating buildings, a water tower, soccer field, and foundations of former buildings is immediately west and north of the site. North of Foster Drive, agricultural and grazing land extends for about 2,500 ft (770 m) north to the industrial properties of General Electric Plastics and E.I. DuPont de Nemours Company. Land immediately to the east, south, and southwest of the site is used for grazing. Tracks of the Baltimore and Ohio (B&O) Railroad are about 250 to 300 ft (77 to 92 m) east of the site boundary, which they roughly parallel. Just east of the B&O Railroad tracks and south of Foster Drive is an electric power substation. South of the substation and directly east of the site are several buildings housing the insulation contracting and sales business of Nitro Industrial Coverings, Inc. Farther to the south and about 700 ft (215 m) southeast of the site are buildings that house the air separation plant of AGA Burdox, Inc., which produces oxygen and nitrogen. The large east-striking building housing the DuPont Blennerhassett Warehouse is only about 150 ft (46 m) south of the site.

Table 2–1. Route and Mileage to Parkersburg Site

Mileage	Route
0.0	Junction of State Highway 68 and U.S. Highway 50 in downtown Parkersburg. Proceed south on State Highway 68.
0.2	Start of bridge over Little Kanawha River.
3.0	Junction of State Highway 68 and State Highway 892 (DuPont Road). Turn right on DuPont Road.
6.15	Large facility of the E.I. DuPont de Nemours Company to right.
6.5	DuPont facility entrance to right.
6.8	Post Office for the village of Washington to left.
7.2	Entrance to the large General Electric Plastics facility to right.
7.7	Turn right (west) on Foster Drive (Secondary State Route No. 34/2).
7.8	About 150 ft (30 m) after crossing the tracks of the Baltimore and Ohio (B&O) Railroad, turn left (south) on the gravel site access right-of-way road that goes southward for about 750 ft (240 m), crosses two railroad tracks of the spur into the L.B. Foster Company, and ends near the northeast corner of the Parkersburg site.
7.95	Entrance gate in security fence surrounding the Parkersburg stabilization mound.

The Parkersburg site is in the unglaciated Allegheny Plateau section of the Appalachian Plateaus physiographic province. Although not glaciated, the site is at an elevation of about 630 ft (195 m) on a high terrace that formed from outwash material deposited by the Ohio River during early Wisconsinan glaciation about 65,000 to 75,000 years ago. Most of Washington Bottom consists of this high terrace surface situated about 60 ft (19 m) above the low water level of the Ohio River. West of the site is a narrow low terrace at an elevation of about 600 ft (180 m) that is adjacent to the Ohio River. This low

terrace formed from late Wisconsinan glacial outwash and is also part of Washington Bottom. About 700 to 1,000 ft (215 to 310 m) east of the site, just east of DuPont Road, low hills rise up abruptly about 200 ft (60 m) and border Washington Bottom. These hills are formed on bedrock of the Dunkard Group of Pennsylvanian and Permian age (Cardwell et al. 1968). Rocks of this group consist of a cyclic nonmarine sequence of sandstone, siltstone, shale, limestone, and coal. Some of the coal has been removed by strip mines (abandoned) scattered through the hills. Bedrock at the site beneath approximately 100 ft (30 m) of glacial outwash sand and gravel is also the Dunkard Group.

The site location in Washington Bottom at an elevation of about 630 ft (195 m) is higher than the highest recorded Ohio River floodwater level of 616.5 ft (187.9 m) in 1913 (NRC 1982). Because of the nearly flat terrain on the terraces of Washington Bottom, surface-water drainage in the area is poor in places, but generally is through small creeks and ditches that drain westward or southward into the Ohio River. Elevation over the 15.16-ac (6.14-ha) stabilization mound portion of the site property varies only about 30 ft (9 m) from about 644 ft (196 m) at the top of the stabilization mound to about 614 ft (187 m) in the drainage at the southwest corner of the property. Surface water at the site drains generally toward the south through an unnamed creek about 200 ft (61 m) east of the property and a ditch along the west property boundary. Both of these drainages empty into the south-flowing Ohio River within 1 mi (1.6 km) of the site.

Soils in the site area are generally classified as the Huntington-Ashton-Wheeling association according to the "Soil Survey of Wood and Wirt Counties, West Virginia" (Ellyson et al. 1970). These soils are deep, well-drained, silty, and occur on bottom lands and terraces along the Ohio River on level or gently sloping terrain. More specifically, soil at the site before the stabilization mound was constructed consisted of the Wheeling, Lakin, and Sciotoville series. Wheeling soil is deep, well-drained silt loam that is moderately permeable; it occurs in the west part of the site. Lakin soil is highly permeable loamy sand that developed on deep, sandy (possibly windblown sand) material on low ridges; it occurs in the central and southeast parts of the site. Sciotoville soil is a deep silt loam, moderately well drained, and of moderately low permeability; it occurs in a small area in the northeast part of the site.

The fenced area of the stabilization mound and most of the immediately adjacent area is open and grass-covered. Dense stands of trees are present along the unnamed south-draining creek that is east of the site, and trees are adjacent and south of a small section of the security fence along the south edge of the stabilization mound.

Climate at the Parkersburg site is humid and continental, as inferred from data from the nearby town of Parkersburg (Ellyson et al. 1970). Annual average precipitation is approximately 40 in (100 cm). Heaviest rainfall is in June, July, and August; and lightest precipitation is in September, October, and November. Annual average snowfall is about 24 in. (60 cm). Winter is usually moderated by warm air that flows up along the Ohio River Valley. However, cold and snow can occasionally be severe, as experienced during January 1994 when 40 in. (100 cm) of snow fell. Large diurnal temperature differences are rare—the average daily temperature range is between 15 and 20° F (8 and 11° C). The lowest average temperature of 33° F (0° C) is in January and the highest average temperature of 75° F (22° C) is in July. Highest temperatures in summer usually reach into the upper 90s° F (35-38° C) and lowest winter temperatures are about 0° F (-18° C). Prevailing winds are from the southwest. Fog commonly occurs along the Ohio River bottom at night and early morning in the summer and fall.

No prior notification or permission is necessary for access to the Parkersburg site; however, personnel working on site are advised to inform the L.B. Foster Company (which leases land north and

west of the site from AMAX) of their presence on or adjacent to the site. Personnel should either call the L.B. Foster Company at (304) 863-3316 or check in at the company office building about 500 ft (150 m) north of the site.

The boundary of the roughly pentagonal-shaped 15.16-ac (6.14-ha) site property that contains the stabilization mound is shown in Plate 1, which is from a site survey conducted in the spring of 1995. A legal description of the site property is given in Appendix B, which contains the description as stated in the General Warranty Deed of AMAX Land Transfer for Tract 101 on July 8, 1993. This boundary description differs from the May 1987 description by AMAX in its license application to the NRC mainly in that the azimuth directions have changed slightly reflecting the resurvey in the spring of 1993 by the U.S. Army Corps of Engineers (COE). Tract 101 is held as fee simple property by the DOE. Also given in Appendix B is the legal description of Tract 101E, which is the 20-foot-wide permanent access road easement through AMAX-owned property from Foster Drive to the DOE-owned Tract 101 that contains the stabilization mound. Tract 101E contains approximately 0.34 ac (0.13 ha) and is shown in Plate 1.

The stabilization mound area is enclosed by a 6-ft (1.8-m) high security fence, which has one entrance gate and four walk gates (Plate 2). All the gates are locked. Keys to the locks are held by the DOE–Grand Junction Projects Office (GJPO) Project Manager and the Rust Geotech Long-Term Surveillance and Maintenance (LTSM) Project Manager (Table 2–2).

The fence around the stabilization mound was constructed in late 1982 and set inside the property boundary by a distance that varies from 15 to 100 ft (4.6 to 30 m). The galvanized security fence is approximately 2,900 ft (890 m) long, is of chain-link construction, and is topped with three stands of barbed wire. The entrance gate near the northeast corner of the site property is a 16-ft (5-m) wide double gate. The four walk gates (about 3-ft [0.9-m] wide) are located at the west end of the north fence, midway along the west fence, at the south end of the west fence, and at the east end of the south fence (Plate 2).

Fifteen warning signs are posted on the security fence around the site to inform the public of the function and ownership of the site and that trespassing is forbidden (Section 3.3.2). The signs are spaced no more than 200 ft (61 m) apart around the site security fence. Because the site is in an active industrial and agricultural area, human intrusion/vandalism could become a problem. Scheduled site inspections (Section 4.1.1) will monitor the effectiveness of these security measures. The DOE 24-hour telephone number on the warning signs (Section 3.3.2) provides an additional security measure.

Table 2–2. Parkersburg Site Key Holders

Title and (current contact)	Telephone	Address
DOE–GJPO Project Manager (Joe Virgona)	(970) 248-6006	U.S. Department of Energy 2597 B 3/4 Road Grand Junction, CO 81503
Rust Geotech LTSM Project Manager (David Scheuerman)	(970) 248-6140	Rust Geotech 2597 B 3/4 Road Grand Junction, CO 81503

2.2 Site History

In 1957, the Carborundum Company built a facility to produce high-grade zirconium metal by processing zircon ore ($ZrSiO_4$), which came mainly from Nigeria. The site of the processing facility included the present area of the stabilization mound and adjacent areas to the west and to the north as far as Foster Drive. The high-grade zirconium metal was produced under an AEC contract for use in the construction of nuclear reactors for the U.S. Navy. The designed capacity for this plant was 600 tons (544 tonnes) of zirconium annually and was an expansion from the company's smaller pilot zirconium-processing facility in Akron, New York.

The zirconium and hafnium (a constituent in the zircon ore) processing method used at the Parkersburg facility was developed by W.J. Kroll for the U.S. Bureau of Mines. Zircon ore is first converted to zircon carbonitride and hafnium carbonitride by mixing it with graphite or coke and fusing the mixture. The carbonitrides are chlorinated in a furnace, and the gaseous chlorides of zirconium ($ZrCl_4$, zirconium tetrachloride) and hafnium are collected in a condenser. The zirconium and hafnium chlorides are reduced to their respective metals using the Kroll method, which involves reacting the chlorides with magnesium metal under pressure. In addition to the magnesium chloride produced in this reaction, another waste product that can become pyrophoric under certain conditions is "sidewall material." The final product, zirconium sponge, contains about 2 percent hafnium and is used in non-nuclear applications. Reactor-grade zirconium (contains about 0.3 percent hafnium) is produced by dissolving zirconium sponge using methyl isobutyl ketone and the hafnium is solvent extracted to hafnium thiocyanate. The resulting zirconium sponge is crushed, compacted into electrodes, and vacuum melted to ingots.

From 1959 to 1962, the Carborundum Company processed Nigerian zirconium ore under AEC surveillance and under several licenses. In addition to zirconium, this ore contained about 3 percent hafnium oxide, up to 8 percent thorium (ThO_2), and about 2 percent uranium oxide (U_3O_8) (NRC 1982). All the ore and the residual materials were stored in drums on the site. The use of this highly radioactive Nigerian ore ended in April 1962, and until January 1964, plant operations were limited to reprocessing and upgrading the zirconium oxide and sponge inventory. In January 1964, plant operations switched to processing Australian zirconium ore, which contained low levels of radioactivity compared to the Nigerian ore.

From June 1965 to May 1967, the site facility was operated under the name of Carborundum Metals Climax, Inc., which was a joint venture of Carborundum Metals Company Division and AMAX Specialty Metals Co., Inc. In May 1967, AMAX (a totally owned division of American Metals Climax, Inc.) became the sole owner of the facility. By 1968, some of the drums containing the radioactive Nigerian ore and residual materials had deteriorated and spilled on the soils in the storage area. High radioactivity in the contaminated soils exceeded approved levels and it became necessary to move the soils and drums from the site. In September 1968, approximately 3,000 drums of zirconium ore, residual material, and soil were transported from the site to the AEC low-level radioactive waste site at Maxey Flats, near Morehead, Kentucky.

In late 1969, AMAX began purchasing zirconium tetrachloride and discontinued processing zirconium ore. Production of zirconium and hafnium metal sponge continued until November 1974 when all production at the site ended. In November 1974, AMAX obtained a license from the NRC to conduct laboratory-scale experiments on baddeleyite ore (ZrO_2), which contained less than

0.5 percent total thorium and uranium. Test material and process residuals were contained in one building. The tests were concluded in late 1975 and all remaining baddeleyite ore and its process materials were transported to Northern Abrasives, a site in Ontario, Canada.

In March 1977, AMAX sold the 375-ac (152 ha) property (only 125 ac [51 ha] of which had been involved with the zirconium-processing operations) and buildings to the L.B. Foster Company, a steel pipe manufacturing business. In September and October 1977, site inspections by the NRC associated with the closeout of AMAX's baddeleyite license found areas of residual soil contamination associated with Nigerian ore processing. The following cleanup program resulted in 70 drums of contaminated soil, which were transported to an NRC-approved disposal site in late 1977. During building construction activities by L.B.Foster Company in March 1978, a backhoe excavation encountered pyrophoric waste material that caused several fires and explosions. Investigation of the causes of the explosions determined that AMAX had not adequately terminated its license with the NRC. As a result, AMAX repurchased the property from L.B. Foster Company and began radiological, geological, and hydrological surveys to evaluate the site for cleanup. The first surveys completed were a radiological assessment of the site conducted from July through October 1978 (ATCOR, Inc. 1978) and an aerial radiological survey flown in August 1978 (EG&G, Inc. 1979). During 1979, AMAX leased part of the property found to be free of radiological contamination back to L.B. Foster Company and its pipe manufacturing operations resumed in late 1979 in buildings to the northwest of the present stabilization mound.

In addition to the initial site studies, AMAX started in 1979 a comprehensive series of technical studies to develop a stabilization plan. Soil test pits and two monitor wells (MW–1 and MW–2) were installed in June 1980 as part of the evaluation of the hydrogeology of the AMAX site completed in August 1980 (Williams and Associates 1980). A geotechnical investigation report (Woodward-Clyde Consultants 1980) completed in September 1980 located borrow material, recommended placement and compaction procedures for earthwork in stabilization mound construction, and presented tests of topsoil material in the area. The radiological survey conducted in 1980 by Chem-Nuclear Systems, Inc., identified an unrestricted area in which the radiation dose levels were above the acceptable limits of 10 CFR 20.105 (NRC regulations for licensed facilities). This survey was presented in the report completed in September 1980 entitled *Radiological Assessment and Stabilization Scenarios* (Chem-Nuclear Systems, Inc. 1980). With these technical study report results, AMAX proposed a site stabilization plan to the NRC in September 1980 (AMAX 1980). The stabilization plan proposed to consolidate the waste site into one area (which had previously been occupied by the zirconium processing operations), protect public health, and restore much of the property to unrestricted use. The consolidated waste material would be capped with clay and protective topsoil so that radionuclide leaching would be minimized, radon emissions would be reduced, erosion and dispersion would be prevented, and the potential for contact with pyrophoric wastes would be eliminated.

In April 1982, the NRC completed an *Environmental Impact Appraisal* (NRC 1982), which evaluated the environmental impact of the proposed stabilization plan. This document determined that preparation of an environmental impact statement for the proposed action was not necessary. Also, in the document the NRC gave its approval with certain provisions for the proposed stabilization plan. The *Environmental Impact Appraisal* was submitted to the EPA for its review and concurrence, but the EPA declined to review the document.

In June 1981, AMAX applied to the NRC for a source material license. In June 1982, after the NRC's completion of the *Environmental Impact Appraisal,* the NRC granted AMAX a license authorizing "the collection, stabilization, and storage of the contaminated soil and rubble which is

present at and adjacent to the AMAX site." After receipt of the license, AMAX proceeded with stabilization of the site from July to November 1982. During construction of the stabilization mound, Chem-Nuclear Systems, Inc., provided radiological data. Two additional monitor wells (MW–3 and MW–4) were installed in the fall of 1982 during the stabilization mound construction. Details of the radiologically contaminated material removed and of the construction of the stabilization mound where it was placed are in the *Stabilization Plan, Construction and Final Survey* prepared by AMAX in March 1984 (AMAX 1984). In late 1983, some minor post-construction adjustments were made to the stabilization mound and adjacent area to facilitate water drainage away from the mound. These adjustments included regrading the slope between the railroad spur and the north edge of the stabilization mound, installing a 120-ft (37-m) section of 42-inch (in) (108-centimeter [cm]) diameter steel culvert at the north end of the west drainage ditch, installing a 50-ft (15-m) section of 60-in (152-cm) diameter steel culvert under the ramp over the west drainage ditch, regrading the banks of the west drainage ditch, and constructing a drainage (perimeter ditch) furrow along the west side of the stabilization mound (AMAX 1984).

The NRC requested that the Oak Ridge Associated Universities Radiological Site Assessment Program conduct a survey to evaluate the effectiveness of remedial action at the AMAX property. This study was completed as a *Radiological Survey of the AMAX Site* and issued in January 1985 (Frame and Berger 1985). Objectives of the survey were to evaluate the adequacy and accuracy of the soil sampling and analytical techniques used by Chem-Nuclear Systems, Inc., evaluate the effectiveness of decontamination operations, and determine the radiological status of the site following cleanup, backfilling, and stabilization mound construction.

Among the requirements of the license issued by the NRC to AMAX were a stipulation that biannual inspections of the stabilization mound be conducted and a report submitted to the NRC. In addition, water samples will be obtained from the four monitor wells and analyzed for gross alpha and gross beta. The first inspection occurred in December 1982, and two inspections per year have occurred subsequently during most years through 1993. All inspections and sampling, except the initial sampling in 1982, have been completed by personnel of the West Virginia Department of Health. All water-sample results for alpha and beta activity have been below the NRC license criteria of 15 picoCuries per liter (pCi/L) for gross alpha and 50 pCi/L for gross beta.

In January 1986, AMAX requested that its contract license be amended to delete the area outside the stabilization mound and that the outside area that no longer contained radioactive material be released for unrestricted use. In March 1987, the NRC released an *Environmental Assessment* (NRC 1987) concerning the license amendment request and approved the amendment subject to two conditions. In May 1987, AMAX applied for a renewal of its license to store radioactive contaminated soil and rubble in the stabilization area. In this license application was a legal description of the 15.16-ac (6.14-ha) area containing the stabilization mound.

After its license was renewed, AMAX in November 1987 requested in a letter to the DOE that the DOE assume title and custody of the stabilization area. This license termination request was submitted pursuant to Subtitle D, Section 151(c) of the Nuclear Waste Policy Act of 1982, which gives the terms for the transfer. AMAX fulfilled the terms for the transfer and the DOE was obligated to assume long-term ownership and responsibility for the site. However, it is the DOE's responsibility, under the DOE Orders 5440.1E, "National Environmental Policy Act (NEPA) Compliance Program," and 5400.1, "General Environmental Protection Program," to assess the potential liabilities the agency may be incurring as a result of its acceptance of title to the site and to determine if the site, as remediated, conforms to applicable State and Federal environmental regulations. To answer these

concerns, particularly in respect to ground-water flow direction and contamination, radon flux, and erosion potential, the LTSM Program at the GJPO, which will provide for the long-term care and custody of DOE disposal sites, collected additional characterization data on the stabilization area in 1994 and 1995.

Rust Geotech, the prime contractor for the DOE at the GJPO, conducted the additional site characterization tasks according to the *Work Plan for Confirmation of Waste Containment at the AMAX Radioactive Material Storage Area* (DOE 1993b), completed in December 1993. The associated documents, *Sampling and Analysis Plan/Quality Assurance Project Plan* (DOE 1994b) and *Health and Safety Plan* (DOE 1994a) were also prepared in early 1994. To adequately characterize ground-water conditions and movement, two additional monitor wells (MW–5 and MW–6) were installed by Rust Geotech along the north edge of the stabilization mound in May 1994. Rust Geotech made radon-flux measurements on the surface of the stabilization mound in August 1994 and prepared a report of the results in September 1994 (Rust Geotech 1994b).

The report on *Site Characterization Results* (DOE 1995b), completed in September 1995, contains results of ground water and radon sampling and concluded that the buried wastes were properly contained within the AMAX stabilization mound. Ground water beneath the site complies with State of West Virginia ground-water standards and with Federal Safe Drinking Water Act standards. Radon emissions were found to comply with the National Emission Standards for Hazardous Air Pollutants (NESHAP) codified at 40 CFR 61, Subpart Q. On the basis of computer modeling results of hydrologic conditions downgradient from the stabilization mound, it was recommended that additional ground-water sampling at MW–5 and MW–6 sometime during the period from 1997 to 2002 (15 to 20 years after site closure) might detect slow-moving contamination that has migrated downgradient (north to northeast) from the stabilization mound.

As part of preparation for transfer of site ownership from AMAX to the DOE, the U.S. Army Corps of Engineers (COE), Huntington District, conducted surveys of the site and of an access road to the site. In February 1993, the COE surveyed the site security fence and its nine corners and determined that the fence enclosed an area of 12.098 ac (4.896 ha). The COE also surveyed a 20-ft (6-m) wide right-of-way easement for a site access road from Foster Drive to the entrance gate near the northeast corner of the security fence around the stabilization mound. The area of this right-of-way was determined to be approximately 0.34 ac (0.13 ha). On July 8, 1993, a General Warranty Deed (Appendix B) transferred title of Tracts 101 and 101E (stabilization mound area and permanent access road easement, respectively) from AMAX to the DOE. However, ownership of the site was not formally assumed by the DOE until March 4, 1994. As a result of the ownership transfer, on June 7, 1994, the NRC cancelled AMAX's license for the site. Additional characterization work in 1994 at the site created the need for another survey, which Rust Geotech subcontracted to a private surveyor. This survey (Plate 1) was conducted in May 1995 and consisted of the following determinations: elevations of all six monitor wells, horizontal coordinates of the two new monitor wells (MW–5 and MW–6), and horizontal and vertical coordinates for the six new boundary monuments.

An initial or baseline inspection of the Parkersburg site was conducted by Rust Geotech in March 1994 (Rust Geotech 1994a). This inspection found the site to be in good condition; main recommendations were to control the headward erosion of the gully near the southwest corner of the site and to set boundary monuments delineating the site property. Six boundary monuments were set on the property corners in late 1994. The second annual inspection of the site was conducted by Rust Geotech in March 1995 (Rust Geotech 1995a). This inspection found the site to be in good condition; main recommendations were to control the headward erosion of the gully near the southwest corner of the site

and to install 15 warning signs on the security fence. The signs were installed on the site security fence in the summer of 1995, and a design for the control of erosion in the gully near the southwest corner of the site has been approved and will be implemented in 1996.

3.0 Final Site Conditions

3.1 Disposal Cell Design

The stabilization mound inside the security fence at the site covers an area of about 12 ac (4.9 ha). The mound was constructed from July to November 1982 by Chem-Nuclear Systems, Inc., under contract to AMAX. Radioactive soil and other debris were removed form other parts of the AMAX property and placed on grade. Part of the existing grade included concrete pad foundations of two buildings (fabrication shop to the west and weld shop to the east) that L.B. Foster Company had started to build in 1978 (Plate 2). Construction activities on the buildings had been halted because of explosions resulting from encounters with pyrophoric material, believed to be zirconium and magnesium metal. During construction of the mound, effort was made to place the most contaminated soil on the concrete pads for the buildings (AMAX 1984). The resulting grass-covered, gently-sloping stabilization mound rises to a maximum height of only about 9 ft (3 m).

Because the mound is gently sloping, surface drainage off the mound is not well defined. To improve surface drainage, about a year after the mound was constructed, in late 1983, a shallow drainage furrow (perimeter ditch in Plate 2) was constructed in the west side of the mound to channel water to the south off the mound. To protect the stabilization mound from horizontal movement of off-site shallow subsurface ground water, a 2-ft (0.6-m) wide barrier trench from 4 to 7 ft (1.2 to 2.2 m) deep was dug around the perimeter of the mound and backfilled with compacted clay (AMAX 1984).

Radioactive soil and pyrophoric material in the stabilization mound are capped by clay and protective topsoil. Information on the construction of the stabilization mound is in the *Stabilization Plan, Construction and Final Survey* (AMAX 1984). A conceptual schematic section of the component layers of the stabilization mound is shown in Figure 3–1.

Radiologically contaminated soil and debris placed on grade was compacted by D-8 bulldozers and tandem truck wheels. An inorganic clayey soil obtained from the field west of the site was spread over the contaminated material and compacted to a dense 6-in (15-cm) thick layer using a flat drum vibrator roller. A low permeability clay cap layer 12 in (30 cm) thick was constructed over the clayey soil layer to protect the waste material from leaching. The clay material, classified as CL and with a high percentage of inorganic clay, was selectively borrowed from the floodplain (a low terrace) just east of the Ohio River to the west of the site. Water was added as necessary to maintain optimum moisture content (about 20 percent) of the clayey material as it was spread by scrapers and compacted using a flat drum vibrator compactor. The clay material in compaction tests exceeded 90 percent density, and permeability of the layer was less than 1×10^{-7} cm/second (sec).

A 30-in. (75-cm) thick layer of topsoil was placed over the clay cap to protect it from weathering and erosion and to provide a soil base for growth of grass cover. The topsoil was obtained from borrow areas just west of the site and was compacted by a smooth drum vibrating compactor after being placed on the mound. The final 6 in. (15 cm) of topsoil was not compacted to allow for seeding of grass. Construction of the topsoil layer allowed surface drainage from all directions off the stabilization mound by limiting the final grade to between 1 and 5 percent over areas where the contaminated material had been placed. The final surface grade exceeded 5 percent at the southwest edge of the mound, which is outside the area where contaminated material was deposited. In late fall 1982, fertilizer, grass seed, and mulch were spread by hydromulch system over the final grade of the mound surface. The mixture

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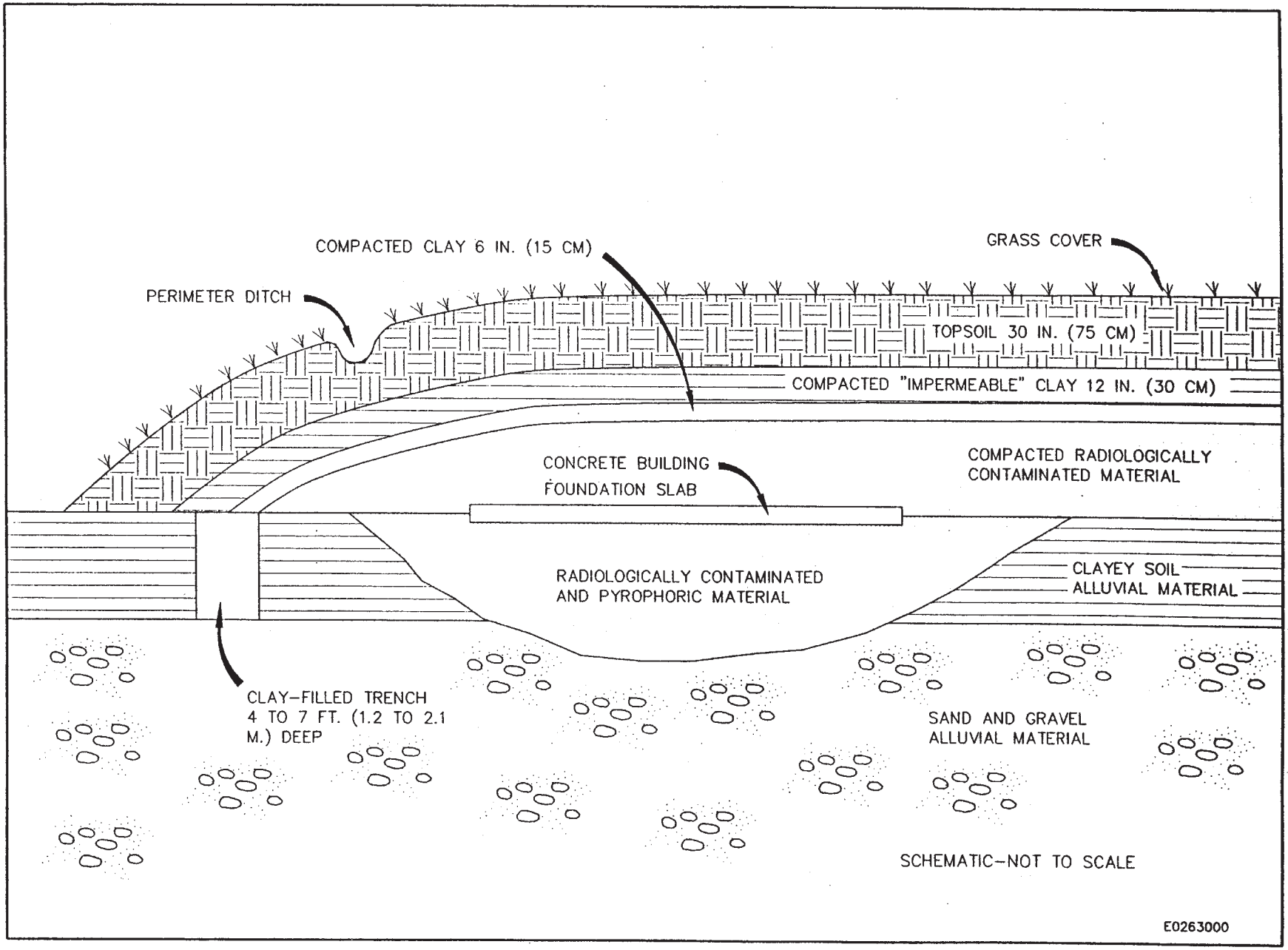


Figure 3-1 Conceptual Schematic Section of Stabilization Mound
(Based on U.S. Nuclear Regulatory Commission, 1988, & AMAX Environmental Services, Inc., 1984

of grasses seeded on the mound included winter wheat, Kentucky 31 Fescue (bluegrass), rye, and red clover.

The surface condition of the stabilization mound will be monitored during annual inspections to determine if the mound and erosion protection measures are functioning as designed. Guidelines to be followed when inspecting the stabilization mound and criteria for corrective action or repairs are as presented in Section 4.0.

3.2 Site Drawings and Photographs

At the completion of remedial action, certain as-built conditions of the stabilization mound and adjacent area were documented by drawings, maps, and aerial photographs. This information is mainly in the *Stabilization Plan, Construction and Final Survey* (AMAX 1984) and the *Radiological Survey of the AMAX Site, Parkersburg, West Virginia* (Frame and Berger 1985). Conditions at the site just before the termination of AMAX's license are documented in the "1994 Annual Site Inspection" (Rust Geotech 1994a) report of the inspection conducted in March 1994. Site conditions soon after the site was transferred to the DOE are described in the "1995 Annual Site Inspection" (Rust Geotech 1995a) report of the inspection conducted in March 1995. The baseline conditions provided by these reports are the basis against which future conditions at the site can be compared.

A site atlas will be prepared that includes a site location map, a topographic map, and a disposal site map. The site atlas will be updated by the GJPO, as necessary, after each site inspection. All the drawings, maps, and photographs will be archived at the GJPO in accordance with the "LTSM Records Management Plan" in the permanent site file as identified in the permanent site file index (Appendix C).

3.2.1 Site Location Map

The main part of the site location map (Figure 1–1) at a scale of 1 in (2.6 cm) = 2,000 ft (610 m) covers an area of approximately 1.0 mi (1.6 km) around the site. The map also shows the relationship of the site to West Virginia and to Wood County and nearby towns. The map shows the site property boundary, surrounding geographic features, industrial facilities, latitude and longitude, drainages, railroads, and roads.

The site location map will be updated, as necessary, after each site inspection. If changes to the map are necessary, a new map will be prepared and will include a revision number and the year of revision.

3.2.2 Site Topographic Map

The site topographic map, as part of the disposal site map shown in Plate 2, was prepared from a Preliminary Plat that AMAX had published on November 25, 1987, as part of the AMAX letter to DOE requesting that DOE assume title and custody of the stabilization area. This topographic map displays a contour interval of 5 ft (1.5 m); however, it was modified from an original topographic map, which was prepared from an aerial photograph taken on November 25, 1982, at a scale of 1 in. (2.6 cm) = 100 ft (30 m) and a contour interval of 1 ft (0.3 m). The 1982 topographic map, shown in the *Stabilization Plan, Construction and Final Survey* (AMAX 1984), shows the site after most of the construction was completed. Post-construction adjustments to drainages on and around the stabilization mound are not shown on the topographic map, and more recent changes to the drainage at the southwest corner of the

site to route the drainage away from the Blennerhassett Warehouse building (Plate 2) are not shown. These features as well as the recent erosion in the outflow channel from the perimeter ditch in the southwest part of the site are reasons to produce a new topographic map of the site. As recommended in the "1995 Annual Site Inspection" report (Rust Geotech 1995b), a new topographic map of the site is needed; the contour interval should be 2 ft (0.6 m) and coverage should extend from the site northward to Foster Drive and elsewhere to at least 500 ft (150 m) outside the site boundary.

When the site topographic map is updated, the revised map will include a revision number and the date of the revision. The original topographic map and all revisions will become part of the permanent site file.

3.2.3 Disposal Site Map

The disposal site map is at a scale of 1 in (2.6 cm) = 100 ft (30 m) and shows the stabilization mound, site property boundary, and site access road. This map will serve as the base map for site inspections (Section 4.1.5). Site inspections conducted in 1994 and 1995 used a base map at a scale of 1 in (2.6 cm) = 50 ft (15 m) that showed the stabilization mound and only part of the site access road.

In addition to topography, the disposal site map includes the following features:

- Site property boundary and boundary monuments
- Site access road easement
- Perimeter ditch on stabilization mound
- Site security fence, gates, and warning signs
- Monitor wells
- Drainages adjacent to site
- Railroad tracks and buildings near site

After each inspection, a new inspection map will be prepared that shows the results of that inspection. Each inspection map will indicate the type of inspection and the date of the inspection. All of the periodic site inspection maps will become part of the permanent site file.

3.2.4 Site Baseline Photographs

Site photographs were not included in the reports (AMAX 1984; Frame and Berger 1985) prepared at the time of completion of stabilization mound construction. Ground photographs were included in the "1994 Annual Site Inspection" (Rust Geotech 1994a) and the "1995 Annual Site Inspection" (Rust Geotech 1995b) conducted in March 1994 and March 1995, respectively. These photographs taken during the initial site inspections will serve as the baseline photographic record of final conditions at the site. Each photograph was recorded on a field photograph log form (Appendix D), and an appropriate description of the feature photographed (including azimuth, if necessary) was recorded on the form. These photographs and negatives, as well as all corresponding field photograph log forms, are in the permanent site file.

3.2.5 Site Aerial Photographs

Aerial photographs were taken of the site in 1978 before remedial action and in 1983 or 1984 after remediation and construction of the stabilization mound. The earlier color photograph was taken in June 1978 and shows two buildings of L.B. Foster Company that appear to be completed (roofs on buildings) in the area that later became the stabilization mound. This photograph was taken as part of the aerial radiological survey of the site conducted for the DOE by EG&G, Inc. (EG&G, Inc. 1979). The later photograph is in black and white and is included in the post-construction radiological survey report conducted by Oak Ridge Associated Universities for the NRC (Frame and Berger 1985). This photograph was taken in 1983 or 1984 just after construction of the stabilization mound was completed. Both photographs are in the permanent site file.

The aerial photographs provide useful information on pre-remediation and post-remediation site conditions. The photographs serve as useful orientation before site inspections. Site conditions have changed in the past 10 to 12 years and a new set of aerial photographs should be made in conjunction with the preparation of a new site topographic map (Section 3.2.2). Because of the constant changes in nearby land use, vegetation, and erosion patterns, the need for updated aerial photographs will be evaluated at 5-year intervals beginning in the year 2001. Updated aerial photographs will be dated and included in the permanent site file. Specifications for aerial photographs at the Parkersburg site are summarized in Table 3–1. More detailed guidance is given in Attachment 3 of the *Guidance for Implementing the UMTRA Project Long-Term Surveillance Program* (DOE 1992).

3.3 Permanent Site Surveillance Features

Permanent surveillance features at the Parkersburg site consist of boundary monuments, warning or perimeter signs, and monitor wells. Six boundary monuments define the six corners of the legal boundary of the site property. Fifteen warning signs are placed on the security fence at spaced intervals around the perimeter of the site so that one or more of the signs is visible in daylight to a person approaching the site from any direction. The construction and emplacement of the boundary monuments and warning signs are described below according to specifications in DOE's *Guidance for Implementing the UMTRA Project Long-Term Surveillance Program* (DOE 1992). Six ground-water monitor wells are around the perimeter of the stabilization mound and inside the security fence; wells are located in the north (three wells) west-central, south-central, and northeast parts of the site (Plate 2).

3.3.1 Boundary Monuments

Bernsten Federal aluminum survey monuments, Model A–1, were used for the six boundary monuments (Figure 3–2). Ceramic magnets are epoxied into the cap and base of each monument and are vertically oriented so that the monument can easily be found if it becomes buried. Each 4-ft (1.2-m) long monument is set with the cap within several inches above the ground surface. All the monuments are set exactly on the property line. Because of thick grass covering the stabilization mound and adjacent area, the boundary monuments may become difficult to locate with time. For this reason, a steel "T" bar fence post that stands 5 ft (1.5 m) above the ground surface was set beside each

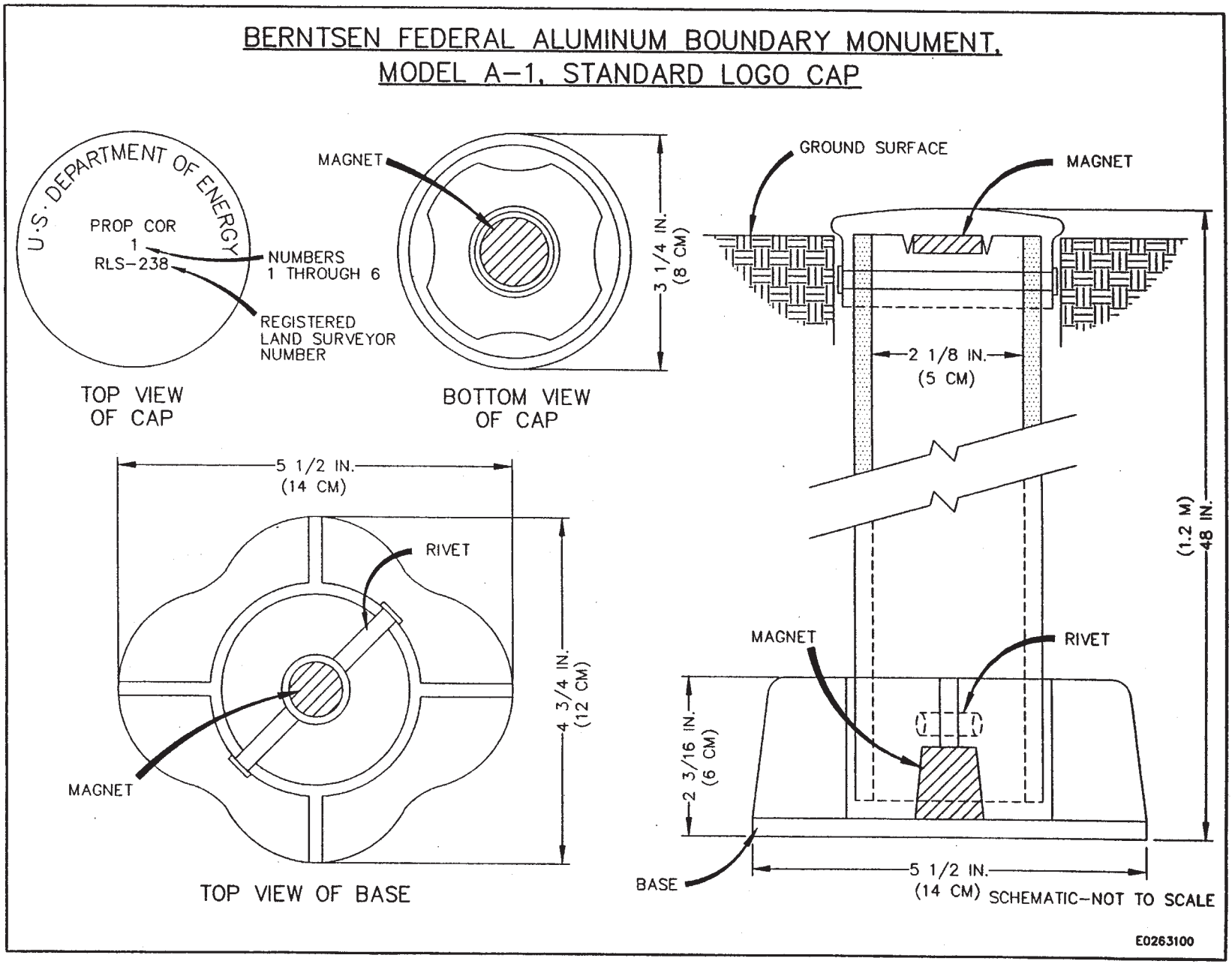


Figure 3-2 Boundary Monument at Parkersburg Site

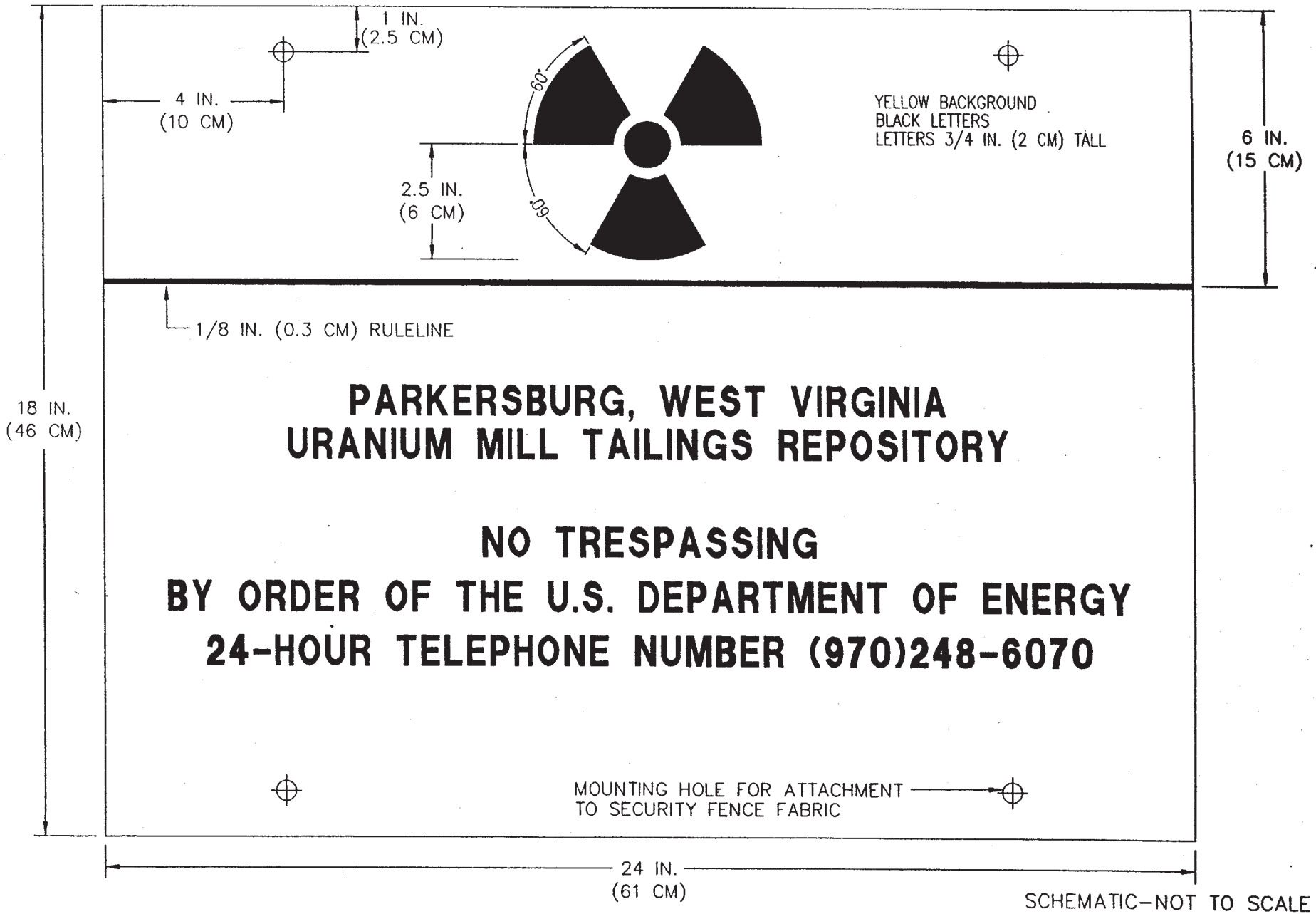
Table 3–1. Aerial Photography Specifications for Parkersburg Site

Area to be photographed	Site property boundary plus a minimum of 0.25 mi (0.4 km) beyond the site boundary, unless site conditions require otherwise.
Products to be delivered	One set of vertical color, infrared stereo contact prints, 9 in. by 9 in. (23 cm by 23 cm), scale 1:2400; double weight, glossy, not trimmed. One index map, scale 1:2400; flight lines and frame numbers will be provided. One set of 2 each of low and high oblique photographs (and negatives) in natural color, 8 in. by 10 in. (20 cm by 25 cm) or 9 in. by 9 in. (23 cm by 23 cm) contact prints.
Flight date	To be determined upon acceptance of this LTSP and re-evaluated at 5-year intervals thereafter.
Camera	Precision, 9 in. by 9 in. (23 cm by 23 cm) format for vertical photos. A 35-millimeter (single lens reflex) or larger format camera for oblique photographs is acceptable.
Film	Eastman-Kodak Aerochrome Infrared 2443, or its equivalent, for vertical photographs. Eastman-Kodak Ektacolor, or its equivalent, for oblique photographs.
Filter	Wratten Nos. 12 or 15 for infrared photographs. Skylight filter for color photos.
Flight line coverage	60 percent end overlap; 30 percent average side overlap.
Ground control	Control stations will be second order, Class 1, for horizontal control and third order for vertical control (standard U.S. Geological Survey map accuracy specifications.)

boundary monument as a reference post to aid in location of the boundary monument. Survey coordinates and elevation for each of the six boundary monuments are given in Table 3–2.

3.3.2 Warning Signs

Fifteen aluminum warning or perimeter signs are bolted on the site security fence by aluminum straps and contain the following information: the name of the disposal site, the international symbol indicating presence of radioactive material, a notice that trespassing is forbidden on this Federally owned site, and the 24-hour telephone number for the DOE–GJPO. The signs are of the dimensions and specifications shown in Figure 3–3. The signs are situated no more than 200 ft (61 m) apart around the site security fence. The signs are numbered in counterclockwise order starting with the sign on the site entrance gate. Perimeter sign locations are shown on Plate 2. Whenever the DOE 24-hour telephone number changes, the new number will be shown on corrected signs.



SCHEMATIC—NOT TO SCALE

Figure 3-3 Warning Sign at Parkersburg Site

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3.3.3 Monitor Wells

Six monitor wells (MW) are around the edge of the stabilization mound, just inside the site security fence. The wells are numbered in the chronological order in which they were drilled and installed and are shown on Plate 2. MW–1 through MW–4 were drilled and installed by AMAX; MW–1 and MW–2 in June 1980 and MW–3 and MW–4 in the fall of 1982. MW–5 and MW–6 were drilled and installed by Rust Geotech in May 1994.

The well heads of the first four wells are protected by rusting steel casings about 2 ft (0.6 m) in diameter that rise 2 to 3 ft (0.6 to 0.9 m) above the ground surface. The casing for MW–3 leans about 15 degrees to the east, is loose, and apparently is not cemented to the subsurface well casing. The top of each steel well casing is closed by a steel cap, which is locked by a padlock. Well construction and completion records are incomplete for these four wells. Completion information for MW–1 and MW–2 is in the report on *Hydrogeology of the AMAX Property* (Williams and Associates 1980). Scant information on MW–3 and MW–4 is in the *Stabilization Plan, Construction and Final Survey* (AMAX 1984).

The last two wells (MW–5 and MW–6) in the north part of the site have their well heads protected by a steel casing of about 8 in. (20 cm) diameter that rises about 18 in. (46 cm) above a concrete pad resting on the ground surface. Three steel posts set in each concrete well pad provide further protection for the well head. The top of each steel well casing is covered by a steel cap, which is secured by a padlock. Well completion and lithologic information are in the report on *Site Characterization Results* (DOE 1995b).

Table 3–2. Survey Coordinates and Elevations for Boundary Monuments and Monitor Wells at Parkersburg Site

Feature	Coordinates[a]		Elevation (ft)	
	North (N)	East (E)	Ground[b]	Measuring Point
Boundary Monument 1	280,769.373	1,381,610.297	631.99	---
Boundary Monument 2	281,125.097	1,380,878.172	629.11	---
Boundary Monument 3	281,163.526	1,380,730.015	626.75	---
Boundary Monument 4	281,002.681	1,380,591.266	618.45	---
Boundary Monument 5	280,367.203	1,380,584.925	611.66	---
Boundary Monument 6	280,188.014	1,381,250.134	634.50	---
Monitor Well 1	---	---	636.8	638.65
Monitor Well 2	---	---	631.7	633.44
Monitor Well 3	---	---	636.2	638.19
Monitor Well 4	---	---	637.3	639.58
Monitor Well 5	281,062.002	1,380,928.770	636.0	638.65
Monitor Well 6	280,917.444	1,381,225,080	635.4	638.05

[a]Coordinates for the older monitor wells, MW–1 though MW–4 were not determined in this survey conducted in the spring of 1995.

[b]Elevation shown for the boundary monuments is that of the survey cap.

4.0 Long-Term Surveillance and Maintenance Program

In 1988, the DOE designated the GJPO to be the program office for long-term surveillance and maintenance of all DOE remedial action project disposal sites, as well as other sites [including Section 151(c) sites] as assigned, and to establish a common office for the security, surveillance, monitoring, and maintenance of these sites. The DOE established the LTSM Program at the GJPO to carry out this responsibility.

The LTSM Program is responsible for the preparation and revision of this LTSP, as well as for site inspection, monitoring, and maintenance of the site. Other responsibilities of the LTSM Program include annual and other reporting requirements and maintenance of site records. General guidance for the LTSM Program is provided in *Draft General Guidance for Long-Term Surveillance and Maintenance of Off-Site DOE Radioactive Waste Disposal Sites* (DOE 1990).

4.1 Site Inspections

Inspections of the Parkersburg disposal site are conducted to ensure that the stabilization mound continues to function as designed. The principal objective of a site inspection is to identify potential problems before extensive maintenance, corrective action, or repairs are needed. Identification and documentation of progressive change caused by slow-acting natural processes are a fundamental part of the inspections. Finds from these inspections will be compared to initial baseline conditions to provide a basis for future inspections. Two types of site inspections are annual or scheduled inspections and follow-up inspections.

Each site inspection must be documented in a report that identifies the findings of the inspection. Copies of each report will be submitted to the DOE–GJPO and will be placed in the Parkersburg permanent site file. Annual or scheduled site inspection reports will be completed and submitted to the DOE–GJPO within 90 days of the inspection. Follow-up inspection reports will be submitted to the DOE–GJPO within 60 days of the inspection.

4.1.1 Frequency of Inspections

Annual inspections of the Parkersburg site will occur for the first 5 years after approval of this LTSP (1996 through 2000). At the end of the 5-year period, the GJPO will evaluate the need to continue annual inspections. The resulting recommendation will be based on an evaluation of the annual reports and any other reports filed for maintenance or unscheduled events. If it is determined that less frequent inspections are required, the GJPO will modify the LTSP and submit it to the DOE–GJPO for approval. Subsequent inspections will be considered as scheduled site inspections.

Late summer and fall are preferred times for inspections at the Parkersburg site. This is a relatively dry time of year and is near the end of the growing season so that the effect of vegetative growth on and around the stabilization mound can be assessed.

4.1.2 Inspection Preparation

Before each scheduled inspection, an inspection team consisting of a chief inspector and one assistant will be selected. Both professionals should be technical experts knowledgeable in processes

that could adversely affect the site. In the case of follow-up inspections, the inspection team will include at least two technical experts having expertise appropriate to the problems under investigation.

Before each inspection, team members will do the following:

- Review the final LTSP, the permanent site file, the previous site inspection report(s) and site inspection map(s), and all maintenance or corrective action reports.
- Prepare the site inspection checklist based on previous inspections or repairs; incorporate any necessary modifications.
- Verify and update the names and telephone numbers of all parties with whom access or notification agreements have been made.
- Verify the DOE–GJPO 24-hour telephone number and arrange to modify the warning signs if necessary.
- Schedule the site inspection and pre-inspection briefing meeting.
- Notify the DOE–GJPO and other appropriate parties for their attendance at the inspection if they so choose.
- Assemble all equipment needed for the inspection
- Adjust the magnetic declination of the Brunton compass to be used in the inspection for that of the Parkersburg area (currently 7 degrees west of true north).

4.1.3 Inspection Checklist

The inspection is guided by the inspection checklist. An initial site inspection checklist for the Parkersburg site is included as Appendix E. This initial checklist is a guideline for the inspectors. After completion of each inspection, the checklist will be revised to include new information or to delete items that are no longer pertinent. The revised checklist will be prepared prior to the next scheduled inspection.

4.1.4 Inspection Photographs

Ground photographs (color prints) will be taken during site inspections to document conditions at the stabilization mound, site perimeter, and outlying areas. These photographs will provide a continuous record for monitoring changing conditions through time. Comparison of these photographs with baseline photographs can be made to determine if changes are affecting site integrity. Each photograph will be recorded on a field photograph log (Appendix D) along with an appropriate description of the feature photographed, including azimuth (if necessary). Copies of the photographs and the photograph log form will be included in the site inspection reports.

When possible, a photograph should include a reference point such as a boundary monument, monitor well, or perimeter sign. A north arrow and scale should also be included for reference in photographs of erosional features or other small-scale subjects. In specific areas where a photograph is used to monitor change over time, the azimuth and distance from the feature should be recorded, and all

subsequent photographs should be taken from the same orientation to provide an accurate record of change. The magnetic declination of the compass should be adjusted so that the compass points to true north. This declination angle adjustment will be recorded on the inspection checklist and on the field photograph log. All site inspection photographs taken, as well as corresponding field photograph log forms, will be maintained in the Parkersburg permanent site file.

The following site features should be documented by photographs during each scheduled inspection at the Parkersburg site:

- Permanent site surveillance features (6 boundary monuments, 15 warning signs, and 6 monitor wells shown on Plate 2). Only one photograph of a representative warning sign is necessary; additional signs should be photographed if they have been damaged.

- Site entrance gate. Show damage to the fence, entrance gate, or walk gates by additional photographs.

- Site access road.

- Surface of the stabilization mound and any evidence of settling, burrowing, ponding of water, erosion (ruts, rills, gullies), seepage, and invasion of noxious vegetation. A 360-degree photographic panorama will be taken from the top of the stabilization mound to document the general condition of the mound surface and its grass cover.

- Perimeter ditch in the west part of the stabilization mound.

- Drainage ditches along the north and west edges (west drainage) of the site.

- Evidence of erosion peripheral to the stabilization mound both inside and just outside of the site property boundary. These are features that the inspector considers to be significant enough to affect the site in the future and which are included in the text of the inspection report. These features may include headward advance of gully erosion in the outflow channel of the perimeter ditch southwest of the stabilization mound, erosion of the stream east of the site, rills that start on the stabilization mound and continue offsite, and concentrations of animal burrows that can initiate and contribute to erosion.

- Areas of ponded water in flat, poorly drained areas just south and east of the stabilization mound.

- Extent and condition of wooded area adjacent to the south security fence.

- Seep areas near the stabilization mound and indications of seeps such as discolored grass or soils.

- Nearby industrial activity or other land uses (including drainage modifications) that might affect the site.

All new or potential problem areas identified during a site inspection will be well documented with photographs. Photographs will also be taken to record developing trends in the condition of the site. These photographic records will be used to make decisions concerning follow-up inspections, custodial

maintenance or repairs, or corrective actions. The number of photographs, view directions, and lenses used will be determined by the inspectors according to site conditions and lighting conditions.

4.1.5 Inspection Transects

To ensure that the Parkersburg site is thoroughly covered during an inspection, the site is divided into two transects that are walked by inspectors. Observations and photograph locations will be recorded and described during the walk through each transect. Observations will be recorded in a field notebook, photograph locations and other notes will be recorded on a disposal site map (Plate 2), and photograph information will be recorded on field photograph log forms. After the inspection, information on the disposal site map will be drafted and retained in the Parkersburg permanent site file. The two transects (stabilization mound, and site perimeter and outlying area) and the permanent site surveillance features and other features that they contain, along with conditions that should be noted, are as follows:

- Stabilization mound – Inspectors will walk over the entire area of the stabilization mound inside the security fence. The objective is to achieve thorough visual coverage of the surface condition of the mound. During each inspection, a 360-degree photographic panorama will be taken from the top of the stabilization mound. The eight photographs that compose the panorama will be taken at 45-degree azimuth increments.

  Inspectors will search for evidence of differential settling or depressions in the mound surface that would affect drainage and cause ponding of water. The presence of vehicle ruts, from water-sampling or grass-mowing activities conducted during times of wet/soft ground conditions, also can affect drainage and create areas of ponded water. Evidence of erosion, slumping, and seepage will be sought along the steeper-sloping southwest edge of the stabilization mound. Wet areas on the mound surface and areas where running water has cut drainage pathways (rills) will be noted. The condition and composition of the grass cover (density and health of grass, discolored or dying grass, and mowed height of grass) will be noted. The mound surface will be examined for disturbances by animals (woodchuck burrows and mice/gopher holes). Trash deposited by wind from nearby industries will be noted and removed from the mound. Inspectors will walk along the length of the perimeter ditch to determine whether drainage is occurring and the ditch is functioning as designed. Included in this transect are the six monitor wells, and their conditions will be noted.

- Site perimeter and outlying area – This transect includes the security fence, gates, and warning signs; the six boundary monuments; the area around the perimeter of the stabilization mound, generally from the security fence outward about 200 ft (61 m); and the site access road. Inspectors will note any damage to the security fence and gates and warning signs (and if any are missing). Emphasis in the area outside the fence will be on the progress of gully erosion in the southwest corner of the site property that is advancing headward toward the edge of the stabilization mound. Erosion rills should be noted and whether or not they are extensions of rills formed on the stabilization mound. Progress of erosion in the drainage in respect to boundary monuments 3 through 5 will be noted. Seep areas will be noted and other indications of seeps such as discolored grass or soils. Animal burrow location and frequency will be noted so that their activities and movements in relation to the stabilization mound can be determined. The condition of the grass cover and extent of woodland along the south edge of the site property will be noted. The presence and evidence of grazing animals will be noted. Wind-transported trash will be removed from the site property (from the security fence to the property boundary). The

condition of the site access road will be noted along with any adjacent land uses that may restrict use of the road.

4.1.6 Inspection Report

After each scheduled inspection, a site inspection report will be completed that includes the following information:

- Narrative that describes the inspection, including results and recommendations.
- Disposal site map (Plate 2), which will show photograph locations, locations of new or anomalous features, locations of features identified during previous inspections for observation or monitoring, and the inspection date. This map will become Plate 1 of the inspection report.
- Inspection photograph log (that describes each photograph) and photographs.
- Description of any new conditions discovered during the inspection that require monitoring or immediate action; recommendation of a follow-up inspection (if required) or custodial maintenance or repair.

A copy of the inspection report will be submitted to the DOE–GJPO within 90 days after the date of the inspection. A copy of all site inspection reports will be kept in the Parkersburg permanent site file.

4.1.7 Follow-Up Inspections

Follow-up inspections are unscheduled inspections conducted to investigate and quantify specific problems found during a scheduled inspection, ground-water sampling event, or special study. They determine whether processes currently active at or near the site threaten site security or stability, and they evaluate the need for custodial maintenance, repair, or corrective action.

The follow-up inspection begins with an on-site visit to assess the need for definitive tests or studies. Additional visits may be scheduled if more data are needed to form conclusions and recommend corrective action.

After completion of the follow-up inspection, information will be analyzed and a follow-up inspection report will be prepared and submitted to the DOE–GJPO within 60 days of the follow-up inspection date. The report will include at least the following:

- A description of the problem.
- A preliminary assessment of the maintenance, repair, or corrective action required.
- Conclusions and recommendations.

- Assessment data, including field and inspection data, and photographs.
- Names and qualifications of the field inspectors.

4.1.8 Custodial Maintenance or Repair

Custodial maintenance will be performed as needed at the Parkersburg disposal site. The need to conduct unscheduled maintenance or repair will be based on the results of annual site inspections and follow-up inspections.

Planned maintenance at the site consists of cutting the grass on the stabilization mound and within the site boundary. Grass cutting will occur at least once per year; a second cutting may occur if conditions warrant during a year of high rainfall.

Unscheduled maintenance or repair that may be required at the Parkersburg disposal site include the following:

- Repairing the security fence and gates.
- Replacing the perimeter warning signs.
- Reestablishing boundary monuments or establishing reference boundary monuments.
- Repairing the site access road.
- Building erosion control structures in drainages on the west and southwest edges of the site.
- Removing trees and brush from the security fence along the south side of the site.
- Controlling burrowing animals on and near the stabilization mound.

The GJPO will prepare a statement of work (including subcontractor qualifications) and purchase order to authorize these types of repair. The annual inspection report should include a summary of the work that was necessary to remediate an unscheduled maintenance or repair item. After work completion, the subcontractor must submit verification of the completed work and/or a written report if the action is considered significant. The DOE will inspect the site, as necessary, and review the report before certifying that all work is completed in accordance with all required specifications. Copies of all records, documentation, and certifications will be included in the Parkersburg permanent site file.

4.1.9 Ground-Water Monitoring

The need for continued ground-water monitoring at the Parkersburg disposal site was evaluated in accordance with DOE Orders 5440.1E, "National Environmental Policy Act (NEPA) Compliance Program," and 5400.1, "General Environmental Protection Program." Ground-water sampling and analysis of the sample data, as part of additional characterization at the site during 1994 and 1995 (DOE 1995b), determined that ground water complies with State of West Virginia ground-water standards and with Federal Safe Drinking Water Act standards. Concentrations of major anions and cations measured in water samples from wells at the Parkersburg site are of the same magnitude as those measured in samples from the public water supply wells (Lubeck Public Service District).

As part of the site characterization (DOE 1995b) a hydrologic assessment and computer modeling were performed to estimate the number of years a contaminant plume would take to reach downgradient wells MW–5 or MW–6 just north of the stabilization mound. This worst-case scenario assumed that the cover of the stabilization mound allowed water to infiltrate and saturate the buried radiologically contaminated material forming a contaminant plume that would migrate about 60 ft (19 m) downward through alluvial material to the alluvial aquifer. Results of computer modeling of hydrologic parameters indicated it would take 15 to 20 years (after site closure in 1982) for contaminants to reach MW–5 or MW–6 using the worst-case scenario.

From the site characterization results (DOE 1995b), recommended sampling of ground water at the Parkersburg site would occur between the years 1997 and 2002 in monitor wells MW–5 and MW–6. Because modeling results indicate that contamination of the aquifer would occur relatively slowly, ground-water quality should be monitored once every 5 to 10 years (after the initial sampling in the 1997 to 2002 time frame). Analysis of ground water should include metals (antimony, barium, beryllium, cadmium, chromium, lead, mercury, nickel, selenium, and thallium) hafnium, zirconium, thiocyanate, major cations and anions (calcium, magnesium, potassium, sodium, chloride, sulfate, and nitrate+nitrite), radionuclides (radium-226, radium-228, and uranium), gross alpha, and gross beta. Analytical results of future ground-water samples will be compared with results of samples collected in 1994 and 1995, published in *Site Characterization Results* (DOE 1995b), to determine if changes in ground-water quality have occurred. A separate sampling plan and report of results will be prepared for each future episode of ground-water sampling at the site.

4.1.10 Corrective Action

If natural or unpredictable events threaten the stability of the stabilization mound, corrective action appropriate to the problem could include temporary emergency measures. In addition, the LTSM Program would evaluate the factors that caused the problem to ensure that recurrence is minimized or avoided. A report of the evaluation would be submitted to DOE–GJPO.

4.1.11 Records

The LTSM Program maintains Parkersburg site records in a permanent site file at the DOE–GJPO in Grand Junction, Colorado. An index of documents in the Parkersburg permanent site file is included in Appendix C.

All LTSM Program records are maintained in full compliance with the following DOE requirements:

- DOE Order 1324.2A, Records Disposition
- DOE Order 1324.5, Records Management Program
- DOE Order 1324.8, Rights and Interests Records Protection Program
- DOE Order 5500.7B, Emergency Operating Records
- Criterion 4, Documents and Records, in both the *Quality Assurance Manual* (Rust Geotech 1995c) and the *LTSM Program Quality Assurance Program Plan* (DOE 1995a).

4.1.12 Emergency Notification and Reporting

Notification agreements with local (county), State, and Federal government agencies for notification of the DOE in the event of human intrusion or unusual or catastrophic natural events in the vicinity of the Parkersburg site have not been established. However, the site is equipped with 15 warning signs posted on the security fence that display a 24-hour DOE telephone number, which the public may use to report problems at the site.

4.1.13 Quality Assurance

The long-term custody of the Parkersburg site and all activities related to the surveillance and maintenance of the site will comply with the following:

- DOE Order 5700.6C., Quality Assurance
- *Quality Assurance Manual* (Rust Geotech 1995c)
- *LTSM Program Quality Assurance Program Plan* (DOE 1995a)

The Rust *Quality Assurance Manual* meets requirements of DOE Order 5700.6C, Quality Assurance, and the draft *Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs* (American Society for Quality Control 1994). The requirements of 10 CFR 830.120, Quality Assurance Requirements, have been recently incorporated. Quality Assurance requirements will be transmitted through procurement documents to subcontractors when appropriate.

Quality assurance/quality control (QA/QC) requirements and procedures followed during ground-water sampling for characterization activities on the site in 1994 and 1995 are described in the *Sampling and Analysis Plan/Quality Assurance Project Plan for Confirmation of Waste Containment at the AMAX Radioactive Materials Storage Area, Parkersburg, West Virginia* (DOE 1994b) and in Appendix C (Quality Assurance and Quality Control) of *Site Characterization Results* (DOE 1995b). Similar QA/QC procedures and requirements will be followed in a revised sampling plan, which will describe ground-water sampling from monitor wells MW–5 and MW–6 during the years 1997 to 2002 and in 5 to 10-year intervals thereafter.

4.1.14 Health and Safety

Health and safety procedures of LTSM Program activities are addressed in the *Health and Safety Manual*, Volumes 1 and 2 (Rust Geotech 1995a). Immediate health and safety concerns are listed in the Inspection Checklist (Section 4.1.3 and Appendix E). Also in the Health and Safety section of the Inspection Checklist are 24-hour emergency phone numbers for fire, hospital and ambulance, police, and sheriff. Also in the checklist is the location of the telephone nearest to the site. The checklist is revised before each inspection to advise on-site personnel of new and continuing health and safety considerations. A Job Safety Analysis is completed before each inspection. At a pre-inspection briefing, on-site personnel review the Job Safety Analysis and are instructed on hazards that may be present at the site and health and safety procedures that must be followed.

Subcontractors (for maintenance) are advised of health and safety requirements through appropriate procurement documents. Subcontractors must submit health and safety plans for all actions subject to OSHA requirements. Subcontractor health and safety plans will be reviewed and approved before the contract is awarded. Proposals from subcontractors without an adequate health and safety plan are rejected.

5.0 References

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Appendix A
Subtitle D of Nuclear Waste Policy Act

Section 151, Nuclear Waste Policy Act of 1982:

SUBTITLE D – LOW-LEVEL RADIOACTIVE WASTE

FINANCIAL ARRANGEMENTS FOR LOW-LEVEL RADIOACTIVE WASTE SITE CLOSURE

Sec. 151. (a) Financial arrangements.

(1) The Commission shall establish by rule, regulation, or order, after public notice, and in accordance with section 181 of the Atomic Energy Act of 1954 [42 U.S.C. 2231 et seq.], such standards and instructions as the Commission may deem necessary or desirable to ensure in the case of each license for the disposal of low-level radioactive waste that an adequate bond, surety, or other financial arrangement (as determined by the Commission) will be provided by a licensee to permit completion of all requirements established by the Commission for the decontamination, decommissioning, site closure, and reclamation of sites, structures, and equipment used in conjunction with such low-level radioactive waste. Such financial arrangements shall be provided and approved by the Commission, or, in the case of sites within the boundaries of any agreement State under section 274 of the Atomic Energy Act of 1954 [42 U.S.C. 2021], by the appropriate State or State entity, prior to issuance of licenses for low-level radioactive waste disposal or, in the case of licenses in effect on the date of the enactment of this Act [enacted Jan. 7, 1982] prior to termination of such licenses.

(2) If the Commission determines that any long-term maintenance or monitoring, or both, will be necessary at a site described in paragraph (1), the Commission shall ensure before termination of the license involved that the licensee has made available such bonding, surety, or other financial arrangements as may be necessary to ensure that any necessary long-term maintenance or monitoring needed for such site will be carried out by the person having title and custody for such site following license termination.

(b) Title and custody.

(1) The Secretary shall have authority to assume title and custody of low-level radioactive waste and the land on which such waste is disposed of, upon request of the owner of such waste and land and following termination of the license issued by the Commission for such disposal, if the Commission determines that—

(A) the requirements of the Commission for site closure, decommissioning, and decontamination have been met by the licensee involved and that such licensee is in compliance with the provisions of subsection (a);

(B) such title and custody will be transferred to the Secretary without cost to the Federal Government; and

(C) Federal ownership and management of such site is necessary or desirable in order to protect the public health and safety, and the environment.

(2) If the Secretary assumes title and custody of any such waste and land under this subsection, the Secretary shall maintain such waste and land in a manner that will protect the public health and safety, and the environment.

(c) Special sites. If the low-level radioactive waste involved is the result of a licensed activity to recover zirconium, hafnium, and rare earths from source material, the Secretary, upon request of the owner of the site involved, shall assume title and custody of such waste and the land on which it is disposed when such site has been decontaminated and stabilized in accordance with the requirements established by the Commission and when such owner has made adequate financial arrangements approved by the Commission for the long-term maintenance and monitoring of such site.

[42 U.S.C. 10171]

Appendix B
Legal Description of Site

Legal Description

The Parkersburg site consists of two tracts (101 and 101E), which together comprise a 15.50-ac (6.27-ha) parcel of land at approximately 39° 15' N and 81° 41' W in the Washington Bottom area of Wood County, West Virginia. Only Tract 101 is held by the DOE as fee simple property; Tract 101E is a permanent access road easement through AMAX-owned property. The boundary of each tract is described in the following two paragraphs and is shown in Plate 1.

TRACT NO. 101

Beginning at an iron pin on the westerly right-of-way line of the Baltimore and Ohio Railroad Company at its intersection with the northerly line of Lot 2 of the Francis Keene Lewis Partition, a plat of which is of record in the Office of the Clerk of the County Commission of Wood County, West Virginia, in Deed Book 124, Page 313, which beginning point is further described as being located N 66° 38' 40" W 2564.68 ft from an iron pipe at the northeasterly corner of said Lot 2; thence, S 26° 23' 39" W along said westerly railroad right-of-way line a distance of 709.73 ft to a point on the southerly line of said Lot 2; thence running with said southerly lot line, N 74° 55' 26" W, passing a concrete monument at 10.20 ft, in all, a distance of 300 ft to the True Point of Beginning; thence, running with the said southerly line of Lot 2,

N 74° 55' 26" W 688.92 ft; thence, leaving said southerly lot line and severing said Lot 2,

N 00° 34' 18" E 635.51 ft
N 40° 46' 55" E 212.42 ft
S 75° 27' 33" E 153.06 ft
S 64° 05' 09" E 813.97 ft
S 31° 46' 54" W 683.89 ft to the True Point of Beginning, and contains 15.16 ac, more or less.

TRACT NO. 101E

Beginning at an iron pin on the westerly right-of-way line of the Baltimore and Ohio Railroad Company at its intersection with the northerly line of Lot 2 of the Francis Keene Lewis Partition, a plat of which is of record in the Office of the Clerk of the County Commission of Wood County, West Virginia, in Deed Book 124, Page 313, which beginning point is further described as being located N 66° 38' 40" W 2564.68 ft from an iron pipe at the northeasterly corner of said Lot 2; thence,

S 84° 26' 31" W 277.63 ft to the True Point of Beginning on the eastline of U.S.A. Tract 101 and has the approximate coordinate value of N280,718.85 E1,381,579.02; thence, running with the centerline of a proposed access road which has a right-of-way width of 20 ft, 10 ft on each side of the herein described centerline,

N 75° 21' 19" E 89.96 ft [88.27 ft][a]
N 30° 36' 39" E 156.11 ft

N 29° 55' 48" E 485.36 ft [493.14 ft][b] to a point on the south edge of West Virginia Secondary State Route No. 34/2, there terminates, and contains 0.34 ac, more or less.

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[a]Distance in brackets is measured distance shown in Plate 1.
[b]Distance in brackets is measured distance to the center of Route No. 34/2 (Foster Drive) shown in Plate 1.

Appendix C
Permanent Site File Index

Permanent Site File Index

Ownership Documentation
A. Final LTSP
B. Transfer of ownership from NRC to DOE

Documentation of DOE Title/Custody
A. Documentation
  -State
  -Federal
B. Legal description of site property and permanent access road easement
C. Custodial care agreements

National Environmental Policy Act (NEPA) Documentation
A. Environmental Impact Appraisal/Environmental Assessment
B. Additional NEPA documentation

Remedial Action Documentation
A. Characterization reports on the site by AMAX from 1978 to 1980
B. AMAX reports in 1980 on site stabilization scenarios and plans
C. Reports on stabilization mound completion and final radiological survey
D. Work plan for confirmation of waste containment at the site and the final reports of *Site Characterization Results* and *Results of Radon Flux Measurements*

Photographs
A. Photographs/video of stabilization mound construction
B. Aerial photographs
C. Inspection photographs
D. Photographs associated with activities related to the *Site Characterization Results* report

Monitoring Documentation
A. Construction permits and diagrams for monitor wells (active and abandoned)
B. Analytical results from monitor well water sampling
C. Inspection reports
D. Follow-up or contingency inspection preliminary assessments, reports, and records
E. Corrective action plans, reports, and records

Other
A. Quality assurance program plan
B. Custodial maintenance or repair reports and records
C. Site atlas

Appendix D
Field Photograph Log

Field Photograph Log

Site: _____ Roll No. __ (of __) Page 1

Date of Inspection: _____ **Time of Day:** From: _____ To: _____

Weather Conditions: _____

Frame	Azimuth	PL No.	Subject/Description

Inspector: _____ _____

Signature Printed Name

[a]Adjusted to match frame number on negative.
[b]Declination angle: _____
[c]Photograph location number. Assigned when inspection report is written. See Plate 1 in inspection report for map of photograph locations.

Field Photograph Log

Site: _____ Roll No. __ (of __) Page 2

Date of Inspection: _____ **Time of Day:** From: _____ To: _____

Weather Conditions: _____

Frame	Azimuth	PL No.	Subject/Description

Inspector: _____ _____

Signature Printed Name

_____

[a]Adjusted to match frame number on negative.

[b]Declination angle: _____

[c]Photograph location number. Assigned when inspection report is written. See Plate 1 in inspection report for map of photograph locations.

Appendix E
Initial Site Inspection Checklist

Initial Site Inspection Checklist for Annual Inspection

Site: Parkersburg Section 151(c) Disposal Site

Date Prepared:

Date of Last Inspection: March 23, 1995

Type of Inspection: Annual Inspection

Type of Planned Inspection:

I. General Instructions

A. This inspection checklist is site specific. It incorporates general and site-specific requirements for annual inspections of the subject site. This checklist may be revised in response to new requirements as result from previous inspections or maintenance develop, or as new information about the site is received.

B. Purpose of the checklist is to support

- Planning for the inspection
- Inspection of the site
- Evaluation of the thoroughness of the inspection before the inspection party leaves the site at the conclusion of the inspection
- Preparation of the inspection report

C. This checklist is provided for the convenience of those planning and conducting the inspection. Other information, materials, or guidance may be used in place of or in addition to the checklist if warranted by site conditions.

II. Preparation for the Inspection Review

A. Review inspection guidance documents:

- *Guidance for Implementing the UMTRA Project Long-Term Surveillance Program* (DOE 1992)
- *Long-Term Surveillance Plan for the Parkersburg, West Virginia, Disposal Site* (DOE this report)

B. Review previous inspection reports, field notes from previous inspections, maps and drawings of the site, and other documents as necessary to become familiar with site history, current conditions at the site, and the results of recent inspections and maintenance. Obtain copies of maps, plans, and other documents required for the inspection:

- 1995 inspection report and field notes
- 1995 inspection drawing
- Set of color photographs from the 1995 inspection report
- Specifications for site maintenance (see Section III.E)
- Information on deer ticks and lyme disease

C. Review site access procedures and protocols. Notify affected agencies. Complete actions required to enter the site.

- Grand Junction Projects Office: Mr. J. Virgona 970-248-6006
- L.B. Foster Company 304-863-3316
- Obtain keys for locks on entrance gate and monitor wells

D. Review specific observations to be made and problems to be studied or resolved during the coming inspection. (See Section III of this checklist.)

E. Inspection equipment: Assemble and pack field equipment required for the inspection of the site:

- Camera
- Spare batteries
- Camera accessories
- Film, two rolls of 36-exposure, ISO 200 (or equivalent) color print film
- Photograph scale/north arrow
- Brunton compass
- 50-foot tape
- 10- to 20-foot tape
- Clipboard
- Canteens or other provision for water in hot weather

- Field photograph log forms
- Orange field notebook
- Black, indelible, felt-tip marker with broad point
- First aid kit
- Extra padlocks and keys for monitor wells, entrance gate, and walk gates
- Rust-preventive lubricant

III. Site Inspection

A. The checklist is not intended to be exhaustive or constraining. The inspection party is free to make other observations as judgment and site conditions dictate.

B. Before the inspection of the site is completed and before the inspection party leaves the site, the inspection party should satisfy itself that the site has been fully inspected and evaluated and that adequate photographs and measurements have been obtained.

C. Health and Safety: The Parkersburg stabilization mound site contains thick grass, which is often wet and some brushy areas are adjacent to the mound. Safety shoes are not required at this site; however, high-topped boots that can be waterproofed are recommended. Inspectors should be familiar with the hazards posed by deer ticks (lyme disease) by reading the provided information on the subject. Weather conditions are characterized by high humidity and occasional rain. Personnel should plan accordingly for the following seasons:

1. Spring, Summer, and Fall:
   - Drinking water (personal canteens recommended)
   - Insect repellent for work in thick grass and underbrush
   - Waterproof footwear
   - Raincoat
2. Winter:
   - Warm, water repellent, layered clothing
   - Waterproof, insulated footwear.

The nearest public phone to the Parkersburg site is along the south side of Foster Drive about 800 ft (240 m) northeast of the site. A telephone is also available in the L.B. Foster Company office north of the site. Emergency contacts and telephone numbers are as follows:

- Emergency Medical Service/Ambulance
  Camden-Clark Memorial Hospital in Parkersburg, 800 Garfield Avenue (State Highway 14, which is one-way southbound)

  Telephone 911 or 304-424-2111. 304-424-2212 for poison center

- Parkersburg Police Telephone 911

- West Virginia Police Telephone 304-420-4600

- Wood County Sheriff Telephone 303-424-1834

- Wood County Fire Department Telephone 911 or 304-485-7711

D. General Surveillance

1. Specific Site Surveillance Features

   - Warning or perimeter signs, 15

   - Boundary monuments, 6

   - Monitor wells, 6

2. Transects

   - Stabilization mound

   - Site perimeter and outlying area

3. For all transects:

   - Settlement, slumping, heaving, cracking

   - Erosion

   - Accumulation of water

   - Accumulation of trash

   - Encroachment of vegetation

   - Intrusion by humans or domestic animals

   - Vandalism

   - Other: animal burrows

4. Area Within 0.25 Mile of the Site

- Change in land use
- New construction or development
- Earth movement, erosion, or changes in nearby stream channels
- Accumulation of trash

5. Specific Tasks and Observations

- Note condition of entrance gate and security fence
- Assess the progress of erosion in the outflow channel near the southwest corner of the site
- Note location and extent of rills around the outer perimeter of the stabilization mound
- Replace padlocks on entrance gate, walk gates, and monitor wells with marine-type (rust-proof) padlocks
- Note condition of the access road
- Note condition of perimeter signs
- Note the location and extent of animal burrows on and adjacent to the stabilization mound
- Note condition of the grass on top of the stabilization mound and the presence of noxious species of vegetation
- Note progress of erosion along the west drainage in respect to boundary monuments 3, 4, and 5

E. Recommendations from previous inspection:

- Add gravel to define or repair part of the site access road
- Remove trees growing through the security fence and remove trees and brush from a strip outside the security fence
- Install 15 new warning signs on the security fence
- Replace padlocks on entrance gate, walk gates, and monitor wells with marine-type (rust-proof) padlocks
- Set witness corners to denote positions of three boundary monuments, which may potentially be removed by erosion
- Remove windblown trash from the west drainage area

- Construct an appropriate erosion control structure to stop headcut erosion in the outflow channel

- Identify standing grass that is invading the site and control it if it is classified as a noxious species

IV. Inspection Closeout Summary

A. At the end of the inspection and before leaving the site, the inspection team should

1. Satisfy itself that it has sufficient information (photographs, measurements, sketches, etc.) to describe and evaluate findings and observations for the site inspection report.

2. Summarize, in the field notes or elsewhere, the following information:

   - Serious problems or threatening factors requiring immediate follow-up action;

   - Actual or potential problems not requiring immediate attention but that require further observation, possibly including a follow-up inspection; and

   - Changes recommended for this checklist before the next inspection.

B. If serious problems are identified during the inspection, the inspection team should

1. Notify the DOE–GJPO Project Manager immediately, and

2. Follow GJPO procedures for compliance with DOE Order 5000.3B (DOE 1993a).

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SUBTITLE D—LOW-LEVEL RADIOACTIVE WASTE

FINANCIAL ARRANGEMENTS FOR LOW-LEVEL RADIOACTIVE WASTE SITE CLOSURE

SEC. 151. (a) FINANCIAL ARRANGEMENTS.—(1) The Commission shall establish by rule, regulation, or order, after public notice, and in accordance with section 181 of the Atomic Energy Act of 1954 (42 U.S.C. 2231), such standards and instructions as the Commission may deem necessary or desirable to ensure in the case of each license for the disposal of low-level radioactive waste that an adequate bond, surety, or other financial arrangement (as determined by the Commission) will be provided by a licensee to permit completion of all requirements established by the Commission for the decontamination, decommissioning, site closure, and reclamation of sites, structures, and equipment used in conjunction with such low-level radioactive waste. Such financial arrangements shall be provided and approved by the Commission, or, in the case of sites within the boundaries of any agreement State under section 274 of the Atomic Energy Act of 1954 (42 U.S.C. 2021), by the appropriate State or State entity, prior to issuance of licenses for low-level radioactive waste disposal or, in the case of licenses in effect on the date of the enactment of this Act, prior to termination of such licenses.

(2) If the Commission determines that any long-term maintenance or monitoring, or both, will be necessary at a site described in paragraph (1), the Commission shall ensure before termination of the license involved that the licensee has made available such bonding, surety, or other financial arrangements as may be necessary to ensure that any necessary long-term maintenance or monitoring needed for such site will be carried out by the person having title and custody for such site following license termination.

(b) TITLE AND CUSTODY.—(1) The Secretary shall have authority to assume title and custody of low-level radioactive waste and the land on which such waste is disposed of, upon request of the owner of such waste and land and following termination of the license issued by the Commission for such disposal, if the Commission determines that—

(A) the requirements of the Commission for site closure, decommissioning, and decontamination have been met by the licensee involved and that such licensee is in compliance with the provisions of subsection (a);

(B) such title and custody will be transferred to the Secretary without cost to the Federal Government; and

(C) Federal ownership and management of such site is necessary or desirable in order to protect the public health and safety, and the environment.

(2) If the Secretary assumes title and custody of any such waste and land under this subsection, the Secretary shall maintain such waste and land in a manner that will protect the public health and safety, and the environment.

(c) SPECIAL SITES.—If the low-level radioactive waste involved is the result of a licensed activity to recover zirconium, hafnium, and rare earths from source material, the Secretary, upon request

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of the owner of the site involved, shall assume title and custody of such waste and the land on which it is disposed when such site has been decontaminated and stabilized in accordance with the requirements established by the Commission and when such owner has made adequate financial arrangements approved by the Commission for the long-term maintenance and monitoring of such site.

[42 U.S.C. 10171]

SUBTITLE E—REDIRECTION OF THE NUCLEAR WASTE PROGRAM

SELECTION OF YUCCA MOUNTAIN SITE

SEC. 160. (a) IN GENERAL.—(1) The Secretary shall provide for an orderly phase-out of site specific activities at all candidate sites other than the Yucca Mountain site.

(2) The Secretary shall terminate all site specific activities (other than reclamation activities) at all candidate sites, other than the Yucca Mountain site, within 90 days after the date of enactment of the Nuclear Waste Policy Amendments Act of 1987.[1]

(b) Effective on the date of enactment of the Nuclear Waste Policy Amendments Act of 1987,[1] the State of Nevada shall be eligible to enter into a benefits agreement with the Secretary under section 170.

[42 U.S.C. 10172]

SITING A SECOND REPOSITORY

SEC. 161. (a) CONGRESSIONAL ACTION REQUIRED.—The Secretary may not conduct site-specific activities with respect to a second repository unless Congress has specifically authorized and appropriated funds for such activities.

(b) REPORT.—The Secretary shall report to the President and to Congress on or after January 1, 2007, but not later than January 1, 2010, on the need for a second repository.

(c) TERMINATION OF GRANITE RESEARCH.—Not later than 6 months after the date of the enactment of the Nuclear Waste Policy Amendments Act of 1987,[1] the Secretary shall phase out in an orderly manner funding for all research programs in existence on such date of enactment designated to evaluate the suitability of crystalline rock as a potential repository host medium.

(d) ADDITIONAL SITING CRITERIA.—In the event that the Secretary at any time after such date of enactment considers any sites[2] in crystalline rock for characterization or selection as a repository, the Secretary shall consider (as a supplement to the siting guidelines under section 112) such potentially disqualifying factors as—

(1) seasonally increases in population;

(2) proximity to public drinking water supplies, including those of metropolitan areas; and

[1] The date of enactment was Dec. 22, 1987.
[2] So in original. Probably should be "site".

(d) LICENSING CONDITIONS–Any license issued by the Commission for a monitored retrievable storage facility under this section shall provide that–

(1) construction of such facility may not begin until the Commission has issued a license for the construction of a repository under section 115(d);

(2) construction of such facility or acceptance of spent nuclear fuel or high-level radioactive waste shall be prohibited during such time as the repository license is revoked by the Commission or construction of the repository ceases;

(3) the quantity of spent nuclear fuel or high-level radioactive waste at the site of such facility at any one time may not exceed 10,000 metric tons of heavy metal until a repository under this Act first accepts spent nuclear fuel or solidified high-level radioactive waste; and

(4) the quantity of spent nuclear fuel or high-level radioactive waste at the site of the facility at any one time may not exceed 15,000 metric tons of heavy metal.

Sec. 149. Financial assistance

42 USC 10169.

The provisions of section 116(c) or 118(b) with respect to grants, technical assistance, and other financial assistance shall apply to the State, to affected Indian tribes and to affected units of local government in the case of a monitored retrievable storage facility in the same manner as for a repository.[11]

SUBTITLE D–LOW-LEVEL RADIOACTIVE WASTE

Sec. 151. Financial Arrangements for Low-level Radioactive Waste Site Closure

42 USC 10171.

(a) FINANCIAL ARRANGEMENTS–(1) The Commission shall establish by rule, regulation, or order, after public notice, and in accordance with section 181 of the Atomic Energy Act of 1954 (42 USC 2231), such standards and instructions as the Commission may deem necessary or desirable to ensure in the case of each license for the disposal of low-level radioactive waste that an adequate bond, surety, or other financial arrangement (as determined by the Commission) will be provided by a licensee to permit completion of all requirements established by the Commission for the decontamination, decommissioning, site closure, and reclamation of sites, structures, and equipment used in conjunction with such low-level radioactive waste. Such financial arrangements shall be provided and approved by the Commission, or, in the case of sites within the boundaries of any agreement State under section 274 of the Atomic Energy Act of 1954 (42 USC 2021), by the appropriate State or State entity, prior to issuance of licenses for low-level radioactive waste disposal or, in the case of licenses in effect on the date of the enactment of this Act, prior to termination of such licenses.

(2) If the Commission determines that any long-term maintenance or monitoring, or both, will be necessary at a site described in paragraph (1), the Commission shall ensure before termination of the license involved that the licensee has made available such bonding, surety, or other financial arrangements as may be necessary to ensure

[11]Public Law 100-203 (101 Stat. 1330) (1987) sec. 5021, added secs. 142-149.

that any necessary long-term maintenance or monitoring needed for such site will be carried out by the person having title and custody for such site following license termination.

(b) TITLE AND CUSTODY–(1) The Secretary shall have authority to assume title and custody of low-level radioactive waste and the land on which such waste is disposed of, upon request of the owner of such waste and land and following termination of the license issued by the Commission for such disposal, if the Commission determines that–

(A) the requirements of the Commission for site closure, decommissioning, and decontamination have been met by the licensee involved and that such licensee is in compliance with the provisions of subsection (a);

(B) such title and custody will be transferred to the Secretary without cost to the Federal Government; and

(C) Federal ownership and management of such site is necessary or desirable in order to protect the public health and safety, and the environment.

(2) If the Secretary assumes title and custody of any such waste and land under this subsection, the Secretary shall maintain such waste and land in a manner that will protect the public health and safety, and the environment.

(c) SPECIAL SITES–If the low-level radioactive waste involved is the result of a licensed activity to recover zirconium, hafnium, and rare earths from source material, the Secretary, upon request of the owner of the site involved, shall assume title and custody of such waste and the land on which it is disposed when such site has been decontaminated and stabilized in accordance with the requirements established by the Commission and when such owner has made adequate financial arrangements approved by the Commission for the long-term maintenance and monitoring of such site.

SUBTITLE E–REDIRECTION OF THE NUCLEAR WASTE PROGRAM

Sec. 160. Selection of Yucca Mountain Site

42 USC 10172.

(a) IN GENERAL–(1) The Secretary shall provide for an orderly phase-out of site specific activities at all candidate sites other than the Yucca Mountain site.

(2) The Secretary shall terminate all site specific activities (other than reclamation activities) at all candidate sites, other than the Yucca Mountain site, within 90 days after the date of enactment of the Nuclear Waste Policy Amendments Act of 1987.

(b) Effective on the date of the enactment of the Nuclear Waste Policy Amendments Act of 1987, the State of Nevada shall be eligible to enter into a benefits agreement with the Secretary under section 170.[12]

Sec. 161. Siting a Second Repository

42 USC 10172a

(a) CONGRESSIONAL ACTION REQUIRED–The Secretary may not conduct site-specific activities with respect to a second repository unless Congress has specifically authorized and appropriated funds for such activities.

[12]Public Law 100-203 (101 Stat. 1330) (1987) sec. 5011, added new Subtitle E.

Plates are not available in electronic format.
Please e-mail lm.records@lm.doe.gov to request the appendix.

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Attachment 2

NRC/DOE Agreement in Principle for Transfer of NRC Restricted Release Sites to DOE as Authorized Under Section 151(b) of the Nuclear Waste Policy Act

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NRC/DOE AGREEMENT IN PRINCIPLE FOR TRANSFER OF NRC RESTRICTED RELEASE SITES TO DOE AS AUTHORIZED UNDER SECTION 151(b) OF THE NUCLEAR WASTE POLICY ACT

BACKGROUND AND JUSTIFICATION

Section 151(b) of the Nuclear Waste Policy Act of 1982 (NWPA) authorizes the U.S. Department of Energy (DOE) to assume title and custody of low-level radioactive waste and the land on which such waste is disposed of upon request of the owner of such waste and land and following termination of the license issued by NRC for such disposal, if the Commission determines that:

> (A) the requirements of the Commission for site closure, decommissioning, and decontamination have been met by the licensee involved and that such licensee is in compliance with the provisions of subsection (a) (i.e., financial arrangements);
>
> (B) such title and custody will be transferred to the Secretary without cost to the Federal Government; and
>
> (C) Federal ownership and management of such site is necessary or desirable in order to protect the public health and safety, and the environment.

If DOE assumes title and custody, DOE will maintain the waste and land in a manner that will protect the public health and safety, and the environment.

The Commission has requested the NRC staff to seek a Memorandum of Understanding (MOU) with DOE that provides a process and criteria for site transfer, as authorized under Section 151(b) of NWPA.

For the NRC staff, long-term control, including institutional control, is a key issue to resolve, to make progress with remediation and successful license termination at some sites. The NRC staff's view is that after license termination, Federal ownership and control may be necessary for long-term protection of the public health and safety and the environment, particularly for those sites with long-lived radionuclides. Federal control may be the only available option for long-term control if local or State governments are unwilling to accept the responsibility and if private arrangements are considered not sustainable over the long-term needed for sites with long-lived radionuclides (i.e., up to 1000 years).

This is an issue that is important to address at this time because there are sites where the NRC staff has started its review of a the licensee's decommissioning plan and preparation of a draft Environmental Impact Statement. Plans for long-term controls (including institutional controls

and financial assurance) as well as engineering controls must be addressed at this point in time. Interactions between DOE and NRC under an MOU will ensure effective communication between our agencies, will keep DOE apprized of the issues associated with site remediation and long-term stewardship, and will provide a mechanism for DOE to contribute its expertise early in the review process.

The NRC staff also believe that the long-term control expertise and sustainability that DOE could provide for these sites is in the Nations's interest because of the need for long-term protection of public health and safety and the environment. Furthermore, the restricted release option may be the only financially viable option for some licensees who do not have funds available for the very high cost of offsite disposal of large volumes of waste. This option may, in some cases, help avoid licensee bankruptcy and the potential need for Federal funding of remediation. In addition, this option could facilitate the decommissioning process and release large portions of sites back to the local communities for unrestricted use.

PURPOSE

The purpose of this Agreement in Principle is to document the general agreement, at the NRC and DOE staff level, to seek development of an MOU and use it to make determinations regarding potential transfers of sites to DOE as authorized in Section 151(b) of NWPA.

AGREEMENT

DOE and NRC staff will seek to develop an MOU that would define the criteria and process that each agency would use to make determinations regarding the potential transfer of a site consistent with the Section 151(b) of NWPA. Activities and responsibilities would be identified for each step in the process. The approved MOU would be signed by NRC's Director of Nuclear Material Safety and Safeguards and DOE's Assistant Secretary of Environmental Management.

APPROVAL SIGNATURES

John T. Greeves

Director, Division of Waste Management, NRC

3/16/01

Date

Gerald Boyd

Deputy Assistant Secretary, Office of Science and Technology, DOE

3/15/01

Date