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James P. Bearzi, Bureau Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505-6303

Subject: Submittal of the Corrective Measures Evaluation Report for Material Disposal Area A

Dear Mr. Bearzi:

Enclosed please find two hard copies with electronic files of the Corrective Measures Evaluation Report for Material Disposal Area A.

If you have any questions, please contact Bruce Wedgeworth at (505) 231-0108 (brucew@lanl.gov) or George Henckel at (505) 606-0960 (ghenckel@doeal.gov).

Sincerely,

Susan G. Stiger, Associate Director
Environmental Programs
Los Alamos National Laboratory

Sincerely,

David R. Gregory, Project Director
Environmental Operations
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Enclosure: 1) Two hard copies with electronic files – Corrective Measures Evaluation Report for Material Disposal Area A (EP2008-0448)

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LA-UR-08-5520
September 2008
EP2008-0448

Corrective Measures Evaluation Report for Material Disposal Area A, Solid Waste Management Unit 21-014, at Technical Area 21

Los Alamos
NATIONAL LABORATORY
EST. 1943

Prepared by the Environmental Programs Directorate

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LA-UR-08-5520
EP2008-0448

Corrective Measures Evaluation Report for Material Disposal Area A, Solid Waste Management Unit 21-014, at Technical Area 21

September 2008

Responsible project leader:

Bruce Wedgeworth		Project Leader	Environmental Programs	8/29/08
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EXECUTIVE SUMMARY

This report documents the corrective measures evaluation (CME) conducted for Material Disposal Area (MDA) A, Solid Waste Management Unit 21-014, at Technical Area 21 at Los Alamos National Laboratory. MDA A is a decommissioned (i.e., removed from service) subsurface site established for the disposal of radioactive solid and liquid chemical waste.

The MDA A site investigation results are the basis for identifying corrective measure alternatives that will be effective in reducing potential future impacts to human health and the environment. The approved MDA A investigation report and the approved MDA status report define the nature and extent of contaminant releases at MDA A and demonstrate that contaminant releases from MDA A pose no present-day potential unacceptable risks to human and ecological receptors. However, a CME is required to ensure that potential risks from future releases from the site are also acceptable.

The objectives of this CME are to (1) provide stakeholders and regulators with an evaluation of corrective measure alternatives that are expected to be protective of human health and the environment, (2) describe how alternatives will be monitored to ensure the effectiveness of the corrective measure implemented, and (3) identify the recommended corrective measure to the regulators. To meet these objectives, the long-term performance of various containment and excavation alternatives was assessed in accordance with U.S. Environmental Protection Agency, U.S. Department of Energy, and New Mexico Environment Department (NMED) risk and dose assessment guidances.

Technologies were first screened for applicability to MDA A and then combined into corrective measure alternatives. Potential technologies were screened to eliminate any technology that (1) did not meet the threshold criteria defined in Section VII.D.4.a of the Compliance Order on Consent (the Consent Order), (2) is not feasible to implement, (3) is unlikely to perform satisfactorily or reliably, or (4) does not achieve the corrective action objectives within a reasonable time frame. The technology screening included a review of site data to identify the following: conditions that limit or promote the use of certain technologies; waste characteristics that limit the effectiveness or feasibility of technologies; and the level of technology development, performance record and inherent construction, and operation and maintenance requirements for each technology considered. The general types of technologies evaluated in this report that may be appropriate for MDA A include no action, institutional controls, containment, barriers, in situ treatment, source removal, and ex situ treatment.

Three corrective measure alternatives were developed for MDA A using the results of the technology screening process. Each corrective measure alternative was evaluated based on overall site conditions at MDA A. The three corrective measure alternatives evaluated during the CME include (1) no further action with monitoring and maintenance; (2) engineered evapotranspiration (ET) cover with monitoring and maintenance; and (3) complete waste-source excavation and off-site waste disposal, and monitoring and maintenance.

The corrective measure alternatives that satisfy the screening criteria were evaluated against balancing criteria specified in Section VII.D.4.b of the Consent Order and evaluation criteria contained in Section XI.F.10 of the Consent Order. The results of the screening process were used to select and justify the corrective measure alternative recommended for MDA A. The recommended corrective measure alternative consists of an engineered ET cover with monitoring and maintenance. This recommended corrective measure alternative best satisfies Consent Order requirements and NMED alternative cover guidance.

If NMED selects the recommended alternative, the design of the engineered ET cover will be optimized during the design phase.

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1.0 INTRODUCTION

This report documents the corrective measures evaluation (CME) conducted for Material Disposal Area (MDA) A, Solid Waste Management Unit (SWMU) 21-014, at Los Alamos National Laboratory (LANL or the Laboratory). MDA A is a Hazard Category 2 nuclear facility (DOE 2003, 087047, p. 1) consisting of a 1.25-acre fenced, radiologically controlled area situated on the eastern end of DP (Delta Prime) Mesa. MDA A is bounded by DP Canyon to the north and Los Alamos Canyon to the south. The site contains potential hazardous waste or constituents subject to provisions of the Resource Conservation and Recovery Act (RCRA) and the New Mexico Hazardous Waste Act, as described in the March 1, 2005, Compliance Order on Consent (the Consent Order). It also contains radioactive wastes managed by the U.S. Department of Energy (DOE) pursuant to the Atomic Energy Act of 1954. Although the scope of the CME required by the Consent Order is limited to corrective actions for releases of nonradioactive contaminants, this CME report incorporates all the requirements affecting closure of MDA A into a single document. Information on radioactive materials and radionuclides, including the results of sampling and analysis of radioactive constituents, is voluntarily provided to the New Mexico Environment Department (NMED) in accordance with DOE policy. DOE will assess the evaluations contained in this report for compliance with the Atomic Energy Act requirements.

Figure 1.0-1 depicts the location of Technical Area 21 (TA-21) and MDA A with respect to other Laboratory technical areas and surrounding landholdings. MDA A is currently inactive and undergoing corrective action. The location of MDA A in relation to TA-21 and surrounding MDAs is shown in Figure 1.0-2 and other SWMUs/areas of concerns (AOCs). MDA A has been designated by the Laboratory as a nuclear environmental site (NES) because of the potential inventory of nuclear materials (LANL 2004, 088713.2, p. 1).

MDA A currently contains the following features and was historically used to dispose of wastes generated during TA-21 operations:

- two buried 50,000-gal. cylindrical steel storage tanks (referred to as the General’s Tanks and designated TA-21-107 [West] and TA-21-108 [East])
- two vertical shafts installed to clarify rinse water generated by cleaning cement paste from a transfer hose between the pug mill and the General’s Tanks but never used
- two eastern pits containing solid waste potentially contaminated with polonium, plutonium, uranium, thorium, and other unidentified chemicals associated with Laboratory operations from 1944 to 1945
- one central pit containing TA-21 decontamination and decommissioning (D&D) debris from 1969 to 1977 potentially contaminated with radionuclides
- a former surface drum storage area that was used to store drums of sodium hydroxide solution and stable iodine from 1946 to 1960

The relative locations of the features described above with respect to the MDA A fenceline, topography, and other SWMUs/AOCs are shown in an orthophotograph taken in 2005 and presented in Figure 1.0-3. Site characterization activities were conducted from April to October 2006 and in November 2007.

The CME uses recent and historical characterization data as a basis for defining the nature and extent of contamination at MDA A. The present-day risk assessment for MDA A, presented in the MDA A investigation report (IR) (LANL 2006, 095046, Appendix G) concluded that surface and subsurface contamination at the site does not currently pose an unacceptable risk to human health or the environment. The CME identifies and evaluates corrective measure alternatives that address potential unacceptable future risk/dose from MDA A and recommends one for implementation. Alternatives where waste is left in place include a monitoring component to confirm that the corrective measure alternative is effective. Actions to be taken if the corrective measure alternative is ineffective are included in the description of the recommended alternative.

This CME addresses the items in Section VII.D.2 of the Consent Order and complies with the outline required in Section XI.F of the Consent Order. The CME also involves the public in corrective measure alternative selection and implementation to ensure that the proposed remedy addresses public concerns about the site. The Public Involvement Plan (Appendix B) includes public meetings to provide data and discuss the alternatives evaluated in the CME.

The Consent Order schedule for MDA A requires the following activities and associated deadlines, which may be adjusted based on actual document approval dates:

1. submit IR (submitted in November 2006 and approved on March 9, 2007)
2. submit the CME report (to be submitted by September 1, 2008)
3. submit the corrective measure implementation (CMI) plan
4. complete the remedy completion report by March 11, 2011

This report is organized according to the content requirements for a CME stipulated in Section XI.F of the Consent Order. Table 1.0-1 provides a summary of the Consent Order requirements and where they are addressed in the CME. Section 2 provides background information, including the site history, SWMU description, waste inventory information, and a summary of previous investigations. Section 3 describes surface and subsurface site conditions. Potential receptors, including source, pathway, and receptor information, are summarized in section 4. Section 5 discusses the regulatory criteria, including applicable cleanup standards, risk-based screening levels, and risk-based cleanup goals for each pertinent medium at the site. It also describes how criteria from the Consent Order were applied for the screening, evaluation, and selection of the preferred corrective measure alternative. The corrective measure alternatives are identified and described in section 6. Section 7 provides an evaluation of corrective measure alternatives, with the selection of the preferred corrective measure alternative presented in section 8. The design criteria to meet cleanup objectives are presented in section 9, the proposed schedule is in section 10, and references and map data sources are in section 11.

2.0 BACKGROUND

This section summarizes the historical and current characteristics of MDA A as excerpted from the historical investigation report (HIR) for MDA A (LANL 2005, 088052.5, pp. 1-90). Table 2.0-1 summarizes the operational history of the site.

2.1 Site History

TA-21 consists of two operational areas, DP West and DP East, both of which produced liquid and solid radioactive wastes. The operations at DP West included plutonium processing, while the operations at DP East included the production of weapons initiators. MDA A was used to store solid and liquid wastes as described in sections 2.1.1 through 2.1.5.

In 1985, site stabilization activities were performed, such as removing surface contamination, adding cover material, recontouring, and reseeding. In 1987, isolated areas at MDA A were reseeded and fertilizer was applied. Gravel mulch was also spread on the north side of the site (LANL 2005, 088052.5, p. 2).

2.1.1 General's Tanks

In 1945, the General's Tanks (50,000-gal. cylindrical steel storage tanks) were constructed at the western end of MDA A as underground storage tanks (Figure 2.1-1). The tanks were designed and installed to receive waste solutions containing plutonium-239/240 and americium-241. Liquid waste from TA-21 plutonium recovery operations was to be stored until improved chemical recovery methods for plutonium 239/240 could be developed. Liquid waste was eventually removed from the tanks in 1975 and 1976 (LANL 2005, 088052.5, pp. 2–3), but an estimated 650 gal. of sludge remains in the bottom of the each tank.

2.1.2 Vertical Shafts

In 1975, two 4-ft-diameter vertical shafts were excavated to a depth of approximately 65 ft below ground surface (bgs), south of the General's Tanks. The shafts were installed to clarify rinse water generated by cleaning cement paste from the transfer hose between the pug mill and the General's Tanks. The tanks were never filled with cement paste, so the vertical shafts were not used. In 1977, the vertical shafts were filled with soil (LANL 2005, 088052.5, p. 3).

2.1.3 Eastern Pits

In 1945, the eastern pits were excavated to receive radioactive solid waste from DP East. The location of the eastern pits is shown in Figure 1.0-2. Early engineering drawings indicate the pits are approximately 18.0 ft wide × 125 ft long × 12.5 ft deep. In 1946, crushed Bandelier Tuff was used to backfill and cover the pits (LANL 2005, 088052.5, pp. 3–4).

2.1.4 Central Pit

In 1969, a large pit was excavated in the center of MDA A to receive and store debris from demolition work conducted at TA-21 (Figure 1.0-2). According to an engineering drawing from May 1976, the pit was 40 ft wide × 150 ft long × 22 ft deep (Desilets 1972, 000484). The pit was later enlarged to measure 172 ft long ×134 ft wide.

In July 1972, exhaust ductwork from building 21-005 was placed in the western end of the pit, covered with about 1 ft of dirt and then the ductwork was crushed. Between February and July 1973, the pit received plutonium-contaminated building debris from the demolition of building 21-012. Building 21-12 had been the plutonium filter and exhaust for DP West. Waste disposed of at MDA A from building 21-012 included items such as doors, lumber, pipes, building materials, roofing materials, electrical boxes, wire, metals, concrete, brick, contaminated soil, and large metal items such as steel columns.

Building debris from other TA-21 buildings and structures was placed into the central pit until late 1974 when the demolition work was completed. However, waste of an unspecified nature may have been placed in the unfilled parts of the pit until 1977 when the waste disposal operations at MDA A ended. Asphalt was also disposed of in this pit.

Radiologically contaminated waste placed into the central disposal pit contained plutonium-239/240, plutonium-238, uranium-235, depleted uranium, and other unspecified radionuclides. The pit was decommissioned in May 1978 and a soil cover (crushed tuff) was placed over the pit (LANL 2005, 088052.5, p. 4).

2.1.5 Former Drum Storage Area

Several hundred 55-gal. drums containing iodide waste were stored on the surface at the eastern end of MDA A in the late 1940s and early 1950s (Table 2.0-1). The stored drums can be seen at the eastern end of MDA A in a 1949 aerial photograph and in a subsequent 1950 photograph (Table 2.0-1). These drums contained sodium hydroxide (NaOH) solution and stable iodine, which were used to scrub ventilation exhaust air containing plutonium and possibly uranium. The corrosion of the drums resulted in liquid releases to the surface soil at MDA A. The drums were removed in 1960 and the storage area was paved (LANL 2005, 088052.5, pp. 4–5).

2.1.6 Surface Storage

Historical photographs indicate the area of the central pit (before excavation) was used to store (likely contaminated) equipment removed during remodeling of the process buildings before shipment to other disposal areas.

2.1.7 Summary of Subsurface Utilities

Active and inactive utility lines present in the immediate vicinity of MDA A are shown in Figure 1.0-2.

Immediately north of MDA A, a 3-in. cast-iron radiological waste line is located in the southern shoulder of North Perimeter Road. This line previously conveyed liquid waste from the Tritium Science and Fabrication Facility and the Tritium Systems Test Assembly (TSTA) to the building 21-257 waste treatment facility located west of MDA A. The depth of the line varies between 4 ft 6 in. and 4 ft 10 in.; the line is equipped with two cleanout valves at the northeastern and northwestern corners of MDA A. The line has been in service since the 1970s, concurrent with the initial operations at TSTA, and it is scheduled for decommissioning along with the TSTA and associated facilities in the near future. An underground telemetry cable runs parallel to the radiological waste line and transmits operating information on the sump pumps and other facilities at the TSTA. This cable will remain in service until the radiological waste line and TSTA and associated buildings are decommissioned.

Two parallel 8-in. cast-iron water lines run east-west along the northern shoulder of the North Perimeter Road, parallel to the MDA A site, and branch off to facilities to the east and west. Both of these water lines remain in service. A fire hydrant is located adjacent to the northeastern corner of MDA A.

Six-inch steel natural gas lines run along the west and southwest. Immediately west of the General’s Tanks (far western portion of the site), the gas line and associated valves are abovegrade. The gas line is active and conveys natural gas to the Los Alamos Neutron Science Center.

A storm drain runs beneath North Perimeter Road near the northeastern corner of MDA A and conveys storm drainage from the roadways adjacent to MDA A to DP Canyon.

The following sections provide a summary of site information. Further information about the current site conditions at MDA A is presented in detail in the approved investigation work plan (LANL 2006, 095046) and the MDA A IR and supplemental report (LANL 2006, 095046) and the status report for supplemental sampling (LANL 2007, 100482). These three documents describe the site and include information on the disposal units, waste inventories, characterization activities, analytical sampling results, and assessments of potential present-day risks to human health and the environment. The following sections summarize the information about the site.

2.2 Inventory Estimates

DOE has categorized MDA A as a Hazard Category 2 nuclear facility as a result of the radioactive inventory contained in the General's Tanks (DOE 2003, 087047). The radionuclide inventory of MDA A is based entirely on what is known about the General's Tanks.

General's Tanks: There have been various estimates of the radionuclide inventory contained in the General's Tanks. These were made for the entire tank contents before pumping and treating the liquid (Rogers 1977, 005707). Posteffluent samples taken on the tank sludge indicate most of the inventory remains in the tanks (LANL 2004, 088713.2). The total estimated current-day inventory corrected for decay of radionuclides of the west tank is approximately 75 Ci and that of the east tank is 25 Ci (LANL 2004, 088713.2). Based on the processes used during operation of the plutonium facility and samples obtained from 1947 Laboratory notebooks of chemical experiments conducted on the tanks contents, chemical content of the sludge indicates the presence of Pu, Am, $Ca(NO_3)_2$, $Mg(NO_3)_2$,I_2, H_2O_2, KNO_3, Al, Fe, Cr, Ni, Mg, and lanthanum and pH of 10 for the west tank and Pu, Am, NO_3^-, NH_4^+, Mg, and Ca with pH of approximately 8 for the west tank. Other test results indicate the presence of Na^+, Cl^-, and K in both tanks. Notebooks from tests conducted in the mid-1970s and 1980s indicate the pH of the east tank was measured at 8.3 and that of the west tank at 11.4 (Attachment E-2 in Appendix E). Total dissolved solids (TDS) were approximately 233,480 and 90,690, respectively (units of measure not reported; probably in parts per million [ppm]). No samples have been collected or tests performed on the wastes using RCRA-accepted analytical methods.

Eastern Pits: Very little documentation has been found detailing the types of chemicals and quantities of radionuclides and/or chemical contamination in the two eastern pits. Material in the pits (inclusive of MDAs A, B, and C) consists of all contaminated waste from the Chemistry and Metallurgy Research operations, including laboratory equipment, building construction material, paper, rubber gloves, filters from air cleaning systems and contaminated or toxic chemicals (Meyer 1952, 028154). Polonium and plutonium-239/240 were thought to be the major contaminants in the waste. Polonium would no longer be present at the site because of its short half-life (138.4 d).

The eastern pits were placed in 1945 and likely contain the same inventory range as would be found in the early portions of the MDA B disposal. Potential radionuclides in the form of contamination present on materials in the pits (see above disposal areas) in the waste include plutonium, polonium, uranium, americium, curium, radium-lanthanum, actinium, and waste products from the Water Boiler (Meyer 1952, 028154). The radiological inventory of MDA A has been conservatively estimated, based on data developed for the MDA B HIR (LANL 2006, 095499); adjusting for the difference in volumes between the two pits is 19 g of plutonium 239 (50th percentile) and 28 g of plutonium 239 for the 90th percentile inventory estimate.

No chemical inventory records are found for the eastern pits or for any of the pits at MDA A. Based on chemicals encountered in the investigation of the site (LANL 2006, 095046), it has been concluded that chemicals of potential concern (COPCs) in the soil surrounding MDA A include aluminum, iodine, arsenic, barium, beryllium, cyanide, iodide, nitrate, perchlorate, selenium cadmium, chromium, copper, iron, manganese, nickel and vanadium, acenaphthene, acetone, anthracene, Aroclor-1254, Aroclor-1260, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, benzoic acid, bis(2-ethylexyl)phthalate, chrysene, dichlorobenzene[1.4-], fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, isopropyltoluene[4-], methylene chloride, phenanthrene, pyrene, toluene, numerous dioxins and furans, americium-241, cesium-137, plutonium-238, plutonium-239, strontium-92, uranium-235, and tritium. Found in various formations below the disposal site or in surface soils directly affected by site runoff, these chemicals are considered possibly to be present in the MDA waste. The levels of these chemicals present in the eastern pits are uncertain. However, it may be concluded that the primary contaminants present in the eastern pits are radioactive isotopes based on (1) the low levels observed in the foundation soil and rock at MDA A, (2) the period (1945) when the materials were disposed of, (3) qualitative historical documentation of disposal, and (4) photographs taken of the disposal pits during operation.

Small quantities of volatile organic compounds (VOCs) may remain in the pits as disposed chemicals but will not constitute a significant source of contamination.

The dioxins and furans are likely a result of surface air contamination and are not believed to be associated with MDA A wastes.

Central Pit: The central pit was used to dispose of demolition debris during the rehabilitation of TA-21 after TA-55 came online as the new plutonium processing operations at Los Alamos. The rehabilitation work was essentially completed by early 1976 (Keenan 1976, 000507). The central pit received waste from late 1969 to closure sometime in May 1978 (Merrill 1990, 011721). The D&D report from the main bag house (structure 21-012) (Christensen et al. 1975, 005481) indicates most of the higher contaminated wastes went to MDA G and that only foundations, soils, and some larger structures went to the MDA A central pit. Photographs taken during filling of the central pit indicate there are plenums from the air-handling equipment, hoods, and other construction debris. Records (logbook #18048, accounting for approximately 2200 yd^3 of material placed between July 1972 and December 1975) (Martin and Hickmott 1993, 059422) indicate the presence of asphalt and radiologically contaminated soil along with metal demolition debris and piping runs.

As with the eastern pits, there is no record for chemical inventory of contamination that might be associated with the D&D material disposed of (such as any coating inside of disposed pipes). It is postulated that a similar list of chemical COPCs might be present as in the eastern pits because the D&D operations were on buildings used for the same period as materials disposed of in MDAs A and B. However, because Laboratory policy prohibited disposal of liquids at TA-21 during this period of MDA A operation, and building debris rather than laboratory wastes were believed to be placed in the central pit, only trace amounts of chemicals seem plausible.

2.3 Results from Previous Investigations

Historical investigations at MDA A include geophysical surveys performed to delineate and confirm subsurface features at MDA A (including pits and tanks) and to identify natural features such as paleochannels; pre-RCRA facility investigations (RFI) before 1992; and RFI occurring from 1992 to the present. The MDA A HIR (LANL 2005, 088052.5) provides details of these investigations and is briefly summarized below.

2.3.1 Geophysical Surveys

Geophysical surveys were conducted at MDA A in 1989, 1996, 1999, 2003, and 2006 (LANL 2005, 088052.5, pp. 5-6; LANL 2006, 095046, p.6). These surveys were conducted to determine the geometry of each of the disposal units and the General's Tanks. Additional features, including paleochannels and miscellaneous buried debris, were also identified. Each of these surveys used a combination of geophysical methods to locate subsurface structures and anomalies. The methods used included a time domain electromagnetic system, seismic refraction, ground-penetrating radar, resistivity, and induced polarization.

The results of these surveys indicated that although the General's Tanks locations were correct, the three waste pits are actually located 15 ft farther east than shown in early engineering drawings. Four strongly magnetic anomalies were identified in the central pit and are likely associated with buried steel exhaust ductwork or similar materials. Three small undocumented subsurface anomalies were also detected inside the fenced area (Gerety et al. 1989, 006893, pp. 24-26, 57). Two possible paleochannel areas (Figure 2.3-1) were indicated north and southeast of MDA A; these may be related to a paleochannel previously verified to the southwest at MDA T in borehole (BH) 21-05051. The Geophex report concluded that there was no evidence, however, of a meandering paleochannel within MDA A (Geophex 1996, 064694).

2.3.2 Pre-RFI Activities

As described in the MDA A HIR (LANL 2005, 088052.5), the pre-RFI sampling and investigation activities conducted at MDA A included surface and subsurface soils.

2.3.2.1 Surface Investigations

Pre-RFI surface soil activities were performed in 1980, 1984, and 1990. As described in the approved MDA A investigation work plan (LANL 2004, 085641, pp. 19-30; LANL 2005, 089415), samples were analyzed for radiological constituents only; all data associated with these samples were unqualified. The surface soil data collected from the 1990 investigation are qualitative only because a sampling location map is unavailable. Based on the information collected during these three investigations, it was determined that concentrations of plutonium-238, plutonium-239/240, americium-241, uranium, and tritium were above established background values (BVs) and fallout values (FVs) in most sampling locations in the area surrounding MDA A (LANL 2005, 088052.5, pp. 7-10).

2.3.2.2 Subsurface Investigations

Pre-RFI subsurface activities were conducted in 1969, 1974, and 1983; all investigations took place within the fenced perimeter. The 1969 investigation was an evaluation of fracture and joint patterns conducted during the excavation of the central disposal pit. The 1974 and 1983 investigations included the installation of 10 vertical boreholes (4 in 1974 and 6 in 1983) with augers near the General's Tanks to determine if the tanks had leaked. These 10 boreholes were sampled to depths of 30 ft (1983) and 35 ft (1974) into the tuff, approximately 20 ft below the base of the General's Tanks. The samples collected in 1974 were analyzed for gross alpha/beta radiation; the 1983 samples were submitted for plutonium-238 and plutonium-239/240 analyses. The results from these two sampling events indicated the tanks had not leaked as of 1983; the only detections noted were plutonium-239/240 in the shallower (0–3-ft) intervals (LANL 2005, 088052.5, pp. 7–10).

2.4 RFIs

Surface sampling was conducted at TA-21 to establish sitewide baseline concentrations for a comprehensive suite of analytes and to identify contaminant trends across TA-21 resulting from airborne stack emissions. Samples were collected at the (LANL 1995, 052350) nodes of a 131-ft × 131-ft grid covering DP Mesa, Los Alamos Canyon, and DP Canyon (LANL 1994, 026073, p. 2-1; LANL 1995, 052350). During this event, seven samples were collected on DP Mesa East and downslope of MDA U from two different depths at each location (0–1 in. and 0–6 in.). The samples were analyzed for inorganic and organic chemicals and radionuclides (americium-241, tritium, isotopic plutonium, isotopic thorium, and strontium-90).

Surface soil samples were collected from a grid covering the entire MDA and extending to the edge of DP Mesa (ERM Program Management Company 1997, 058979). A total of 54 samples were collected from the grid, and 7 additional samples were collected from points off of the grid nodes. Nine channel sediment samples (three locations sampled at three depth intervals [0–0.25 ft, 0.25–0.5 ft, and 0.5–1 ft]) were collected in the small drainage leading into DP Canyon. Soil and sediment samples were analyzed for radionuclides (tritium, total uranium, isotopic plutonium, strontium-90, and gamma-emitting radionuclides by gamma spectroscopy); inorganic chemicals; and semivolatile organic compounds (SVOCs).

Overall, the RFI data are the most reliable historical data and have been determined to be of adequate quality to be useable (LANL 2006, 095046, Appendix F). However, limited documentation of laboratory quality control (QC) samples or their results for inorganic or organic chemicals is available. Similarly, minimum detectable activity for radionuclides is available. Therefore, the only data from historical investigations that are used in this evaluation are results from samples collected for the purpose of verifying prior results.

2.5 2006 Field Investigation

Core samples were screened by (1) visual examination, (2) headspace vapor screening for VOCs, (3) polychlorinated biphenyl (PCB) immunoassay field analytical screening, and (4) continuous screening for radiological contamination. In addition, the screening results collected in the field were used to identify samples for laboratory analysis. Field-screening results were recorded in the borehole logs, sample collection logs, photoionization detector screening log, and the radiological control technician's (RCT's) field log. Tables 2.5-1, 2.5-2, 2.5-3, and 2.5-4 present the field-screening results.

Sixteen boreholes were drilled to characterize potential contamination beneath MDA A: 13 were vertical and 3 were angled. The angled boreholes (BH-1 [location 21-26589], BH-14 [location 21-26598], and BH-16 [location 21-26590]) were drilled to assess the lateral and vertical extent of potential releases from the General's Tanks. Six shallow-depth boreholes (35 ft bgs) (BH-6 [location 21-26591], BH-7 [location 21-26592], BH-8 [location 21-26593], BH-9 [location 21-26594], BH-10 [location 21-26595], and BH-11 [location 21-26596]) were installed in the vicinity of the eastern pits and the former drum storage area to determine the extent of potential releases from these areas. BH-2 (location 21-26597) was drilled to 85 ft bgs to evaluate the unused vertical shafts. One deep borehole (BH-12 [location 21-26588]) was drilled adjacent to the central disposal pit and the eastern disposal pits to a depth 10 ft beyond the Cerro Toledo/Otowi contact. Two boreholes (BH-13 [location 21-26482] and BH-15 [location 21-26484]) were installed to evaluate a possible paleochannel (Figure 2.3-1). Table 2.5-5 summarizes the sampling depths related to the 2006 characterization activities.

After completing the drilling, subsurface pore-water vapor samples for VOCs and tritium were collected in accordance with Standard Operating Procedure (SOP) 06.31 from all boreholes after completion of drilling. For each borehole, pore-water vapor samples were collected from each core sample depth. The total depth (TD) pore-water vapor sample from each borehole was collected through the augers using a single inflatable packer. This approach ensured access to the TD of the borehole. All subsequent pore-water vapor samples were collected after the augers were removed using a straddle packer system that isolated a 2-ft interval within the borehole.

Characterization surface and shallow-subsurface sampling data results in 2006 are summarized in Tables 2.5-6, 2.5-7, 2.5-8, 2.5-9, 2.5-10, 2.5-11, and 2.5-12.

2.5.1 DP Canyon Slope

The slope and drainage into DP Canyon immediately north and east of MDA A were characterized by collecting surface and shallow-subsurface samples. The 13 locations included three locations sampled during the 1992–1994 RFI and one location positioned in the drainage on the eastern edge of MDA A, which drains to the DP Canyon slope. A total of 12 inorganic COPCs, 15 organic COPCs, and 4 radionuclide COPCs were identified on the DP Canyon slope.

The distribution of inorganic COPCs was not widespread. Elevated lead concentrations were localized and defined vertically and laterally. Perchlorate and nitrate were detected across the site at low concentrations (less than 0.13 mg/kg and 3.0 mg/kg, respectively), with no discernible distribution trends.

Nitrate was present naturally in the soil and tuff. Concentrations of nitrate and perchlorate did not indicate a release from MDA A.

Organic chemical concentrations were generally less than 0.5 mg/kg and distribution was widespread. Organic chemicals were detected only in surface samples on the DP Canyon slope, except for benzoic acid at location 21-26491. Concentrations also decreased down the slope toward the bottom of DP Canyon; locations 21-26492 and 21-26494 did not show any detected SVOCs. The lateral distribution of SVOCs around MDA A was also defined by lower concentrations or no detected concentrations in the perimeter sampling locations.

The vertical and lateral extent of americium-241, plutonium-238, and plutonium-239 were defined in the surface and shallow subsurface. Americium-241, plutonium-238, and plutonium-239 concentrations decreased with depth at all sampling locations (except location 21-26493 for plutonium-238 and plutonium-239). Plutonium-238 and plutonium-239 were detected in the 1.5–2-ft sample at location 21-26493 along the eastern drainage adjacent to MDA A. Samples from locations 21-24776 and 21-24778 collected as part of the investigation at MDA U farther to the east did not detect plutonium-238 and plutonium-239 from surface to 120 ft bgs (LANL 2006, 092589, Figure 6.3 3). The maximum plutonium-239 activity (16.6 pCi/g) was in the 0–0.5-ft sample from the DP Canyon slope (location 21-26486). Maximum americium-241 concentrations (0.827 pCi/g and 0.856 pCi/g) were detected at locations 21-26488 and 21-26489. Concentrations for all three radionuclides decreased down the slope toward the bottom of DP Canyon.

The vertical and lateral extent of strontium-90 were defined in the surface and shallow subsurface. Strontium-90 was detected at five sampling locations in the 1.5–2-ft samples. The concentrations and distribution of strontium-90 did not indicate a release from MDA A.

2.5.2 MDA A Cover

The cover of MDA A was characterized by collecting surface and shallow-subsurface samples from nine locations. The results indicated vertical stratification of contamination in the cover material. Concentrations of COPCs tended to increase in activity or concentration at 1.5 ft bgs to 2.0 ft bgs, relative to the surface sampling results and then decreased. Contaminants were generally more extensive and at higher concentrations in soil and fill than the underlying tuff. Observations made during the 2006 drilling activities indicated this horizon may have been the former operation era surface, as noted by the presence of angular gravel and surface compaction. COPC concentrations decreased laterally. Based on the results of adjacent boreholes, the lateral and vertical extent were defined for the existing MDA A cover material. Radiological walkover surveys did not indicate widespread elevated radiological contamination in surface soils in the MDA A cover.

2.5.3 MDA A Subsurface

A total of 16 borehole locations were drilled and sampled. COPCs were identified for all subsurface materials.

Inorganic chemicals detected above BVs decreased in concentrations with depth at almost all locations. A few inorganic chemicals were detected at TD of the deep borehole (location 21-26588), but most were at lower concentrations than shallower samples. In addition, the BVs were lower for Qbt 1g and Qbo than shallower tuff units.

Perchlorate was detected at trace concentrations (approximately 0.00052 mg/kg to 0.00761 mg/kg). One sample exceeded this range with a result of 0.121 mg/kg. Concentrations were less in the surrounding boreholes, and perchlorate was not detected at the TD of the deep borehole (location 21-26588). Concentrations of perchlorate did not indicate a release from MDA A.

Nitrate was detected in 20 tuff samples collected in 2006 at concentrations less than 3.0 mg/kg. All borehole results showed level or decreasing concentrations with depth. Nitrate was present naturally in the soil and tuff, and concentrations did not indicate a release from MDA A.

Iodide was detected at low concentrations (generally less than 4 mg/kg) in the subsurface of MDA A. The concentrations identify the area impacted by former drum storage activities on the eastern side of MDA A. Location 21-26594 was centered on the former drum storage area, and iodide results indicated that the highest concentration of iodide was detected at location 21-26594 in the 1.5–3-ft bgs sample (156.47 mg/kg). The vertical extent was defined by decreasing iodide concentrations with depth in this borehole; concentrations decreased to one-third of the maximum at 35 ft bgs. The lateral extent of iodide was defined by lower concentrations in the surrounding borehole locations. Iodide was detected at less than 4 mg/kg in the perimeter samples and on the DP Canyon slope.

Several organic COPCs (Aroclor-1254, Aroclor-1260, bis[2-ethylhexyl]phthalate, nitroaniline[2-], toluene, and methyl-2-pentanone[4-]) were detected in one to five samples. Concentrations decreased with depth in all boreholes and were limited in occurrence.

Acetone was detected in 21 samples in eight boreholes, with results ranging from 0.00284 to 0.0159 mg/kg. Acetone was detected at TD in several boreholes at concentrations less than 0.02 mg/kg. The concentrations of acetone either occurred sporadically in a borehole (detected at only one depth), did not change with depth (consistently detected at low levels), or decreased with depth.

Dioxins and furans were detected in 28 tuff samples. The number of congeners decreased with depth in each borehole. The concentrations also generally decreased with depth and were at trace levels (near or below the estimated quantitation limit) at TD. The dioxin congener 1,2,3,4,6,7,8,9-octachlorodibenzo dioxin was detected in 28 samples and decreased in concentration with depth, where present, in more than one sample in a sampling location. The suite of congeners consistently detected in tuff at depth was indicative of background levels of these organic chemicals, consisting of the octa- and hepta-congeners.

Polycyclic aromatic hydrocarbons (PAHs) were detected in several boreholes. Concentrations decreased with depth in all boreholes; no PAHs were detected at TD.

Americium-241 concentrations were limited to the upper 4 ft and the concentrations decreased laterally. Plutonium-238 and plutonium-239 results from location 21-26594 at 25–27 ft represent the deepest detection of plutonium-238 and plutonium-239 at MDA A and decreased vertically and laterally. Cesium-137 concentrations were less than 1 pCi/g and were not indicative of a release from MDA A. Cesium-137 was detected at TD in one borehole (location 21-26589); it was not detected in shallower samples from this borehole. It was also not detected in the deep borehole (location 21-26588) or any boreholes adjacent to location 21-26589. Uranium-235 concentrations were approximately 0.002 pCi/g to 0.03 pCi/g above the BVs (0.09 pCi/g for Qbt 3 and 0.18 pCi/g for Qbo), which indicated naturally occurring levels of uranium-235.

2.5.4 Pore-Water Vapor

The maximum detected activity of tritium (1,092,486 pCi/L) was at location 21-26593 at a depth of 34–35 ft south of the eastern disposal pits. An increase in activity was noted from the near-surface sample concentration of 1300 pCi/L at 3 ft to the maximum activity at 34 ft. However, adjacent boreholes (locations 21-26595 and 21-26594) located approximately 40–70 ft from location 21-26593 had lower tritium pore-water-vapor activities at the same depth. The deep borehole (location 21-26588), approximately 70 ft from location 21-26593, had substantially lower tritium at TD (360 ft); here, tritium was detected at 1762.9 pCi/L instead of the 1,092,486 pCi/L at location 21-26593. Tritium activity in the deep borehole decreased with depth. Activity also decreased laterally away from locations 21-26593 and 21-26588.

VOCs in pore-water vapor were detected at low concentrations (generally less than 300 μg/m^3); the maximum concentration detected was 780 μg/m^3 for 1,1,1-trichloroethane (TCA) in the deep borehole (location 21-26588). The concentration of TCA decreased to 25 μg/m^3 at TD (360 ft). Acetone was detected in several boreholes (maximum concentration of 680 μg/m^3). Concentrations of acetone increased with depth at locations 21-26484 and 21-26482 (maximum concentrations of 500 μg/m^3 at TD). The closest boreholes (locations 21-26480, 21-26485, 21-26589, 21-26590, 21-26593, 21-26595, and 21-26596) had lower acetone concentrations (approximately a fifth to a third of the maximums) at similar or deeper depths.

2.5.5 Geotechnical Sampling Results

One geotechnical sample was collected to assess subsurface flow properties. Geotechnical analyses conducted include percent moisture, bulk density (American Society for Testing and Materials [ASTM] D2937), saturated hydraulic conductivity (ASTM D2434), gravimetric moisture content (ASTM D2216V), and calculated total porosity (Methods of Soil Analysis 18-1986).

Geotechnical results were measured at MDA A location 21-26588 at a depth of 337.5 ft bgs to 339 ft bgs in the Cerro Toledo interval. The bulk density value of 0.97 g/cm^3 measured at MDA A can be compared with bulk density values of 1.03 g/cm^3 and 1.06 g/cm^3 measured at MDA T borehole location 21-24262 at a depth of 335–336 ft bgs and at MDA U BH-4 at a depth of 332.5–333 ft bgs in the Cerro Toledo interval. Conductivity, saturated hydraulic conductivity, moisture content, and porosity at MDA A are comparable to values for these parameters measured at MDAs T and U. MDA A location 21-26588 subsurface geotechnical results do not indicate saturated (water-bearing) conditions or zones beneath MDA A.

2.5.6 Paleochannel

Two possible paleochannels were reported in previous surface geophysical studies across TA-21 (Geophex 1996, 064694). Drilling at location 21-26484 to the north and location 21-26482 to the south were designed to intercept these possible paleochannels. Subsurface conditions in location 21-26484 indicated the presence of a paleochannel from the surface to approximately 23 ft bgs. Bandelier tuff (Qbt 3) was noted from 23 ft bgs to TD (45 ft bgs) in the borehole. The material was silty to clayey medium-grained sand, becoming coarser with depth. A conglomerate basal zone was noted from 20 to 22 ft bgs.

No paleochannel material was noted in location 21-25482. Tuff (Qbt 3) was noted at 1.5 ft bgs and was consistent throughout the borehole.

2.6 2007 Field investigation

The 2007 supplemental sampling of MDA A was conducted as a follow-up to the 2006 MDA A IR to address NMED's concerns regarding the completeness of the MDA A IR submitted by the Laboratory to NMED on November 9, 2006 (LANL 2006, 095046). In response to NMED's "Approval with Modification for the Investigation Report for Material Disposal Area A at Technical Area 21, Solid Waste Management Unit (SWMU) 21-014" (2007, 095047), dated February 15, 2007, the Laboratory proposed to deepen existing BH 21-26593 (BH-8) and collect pore-water vapor samples. The Laboratory also proposed collecting additional pore-water vapor samples in locations 21-26481 (BH-5), 21-26485 (BH-3), 21-26588 (BH-12), and 21-26596 (BH-11) (LANL 2007, 098321). The pore-water vapor samples were to be analyzed for tritium and VOCs. NMED accepted the Laboratory's proposal on May 29, 2007, and made an additional request in its letter, "Comments on the Response to the Approval with Modification for the Investigation Report for Material Disposal Area A at Technical Area 21, Solid Waste Management Unit (SWMU) 21-014" (NMED 2007, 098322), that the Laboratory collect additional tritium samples from location 21-26484 (BH-15) to further determine the need for long-term vapor monitoring. The Laboratory responded by proposing collection and analysis of pore-water vapor samples for VOCs in addition to tritium from location 21-26484.

In summary, the principal objectives of the 2007 sampling were to

- assess the vertical extent of tritium at location 21-26593 (BH-8) by deepening the borehole and collecting pore-water vapor samples from that location;
- further characterize tritium and VOC pore-water vapor beneath MDA A by additional sampling at locations 21-26485, 21-26481, 21-26593, 21-26596, 21-26588, and 21-26484; and
- plug and abandon locations 21-26480 (BH-4), 21-26481 (BH-5), 21-26482 (BH-13), 21-26484 (BH-15), 21-26485, 21-26588 (BH-12), 21-26591 (BH-6), 21-26592 (BH-7), 21-26594 (BH-9), 21-26595 (BH-10), 21-26596 (BH-11), and 21-26597 (BH-2) after sampling activities were completed.

Tables 2.6-1, 2.6-2, 2.6-3, and 2.6-4 summarize the pore-gas screening results, the tritium and VOC pore-gas sample locations and depths, the VOC pore-gas results, and the tritium pore-gas results for the 2007 supplemental sampling, respectively.

2.6.1 MDA A Subsurface Vapor Data

A second round of vapor-phase VOC and tritium pore-water vapor samples was collected from previously sampled depths of five boreholes: locations 21-26481, 21-26484, 21-26485, 21-26588, and 21-26596. In addition, location 21-26593 (BH-8) was drilled from 35 to 115 ft bgs, and tritium and VOC pore-water vapor samples were collected every 20 ft, from 35 to 115 ft bgs. Before sample collection, the pore-water vapor system was purged. Once proper purge of the sampling system was verified, vapor sampling proceeded in accordance with EP-ERSS-SOP-5074, "Sampling for Subatmospheric Air." Subsurface pore-water vapor samples were collected in SUMMA canisters for VOC analysis and in silica gel samplers for tritium analysis.

2.6.2 VOCs

Thirty-eight pore-water vapor samples were collected and analyzed for VOCs. Twenty-four VOC compounds were detected in the 2007 pore-water vapor samples. Most results were less than 240 µg/m^3. Concentrations are generally lower than the 2006 VOC pore-water vapor results. The higher results are discussed in detail below.

Toluene was detected at location 21-26481 (BH-5) at a concentration of 3,500 µg/m^3 from a depth of 40.5 to 42 ft bgs. This sample had the highest VOC concentration detected in pore-water vapor from the 2007 sample event. The sample collected from 45 to 46 ft at the same borehole had a concentration of 190 µg/m^3. Toluene shows a clear decreasing vertical trend at this borehole as well as at the other boreholes sampled in 2007.

Distribution of the nine most prevalent compounds in the boreholes with the maximum concentrations indicated concentrations decreased with depth for five of the compounds (butanone[2-], tetrachloroethene, toluene, trichloroethane[1,1,1-], and xylene[1,3-] xylene [1,4-]), remained unchanged for two of the compounds (chloroform and dichlorofluoromethane), and increased with depth for two of the compounds (acetone and trichloroethene).

The vertical extent of pore-water vapor VOCs was defined by locations 21-26588 (BH-12) and location 21-26593 (BH-8); VOC contamination decreased with depth at both locations (360 ft bgs, and 115 ft bgs, respectively). Lateral extent of VOCs in pore-water vapor was defined for all detected pore-water vapor compounds with the exception of trichloroethene in location 21-26481 (BH-5) to the south and acetone in location 21-26596 (BH-11) to the east; however, the concentrations were well below screening values required for potential impact to groundwater.

VOC pore-water vapor results from 2007 indicated fewer chemicals were detected (24 in 2007, 31 in 2006) and at lower concentrations. Chemicals detected in 2006 that were not detected in the 2007 samples include bromodichloro-methane, carbon tetrachloride, chloromethane, dichloroethane[1,1-], dichloroethane[1,2-], dichloropropane[1,2-], ethanol, methylene chloride, propanol[2-], styrene, trichloro-1,2,2-tri-fluoroethane-[1,1,2-].

2.6.3 Evaluation of VOC Pore-Water Vapor

The VOC results from pore-water vapor sampling were screened to evaluate whether concentrations in the subsurface pore-water vapor were of concern as a potential source of groundwater contamination. Because screening levels (SLs) are not available for pore-water vapor to address the potential for groundwater contamination, the screening evaluation was developed. The evaluation is based on groundwater cleanup levels contained in the Consent Order and Henry's law constants. The screening calculations describe the equilibrium relationship between vapor and water concentrations. Henry's law constants were obtained from either the NMED soil screening level (SSL) technical background document (NMED 2006, 092513) or the Pennsylvania Department of Environmental Protection chemical and physical properties database (http://www.dep.state.pa.us/physicalproperties/Default.htm). The SV calculations and full description are provided in the MDA A investigation report, Appendix I (LANL 2006, 095046).

If the SV is less than 1, the maximum concentration of VOC in pore-water vapor is not sufficiently high to cause the water SL to be exceeded, even if the VOCs were in contact with groundwater. Twenty-four VOCs having maximum contaminant level (MCL), New Mexico Water Quality Control Commission (NMWQCC) standards, and/or U.S. Environmental Protection Agency (EPA) Region 6 tap water SLs were detected at MDA A. For each of these VOCs, screening was performed using the maximum detected pore-water vapor concentration. These results showed that the SV was below 1 in all cases. The results of this screening indicated that VOCs in subsurface pore-water vapor at MDA A are not a potential source of groundwater contamination.

2.6.4 Tritium

Thirty-eight samples of pore-water vapor were collected and analyzed for tritium. Of the 38 tritium results, none were above 1100 pCi/L. The maximum detected tritium activity (1073.84 pCi/L) was detected at borehole location 21-26596 (BH-11) at a depth of 34 to 35 ft bgs.

Tritium results from 2007 were over an order of magnitude lower than the levels measured in the same locations in 2006. Tritium levels in 2007 ranged from nondetect to 1073.84 pCi/L. Tritium activities either remained relatively consistent or decreased with depth. Concentrations decreased laterally away from the maximum activity measured in 2007 at borehole location 21-26596. The vertical and lateral extent of tritium in pore water vapor are defined at MDA A. The maximum detected level of tritium was approximately 5% of the MCL for tritium. Therefore, the tritium detected in the subsurface at MDA A is not a potential source of groundwater contamination.

3.0 SITE CONDITIONS

The site conditions at MDA A are described in detail in the approved investigation work plan (2004, 087624, pp. 24-25; LANL 2006, 094673, pp. 1–4) and the approved IRs for MDA A (LANL 2006, 095046, pp. 99, 11-15; LANL 2007, 096409, pp. 7-9).

The following sections summarize the surface and subsurface conditions at MDA A.

3.1 Surface Conditions

The elevation of DP Mesa in the vicinity of MDA A ranges from 7125 to 7135 ft, with a gentle slope into DP Canyon to the north. The DP Canyon slope ranges in elevation from 7035 ft at the bottom to 7125 ft on the northern edge of DP Mesa, immediately north of MDA A.

The surface of MDA A is heavily vegetated with forbs, native grasses, and sagebrush. The surface slopes at a gradient of less than 5% (2.25 degrees) downward across the site from south to north. Approximately 30 ft north of the site, the slope increases to approximately 67% (30 degrees). MDA A is located in Bandelier Tuff, which breaks into a series of benches and steep slopes that grade into DP Canyon, approximately 175 ft north of MDA A’s western end and 60 ft north of the eastern end of MDA A.

3.1.1 Surface Surveys

This section describes the results of field surveys completed at MDA A, including geophysical, radiological, and geodetic surveys. Additional details can be found in Appendix C of the MDA A IR (LANL 2006, 095046) for field surveys and geodetic surveys. Details of the radiological survey results are presented in Appendix K in the MDA A IR (LANL 2006, 095046).

3.1.1.1 Geophysical Survey

A nonintrusive geophysical investigation was conducted at MDA A by ARM Group, Inc., from April 18 to April 20, 2006. The purpose of the investigation and a summary of the field methods used are provided in section 3.2.1.1. Details of the geophysical survey are presented in Appendix L of the MDA A IR.

The results indicated that not all pit boundaries are clearly defined by the geophysical data because of an insufficient contrast in physical properties. These contrasts indicate only minor variations in the electrical properties between disturbed and undisturbed areas. The concrete pad and metal associated with the General's Tanks produced strong anomalies that resulted in the delineation of these features with reasonable confidence when viewed in the context of historical documentation of the location and dimensions of the pits and the General's Tanks. Some variation exists, however, between the interpreted target locations and the historical information. Field verification of the corners of the General's Tanks concrete slab were completed in accordance with MDA A drilling surveillance procedure NES Detailing Operating Procedure 0101 before finalizing the angled borehole drill locations. The locations of the eastern disposal pits were shifted slightly to the east from locations historically portrayed in design drawings and maps. An overlay of the 2006 geophysical results and available design and orthophotograph data were used to conservatively estimate the location of the pit boundaries.

3.1.1.2 Radiological Survey

Two surface radiological walkover surveys were performed from April 20 to April 24, 2006, by the Environmental Restoration Group, Inc. The purpose of the investigation and a summary of the field methods used are provided in section 3.3.1.2. Details of the radiological survey are presented in Appendix K of the MDA A IR.

Background count rates from the high-energy and low-energy detectors were comparable with those levels found during previous surveys conducted around the DP West facility and hillslope. No areas of surface contamination were observed with either detector.

3.1.1.3 Geodetic Survey

The location of the waste units was defined by reviewing historical orthophotographs and engineering design documents. Current and past geophysical surveys were used to verify the locations and configurations of known subsurface structures and to identify any additional unknown structures/objects that may not have been documented. The available information was used to identify the waste unit boundaries and to guide the location of the boreholes. Because of uncertainty associated with the waste unit boundaries, appropriate setbacks for drilling were applied.

Geodetic surveys were performed in July and September 2006 by certified land surveyors using approved methods in accordance with SOP-03.11, "Coordinating and Evaluating Geodetic Surveys." The horizontal accuracy of the instrumentation was referenced from Laboratory control points and was accurate within 0.2 ft. Complete copies of the survey reports are provided in Appendix C of the MDA A IR.

3.2 Surface and Shallow-Subsurface Sampling

Surface and shallow-subsurface soil samples were collected on the DP Canyon slope in May 2006. The sampling locations are shown in Figure 1.2-1 in the MDA A IR (LANL 2006, 095046). These sampling activities were performed with the following objectives.

- To confirm if the 1992–1994 RFI sampling results are representative of current DP Canyon slope conditions—Six of the 66 historical sampling locations were resampled from the surface (0–0.5 ft) and shallow-subsurface soil (1.5–2.0 ft), as directed in the approved investigation work plan (LANL 2005, 089415; LANL 2005, 088052.113, p. 25). Previous RFI sampling results are depicted in Figures 4.1-1, 4.1-5, and 4.1-9 of the HIR (LANL 2005, 088052. 5, pp. 41, 45, 49).

- To identify surface/drainage impacts downslope of MDA A in DP Canyon—Ten locations were selected within obvious drainages and depositional areas north of MDA A. Surface (0–0.5-ft) and shallow-subsurface (1.5–2.0-ft) samples were collected.
- To characterize the cover/fill used to stabilize MDA A in 1985—Nine surface samples (0–0.5 ft) were collected of the cover/fill from borehole locations within the NES, including from the borehole locations described in section 3.1.2.

All surface and shallow-subsurface samples were analyzed for SVOCs, target analyte list metals, total cyanide, nitrate, total iodide, pH, perchlorate, radionuclides (by gamma spectroscopy), americium-241, isotopic plutonium, isotopic uranium, and strontium-90.

A summary of the surface and shallow-subsurface analytical results and the frequency of detections for the slope are provided in Tables 4.2-2 through 4.2-9 of the MDA A IR (LANL 2006, 095046). A more detailed discussion of the surface sampling results from the DP Canyon slope is presented in section 6.3.1 and in Appendix H of the MDA A IR (LANL 2006, 095046).

VOCs were not analyzed for surface and shallow-subsurface samples on the slope because historical data showed that VOCs were not COPCs. In addition, low-vapor-pressure organic chemicals are unlikely to remain on the slope because the MDA A cover was installed over 20 yr ago.

Dioxins and furans were not analyzed for surface and shallow-subsurface samples on the slope because these areas are a distance away from MDA T where historical operations included these chemicals. It is unlikely that these areas would have been impacted.

PCB samples also were not analyzed for surface and shallow-subsurface samples on the slope because these chemicals are relatively insoluble and likely would not have transported from beneath the MDA A cover/fill material to the surface of the slope.

3.3 Surface Water

Mesas of the Pajarito Plateau are generally dry, both on the surface and within the bedrock forming each mesa. Canyons range from wet to relatively dry; the wettest canyons contain continuous streams and perennial groundwater in the canyon floor alluvium. DP Mesa is bounded on the north by DP Canyon and on the south by Los Alamos Canyon and BV Canyon (so named because of its geographical location between MDAs B and V), which joins Los Alamos Canyon near MDA V. DP and Los Alamos Canyons have intermittent flow that is sufficient to support alluvial groundwater systems (LANL 1998, 059599, pp. 2-16, 2-18, 4-48, 4-52).

There are no streams on DP Mesa; stormwater and snowmelt generally run off the mesa as sheet flow and in small drainages off the mesa sides. Stormwater runoff from MDA A mainly occurs as sheet flow north into DP Canyon. Some stormwater from MDA A may flow laterally in an easterly or westerly direction, but this overland flow is captured in a drainage ditch and is diverted north into DP Canyon through a culvert. Currently, shallow diversion channels are present on the southern, western, and eastern sides of MDA A. These channels move water around the base of MDA A, toward the north, and prevent run-on to MDA A. During July 2001, a surface-water site assessment was conducted for MDA A in accordance with SOP-02.01, “Surface-Water Site Assessments.” The results of the assessment documented an erosion potential score of 15.8 (Appendix J in the MDA A IR), indicating a low erosion potential at MDA A (LANL 2001, 087375, p. 5). Current conditions are unchanged from those documented in the 2001 surface-water site assessment.

3.4 Subsurface Conditions

At TA-21, including MDA A, the natural or undisturbed surface soil cover is limited because of Laboratory operations, such as building and road construction and demolition. Where undisturbed, soils on the mesa surface are thin and poorly developed. Soils tend to be sandy in texture near the surface and more claylike beneath the surface. Soil profiles tend to be more poorly developed on the cliff-forming, south-facing slopes than on the north-facing slopes, which tend to have a higher organic content. A discussion of soils in the Los Alamos area can be found in section 2.2.1.3 of the installation work plan (LANL 1998, 062060, pp. 2-21) and in Nyhan et al. (1978, 005702, pp. 24-25).

3.4.1 Stratigraphy

The generalized stratigraphy of DP Mesa in the area of MDA A is shown in Figure 3.4-1. DP Mesa consists of Bandelier Tuff (Qbt) overlain by a thin layer of alluvium and soil. The Bandelier Tuff unit is subdivided into two members, the Otowi and the Tshirege (in ascending order). MDA A is situated within the Tshirege Member, which is a compound cooling unit divided into four distinct cooling units: Qbt 4, Qbt 3, Qbt 2, and Qbt 1v/1g (Broxton et al. 1995, 050121, pp. 33-63). The bedrock directly underlying TA-21 is cooling unit 3 (Qbt 3) of the Upper Tshirege, a cliff-forming, nonwelded to partially welded tuff. Below MDA A, the Otowi and Tshirege Members are separated at about 340 ft bgs by the Cerro Toledo (Qct) interval, a 10–40-ft-thick sequence of volcaniclastic sediments deposited in braided stream systems. Bandelier Tuff and deposits of the Cerro Toledo interval are derived primarily from explosive volcanic eruptions in the Valles Caldera approximately 1.2 million years ago (Goff 1995, 049682, p. 7). The basal Guaje Pumice Bed of the Otowi Member separates Bandelier Tuff from the underlying clastic fanglomerate sediments of the Puye Formation (Tertiary Puye) (LANL 2004, 087358, p. 13).

Previous geophysical studies conducted at MDA A have determined that there may be at least two paleochannel areas in the subsurface near or below MDA A (Johnson 1999, 087457, p. 6; Martin 1999, 087458, p. 5; Quesada 1999, 087456, p. 4; AGS 2003, 081176, p. 10). The two paleochannel areas north and east of MDA A may actually be an eastern bifurcation of the primary paleochannel identified at MDA T. Previous drilling activities (borehole location 21-05051) have verified the presence of the paleochannel located at MDA T (LANL 2004, 085641, p. B-28); however, the areas identified to the north and east of MDA A have not been verified. Borehole locations 21-26482 and 21-26484 were drilled in areas likely to intercept the potential paleochannels. Borehole location 21-26484 identified paleochannel sediments from 14.9 to 26.7 ft bgs (borehole log, Appendix C, in the MDA A IR). Subsurface lithology through MDA A is presented in two cross-sections of the site that intersect at borehole location 21-26597. The cross-section locations are shown in Figure 1.2-1 in the MDA A IR (LANL 2006, 095046). Cross-section A-A’ is presented from west to east to include BH-2 (location 21-26597), BH-12 (location 21-26588), BH-7 (location 21-26592), and BH-11 (location 21-26596) at MDA A. Cross-section B-B’ is drawn from south to north to include BH-2 (location 21-26597), BH-14 (location 21-26598), BH-15 (location 21-26484), and BH-16 (location 21-26590) at MDA A. All boreholes were completed during the 2006 investigation.

3.4.1.1 Quaternary Bandelier Tuff Unit 3

Qbt 3 is approximately 110 ft thick at MDA A and consists of nonwelded to moderately welded ashflow tuff. The degree of welding tends to increase with depth. However, the degree of welding was not closely associated with an increase in fracture density. Fracture density was not continuous across MDA A, occurring in approximately 60% of the boreholes. Fractures were observed in BH-1 (location 21-26589), BH-2 (location 21-26597), BH-3 (location 21-26485), BH-5 (location 21-26481), BH-7 (location 21-26592), BH-8 (location 21-26593), BH-12 (location 21-26588), BH-13 (location 21-26482), BH-14 (location

21-26598), and BH-16 (location 21-26590). Fractures tended to be vertical and approximately 1 in. wide or less. The fractures generally were filled with brown clays. One exception to this was a fracture observed at 43.5 ft bgs in borehole 13 (location 21-26482), where a sample of the matrix and fracture fill material was collected and submitted for analyses. The fracture was notable in that it extended vertically along the borehole for approximately 2 ft (borehole log, Appendix C in the MDA A IR, LANL 2006, 095046).

3.4.1.2 Quaternary Bandelier Tuff Unit 2

Qbt 2 is a vertical cliff-forming unit typically 80–90 ft thick. The upper contact is defined by the appearance of generally thin, nonwelded, and unconsolidated tuff. The lower contact is generally marked by an abundance of phenocrysts and pumice fragments. Fracture zones tend to be prevalent in this unit. However, at BH-12 (location 21-26588), the unit was 110 ft thick and predominantly welded with thin discontinuous laminations. The unit is described in the log for BH-12 (location 21-26588), Appendix C in the MDA A IR.

3.4.1.3 Quaternary Bandelier Tuff Units 1v and 1g

Qbt 1v is used to identify the vapor phase unit of Qbt 1. Qbt 1g represents the glass phase of the unit. The vapor phase unit (Qbt 1v) separates the glass phase unit (Qbt 1g) from the overlying Qbt 2. At MDA A, the Qbt 1v unit was found to be 50 ft thick and consisted primarily of devitrified, nonwelded ashflow tuff. The lower contact of the Qbt 1v unit was distinct, a light red devitrified tuff with trace sanidine, pumice fragments. The Qbt 1g tuff was a nonwelded light-gray ashflow tuff. The glass phase of the Tshirege Member of Bandelier Tuff (Qbt 1g) was found to be a 95-ft-thick massive, poorly indurated, soft tuff. The unit is described in the borehole 12 log (location 21-26588), Appendix C in the MDA A IR (LANL 2006, 095046).

3.4.1.4 Tsankawi Pumice Bed

The Tsankawi Pumice Bed (approximately 4 ft thick at MDA A) is the basal pumice fall of the Tshirege Member of Bandelier Tuff. The Tsankawi Pumice Bed consists of a gray to white angular pumice layer, grading from 0.39- to 1.18-in.-diameter pumice gravel in the basal layer at a depth of 345 –346 ft bgs. The unit is described in the BH-12 log (location 21-26588) Appendix C in the MDA A IR (LANL 2006, 095046).

3.4.1.5 Cerro Toledo and Otowi Intervals

The Tshirege and Otowi Members are separated by the Cerro Toledo interval, a volcaniclastic sequence of sediments deposited as part of a braided stream system (Broxton and Eller 1995, 058207). Drilling at BH-12 (location 21-26588) advanced 10 ft into the Otowi Member to a depth of 353 ft bgs. The Otowi Member, a light-gray ashflow tuff with light-gray pumice clasts, is estimated to be 180 ft thick at TA-21. Drilling was terminated 10 ft into the Otowi, at a TD of 360 ft in accordance with the approved investigation work plan.

3.4.2 Cliff Retreat and Fractures

Tributary stream systems and their canyons (possibly including BV Canyon and the upper reaches of DP Canyon) developed before the incision of Los Alamos Canyon; minimal cliff retreat has occurred in these canyons (Reneau 1995, 050143, pp. 65-92). The exposure of most of the MDAs at TA-21 on DP Mesa (including the area adjacent to MDA A), through cliff retreat, is improbable over periods exceeding 10,000 yr. Fracture characteristics of Qbt 2 of the Tshirege Member, which was the focus of the study, are very similar to previous fracture studies of Qbt 3, allowing for an extrapolation of the results to the rocks directly below TA-21.

An additional fracture study was conducted in June 1969 during the excavation of the MDA A central disposal pit (Purtymun 1969, 000519, p. 1). Although findings of this study are similar to those discussed in the 1995 study (Wohletz 1995, 058845, pp. 19-31), indicating fracture sets oriented in a northerly direction, other fracture orientations were noted from N40°E to N60°E and from N70°E to N80°E. It also was noted that these fractures/joints contained a dark-brown to gray clay plating.

3.4.3 Climate

Los Alamos County has a semiarid, temperate mountain climate. “Los Alamos Climatology” (Bowen 1990, 006899) provides detailed discussion of the Los Alamos climate and includes frequency analyses of extreme climatologic events.

3.4.4 Seismicity and Volcanism

Seismic source zones at Los Alamos include the Rio Grande rift, the Jemez Volcanic Province, the Colorado Plateau transition tone, the Southern Rocky Mountains, and the Great Plains Provinces.

The Laboratory is situated near the western edge of and within the Rio Grande rift, a tectonically, volcanically, and seismically active province in the western United States. The instrumental and historical records of earthquakes in New Mexico extend back only about 100 yr.

The most recent volcanic activity within the Jemez volcanic field occurred about 50,000 to 60,000 yr ago. Studies have found more evidence for recurring seismic activity along the Pajarito fault system than for recurring volcanic activity in the Jemez volcanic field (Olig et al. 1996, 057574; Reneau et al. 1996, 057002). The three most significant and closest fault zones to the Laboratory are the Pajarito, Guaje Mountain, and Rendija Canyon faults, which are accompanied by numerous smaller, secondary faults. The larger faults are clearly expressed by surface offsets at some locations; their presence at other locations is inferred from geologic evidence (Wong et al. 1995, 070097).

A study by Woodward-Clyde evaluated the seismic measurements recorded by the Laboratory from 1973 to 1992 (Wong et al. 1995, 070097). Only one well-located earthquake has occurred in the vicinity of the Laboratory or the three local faults. The maximum depth of seismic activity in the northern Rio Grande rift is about 12 km (7.5 mi), which is consistent with elevated temperatures in the crust. Focal mechanisms show normal and strike-slip faulting generally on northerly striking planes. Consistent with the Rio Grande rift zone, an approximately east-to-west extension characterizes the tectonic stress field.

The Pajarito fault is thought to mark the currently active western boundary fault of the Española basin (Wong et al. 1995, 070097). This fault forms the western boundary of the Pajarito Plateau and is easily visible above West Jemez Road as an east-facing escarpment about 91 m (300 ft) high. The Rendija Canyon and Guaje Mountain faults are shorter than the Pajarito fault. All three faults are geologically young and are capable of producing earthquakes.

The Pajarito fault zone trends north along the western boundary of the Laboratory. The Rendija Canyon fault zone is located 3.2 km (2 mi) east of the Pajarito fault zone and trends north to south across the Laboratory. The Guaje Mountain fault zone is located 1.6 to 2.4 km (1 to 1.5 mi) east of the Rendija Canyon fault zone and also trends north to south. Maximum magnitudes for the random earthquakes within these provinces range from 6.0 to 6.5 Mw (Wong et al. 1995, 070097).

3.4.5 Groundwater

Two geologic properties of Bandelier Tuff that influence recharge rates are the degree of welding and devitrification; both bear the effects of the prolonged presence of residual gases and high temperatures after deposition. Cooling of the units was not uniform, as the different tuff units were deposited at different temperatures. Welding tends to vary spatially, both between units and within separate depositional layers. Welded tuffs tend to be more fractured than nonwelded tuffs. Fractures within the tuff, however, do not enhance the movement of dissolved contaminants unless saturated conditions exist because the fractures tend to be clay-filled, resulting in generally higher sorptive capacity.

Saturated conditions do not currently exist at MDA A, moisture content of site soils ranged from 6% to 20%, averaging less than 20%. At these moisture levels, the fractures beneath the site are unsaturated. Fractures will only conduct water in situations where substantial infiltration occurs from the ground surface; however, past modeling studies indicate that when fractures become discontinuous at stratigraphic subunit contacts, fracture moisture is absorbed into the tuff matrix (Soll and Birdsell 1998, 070011, pp. 200-201).

Perched groundwater zones are defined as saturated zones above the regional aquifer and are thought to form mainly at horizons where medium properties change dramatically, such as at paleosol horizons with clay or caliche found in basalt and volcanic sediment sequences (Broxton and Eller 1995, 058207). The Cerro Toledo interval, the Guaje Pumice Bed, and the Puye Formation are examples of significant hydrogeologic property changes in the local stratigraphic sequence where a perched saturation zone may exist.

Perched saturation zones have been observed in some locations on the DP Mesa within approximately 1.25 mi of MDA A, such as at well LADP-3 (Figure 3.4-2) to the southwest in Los Alamos Canyon (in the Guaje Pumice Bed at 6430 ft), well R-7 to the south (in the Puye Formation at 6420 ft), and well Otowi-4 on the eastern base of DP Mesa (in the Puye Formation at 6380 ft). However, at the Cerro Toledo interval beneath MDA A (encountered at 342 ft bgs), a perched saturation zone was not observed. Evidence of other saturated zones in the subsurface at MDA A was not observed.

A recent analysis of the regional-aquifer monitoring network near TA-21 concluded that the regional groundwater-monitoring network is performing adequately (LANL 2007, 099936, p. 19). Groundwater flow and contaminant transport directions near TA-21 generally follow the gradient of the regional water table; the flow is generally east/southeastward (LANL 2007, 099936, p. 10).

The regional aquifer is approximately 1265 ft bgs at MDA A (Figure 3.4-2). Because groundwater was not encountered beneath MDA A during the 2006 investigation to a depth of 360 ft bgs, groundwater is not a medium of concern at MDA A.

Groundwater monitoring will be performed in accordance with the “2007 Interim Facility-Wide Groundwater Monitoring Plan” (IFGWMP) (LANL 2007, 096665) and subsequent watershed-specific plans.

4.0 POTENTIAL RECEPTORS

Conceptual site models (CSMs) are based on existing site knowledge and observations. They describe potential contaminants, exposure pathways, transport mechanisms to potential receptors, current and reasonably foreseeable land uses, and any currently uncontaminated media that may become contaminated in the future because of contaminant migration (EPA 1989, 008021, pp. 4-10). The current CSM for MDA A is detailed in the approved MDA A IR (LANL 2006, 095046, section 4; NMED 2007, 095047). The potential sources, pathways, and receptors are illustrated schematically in Figure 4.0-1. The sources and pathways are also summarized below.

4.1 Sources

The known sources of environmental contamination, documented in the MDA A IR (LANL 2006, 095046) are as follows:

- Two buried 50,000-gal. cylindrical steel storage tanks (referred to as the General's Tanks and designated TA-21-107 [West] and TA-21-108 [East]) constructed for underground storage of residual process solutions were contaminated with plutonium-239/240 and americium-241.
- Two eastern pits containing solid waste were potentially contaminated with polonium, plutonium, uranium, thorium, and other unidentified chemicals associated with Laboratory operations.
- One central pit contained TA-21 D&D debris was potentially contaminated with radionuclides.

4.2 Pathways

4.2.1 Contaminant Transport Pathways

As described in the approved MDA A IR (LANL 2006, 095046, pp. G-6-G-7; NMED 2007, 095047), a function of chemical-specific properties, the physical form and/or container associated with a waste, and the nature of the transport process.

The CSM includes the following modes of contaminant release:

- leaching (dissolution) by water infiltrating at the ground surface, then seeping through the covers and into the waste volume
- volatilization or vaporization and diffusion of certain contaminants within the waste
- release of liquid due to degradation of the General's Tanks
- incorporation into plants whose roots grow into the waste
- excavation by animals burrowing into the waste
- exposure of wastes because of erosional processes (wind, water, and mass wasting)

Contaminants released from the disposed waste may be redistributed within and beyond the site by the following primary transport pathways:

- vapor-phase transport of volatile chemicals (VOCs and tritium) into the surrounding unsaturated zone with potential for transport to the regional aquifer
- vapor-phase transport of volatile chemicals (VOCs and tritium) into the atmosphere
- surface-water transport of contaminated surface soils as eroded sediment into adjacent canyons by runoff
- airborne transport of small particulates brought to the surface by biointrusion or erosion;
- unsaturated transport of contaminants with infiltrating water through the thick (1200-ft) unsaturated zone

- saturated-zone transport of contaminants, if contaminants reach the regional aquifer
- biointrusion transport via plant roots and burrowing animals

With respect to the transport pathways, the pathway through the unsaturated zone below MDA A is of concern because contaminants may eventually reach the regional aquifer, which is the water supply for Los Alamos County and the Laboratory. Unsaturated-zone monitoring will address the effectiveness of the corrective measures and verify infiltration rates. Current site characterization data indicate that the tuff beneath MDA A is unsaturated and that the moisture contents are consistent with mesa-top infiltration rates of 0.04 in./yr (1 mm/yr) (Hollis et al. 1997, 063131, p. 2-51). In addition to unsaturated-zone monitoring, groundwater monitoring near MDA A will be used to sample for contamination in the regional aquifer and any perched intermediate zones in accordance with the Laboratory's 2007 IFGWMP (LANL 2007, 096665). Regional and perched intermediate aquifer samples are currently collected at wells R-60, R-6i, R-7, R-8, R-9, R-9i, LAOI(A)1.1, LADP-3, LAOI-3.2, and LAOI-7. No new regional monitoring wells for TA-21 were proposed in the approved report "Los Alamos and Pueblo Canyons Groundwater Monitoring Well Network Evaluation and Recommendations" (LANL 2007, 098548).

Vapor-phase transport accounts for the observed migration to depth of VOCs in pore gas within the Bandelier Tuff. Extensive analyses of the VOC contamination in pore gas beneath MDA A have shown that vapor-phase transport accounts for the migration of VOCs, for which vapor-phase concentrations are in equilibrium with water concentrations as determined by Henry's law partitioning. Vapor migration of VOCs in the subsurface can be described by diffusive behavior that is unaffected by preferential air flow or barometric pumping within the mesa (Stauffer et al. 2005, 090537). Diffusion theoretically spreads contamination in a spherical direction along concentration gradients. However, topography plays an important role in vapor transport at TA-21. With low vapor concentrations occurring at the top and sides of the mesas, the steepest concentration gradients are toward the surface. These steep gradients preferentially lead to vapor transport toward these external boundaries rather than downward toward the regional aquifer.

Tritium is transported in the subsurface at MDA A through a multiphase coupled process, primarily the diffusion of moisture. However, as tritiated moisture diffuses away from a source area, it readily equilibrates with tritium-free pore water already in the unsaturated zone. The relatively rapid process of vapor-phase diffusion (in the case of tritium, the vapor is moisture) is effectively slowed by the presence of pore water, which acts as a reservoir for tritium that partitions from the vapor. This interaction with pore water results in a lower effective water-vapor diffusion coefficient than would be observed if no liquid pore water were present. This conceptual model is based on observations of tritium in the subsurface at both MDA G and TA-53 (Vold 1996, 070155; Stauffer 2003, 080930). Data and modeling results from TA-54 indicate that the effective vapor-phase diffusion coefficient for tritium is 25 times lower than for the more volatile vapor-phase VOCs at TA-54, primarily because those VOCs do not partition as readily into pore water. Diffusion of tritium toward the surface leads to some surface flux of tritium to the atmosphere in water vapor. In addition, radioactive decay of tritium (half-life of 12.3 yr) decreases tritium mass as it migrates through the unsaturated zone. Any tritium reaching the water table by water-vapor diffusion would occur directly below the disposal site because this pathway is the shortest diffusive pathway, and the tritium would partition into the groundwater. Tritium activities in the subsurface will undergo radioactive decay in 120 to 240 yr (10 to 20 half-lives). For example, the highest concentration of tritium in pore gas at MDA A, 77,100 pCi/L, would decay to approximately 75 pCi/L in 123 yr.

A better understanding of saturated-zone transport pathways will be achieved by regional groundwater monitoring in accordance with the Laboratory's 2007 IFGWMP (2007, 096665). Appendix E contains analytical calculations demonstrating that moisture will not migrate to the regional aquifer under the existing site conditions if water flux through the surface cover remains at or below the design rate of

1 mm/yr. Because potential contaminants of concern in the wastes at MDA A will not migrate faster than the moisture flux under the site, there is no present or future (up to 1000 yr) pathway connection between the site and the regional aquifer. This would also be the case if the intermediate aquifer is present below the site.

The two other contaminant transport pathways of the CSM are biointrusion and surface water. Any corrective measures alternative selected must address these two pathways.

5.0 REGULATORY CRITERIA

5.1 Cleanup Standards, Risk-Based Screening Levels, and Risk-Based Cleanup Goals

The cleanup and screening levels described in Section VIII of the Consent Order were applied to the corrective measure alternatives. The cleanup levels are based on the NMWQCC's groundwater and surface water standards and NMED's cleanup levels for protection of human health and are consistent with EPA's National Oil and Hazardous Substance Pollution Contingency Plan, 40 Code of Federal Regulations (CFR) Section 300.430(e)(2)(i)(A)(*2*) (Table 5.1-1).

NMED has selected a human health target risk level of 10^{-5} and a hazard index (HI) of 1.0 as cleanup goals for establishing site-specific cleanup levels for one or more contaminants for which toxicological data are published. NMED and the EPA have SSLs and MCLs, and the NMWQCC has adopted groundwater and surface water standards that are described below. DOE has established a cleanup goal of 15 mrem/yr (0.25 mSv/yr) incremental exposure for radioactively contaminated sites.

Screening for ecological risk for determining the recommended corrective measure alternative used the ecological screening levels (LANL 2004, 087630; LANL 2005, 090032) and the information contained within the ECORISK Database, Version 2.1 (LANL 2004, 087386).

5.1.1 Soil

NMED has specified SSLs that are based on a target total excess cancer risk of 10^{-5} and for noncarcinogenic contaminants a target HI of 1.0 for residential and industrial land use. Residential and industrial SSLs are from NMED's "Technical Background Document for Development of Soil Screening Levels, Revision 4.0" (NMED 2006, 092513). The Laboratory uses the most recent version of the EPA Region 6 Human Health Medium Specific Screening Level (HHMSSL) for residential and industrial soil (adjusted to 10^{-5} risk for carcinogens) if an NMED SSL has not been established for a contaminant for which toxicological information is published.

These SSLs will be used as cleanup levels as specified in the Section VIII.B.1 of the Consent Order if an excavation alternative is selected.

5.1.2 Groundwater

As required by NMED in a letter dated April 5, 2007 (NMED 2007, 095394), a "Los Alamos and Pueblo Canyons Groundwater Monitoring Well Network Evaluation and Recommendations" report (LANL 2007, 098548) was submitted to NMED. NMED approved this report and did not require the Laboratory to install any new regional or perched intermediate wells around TA-21 during 2008. The corrective measures alternative chosen will be required to meet the groundwater-quality standards given in Section VIII.A of the Consent Order. These standards include the NMWQCC groundwater standards, including alternative abatement standards (20.6.2.4103 New Mexico Administrative Code [NMAC]), and the drinking water

MCLs adopted by EPA under the federal Safe Drinking Water Act (42 U.S. Code Sections 300f–300j-26) or the Environmental Improvement Board (20.7.10 NMAC). If both an NMWQCC standard and an MCL have been established for an individual substance, then the lower of the two levels is considered the cleanup level for that substance.

NMED uses the most recent version of the EPA Region 6 HHMSSL for tap water as the screening level if either an NMWQCC standard or an MCL has not been established for a specific substance. If no NMWQCC groundwater standard or MCL has been established for a contaminant for which toxicological information is published, then the Laboratory uses a target excess cancer risk level of 10^{-5} and/or an HI of 1.0 as the basis for proposing a cleanup level for the contaminant. If the naturally occurring (background) concentration of a contaminant exceeds the standard, then the cleanup goal defaults to the background concentration for that specific contaminant.

5.1.3 Surface Water

No surface water is present at MDA A, and MDA A does not have discharges of pollutants to surface water subject to a permit under Section 402 of the federal Clean Water Act. The surface water cleanup levels contained in Section VIII.C of the Consent Order, therefore, are not applicable to corrective measures at MDA A.

5.1.4 Pore Gas

There are no regulatory standards applicable to VOCs in pore gas. VOC results from pore-gas sampling were screened (LANL 2006, 095046, Appendix I, p. I-9) to evaluate whether concentrations of VOCs in the subsurface pore gas may be of concern as a potential source of groundwater contamination. Because no screening levels for pore gas address potential for groundwater contamination, the screening evaluation was based on groundwater cleanup levels contained in the Consent Order and Henry's law constants that describe the equilibrium relationship between vapor and water concentrations. The source of the Henry's law constants was the NMED SSL technical background document (NMED 2006, 092513). If Henry's law constants were not available from this source, they were obtained from the Pennsylvania Department of Environmental Protection chemical- and physical-properties database at the following URL: http://www.dep.state.pa.us/physicalproperties/Default.htm. The following dimensionless form of Henry's law constant was used:

$$H' = \frac{C_{air}}{C_{water}} \qquad \textbf{Equation 5-1}$$

where C_{air} is the volumetric concentration of contaminant in air and C_{water} is the volumetric concentration of contaminant in water. Equation 5-1 can be used to calculate the following screening value:

$$SV = \frac{C_{air}}{1{,}000 \times H' \times SL} \qquad \textbf{Equation 5-2}$$

where C_{air} is the concentration of VOC in the pore-gas sample (µg/m^3), *H'* is the dimensionless Henry's law constant, *SL* is groundwater the screening level (µg/L), and 1000 is a conversion factor from L to m^3. The SLs are groundwater cleanup levels specified in the Consent Order, which are the EPA MCL or the NMWQCC groundwater standard, whichever is lower. As specified in the Consent Order, if no MCL or NMWQCC standard is available, the EPA Region 6 HHMSSL for tap water is used (adjusted to 10^{-5} risk for carcinogens). The numerator in Equation 5-2 is the actual concentration of VOC in pore gas, and the denominator represents the concentration in pore gas that is needed to exceed the *SL*. Therefore, if the *SV* is less than 1, the concentration of VOC in pore gas is not sufficiently high to cause the water *SL* to be exceeded, even if the VOC plume were in contact with groundwater.

Equation 5-2 was used to screen the VOC pore-gas data for the supplemental investigation at MDA A. The screening was performed using the maximum detected value from the deepest stratigraphic unit sampled, which is the Otowi Member of the Bandelier Tuff. Data from the deepest unit were used in the screening because this unit is closest to the regional aquifer. Thirty-one VOCs having MCLs, NMWQCC standards, and/or HHMSSLs were detected (LANL 2006, 095046, Appendix I, p. I-45). These results show the SV is below 1 in every case. Based on these screening results, the VOCs detected in subsurface pore gas at MDA A do not presently appear to be a potential source of groundwater contamination. Therefore, the corrective measures alternatives do not address VOCs in pore gas.

5.2 Consent Order Criteria

The formal process for alternative identification and screening employed in this CME began with identifying and screening the technologies that could be used to address contaminants at MDA A against the set of threshold criteria identified in Section VII of the Consent Order (section 6). Based on the technologies passing the screening, a series of representative alternatives were developed for further evaluation. The alternatives are evaluated for applicability, technical practicability, effectiveness, implementability, human health and ecological protectiveness, and cost in section 7. These results are used in the selection of the preferred alternative discussed in section 8.

A range of corrective measure alternatives was screened and evaluated to determine what corrective measures were most appropriate at MDA A to ensure protection of human health and the environment in the future. A range of alternatives, including contaminant removal, were assessed in accordance with NMED, EPA, and DOE risk/dose assessment guidance. The containment alternatives were evaluated to ensure that contaminant concentrations in environmental media do not exceed cleanup levels if the material in the subsurface disposal units is left in place. The benefits, costs, and implementation risks of the alternatives were compared with the no-further-action (NFA) alternative as a baseline.

5.2.1 Threshold Criteria

As described in Section VII.D.4.a of the Consent Order, all corrective measure alternatives were screened for further analysis based on the following threshold criteria. To be selected, the alternative must

1. protect human health and the environment,
2. attain media cleanup standards,
3. control the source or sources of releases so as to reduce or eliminate further releases of contaminants that may pose a threat to human health and the environment to the extent practicable, and
4. comply with applicable standards for management of wastes.

This screening process was applied to eight corrective measure alternatives as detailed in section 7.

5.2.2 Balancing Criteria

Section VII.D.4.b of the Consent Order identifies balancing criteria to be applied upon screening of the initial set of corrective measure alternatives. These balancing criteria include

1. long-term reliability and effectiveness;
2. reduction of toxicity, mobility, or volume;
3. short-term effectiveness;
4. implementability; and
5. cost.

These criteria closely overlap with the evaluation criteria described in Section XI.F.9 of the Consent Order. Therefore, these criteria were combined with the evaluation criteria in section 5.2.3. The combined criteria were used to evaluate three corrective measure alternatives that passed the initial screening in section 6. This evaluation is discussed in section 7.

5.2.3 Evaluation Criteria

Section XI.F.10 of the Consent Order required the evaluation of corrective measure alternatives based on the following:

1. applicability
2. technical practicability
3. effectiveness
4. implementability
5. human health and ecological protectiveness
6. cost

Overlap between the balancing criteria described in section 5.2.2 with these evaluation criteria was addressed by discussing the balancing criteria within the six corresponding evaluation criteria in section 7.

5.2.4 Selection Criteria

Based on the evaluation of the three final corrective measure alternatives, one alternative was selected as the recommended corrective measure alternative. Compliance of this alternative with a final set of criteria described in Section XI.F.11 of the Consent Order is detailed in section 8 of this report. The criteria used in the description of the final selection were as follows:

1. achieve cleanup objectives in a timely manner
2. protect human and ecological receptors
3. control or eliminate the sources of contamination

4. control migration of released contaminants
5. manage remediation waste in accordance with state and federal regulations

The justification for the preferred corrective measure alternative includes the supporting rationale for the remedy selection, based on the factors listed in sections 6 and 7.

5.3 DOE Directives and Criteria for Radioactive Waste and Radiation Protection of the Public and the Environment

Although the hazardous waste component in MDA A is regulated under the Consent Order, the radioactive waste component is regulated under DOE directives, specifically DOE Manual 435.1-1, “Radioactive Waste Manual,” and DOE Order 5400.5, “Radiation Protection of the Public and the Environment.”

MDA A was used for disposal of radioactive materials. According to DOE Order 5400.5, DOE must protect the public and the environment from radiation or radioactive material. These requirements mandate continued control by DOE of property until the radiological hazard associated with this property is reduced to levels that no longer pose a threat to the public and environment (DOE 2000, 067489). Because the primary radionuclides at MDA A are plutonium and americium, both with significant half lives, DOE or its successor will need to maintain institutional control of the site indefinitely, unless the radionuclide inventory is removed.

5.4 Hazardous Waste Regulations

MDA A was not used to dispose of hazardous wastes after the effective date of RCRA. Therefore, MDA A is not subject to closure requirements under hazardous waste regulations.

A waste management plan is not included in this report because the selected remedy is not expected to generate any appreciable waste streams.

6.0 IDENTIFICATION OF CORRECTIVE MEASURE OPTIONS

Potential corrective measures are identified and described to control the sources, pathways, and receptors identified in section 4. The potential corrective measures are developed by selecting and combining potential technologies described in Appendix C. The potential technologies were screened for use in remedies at MDA A with screening performed against the Threshold Criteria identified in the Consent Order, Section VII.D.4.a. The evaluation is presented in Table 6.0-1. Not all technologies met the screening criteria in and of themselves, so the next step was to evaluate individual technologies for applicability at MDA A, as presented in Table 6.0-1.

The potential technologies carried forward from the screening process were used to develop and combine specific technologies, considering the necessary controls and site-specific potential corrective measures that are identified for further evaluation. Three corrective measure alternatives are developed and represent a practical range of appropriate technologies suitable for implementation at MDA A. Table 6.0-2 presents the potential remedies developed using suitable technologies identified in Appendix C.

The technologies and alternatives evaluated for MDA A include NFA, institutional controls, engineering controls, in situ and on-site remediation alternatives, and complete removal. Alternative remediation strategies are identified based on industry standards for waste handling and disposal as well as treatment and containment technologies used at other DOE sites. For purposes of the corrective measure identification, the site is divided into two areas based on the types of wastes:

- the General's Tanks, which stored liquid process wastes and contain residual radioactive contamination that potentially is transuranic (TRU)
- the eastern and central pits, which contain solid waste

Remediation alternatives can be divided into three broad types, identified in the 2008 sitewide environmental impact statement (SWEIS) for continued operations at the Laboratory (DOE 2008, 102731).

1. NFA
2. Installation of a cover
3. Removal of wastes

6.1 Technologies Evaluation

6.1.1 Technologies Dismissed As Not Suitable for Application at MDA A

All screening technologies were evaluated for implementability at MDA A except NFA (existing cover) without institutional controls and removal, treatment, and disposal of the heel (the remaining waste contents of the General's Tanks following pumping performed in the 1970s). In situ and ex situ waste treatment technologies for the eastern and central pits was also eliminated as impractical. NFA without institutional controls does not meet two of the four threshold screening criteria. Furthermore, NFA with institutional controls and ex situ treatment and disposal of the General's Tanks waste will be evaluated as a baseline alternative and is considered to provide a heightened level of source control.

General treatment technologies include some form of macroencapsulation or solidification depending on the content of the waste by using cement-based products, isolation of the waste from the surrounding environment by forming a barrier, and melting to solidify the waste using heating techniques. The following sections briefly describe the technologies and provide the justification for retaining or eliminating the technologies.

6.1.1.1 In Situ Grouting

In situ grouting for macroencapsulation is dismissed for use as a corrective measure relative to the disposal pits because the waste form is such that there may not be continuous void spaces available to accept the grout. What would result is a partially encapsulated mass that would be ineffective in isolating the waste from the environment. However, this screening technology is suitable for use on the General's Tanks waste because of the small residual volume of waste within the large void space of each tank. An engineering feasibility test was performed on a surrogate waste using similar geometry as anticipated for the General's Tanks (AEA 2004, 102711). The results of the test indicate the waste remaining in the tanks can successfully be encapsulated. Further bench-scale tests are required to demonstrate the performance of the grouted material on the actual waste contained in the tanks. Uncertainty remains regarding the ability of the 70-plus-year-old tanks to withstand the mixing process without leaking.

6.1.1.2 In Situ Perimeter Grouting (Containment Cells and Structural Barriers)

In situ grouting to form a barrier would consist of injecting grout into boreholes drilled into the bedrock below the site to intercept and fill any fractures. Angled and vertical boreholes are typically used. Because of the geometry of the central and eastern pits, technology does not exist that is capable of effectively grouting the entire bedrock mass under the site. Experience with grouting to control seepage under water retention structures indicates that grout curtains are only partially effective at precluding preferential seepage pathways. Furthermore, the grouted barrier would not have a permeability less than the existing rock mass because the grout would not penetrate into the bedrock mass. Therefore, using grouting techniques will not result in an effective barrier and are eliminated.

6.1.1.3 In Situ Vitrification

In situ vitrification has been successfully used to turn soil and rock masses into glass monoliths. The application of the technology to the wastes found at MDA A is not considered practical for the following reasons. A demonstration was conducted at MDA V (LANL 2003, 080923) absorption beds (crushed tuff gravel, cobbles, and boulders plus underlying tuff bedrock) with the resulting melt material having small metal inclusions but otherwise successfully encapsulating the radioactivity and other contaminants in a durable glass material. However, application of this technology to waste disposal pits would likely be unsuccessful. Large metal objects present in the melt would likely result in pools of metal in and below the melt. Cardboard and other flammable materials could result in small fires. The resulting emissions of carbon monoxide and carbon dioxide would require additional treatment. The power consumption to treat a mass the size of MDA A would be very large. The resulting glass would resemble obsidian rock and might be used as a resource in the future for human activities. For these reasons, in situ melting is eliminated.

6.1.1.4 Ex Situ Treatment

Ex situ vitrification of heterogeneous waste may result in eliminating some of the problems encountered in the in situ melting process because a more controlled melting process would be employed. However, to control the melt, it would be necessary to segregate the waste during exhumation in order to control the feed type going into the melter. While the technology can meet the threshold criteria for a resulting waste product, all of the other negatives cited for in situ melting would remain. Therefore, the technology is eliminated.

Ex situ grouting has been successfully used at other DOE facilities to macroencapsulate waste forms to reduce the potential for leaching of contaminants from the waste material. However, because of the heterogeneous nature of the waste from MDA A pits and the use of soil to reduce voids when the material was placed into the disposal pits, considerable preprocessing of the waste would be required to separate the waste streams, making it an impractical application of the technology. Furthermore, macroencapsulation, while reducing the void spaces of the waste material, would not reduce the toxicity of the waste and would increase the pH of the waste that could result in accelerated leaching of contaminants. Therefore, ex situ grouting of the waste is eliminated because it is not considered a practical or cost-effective technology for MDA A.

6.2 Remaining Technologies

All corrective measures will require access control because the end state of the site is industrial. Access controls include fences and DOE retaining ownership of the land indefinitely where waste is left in place. If all waste is removed, cleanup will again reach a planned industrial end use and deed restrictions would be required if ownership of the land transfers from DOE. Because all technologies evaluated include access controls, it is not discussed further.

6.2.1 No Further Action

An NFA alternative is used as a basis to compare the effectiveness of the other remedies. For MDA A, NFA will involve continued maintenance of the existing 2–6-ft thick cover, including repairing any surface erosion, filling any collapses or subsidence of the cover surface caused by collapse of waste voids (excluding the General's Tanks that will have concrete or grout fill placed in the tanks following waste removal to mitigate degradation and collapse), and maintaining fencing and access controls. In addition, this alternative includes monitoring the vadose zone below the MDA as an early indication of contaminant migration toward the groundwater.

6.2.2 Technologies Associated with General's Tanks Waste

The General's Tanks, although buried approximately 8 ft below existing grade, are not in a suitable state for an NFA alternative. Currently uncharacterized, the potentially unvented tanks contain gram quantity plutonium and americium wastes. There is a safety concern that residual radioactive material contained within the tanks has the potential to generate hydrogen at levels that could be dangerous until the tanks are opened and vented before waste removal. The tank atmospheres must be vented and the contents removed, the void space over the tank waste (heel) must be filled, or the heel must be stabilized in order to render an acceptable corrective measure for MDA A. Alternatives considered suitable for the General's Tanks include (1) *leaving the heel* in place and filling the remaining void space with grout or concrete, (2) *stabilizing the waste* by in situ treatment and filling the remaining tank space with grout or concrete, (3) *removing the waste* (tank heel) and ex situ treatment of the waste before packaging for shipment to TA-54, an off-site commercial disposal facility, or Waste Isolation Pilot Plant (WIPP), depending on the final waste characteristics. Treatment may be performed as part of the removal process.

The tank shell could be left in place; any residual removable surface contamination may be fixed by spraying a fixative coating to the tank interior, passively vented; and the tank void space could be filled with grout or concrete.

Ex situ grouting of the approximately 1300 gal. of General's Tanks waste will probably be required to immobilize inorganic chemical contaminants anticipated to be present before shipping the waste to WIPP, off-site, or MDA G. According to the Federal Remediation Technology Roundtable available at http://www.frtr.gov/matrix2/top_page.html, grouting is an approved stabilization technology for use with inorganic chemicals. The estimated 650 gal. of heel in each tank could range from dry to sludgelike in nature or be a stratified liquid and solid form. Assuming the entire volume is liquid, a total release from degradation of both tanks would be 1300 gal. An instantaneous release could result in a saturated rock volume (assuming 30% porosity) of 290 ft^3 for each tank. An analysis of this condition (Appendix E) indicates that without additional liquid to keep the material saturated, unsaturated conditions would quickly develop. The two-dimensional modeling indicates that pCi/g levels of plutonium at approximately 234 ft below the bottom of the tanks. The depth depicted by the modeling represents a worst-case condition. A more detailed analysis of the leakage scenario would likely result in the contaminant front at shallower depth. However, additional modeling is not warranted because DOE decided to remove the waste.

A value analysis session conducted in June 2007 for TA-21 (MOTA Corporation 2007, 102709) evaluated technology options for the heel in the General's Tanks. The evaluation, performed by a panel of experts in environmental waste cleanups, determined the removal, treatment, and disposal of the waste is preferable over in situ treatment. The session also considered removing the heel and tanks all together and determined the removal of the heel and leaving the tanks in place preferable.

A suitable excavation, treatment, and disposal technology for the General's Tanks waste includes removal of the waste heels, ex situ treatment using cement or other fixing agents, and disposal as determined by waste characteristics. Partial removal is considered a subset of the full removal alternative. However, since it is desirable to remove the content of the General's Tanks due to the small volume and relatively high radioactivity, the technology is carried forward as part of all alternatives evaluated.

6.2.3 Monitoring Technologies

The time periods applicable to monitoring and maintenance for MDA A following completion of the corrective action are presented in Table 6.2-1. There are a broad range of monitoring technologies available for monitoring present or former inactive waste disposal areas. Detailed monitoring options will be specific to the technologies used for a selected corrective measure. The broad range of *monitoring options* include cover and waste unit monitoring over time to determine moisture migration into and out of the cap, monitoring the vadose zone below the waste, and no monitoring if wastes are no longer present.

ET caps are a proven technology and do not require monitoring to demonstrate the technical effectiveness. Because contaminant migration is controlled from the disposal pits into the vadose zone below MDA A and above the regional or perched aquifer (not identified as present to the depths drilled in the remedial investigation) by the downward movement of moisture present in the bedrock, monitoring for potential contaminants is not necessary. The effectiveness of the remediation can be monitored by determining the change in moisture content below the waste over time. If the waste is removed, no monitoring is required.

Vadose zone monitoring will serve as an early warning system before contaminants reach the groundwater. This will allow corrective actions to be taken to avoid ground water contamination.

Groundwater monitoring will be performed in accordance with the 2007 IFGWMP (LANL 2007, 096665) and subsequent watershed-specific plans.

Monitoring for dust and air emissions during construction may be performed using commercially available fixed or portable air-monitoring stations. Monitoring stormwater runoff for sediment and contaminants may also be performed using commercially available devices. Once vegetation is established, stormwater monitoring will no longer be necessary.

6.2.4 Technologies Associated with Covers

Capping technologies used in cover designs take several forms including the RCRA Subtitle C prescriptive cover, an ET cap, a capillary barrier, and monolithic concrete cap. Most of these technologies are evaluated in the Laboratory's "Cover System Design Guidance and Requirements Document" (Dwyer et al. 2007, 096232). The evaluations performed in the guidance document concluded the best cover for the Laboratory's MDAs is an ET cover. The ET cap is superior over other capping technologies due to better long-term performance with minimal maintenance when compared with the other technologies. The monolithic concrete cap was not assessed in the guidance document; however, covering a large area with a concrete slab would tend to increase the moisture content immediately below the slab and could lead to enhanced contaminant transport from the waste. Therefore, the ET cap is selected as the preferred capping technology for use in developing a cover alternative for the MDA A pits.

6.2.5 Technologies for Source Removal (Waste)

Removal actions for the General's Tanks waste have been previously discussed in section 6.2.2.

Removal of the eastern and central pits is a feasible alternative. Although some of the waste currently in the pits may meet the criteria of "mixed" radioactive and hazardous waste, most of the waste is low-level radioactive waste (LLRW) acceptable for disposal at Area G or an off-site LLRW disposal site. Using the ongoing studies of the inventory for MDA B as representative of the potential for wastes to be encountered in the eastern pits and the limited records of disposal in the central pit, it is assumed 50% of the waste could be disposed of as LLRW. The remainder of the waste will be disposed of at an off-site mixed waste landfill. Transport of the wastes from MDA A to the disposal site(s) would be via truck and surface roads.

It is believed there is between approximately 2200 and 6000 yd^3 of waste in the central pit. The lower bound is the volume calculated from a 1972 to 1975 notebook (Martin and Hickmott 1993, 059422). The upper bound volume is calculated from a sketch of the original excavation (Purtymun 1969, 000519) that assumes 60% of the volume consists of waste and 40% of the volume consists of clean soil intermediate covers. The geometry of the original pit contained in a November 9 memorandum (Desilets 1972, 000484) does not agree: the Desilets dimensions are roughly the same length but half the width as drawn by Purtymun (1969, 000519). The depth of 22 ft mentioned by Desilets is 10 ft less than can be measured from the Purtymun sketch. As indicated by Purtymun (1969, 000519), the practice of the day was to layer the waste with clean soil. Areal photographs taken when the pits were open indicate rough surface expression different from the dimensions described by these memorandums. A 1971 memorandum (Meyer 1971, 000517) indicates the central pit volume is 8500 yd^3. If the volume from the Desilets memorandum (6000 yd^3) is added to the initial volume, the total central pit volume is 14,600 yd^3. This value is likely close to the true volume and is recommended for use in a corrective measure design.

If 6000 yd^3 of storage was provided in 1972, and the waste records indicated roughly 2200 yd^3 of waste coming from building 21-12 as the intended target waste, it would indicate that around 2–2.5 times the volume of contaminated waste was clean soil used as temporary covers.

The eastern pits geometry is better defined than that of the central pit. Drawings and dimensions match fairly closely with the Meyers memorandum and place the total volume of the eastern pits at 4000 yd^3, which is the actual volume calculated for the eastern pits if excavated according to the design drawings. Although waste practices of the day were to use approximately 1:1 clean soil versus contaminated waste, the entire volume is recommended for design of the waste removal option.

6.3 Alternative Description

6.3.1 Alternative 1, NFA with Monitoring and Maintenance

The central and eastern pits have 2 to 6 ft of cover, based on interpolation between boreholes conducted for the IR (LANL 2006, 095046). Therefore, the NFA alternative actually is an ET cap.

NFA with monitoring and maintenance alternative uses the existing conditions at the site and monitors the performance of the existing ET cover. This alternative includes removal, treatment, and disposal of the waste heels in the General's Tanks as the residuals are radioactive waste from the former plutonium processing facility and probably contain only minor amounts of metals. Figure 6.3-1 shows the layout of the site for the no action with monitoring and maintenance alternative. The existing site conditions include an approximate 30-in. thick crushed tuff/soil ET cover that supports healthy native vegetation. Verification of the existing cap thickness will be accomplished using standard drilling and sampling technology such as a geoprobe over the waste pits.

Each General's Tanks shell will be left in place; the interior may be sprayed with a fixative if removable radioactive contamination is still present and backfilled with concrete or grout.

Monitoring of the existing waste units is limited to the eastern pits. Although primarily thought to contain mostly radioactive-contaminated materials from early processing and experiments, the presence of RCRA chemicals cannot be ruled out. The central pit contains radioactive-contaminated construction debris placed in a dry state and will not require monitoring. The General's Tanks waste contents will be removed, making monitoring of that waste unnecessary.

Monitoring will consist of neutron probe boreholes that will serve as an early warning system to signal a potential for contaminant migration from the waste units, as discussed in section 6.2.3. If moisture increases at a location below one of the waste units, additional boreholes may be installed at the identified location in order to further assess the condition. The location of the neutron tubes will be just outside the waste unit boundary, and the depth will extend 20 ft below the deepest contamination in the investigation of MDA A (LANL 2006, 095046).

Monitoring for dust and air emissions during construction is a Laboratory institutional requirement. Monitoring stormwater runoff for contaminants is also a Laboratory institutional requirement and will be performed until vegetation is established on the cover. Once vegetation is established, stormwater monitoring will no longer be necessary.

Maintenance will also include annual inspections of the cover for signs of damage and conditions adverse to proper performance of the ET cover. After a period of inspections that indicates stable conditions, the frequency of inspections may be reduced. In addition to these general inspections, event-driven inspections will be required following extreme events, such as forest fires, earthquakes, or large precipitation events.

Anticipated physical maintenance resulting from inspections may include filling minor erosion gullies in the cover, replanting bare soil areas on the cover, and repairing ditches and stormwater best management practices (BMPs). Vegetation control will extend laterally beyond the pit boundaries a sufficient distance to prevent roots from entering the pits. To control this area, the boundary fence will be relocated to contain the needed control area.

6.3.2 Alternative 2, ET Cover

Alternative 2 is similar to that of Alternative 1, except the existing cover is partially removed and replaced with a cover system that has enhanced features needed to reduce maintenance and add robustness of performance. This alternative includes removal, treatment, and disposal of the waste heels of the General's Tanks. A plan view of this alternative is shown in Figure 6.3-2. Figure 6.3-3 depicts a cross-section through the cover. The remediation alternative removes the existing cover to within 2 ft of the waste surface. A 2-ft-thick cobble size biotic barrier is placed over the graded surface to prevent the intrusion of plant roots and animals downward from the ground surface. A geotextile construction separator is placed on the graded surface before barrier placement to aid in the construction placement of the barrier. After a second geotextile construction separator is placed atop this layer, a 45-in. ET cover will be constructed. The cover will consist of a 33-in. thick moisture retention layer and a 12-in.-thick rooting media. The upper 2–3 in. of the rooting media will consist of 25%–50% up to 1-in. in diameter gravel to enhance the rooting capacity of the rooting media.

A lateral barrier consisting of a geomembrane with a geocomposite on both sides will be placed to just below the maximum waste depth. The geocomposite will consist of both geotextile and geonet materials.

This lateral barrier will reduce the potential for surface water infiltrating the ground around the cover perimeter and moving laterally through bedrock fractures into the waste pits. It will also reduce the potential for lateral penetration of roots into the waste. A detail of the total cover system is shown in Figure 6.3-4.

The top slope of the cover is approximately 3%, allowing the surface to resist extreme storm events, even if no vegetation is present. The northeast and west sides of the cover require rock rip rap armoring to resist runoff forces generated during extreme storm events. The rip rap is keyed into bedrock to prevent gullies that might form below the site from moving into the cover area. The geometry of the site is such that the rip rap slope is no greater than 4 horizontal to 1 vertical. The height of the south side of the cover is low and allows a 10 horizontal to 1 vertical cover with similar cross-section to that of the ET cover. A cross-section of the north side slope is shown in Figure 6.3-5.

Before placement of the ET cover system, each General’s Tanks shell will be left in place; the interior will be sprayed with a fixative and backfilled with concrete or grout.

Monitoring of the existing waste units is limited to the eastern pits. Although primarily thought to contain mostly radioactive-contaminated materials from early processing and experiments, the presence of RCRA chemicals cannot be ruled out. The central pit contains radioactive-contaminated construction debris placed in a dry state and will not require monitoring. The General’s Tanks waste contents will be removed, making monitoring of that waste unnecessary.

Monitoring will consist of neutron probe boreholes that will serve as an early warning system to signal a potential for contaminant migration from the waste units, as discussed in section 6.2.3. If moisture increases at a location below one of the waste units, additional boreholes may be installed at the identified location in order to further assess the condition. The location of the neutron tubes will be just outside the waste unit boundary, and the depth will extend 20 ft below the deepest contamination in the investigation of MDA A (LANL 2006, 095046).

Maintenance will also include annual inspections of the cover for signs of damage and conditions adverse to proper performance of the ET cap. After a period of inspections that indicates stable conditions, the frequency of inspections may be reduced. In addition to these general inspections, event-driven inspections will be required following extreme events, such as forest fires, earthquakes, or large precipitation events.

Anticipated physical maintenance resulting from inspections may include the filling of minor erosion gullies in the cover, replanting bare soil areas on the cover, and repairing ditches and stormwater BMPs. Vegetation control will extend to the outer limits of the cover. To control this area, the boundary fence will be relocated to contain the needed control area.

6.3.3 Alternative 3, Source/Waste Removal

Removal of waste will involve the excavation of the eastern pits, central pit and the General’s Tanks. Removal operations at MDA B form the basis for removal operations at MDA A, modified only for specific conditions that differ between the sites. Differing conditions include a reduced exposure for the exposure caused by explosion of potential chemicals buried in the pits and the geometry and size of the removal action. The removal alternative includes construction of a weather enclosure to facilitate operations. The movable enclosure will be sized to cover the entire central pit and accommodate the equipment required to remove and handle the waste. Because the eastern pits and General’s Tanks areas are smaller, the size of the enclosure will be sufficient to cover these areas as well. Removal will begin with the eastern pits because the waste is the most similar to that contained in MDA B. Because of the relatively small size of the eastern pits, all excavation, waste sorting and handling, and waste packaging will occur within the main enclosure. Any special packaging required to meet the waste acceptance criteria (WAC) of the disposal facility will be accomplished within the enclosure. Once properly packaged, the wastes will be loaded into trucks and transported to the appropriate on-site or off-site disposal facility. The vertical shafts and the former drum storage area are not waste sources and do not require removal.

Before the waste is excavated, the existing clean soil (below residential screening action levels [SALs] or SSLs) will be removed from the excavation area and stockpiled nearby for reuse as backfill material. During excavation of the trenches, any clean soil encountered would be tested, and if clean, segregated and placed in the nearby stockpile. Contaminated soil would be disposed of as waste.

Upon completion of excavation, the pits will be backfilled from the clean soil stockpile and any needed additional clean fill will be imported from off-site. Off-site borrow will be minimized by regrading the site to optimize the use of cover material extending beyond the trench boundaries (Figure 6.3-6).

Upon completion of the eastern pits removal operation, the enclosure will be moved over the central pit and the removal process repeated. Some size reduction of waste placed in the central pit is anticipated. In addition, it is anticipated that a larger segregation effort will be required because waste placement practices used in the central pit included placing the waste in layers and then placing soil over the waste layer and compacting to minimize voids in the waste. The potential chemical hazard from stored liquids that is present in the eastern pits is not expected for the central pit.

Upon completion of the central pit removal operation, the containment structure will be moved over the General’s Tanks area. Removal of the General’s Tanks will involve removal and stockpiling of the clean cover soils, demolition removal and disposal of the concrete slab, and further removal of soil below the slab depth to expose the upper one-half of both tanks. The upper portion of each tank will be removed to allow removal of the tank heel (waste). Once the shell is removed, the interior surface of the tank may be sprayed with a fixative if removable radioactive contamination is present and the tank cut up and packaged for disposal using guidance of the WAC of the appropriate disposal facility.

All waste will be managed appropriately based on characterization results as material is removed. The waste will then be appropriately segregated, treated as necessary, packaged for shipment according to the applicable WAC, and disposed of at a licensed receiving facility.

Following removal of the tanks and confirmation that the excavation meets cleanup criteria, the enclosure will be removed and the area backfilled and regraded as necessary. The enclosure will be disposed of along with fencing and any other unnecessary infrastructure.

The northward slope to the site allows an excavation to be made for the waste that daylights into DP Canyon. A minor (less than 2-ft-) backfill thickness to support vegetation in the bottom of the excavation will be placed. The bottom will be contoured in a swale of less than 0.5% to drain outward into DP Canyon.

Because all waste and subsurface material will be removed to industrial cleanup standards, no monitoring and maintenance activities will be necessary.

7.0 EVALUATION OF CORRECTIVE MEASURES OPTIONS

The three alternatives developed from technologies screened against threshold criteria 1 through 4 of Section VII.D.4.a of the Consent Order are further evaluated for applicability, technical practicability, effectiveness, implementability, human health and ecological protectiveness, and cost.

7.1 Alternative 1: NFA with Monitoring and Maintenance

Alternative 1 is described in section 6.3.1. Alternative 1 consists of monitoring and maintenance of the existing cover system at MDA A and removal of the General's Tanks waste inventory in order to control the long-term potential release of radionuclides below the site (Appendix E). The monitoring system is enhanced by additional monitoring of the vadose zone immediately below the waste disposal units. Calculations and modeling supporting the development of the alternative are presented in Appendix E. The relative advantages and disadvantages of Alternative 1 are listed below:

Advantages:

- has lowest cost
- meets regulatory requirements
- provides protection for further migration of contaminants from the waste pits and tanks
- monitors vadose zone to allow for early detection of problems with the cover in order to institute corrective actions before the groundwater is impacted

Disadvantages:

- allows limited biointrusion into the waste
- relies solely on maintenance to prevent biointrusion into the waste
- does not provide for redundant systems to help ensure cover performance
- has limited stormwater erosion resistance for the cover and relies on a good stand of native vegetation to resist erosion
- precludes reuse of the site and surrounding buffer areas for other activities

7.1.1 Applicability

The existing cover has been in place for approximately 30 yr without additional changes or enhancements. Before that, a thinner cover of indeterminate configuration was present following closure of the eastern pits in 1945 and the central pit in 1976. The General's Tanks were designed, built, and operated with a concrete and soil cover. Based on the limited historical information, there were no reported problems with the waste unit covers. The work performed for the IR (LANL 2006, 095046) indicates the current conditions are effective at preventing further release of contaminants to the environment. Regular inspection of the facility will allow early detection of damage to the cover from biointrusion, erosion, and detection of intruders. These problems can be repaired periodically to maintain the improved natural cover performance. In addition, inspections following extreme events, such as an earthquake or large rainfall event, will also detect damage to the cover and surrounding area, which might lead to cover damage over time.

The existing cover has sufficient thickness to limit infiltration to low levels but less than that required of the RCRA prescriptive cover of 10^{-7} cm/s as contained in 20 NMAC 9.1. The existing site conditions are, therefore, applicable as a corrective measure at MDA A.

7.1.2 Technical Practicability

Removal of the remaining waste in the General's Tanks is feasible but because of the potential for TRU waste to be generated in the removal operation, it will be the most difficult part of the corrective measure.

Added controls will be necessary to safely perform operations, potentially including the installation of containments, ventilation systems, and remote handling operations.

Inspection and maintenance of MDA A are technically feasible and are the methods currently employed to ensure the integrity of the disposal units. Native vegetated soil cover has been used for nearly 50 yr at MDA G with minimal maintenance (LANL 2005, 090513, p. vi). Inspection will include an annual site walk-through to find areas where gullies are forming, where subsidence has occurred, and where focused recharge may occur. Condition specific inspections will occur following extreme events, such as earthquake or excessive rainfall. Monthly inspections of security fences will be performed.

In addition to monitoring the surface conditions by visual inspection, the continued performance of the existing cover will be monitored by measuring changes in moisture content from neutron access tubes. Because VOCs are not a concern at MDA A, the change in moisture levels will signal an abnormal functioning of the cover with resulting potential movement of contaminants and will allow early evaluation of corrective actions and additional monitoring.

The feasibility of inspection and maintenance activities has been demonstrated at the site during the past 30 yr. Existing procedures have ensured that access barriers are inspected and maintained. Processes have been further formalized with implementation of DOE Order 10 CFR Part 830, Nuclear Safety Management, in 2006 as part of the TA-21 nuclear facility authorization basis. Although the authorization basis will no longer be needed following corrective actions at MDA A because it will be considered a closed facility, Laboratory operations will perform all required inspections and maintenance as part of its environmental program. Monitoring and maintenance requirements will be contained in formal documented operating procedures as required in order to conform to DOE Order 5480.19.

7.1.3 Effectiveness

Alternative 1 will be effective and maintain current conditions at MDA A as long as active monitoring and maintenance continue. Removal of the General’s Tanks waste eliminates a significant portion of the radiological inventory estimated at MDA A. Following waste removal, the void space of the General’s Tanks will be filled to prevent collapse of the tanks in the long-term.

Erosion of the soil immediately over the waste pits and surrounding area is limited by the existing vegetation. Current inspection and maintenance procedures at MDA A enable early detection of damage to access barriers, deterioration of erosion controls, evidence of intruders, or damage from biota. This monitoring is necessary because the cover lacks gravel mulch for erosion protection. The remaining cover has steep slopes (4% to 25%), which are potentially eroded under severe storm events such as the probable maximum precipitation (PMP). The cover will be inspected and repaired after high-intensity storms, which have deleterious effects on cover performance.

An inspection will occur after every storm with an intensity of 6 in./h or greater which is one-tenth that of the PMP event (Appendix E). Erosion modeling results from Appendix E indicate an average annual soil loss 1.34 tons/acre/yr for bare soil conditions and 0.01 tons/acre/year for vegetated conditions. Under bare soil conditions, less than 9 in. of soil will be eroded every 1000 yr. With vegetation present, erosion is limited to less than 0.1 in. in 1000 yr.

Moisture monitoring of the bedrock below MDA A will be performed to ensure the cover is performing as designed.

Biointrusion is not accounted for in the current design. There is no vertical or lateral protection from tree roots and certain climax species deep rooting plants from penetrating the cover or surrounding soil and rock. Ants are currently established on the cover and may penetrate into the waste in the future. Therefore, if this alternative were selected, maintenance will be required for an indefinite period.

7.1.4 Implementability

Implementation of Alternative 1 poses no administrative or technical implementation challenges. The equipment and materials required are readily available. Except for installation of the soil moisture monitoring devices and the relocation of the north fence, no additional construction is required. Therefore, this alternative can be immediately implemented.

7.1.5 Human Health and Ecological Protectiveness

Impacts to human health and ecological receptors from implementation of Alternative 1 are assessed separately as the remedy implementation/installation period (short-term) and the remedy operation period (long-term). This separation distinguishes between hazards associated with installation of the monitoring devices and hazards associated with cover maintenance.

7.1.5.1 Short-Term Human Health Risk

Removal of the heel from the General's Tanks will result in small risks to the workers engaged in the removal operation. The SWEIS (DOE 2008, 102731) estimated the worker and public dose rate from removal of the heel from the General's Tanks. Because most of the potential dose comes from the tank heel, this represents a reasonable estimate, or an upper bound, to the doses that will be experienced during tank remediation.

The estimated worker dose rate from remediation of the General's Tanks will be approximately 1.7×10^{-5} rem/h (DOE 2008,102731, Table 1-79). Assuming 70,000 worker hours for removal of the heel (DOE 2008, 102731), this will result in a maximum worker dose of approximately 1.05 person-rem or a lifetime latent cancer fatality (LCF) risk of 6.3×10^{-4}.

Members of the public will also experience a dose from the removal of the contents of the tanks. For MDA A, this was estimated in the SWEIS to be approximately 6.6×10^{-4} person-rem per year over a removal period of 1.8 yr (DOE 2008, 102731). This represents a lifetime LCF risk of approximately 7.1×10^{-7}. While this was an estimate for removal of the entire MDA (Alternative 3), the inventory used was dominated by the inventory in the General's Tanks and forms a reasonable upper bound estimate. Doses and risks will be reduced by using standard radiation protection techniques; in no case will the work be conducted in such a way as to cause violations of the applicable legal and administrative dose limits.

In the short-term (0 to 100 yr) after removal of the General's Tanks contents, the existing cover is assumed to remain in place. The institutional controls currently in place will remain in place and periodic maintenance will occur. Industrial workers will perform site surveillance, maintenance, and monitoring activities designed to prevent deep-rooting plants and burrowing animals from transporting buried waste to the surface, to maintain BMPs, and to repair erosion damage. The MDA IR determined that the potential risk from carcinogenic and noncarcinogenic chemicals and a radiation dose from radionuclides is applicable to this alternative. Appendix I provides a summary of the human health risk results Based on these results, the MDA A IR concluded, "there is no potential for unacceptable dose or risk to human health for the decision scenarios" (LANL 2006, 095046, Appendix I).

Risks will also be incurred by the crew and the public during transportation of the contaminated concrete, soil, and tank heel. The concrete and soil arise from removal of the concrete slab and soil overburden necessary to uncover the tanks. This volume was estimated to be 445 yd^3 of low-specific-activity low-level waste and is suitable for shipment to an off-site, DOE facility, based on the methods used in the SWEIS (DOE 2008, 102731, section I.3.3.2.4.2). The assumptions in the SWEIS are used to determine that this waste removal will be accomplished in 34 one-way shipments. The tank heel will be 68 yd^3 of contact-handled TRU waste transported to the WIPP in eight one-way shipments (DOE 2008, 102731, section I.3.3.2.2.5). The assumptions from Appendix I, Table I-4.1-1, are used to develop the following transportation risks:

- Crew (LCF)—1.40×10^{-4}
- Population (LCF)—4.06×10^{-5}
- Radiological Accident (LCF)—4.42×10^{-7}
- Nonradiological accident (fatalities)—9.62×10^{-4}

7.1.5.2 Short-Term Ecological Risk

During removal of the General's Tanks contents, terrestrial resources will be disturbed. This activity will have minimal direct impact because most of the MDA is a grassy area enclosed by fencing; however, the operation of temporary support facilities could disrupt some nearby habitat over the short-term, and noise and human presence during removal could also disturb wildlife. Proper maintenance of equipment and restrictions preventing workers from entering adjacent undisturbed areas will be implemented, as appropriate, to minimize impacts on ecological resources. Once the tank waste is removed, the MDA will provide habitat similar to that existing before corrective actions were implemented (fenced, grassy areas).

Removal of the contents of the tanks and subsequent maintenance activities will have no impact on wetlands or aquatic resources. MDA A does not contain such resources. BMPs will be implemented to prevent erosion and any subsequent sedimentation of canyon wetlands or ephemeral streams.

Although MDA A borders on foraging habitat for the Mexican spotted owl, direct impacts on this species are not expected from tank waste removal or subsequent maintenance activities. This threatened and endangered species will not likely be present because of the disturbed nature of the MDA A and TA-21. Additionally, tank waste removal will not result in habitat loss. Indirect impacts on the Mexican spotted owl from noise are possible. Tank waste removal could in some cases generate noise levels greater than 6 decibels (dBA) above background levels (DOE 2008, 102731). A Laboratory biological assessment determined that if reasonable and prudent alternatives were implemented, work at MDA A may affect, but is not likely to adversely affect, the Mexican spotted owl.

Because all of the chemicals for potential ecological concern (COPECs) were eliminated by an analysis of background concentrations, potential effects, the area of contamination, the relative toxicity of related compounds, the infrequency of detection, and other factors, the IR concluded there was no potential risk to ecological receptors at the site (LANL 2006, 095046). These conclusions are equally applicable to the short-term ecological risks under Alternative 1.

7.1.5.3 Long-Term Human Health and Ecological Risks

Over the 1000 yr of the long-term conditions, the cover on MDA A will be managed so it will remain intact. The area will remain under institutional control and the waste will remain isolated. The dominant source of radiation dose from MDA A, the contents of the General's Tanks, will be removed from the site. None of the organic or inorganic COPCs in MDA A have degradation products that exhibit greater risk than currently exist at MDA A. No processes will be active that will tend to make the COPCs more available; therefore, the risk can be expected to decrease over time. Under these conditions, the long-term risks/doses from the radioactive and hazardous COPCs at MDA A are not expected to exceed those currently found at the site.

7.1.6 Cost

Costs associated with Alternative 1 have been estimated for all phases of the project, including support activities, site preparation, construction, materials, and continuation of site institutional controls for a 0- to 30-yr period. Significant detailed assumptions were made about the remedy and the approach for the construction and sources for materials of construction in the development of a cost estimate.

Present-value costs for the alternative are given as the sum of all capital costs and continuing costs in the following sections. Determining capital and operating and maintenance costs as present value is consistent with the CME requirements contained in Section VII.D.4.b.v of the Consent Order. The principle is also embraced for federal programs. The Office of Management and Budget (OMB) Circular A-94 states, “The standard criterion for deciding whether a government program can be justified on economic principles is net present value” (Office of Management and Budget 1992, 094804, p. 3). The OMB circular recommends a base-case analysis using a discount rate of 7% for projects that fit the category of public investments. Although it is unclear if the closure of MDA A should be considered a benefit-cost analysis or a cost-effectiveness analysis, analyses including alternative discount rates are encouraged by the circular.

Information contained in the National Institute of Standards and Technology report, “Guide to Computing and Reporting the Life Cycle Cost of Environmental Management Projects” (Schultz and Weber 2003, 094782, p. 13), indicates that the values from the OMB circular (Office of Management and Budget 1992, 094804, p. 7) presented Appendix G of this CME should be used as a source of real discount rates for DOE environmental projects.

The present-value analysis method is used to compare different remedial alternatives with different operating time periods on the basis of a single cost figure.

Net present value was calculated according to the following formula:

$$PV_{total} = \sum_{t=1}^{t=n} \frac{1}{(1+i)^t} \cdot C_t$$

Where PV_{total} = present single sum of money

t = specific year

n = final project year

i = the discounted interest rate

C_t = cost in year t in base year dollars

The discount factor, the $1/(1+i)^t$ term from the present value equation, has been calculated for an interest rates of 7%.

Cost estimates (from the preliminary status of the design) were developed based on past DOE experience at Idaho National Laboratory (INL) (Holdren et al. 2007, 098642) and other factors. Safety and security activities have been estimated but a high degree of cost uncertainty exists until a site-specific health and safety plan, documented safety analysis, and a security plan are developed.

7.1.6.1 Estimate of Capital Costs

Capital costs consist of direct costs (construction) and indirect costs (nonconstruction and overhead). Table 7.1-1 summarizes the capital cost for Alternative 1. Detailed estimates of capital cost in calendar year (CY) 2008 dollars are provided for this alternative in Appendix F. Cost estimates are expected to be within the accepted standard accuracy range from +50% to –30%, established by EPA for remedial alternative estimates at the alternatives-screening stage (EPA 2000, 071540, p. 2-4).

7.1.6.2 Estimate of Periodic and Recurring Costs

Annual costs for surface surveillance and maintenance for Alternative 1 are estimated to be based on costs for materials and equipment to maintain the cover for personnel performing cover maintenance and for maintenance of the monitoring system and data analysis (Appendix G). The operating and maintenance costs for the alternative are limited to the 100-yr monitoring and maintenance period.

The following major assumptions were made in development of the cover operating and maintenance cost estimate.

- Inspection and maintenance activities for MDA A will require two personnel working an average of 4 h a week once a year.
- No major reconstructions or repairs of the cover will be required during the 100-yr monitoring and maintenance period. Repairs will be limited to replacing soil removed by erosion and/or subsidence, revegetating eroded areas, repairing or replacing BMPs, and repairing the fence.

The annual costs for monitoring vadose zone moisture, dust, and stormwater sediment are presented in Table 7.1-1.

7.2 Alternative 2: Engineered ET Cover with Monitoring and Maintenance

Alternative 2 is described in section 6.3.2. The design plans and specifications are provided in Appendix D. Calculations and modeling supporting the development of the alternative are in Appendix E. Alternative 2 consists of enhancing the existing cover to improve performance characteristics and monitoring and maintenance of the site including the vadose zone immediately below MDA A. The relative advantages and disadvantages of Alternative 2 are as follows:

Advantages:

- meets and exceeds regulatory requirements
- limits infiltrating moisture into the waste to low values for bare soil conditions and extremely low values for vegetated conditions
- provides protection for further migration of contaminants from the waste pits
- protects the waste from intrusion of plant roots, insects such as ants, and burrowing animals
- provides redundant erosion protection including selection of resistant particle size of the moisture holding layer and the addition of gravel sized rock to allow formation of a surface pavement with long-term soil loss

- provides redundant infiltration limiting layers including the rooting media/moisture holding layers and the biotic barrier layer designed to perform as a capillary barrier layer
- provides redundant lateral biointrusion limiting features including a geomembrane layer to and a large distance from the edge of the cover to the closest waste pits
- includes a geomembrane barrier to prevent the lateral movement of any surface water that may infiltrate the cracks in the bedrock and move laterally into the waste
- includes vadose zone monitoring to allow for early detection of problems with the cover in order to predict contaminant migration and institute corrective actions before the groundwater is impacted
- protects from erosion by the PMP event
- resists the PMP storm event runoff for bare soil conditions but provides optimal conditions for vegetative growth

Disadvantages:

- relies solely on maintenance to prevent trees from becoming established on the cover and extending roots into the waste
- costs more than using the existing cover and relying on maintenance and monitoring to maintain the needed performance aspects
- requires long-term monitoring and maintenance of the site
- precludes reuse of the site and surrounding buffer areas for other activities

7.2.1 Applicability

The Alternative 2 cover is applicable and well-suited to the MDA A site. With the exception of the General's Tanks, waste disposed of at MDA A is stable and not prone to migration in the absence of focused recharge. Although infiltration is low in the arid environment of northern New Mexico, the implementation of an ET cover ensures uniformly low infiltration comparable to natural soil profiles. The ET cover alternative also provides additional barriers to human intrusion into the waste and reduces potential exposures from dispersion of waste and contaminants. It also limits biointrusion by plants and animals.

7.2.2 Technical Practicability

Removal of the remaining waste in the General's Tanks is feasible, but because of the potential for TRU waste to be generated in the removal operation, it will be the most difficult part of the corrective measure. Added controls will be necessary to safely perform operations potentially including the installation of containments, ventilation systems, and remote-handling operations.

Engineered ET covers with a vegetative component, such as the Alternative 2 cover, have proven effective in the arid and semiarid environments of the southwestern United States (Nyhan et al. 1998, 071345, p. 1; Dwyer et al. 2000, 069673, pp. 23–26). Dwyer et al. (2000, 069673) monitored soil moisture flux rates over a 4-yr period in an alternative cover comparison demonstration program at Sandia National Laboratories. Their study measured flux rates through an ET cover, which are less than the rates through RCRA Subtitle C prescriptive covers and through a cover with a geosynthetic clay liner.

Engineered ET covers are reliable because they use the "natural" conditions at the site to protect the soil surface from erosion, while storing infiltration water for vegetative growth. The result minimizes downward water movement. Engineered ET covers have been installed at several locations in the southwest where their successful performance has been demonstrated when properly maintained (Dwyer et al. 2000, 069673; Nyhan et al. 1998, 071345).

The Alternative 2 cover is relatively simple, easy to construct and maintain, uses readily available native tuff in combination with other available construction materials, and is an appropriate selection for the semiarid climate in Los Alamos. Using local materials for construction to the maximum extent achievable reduces transportation costs. It also provides the opportunity to inspect the durability and performance of natural materials under similar climatic conditions.

The Alternative 2 cover promotes vegetation that will work in conjunction with evaporation to transpire moisture and maximize available moisture storage for subsequent precipitation events. Vegetation also limits soil erosion and establishes the cover as a natural part of the mesa environment. The native seed mix planted in the cover will foster the growth of additional local plant species to produce predictable, long-term cover stability.

The enhancements of the existing cover provide redundancy of functions and improve the robustness of operation. As a result, there will be less reliance on maintenance and monitoring as part of the overall remedy. However, the maintenance and monitoring program proposed for Alternative 2 is the same as that proposed for Alternative 1.

7.2.3 Effectiveness

The Alternative 2 cover reduces erosion potential and minimizes the amount of cover soil required. The cover can resist erosion under 1000-yr storm conditions (PMP storm event as well as annual rainfall occurrences). Erosion is limited by a gradual, less than 3% slope under bare soil and vegetative conditions. Removing deep-rooted plants during the maintenance period ensures the low erosion rates by preserving a grassy cover. Holes in the cover created by uprooted trees and shrubs will be repaired. Alternative 2 has the best aesthetics because it resembles natural landforms and is constructed from readily available materials. In addition, the cover thickness is designed to minimize infiltration to stay below RCRA Subtitle C-equivalent levels. Most stormwater impacting the cover will be directed to a sediment basin. The basins will capture suspended contaminants before they are dispersed into the canyon and will also provide sampling locations for cover performance monitoring. This optimized ET cover provides added protection from biointrusion and erosion. Monitoring and maintenance of the cover will continue during the assumed 30-yr postclosure care period. Active institutional controls will continue indefinitely on a limited basis to control the growth of trees on the site and maintain appropriate land use.

For this alternative, routinely scheduled inspections will be supplemented by inspections after storm events with an intensity of 6.0 in./h or greater. Erosion modeling in Appendix E indicates an average annual soil loss of 1.34 tons/acre/yr for bare soil conditions and 0.01 tons/acre/yr for vegetated conditions. Under bare soil conditions, less than 9 in. of soil will be eroded every 1000 yr. With vegetation present, erosion is limited to less than 0.1 in. in 1000 yr.

Geomorphic studies on DP Mesa (Broxton and Eller 1995, 058207, pp. 66-69) indicate tributary stream systems and their canyons (including DP Canyon) developed before incision of Los Alamos Canyon, and minimal cliff retreat has occurred in these canyons since then. Exposure of waste at MDA A is improbable over periods exceeding 10,000 yr.

7.2.4 Implementability

The Alternative 2 ET cover alternative is readily implementable since it requires no advanced construction techniques and no complex engineering design. Standard surveying and earth-moving equipment are adequate to prepare, mix, and place the component layers of the cover in required thicknesses with the desired slopes. Materials for construction are readily available. Standard construction techniques are adequate for installing the cover, ditches/swales, rock armor, and fences.

Some of the performance properties of the cover (soil compaction, surface gradients, and overall thickness) depend upon proper installation. Other performance properties are inherent in the earthen materials and the design geometry. Erosion calculation results presented in Appendix E show that the cover has minimal erosion potential. Monitoring, inspection, and repairs conducted during a 30-yr monitoring and maintenance period ensures that the cover performs as expected. This monitoring period will allow any damage identified to be addressed, potentially extending the overall life of the remedy. Inspections will include a site walk-through every month to find areas where gullies are forming, where subsidence has occurred, where focused recharge may occur, and where cliff retreat may impinge on waste in trenches. Maintenance will include repairing gullies, BMPs, and subsidence areas with rock armor or additional fill. Waste and contaminated soil may be removed if cliff retreat impacts a waste disposal unit. Damage to the cover from tree roots can be repaired on an as-needed basis following inspections. An inspection will occur monthly and after every storm with an intensity of 6.0 in./h or greater. Following the 30-yr postclosure care period, inspections and maintenance to identify and remove trees will take place at approximately 10-yr intervals.

7.2.5 Human Health and Ecological Protectiveness

Impacts to human health and ecological receptors from implementation of the alternative are assessed separately as the remedy implementation/installation period (short-term) and the remedy operation period (long-term). This separation differentiates between hazards associated with construction of the remedy versus hazards associated with cover maintenance. The monitoring and maintenance period following completion of the cover installation are assessed under long-term effects.

7.2.5.1 Short-Term Human Health Risk

Removal of the heel from the General’s Tanks will result in small risks to the workers engaged in the removal operations. The SWEIS estimated the worker dose rate from removal of the heel from the General’s Tanks to be approximately 1.7×10^{-5} rem/h (DOE 2008, 102731, Table I-79). Assuming 70,000 worker hours for removal of the heel (DOE 2008, 102731, Table I-78), this will result in a maximum worker dose of approximately 1.05 person-rem, or a lifetime LCF risk of 6.3×10^{-4}.

During the construction of the ET cover, there will be an increase in radiological doses received by site workers compared with Alternative 1. The SWEIS (DOE 2008, 102731, Table I-78) assumed total labor hours to cover a small MDA at either 3700 of 7500 h, depending on whether a thin or thick cover was used. Assuming an hourly exposure rate of 1.14×10^{-5} rem/h (DOE 2008, 102731, p. I-198), the total worker dose will range between approximately 4.2×10^{-2} person-rem and 8.6×10^{-2} person-rem. This worker dose corresponds to a lifetime LCF risk ranging from 2.5×10^{-5} to 5.2×10^{-5}. Risks to workers from possible exposure to hazardous or toxic chemicals will continue to be minimized through training, administrative controls, monitoring, and proper use of equipment.

In the short-term (0–100 yr) after construction, the ET cover is assumed to function as designed. Appropriate institutional controls will be in place and periodic maintenance will occur, similar to maintenance activities occurring today. Industrial workers will perform site surveillance, maintenance, and monitoring activities designed to prevent deep-rooting plants and burrowing animals from transporting buried waste to the surface, to maintain erosion controls, and to repair erosion damage. Because the ET cover reduces the ability of contaminants to migrate to the soil surface, risks from these sources will be reduced compared with Alternative 1. Because the ET cover will reduce the ability of contaminants to migrate to the soil surface, the potential risk from carcinogenic and noncarcinogenic chemicals and radiation dose from radionuclides determined by the MDA A IR (LANL 2006, 095046) in the absence of the ET cover provides a reasonable upper bound risk for this alternative. Appendix I, Table I-4.1-2, provides a summary of the human health risk results. Based on these results, the MDA A IR concluded, “there is no potential for unacceptable dose or risk to human health for the decision scenarios” (LANL 2006, 095046). These conclusions are equally applicable to the short-term human health risks under Alternative 2.

Risks will also be incurred by the crew and the public during transportation of the contaminated concrete, soil, and tank heel. The concrete and soil arise from removal of the concrete slab and soil overburden necessary to uncover the tanks. This volume was estimated, based on the methods used in the SWEIS (DOE 2008, 102731, section I.3.3.2.4.2), to be 445 yd^3 of low specific-activity low-level waste and suitable for shipment to an offsite, DOE facility. Using the assumptions in the SWEIS, this will be accomplished in 34 one-way shipments. The tank heel will be 68 yd^3 of contact-handled TRU waste transported to WIPP in eight one-way shipments (DOE 2008, 102731, section I.3.3.2.2.5). The assumptions found in Appendix I, Table I-4.1-1, are used to develop the following transportation risks:

- Crew (LCF)—1.40×10^{-4}
- Population (LCF)—4.06×10^{-5}
- Radiological Accident (LCF)—4.42×10^{-7}
- Nonradiological accident (fatalities)—9.62×10^{-4}

7.2.5.2 Short-Term Ecological Risk

Under Alternative 2, terrestrial resources will be locally disturbed as the MDA is cleared of vegetation and covered. This activity will have minimal direct impact because most of the MDA is a grassy area enclosed by fencing. However, the operation of temporary support facilities could disrupt some nearby habitat over the short-term, and noise and human presence during remediation could disturb wildlife. Proper maintenance of equipment and restrictions preventing workers from entering adjacent undisturbed areas will be implemented, as appropriate, to minimize impacts to ecological resources. Once the MDA is covered and revegetated, it will provide habitat similar to that existing before corrective actions were implemented (fenced, grassy areas).

Alternative 2 will have no impact on wetlands or aquatic resources. MDA A does not contain nor is located near these resources. BMPs will be implemented to prevent erosion and any subsequent sedimentation of downstream wetlands or ephemeral streams.

Although MDA A borders on foraging habitat for the Mexican spotted owl, direct impacts on this species are not expected from activities. This threatened and endangered species will not likely be present because of the industrial nature of DP Mesa. Additionally, activities will not result in habitat loss. Indirect impacts on the Mexican spotted owl from noise are possible. Corrective action could in some cases generate noise levels greater than 6 dBA above background levels (DOE 2008, 102731). A Laboratory biological assessment determined that, if reasonable and prudent alternatives were implemented, work at MDA A may affect, but is not likely to adversely affect, the Mexican spotted owl.

Ecological risks from contaminants being reintroduced into the environment by biological processes will be reduced. The cover over MDA A will be designed to prevent or reduce intrusion by roots or burrowing animals. The covered site will be maintained in a grassy state; deep rooted shrubs and trees will be prevented from becoming established. Penetration of the waste by burrowing animals will be prevented by the design of barriers within the final MDA cover.

Because the ET cover reduces the ability of contaminants to migrate to the soil surface, the ecological risk determined by the MDA A IR (LANL 2006, 095046) in the absence of the ET cover provides a reasonable upper bound risk for this alternative. Because all of the COPECs were eliminated by an analysis comparing them to background concentrations, potential effects, the area of contamination, the relative toxicity of related compounds, the infrequency of detection, and other factors, the MDA A IR (LANL 2006, 095046) also concluded there was no potential risk to ecological receptors at the site. These conclusions are equally applicable to the short-term ecological risks under Alternative 2.

7.2.5.3 Long-Term Human Health and Ecological Risk

Over the 1000 yrs of the long-term conditions, the ET cover on MDA A will likely remain intact. The General's Tanks contents will be removed and unavailable for release. The area will remain under institutional control and the remaining wastes will remain isolated. The cover over MDA A will be designed to prevent or reduce intrusion by roots or burrowing animals. The covered site will be maintained in a grassy state; shrubs and trees will be prevented from becoming established. Penetration of the waste by burrowing animals will be prevented by the design of barriers within final MDA cover. Thus, the human health and ecological risk determined by the MDA A IR (LANL 2006, 095046) in the absence of the ET cover provides a reasonable upper bound risk for this alternative. Appendix I, Table I-4.1-2, provides a summary of the human health risk results. Based on these results, the MDA A IR (LANL 2006, 095046) concluded, "there is no potential for unacceptable dose or risk to human health for the decision scenarios." Because all of the COPECs were eliminated by an analysis of background concentrations, potential effects, the area of contamination, the relative toxicity of related compounds, the infrequency of detection, and other factors, the MDA A IR (LANL 2006, 095046) concluded there was no potential risk to ecological receptors at the site. These conclusions are equally applicable to the short-term human health risks under Alternative 2.

7.2.6 Cost

Costs associated with the Alternative 2 ET cover have been estimated for all phases of the project, including support activities, site preparation, construction, materials, analytical costs, and a 100-yr monitoring and maintenance period following cover installation. Significant detailed assumptions about the alternative and the construction approach and material sources were made in development of the optimized ET cover cost estimate. Actual project costs will depend on specific design details and project decisions that would be made only if the ET cover alternative is selected.

The Alternative 2 ET cover includes construction costs spent at the beginning of a project (e.g., capital costs) and annual operation and maintenance costs required to maintain and monitor the cover after the initial construction period. To compare costs with other alternatives that have expenditures over differing time periods, all costs were discounted to a 2008 net present value, as described in section 8.1.6. The present-value analysis is provided in Table 7.1-1.

7.2.6.1 Estimate of Capital Costs

Capital costs consist of direct costs (construction and materials), indirect costs (nonconstruction and overhead), and uncertainty estimates (contingency allowances) for the ET cover alternative. Table 7.1-1 summarizes the capital cost for the cover alternative by major project activity. Detailed estimates of capital cost in CY2008 dollars are provided for the Alternative 2 cover in Appendix G.

The following major assumptions were made in development of the capital cost estimate for the Alternative 2 cover.

- Bandelier Tuff required for the cover will be quarried from TA-61 and trucked to TA-21, where the materials will be stockpiled.
- New project management and worker change-out/shower facilities will be installed at MDA A for construction-project activities.
- Installation activities will require 12 mo.

7.2.6.2 Estimate of Periodic and Recurring Costs

Inspection, maintenance, and monitoring costs following installation of the ET cover include associated labor, management and administrative costs, other indirect costs, and contingency estimates. Detailed estimates of operating and maintenance cost in CY2008 dollars are provided for the Alternative 2 cover in Appendix G. The monitoring and maintenance costs for the alternative are limited to the 100-yr monitoring and maintenance period following the implementation of the alternative.

The following major assumptions were made in developing the cover operating and maintenance cost estimate.

- Inspection and maintenance activities for MDA A will require two personnel working an average of 4 h a week per year.
- No major reconstructions or repairs of the cover will be required during the 100-yr monitoring and maintenance period. Repairs will be limited to replacing soil removed by erosion and/or subsidence, revegetating eroded areas, repairing BMPs, and repairing the fence.

The annual costs for monitoring the vadose zone, dust, and stormwater sediment are presented in Table 7.1-1.

7.3 Alternative 3: Waste Removal

Alternative 3 includes complete waste-source excavation and disposal described in section 6.3.3. The relative advantages and disadvantages of Alternative 3 are listed below:

Advantages:

- meets and exceeds regulatory requirements
- removes the source of contamination from the site
- does not rely on engineered features to successfully implement the remedy
- provides optimal protection of the groundwater from future potential contamination from existing waste sources
- allows industrial reuse of the site
- does not require long-term monitoring or maintenance

Disadvantages:

- has highest cost of all alternatives considered
- poses increased risk to workers and the public due to exhumation and shipping of wastes
- requires waste characterization to determine the disposal pathway for the waste
- requires restricted use due to elevated contamination remaining in the bedrock above residential cleanup levels (but below industrial cleanup levels)

7.3.1 Applicability

Excavation of waste and off-site disposal is applicable to the complete range of contaminant groups with no particular target group. Although it does not reduce the volume or eliminate any of the waste, it is frequently considered an option because it relocates the waste to a different (and presumably safer) site. The waste source is removed to approved cleanup levels and monitoring of the site is not required.

7.3.2 Technical Practicability

According to data obtained from the Federal Remediation Technology Roundtable (available at http://www.frtr.gov/matrix2/top_page.html), excavation and off-site disposal is a proven and readily implementable technology. Before the mid-1980s, excavation and off-site disposal were the most common method for cleanup of hazardous waste sites.

In the long-term, the performance, reliability, and minimization of hazards at the site are optimal because no waste remains at MDA A. This alternative does, however, present short-term considerations. The large volume of material to be transported for off-site disposal may impact the practicability of this alternative. The estimated volume of material, both waste and contaminated soil contained in and around the disposal units to be excavated and transported is 28,700 yd^3 and does not account for the bulking factor upon removal. This estimate assumes that a portion of the overburden is not contaminated and will be used for backfill cover of the excavation. Because the waste is probably similar to that at MDA B (expected to be heterogeneous debris, soil, and mixed contaminated media), with similar uncertainty as to waste type, the excavation will be similarly conducted in a ventilated enclosure to mitigate off-site releases of dust and contaminants.

7.3.3 Effectiveness

Complete excavation of wastes and the surrounding contaminated tuff to cleanup levels is effective in eliminating the potential long-term impacts of wastes to the areas in and surrounding MDA A. Complete excavation to remove waste and contaminated media to cleanup levels eliminates the need for long-term maintenance and/or monitoring at the location. Institutional controls including limiting site access, DOE ownership of the land or enforceable deed restrictions if the land is sold would limit the potential for improper use of the land.

The sorting and segregation of the excavated materials could potentially increase the quantity of waste disposed of by increasing the amount of packaging materials necessary for transport and disposal at various locations depending on the waste type.

The Federal Remediation Technology Roundtable estimates typical excavation times of about 2 mo for the excavation of 20,000 tons of contaminated soil (available at http://www.frtr.gov/matrix2/top_page.html). However, wastes at MDA A are not comparable to Roundtable estimates, and the excavation times are expected to be substantially longer. Sorting for treatment and packaging for disposal will complicate and lengthen the process.

This alternative is the least effective of the three in the short-term at mitigating the impact of contamination. Disturbance and excavation of the disposal units increase the possibility of accidental release of hazardous and/or radioactive materials. The possibility of release upon disturbance of the units containing unknown waste materials increases the short-term risk and dose from dispersal of contamination.

7.3.4 Implementability

Implementation of this alternative requires

- conducting a hazard categorization and hazard analysis to identify requirements associated with unknown wastes materials, and
- using administrative and engineering controls such as personal protective equipment up to Level B (supplied air) and possibly remote handling to reduce risks associated with unknown RCRA chemicals and radiologically contaminated materials.

Approximately 11,000 yd^3 of clean material (overburden) will be removed from the excavation and transported for temporary storage to a preapproved site located within 1000 ft of the excavation site. After excavation is completed, the site will be contoured to allow drainage northward to DP Canyon. The previously excavated clean overburden material will be transported back to the MDA A site and used as backfill to provide a seeding layer over the site. Once the excavated area has been backfilled, the site will be revegetated.

7.3.5 Human Health and Ecological Protectiveness

7.3.5.1 Short-Term Human Health Risk

Alternative 3 will result in larger radiation doses to site workers than Alternatives 1 and 2. Assuming 70,000 h to remove each of the three sections of MDA A (DOE 2008, 102731, Table I-78) and estimated worker dose rates of 1.3×10^{-5} rem/h (eastern pits), 1.2×10^{-6} rem/h (central pit), and 1.7×10^{-5} rem/h (General's Tanks) (DOE 2008, 102731), the total worker dose for complete removal of contamination from MDA A is estimated to be 2.2 person-rem. This is equivalent to a lifetime LCF risk of 1.33×10^{-3}. Doses and risks would be reduced by using standard radiation protection techniques.

Compared with Alternative 2, Alternative 3 could result in increased risks to site workers from exposure to hazardous or toxic chemicals. These risks will be minimized through training, administrative and engineered controls, monitoring, and proper use of equipment.

Risks will also be incurred by the crew and the public during transportation of the contaminated material from the removal action. The SWEIS (DOE 2008, 102731, Table I-54) estimated 130 shipments of low-specific activity waste, 1350 shipments of low-level and mixed low-level waste, and 120 shipments of contact-handled TRU waste (CH-TRU). For this analysis, the CH-TRU waste was assumed to be shipped to WIPP, and the other waste was shipped to an off-site DOE facility. The assumptions found in Appendix I, Table I-4.1-1, are used to develop the following transportation risks:

- Crew (LCF)—1.2×10^{-2}
- Population (LCF)—3.8×10^{-3}

- Radiological accident (LCF)—3.0×10^{-8}
- Nonradiological accident (fatalities)—6.4×10^{-5}

7.3.5.2 Short-Term Ecological Risk

Short-term impacts on ecological resources under Alternative 3 will be similar to those described for Alternative 2. Although little habitat exists within MDA A, the operation of temporary remediation support facilities could disrupt some nearby habitat over the short-term, and noise and human presence could disturb wildlife. This will probably occur whether removal is complete or partial. Once corrective actions are complete, the site will be recontoured and revegetated. Establishment of natural conditions following removal will provide additional habitat for wildlife.

7.3.5.3 Long-Term Human Health and Ecological Risk

Alternative 3 will reduce long-term potential risk from carcinogenic and noncarcinogenic chemicals and radiation does from radionuclides to members of the public from either contaminants released slowly over time or inappropriate uses of the sites assuming temporary future accidental breakdowns in institutional control. All of the contamination within and near the MDA A will be removed.

Although actions will create a disruptive environment for local wildlife in the short-term, long-term impacts will be beneficial. With the removal of wastes and contamination from the MDA, deep-root penetration and burrowing animals will not reintroduce contamination to the environment. Thus, this alternative will result in long-term ecological benefits.

7.3.6 Cost

7.3.6.1 Estimate of Capital Costs

Capital costs consist of direct costs (construction), indirect costs (nonconstruction and overhead), and uncertainty estimates (contingency allowances). Table 7.1-1 summarizes the capital cost for this alternative. Detailed estimates of capital cost in CY2008 dollars are provided for each alternative in Appendix H. Cost estimates are expected to be within the accepted standard accuracy range of +50% to –30% established by EPA for remedial alternative estimates at the alternatives screening stage (EPA 2000, 071540, p. 2-4).

Cost estimates were developed based on previous on-site removal actions (MDA P), estimates made at INL and other DOE site experience (Sandia, Hanford, and Rocky Flats), and factors such as the MDA A site location near existing operating facilities.

Safety and security activities have been estimated, but a high degree of cost uncertainty exists until site-specific health, safety, and security plans are written.

Capital Costs for Monitoring

Even though monitoring and maintenance of the corrective measure is not required for performance considerations, costs for the analysis of monitoring dust and stormwater runoff are included in this estimate because they will be required during implementation and until vegetation is established.

7.3.6.2 Estimate of Periodic and Recurring Costs

There are no periodic or recurring costs associated with this corrective measure.

8.0 SELECTION OF PREFERRED CORRECTIVE MEASURE

A detailed corrective measures analysis was made of three potential alternatives. These alternatives are

- Alternative 1, NFA (existing cover), monitoring, and maintenance;
- Alternative 2, engineered ET cover, monitoring, and maintenance; and
- Alternative 3, complete waste-source excavation to meet industrial cleanup levels and dispose of the waste.

Selection of the preferred alternative is based on the criteria listed in Table 7.1-1, which summarizes the corrective measure alternatives based on the six evaluation criteria defined in Section XI.F.10 of the Consent Order. Table 7.1-1 gives a summary comparison of the estimated costs associated with each alternative. The numeric ranking ranged from 1 (least able to meet the criteria) to 3 (most readily able to meet the selection criteria). It also includes six selection criteria defined in Section XI.F.11 of the Consent Order and discussed in section 7 of this report. Ranking order indicates that Alternatives 1, 2, and 3 accrued points of 25, 28, and 26, respectively. Alternative 2 is the recommended corrective measure alternative.

8.1 Ranking with Evaluation Criteria

Alternative 2 has the highest ranking from CME evaluation criteria 1 through 6 from Table 7.1-1. Only two points separate the lowest and highest alternative. No weighting of the criteria was assigned.

8.2 Ranking with CME Selection Criteria

8.2.1 Achieving Cleanup Objectives in a Timely Manner

Because of the relatively small size of MDA A, any of the alternatives are achievable in a single construction season. Removal of waste is the most complex alternative and requires the most detailed planning for implementation. Based on experience with planning work for removal of MDA B, the added planning, including compilation of documentation in compliance with DOE Safety Basis (10 CFR 830) requirements, will require at least 12 mo (including lessons learned from that activity) in addition to the field implementation.

8.2.2 Protect Human Health and Ecology

All alternatives are protective of human health and the environment. The alternatives employing engineered barriers (existing and ET covers) will require indefinite maintenance to ensure that roots from trees do not intrude into the waste. Monitoring is part of Alternatives 1 and 2 remedies and will ensure the performance of the covers by allowing early detection of increases in moisture content that might signal the downward movement of contaminants. Early detection will allow evaluation and determination of any needed corrective actions before the groundwater is impacted.

8.2.3 Control or Eliminate Sources of Contamination

All alternatives serve to control sources of waste in a similar manner. The first two alternatives rely on a cover and maintenance to limit contaminant migration. Only the degree of maintenance is different; Alternative 2 is more robust because of added design features, such as biotic and lateral infiltration barriers and better erosion and stormwater runoff control measures. Removal of the waste in Alternative 3 eliminates future maintenance at MDA A but transfers the responsibility of waste management to other (licensed) sites because the nature of the waste is such that it cannot be eliminated.

Because of the potential environmental impact from a release of the General's Tanks waste, evaluated in Appendix E, all three alternatives include removal of the tank heel waste, treatment, and disposal at an appropriate waste disposal facility, depending on waste characteristics. Alternative 3 includes the complete removal of the tanks, while Alternatives 1 and 2 will fix any remaining contamination on the interior of the tanks and then will backfill the tanks with concrete or cement grout.

8.2.4 Control Migration of Released Contaminants

The current site conditions are such that contamination in the soils and bedrock outside the waste pits meets industrial screening levels. Therefore, one alternative is not better than the other for controlling or mitigating already released contaminants. As presented in Appendix E, modeling indicates little potential for a groundwater pathway to exist at MDA A. Once the waste in the General's Tanks is removed the potential for future migration of contaminants to the surrounding bedrock will be removed. Modeling indicates near study state conditions have been established below the existing cover and that increases in moisture content necessary for additional contaminants to migrate from the waste will not occur.

8.2.5 Manage Remediation Waste in Accordance with State and Federal Regulations

The existing and ET covers (Alternatives 1 and 2) monitoring system installations may generate small quantities of low-level chemical and radiologically contaminated drill cuttings that would require handling and disposal as investigation-derived waste. Alternatives 1 and 2 would also require wastes removed from the General's Tanks to be handled in compliance with treatment, packaging, transportation and disposal regulations, depending on the waste characteristics and the receiving facility's WAC. Complete waste removal in Alternative 3 would generate quantities of excavated waste that requires compliance with transportation, packaging, and disposal regulations.

8.3 Benefits and Possible Hazards

Alternative 1 (NFA with monitoring and maintenance) has the lowest cost. Maintenance gives the required degree of protectiveness. Alternative 2 (ET cover with monitoring and maintenance) is intermediate in cost, requires the greatest use of imported fill material from outside DP Mesa but is more protective of the waste left in place due to the cover enhancements, including reduced infiltration, a biotic protection barrier effective for all biota except tree roots, increased erosion features to protect from extreme storm events, and a lateral moisture infiltration barrier to protect the waste from stormwater seeping into the waste along any preferential pathways. Alternative 3 is the most expensive remedy and has some added risk of public exposure to contamination because of the excavation and transportation of hazardous and radioactive materials along public highways. Because there would be a similar number of trucks on the highway, the risk of an accident is similar to that of hauling clean soil onto DP Mesa in Alternative 2.

All alternatives are protective of the groundwater, as indicated in the modeling performed for MDA A alternatives (Appendix E).

Maintenance is relied upon to maintain long-term performance of Alternatives 1 and 2 because the waste remains in place, and plant uptake cannot be totally prevented without control of the presumed piñon-juniper and Ponderosa pine forest climax vegetation. However, because of the enhancement of Alternative 2 with the biotic barrier, animal and insect intrusion into the waste is eliminated as is intrusion by plant species except trees. As indicated in Appendix I, there is an increased risk for the dispersal and uptake of contaminants for Alternative 3 during waste removal, packaging, and shipping.

No maintenance or monitoring is required for Alternative 3 (waste removal and disposal) because once removed, the site will meet industrial cleanup levels. The industrial restriction on land use is required because the shallow depth of backfill within the excavated area leaves contaminated soil and bedrock near the ground surface.

9.0 DESIGN CRITERIA TO MEET CLEANUP OBJECTIVES

As required in Section XIF.12 of the Consent Order, this section presents a preliminary plan and specifications to illustrate the preferred Alternative 2 ET cover technology and its anticipated implementation as well as the neutron monitoring holes required for monitoring the vadose zone. The preliminary design information includes a discussion of the design life of the alternative and provides reference to engineering calculations for the proposed remediation.

9.1 Conceptual Design Verification

Selection of the preferred alternative, Alternative 2, requires designing an engineered ET cover during the CMI phase for MDA A. Before the design can begin, verification of certain assumptions made for the conceptual design is required. These include the following steps:

1. perform field investigations to verify the modeling assumptions and geotechnical and hydraulic input parameters for the long-term hydrological performance assessment of the selected remedy
2. verify the long-term climax vegetation for TA-21
3. verify the geometry composition and contaminants of the General's Tanks
4. verify the thickness of the existing cover over the waste trenches (the cover geometry of the General's Tanks area has already been verified)
5. perform focused radiological survey of anthills and vegetation present on the existing cover to determine existing migration of contaminants
6. determine the existing cover geotechnical and hydraulic materials properties
7. verify the potential biotic intruders that might be present at TA-21

The design processes for the ET cover will include those contained in "Cover System Design Guidance and Requirements Document" (Dwyer et al. 2007, 096232) using the following site-specific requirements.

1. Erosion protection and ditch design will be based on the PMP obtained using procedures from the National Oceanic Atmospheric Administration Hydrometerological Report HMR 55a (available at www.nws.noaa.gov/oh/hdsc/On-line_reports/Hmr55A/HMR_55A-full.pdf). The PMP event was selected because it represents a design storm that should never be exceeded at MDA A.
2. Meteorological data for infiltration events will be based on the historical data obtained from the weather recording station located at TA-53 to perform potential ET calculations. Average meterological data for the 16.5 yr of record are considered representative for infiltration modeling.

Future wetter or drier climate cycles occur over decades to millennia and are not evaluated. HMR 55a examined the climatological cycle before the 1980s and found no significant trend for wetter or drier climates, although it is apparent there has been a shift toward a drier climate over the past two decades.

2. Soil and rock properties will use values determined from the actual borrow source or backfill source materials. The use of material specific parameters will result in more accurate representation of cover design features than can be obtained from regional or text book values. Where possible New Mexico Department of Transportation rock and gravel gradations will be used.
3. The Laboratory wild land seed mixture will be used for vegetation. Irrigation to enhance germination will not be permitted because it will adversely affect infiltration control. Over the past decade since the Cerro Grande fire, a highly developed seed mix has been specified for use on Laboratory projects, resulting in higher germination rates using natural plant species.
4. The design requirements will be determined for the biobarrier.
5. Verification of this design will confirm that it performs in compliance with the requirements of 20 NMAC 9.1 for alternative cover design.
6. An operation and maintenance manual will be developed based on design and monitoring requirements that will be reviewed during final design meetings and submitted to NMED for approval.
7. Design requirements for installation of the lateral infiltration barrier and geotextiles will be developed based on industry standards for flexible membrane liners and as appropriate for the planned usage.

9.2 Design Description

The use of covers at RCRA sites is part of the accepted closure technology for isolation of waste from the environment. The RCRA Subtitle C prescriptive cover must limit infiltration to values below the saturated hydraulic conductivity of the basal liner system. 20 NMAC 9.1, Subpart V, “Closure and Post Closure Requirements for Municipal or Special Waste Landfills,” requires the cover to have an 18-in. layer with saturated hydraulic conductivity of less than the natural soil but no greater than 10^{-5} cm/s as well as a 6-in. erosion layer. In addition, 20 NMAC 9.1 also allows alternative cover systems meeting these requirements. Side slopes are to be no steeper than 25% and top slopes between 2% and 5%.

The proposed MDA A cover meets the requirements of 20 NMAC 9.1. The alternative cover called an ET cover will have an upper layer consisting of a 12-in.-thick rooting layer of crushed tuff/topsoil obtained from on-site excavation of the upper average 1.5 ft of existing cover material. In addition, the material will contain between 25% and 50% gravel having a diameter no greater than 1 in. mulch to enhance vegetative growth and resulting transpiration of infiltrating moisture (Nyhan et al. 1998, 071345). Calculations (Appendix E, PMP runoff surface erosion) show the bare soil tuff sufficient to resist erosion without the gravel treatment under severe rainfall events, including the PMP event, a not-to-be exceeded estimate of rainfall for the site. A lower 33 in. water storage layer consisting of crushed tuff obtained from on-site or TA 61 (Shaw Environmental Inc. 2006, 091368) is part of the ET cover. This total 45-in.-thick cover allows for 9 in. of surface erosion calculated (Appendix E, Revised Universal Soil Loss Equation) to occur for the bare soil over a 1000-yr period using the modified Universal Soil Loss Equation. The gravel mulch should further reduce this amount of erosion by forming a “pavement” of small stones as wind and water remove the finer-grained soil from the cover surface.

ET covers are intended to function under unsaturated conditions; consequently, obtaining very low saturated hydraulic conductivity is not essential to a successful cover. The cover soil moisture characteristics and cover compaction density are crucial parameters. Compaction density requirements will be based on the design criteria established in the "Cover System Design Guidance and Requirements Document" (Dwyer et al. 2007, 096232) but generally will achieve a density in the upper soil layer that approximates that of the surrounding undisturbed soil. Uniformity of compaction is critical to avoid creating preferential infiltration pathways.

The north, east, and west side slopes of the cover are a maximum of 20%. The 20% slopes are protected by 4-in. diameter (D_{100}), 2-in. diameter (D_{50}) durable rock designed to withstand tractive forces imposed by the PMP event. The south-side slope is less than 3 ft high and will be a 10% vegetated slope. Having little top slope run-on (only 50 ft of a small area of the top slope drains toward the north), the north slope is suitable for vegetated cover erosion resistance.

To limit biotic intrusion into the waste, a biobarrier is included below the ET cover and will have cobble (minimum 4–8 in.) size rock placed in a 24-in. layer. This layer will extend to the horizontal limit of the top slope where it will be joined to a lateral barrier consisting of a near-vertical geomembrane layer that in turn extends to the bottom of the waste trenches and General's Tanks. The entire system will prevent burrowing animals and limit plant roots from penetrating into the waste. Insects, such as harvester ants, will be limited from access to the waste by the total cover thickness, including the 24 in. of existing cover left in place over the waste. The biotic barrier will function as long as the cover system remains in place. However, the barriers will not be effective in preventing potential climax species tree roots from penetrating into the waste in the long-term. The barrier system will also slow but not prevent deep-rooting bushes from penetrating into the waste (Nyhan et al. 1998, 071345). Therefore, a maintenance program will be required to remove trees and bushes from the site.

9.3 Preliminary Plan

The conceptual design of the preferred alternative is presented in section 6.3.2. Appendix D includes a plan of MDA A before construction, a plan of the cover installation, a cross-section of the cover installation, and key cover details.

9.4 Preliminary Specifications

Specifications will follow the Construction Specification Institute (CSI) format. Quality assurance (QA) and QCs for each material and/or work will be included in each specification item. Preliminary specifications needed for execution of the design includes the following.

GENERAL REQUIREMENTS:

01 1110 Summary of Work

This specification describes the overall scope of work involved the subcontract work for the MDA A remediation.

01 1116 Work by Owner

This specification describes any activities being performed by the Laboratory, independent of the subcontractor work.

01 2500 Substitution Procedure

This specification describes the procedure by which the subcontractor may submit for approval by the Laboratory processes or materials differing from those specified. Certain items, such as liner materials and previously identified and approved borrow sources, will specifically be exempted from substitution.

01 3300 Submittal Procedure

This specification details general submittal requirements and stormwater submittal requirements necessary to meet state and federal permit requirements.

01 4000 Quality Requirements

This specification identifies the processes for QC and QA. QC of specific processes or materials will be contained in a section of the individual execution specifications.

01 4200 References

This specification lists all subcontract document specifications procedural standards requirements.

01 5705 Temporary Controls and Compliance Requirements

This specification describes requirements for handling, storage, disposal and monitoring wastes generated by the on-site activities.

01 6000 Product Requirements

This specification describes how the subcontractor will be required to handle and store any procured materials consistent with the Laboratory materials receipt and inspection processes.

01 7700 Closeout Requirements

This specification describes the subcontractor requirements to close out the construction of the corrective measure.

01 7839 Project Record Documents

This specification provides requirements for documentation of work (records) and the method of records storage and retention during project execution. The turnover of records requirements is given.

EARTHWORK:

31 2000 Earth Moving

This specification presents general requirements for excavating and stockpiling of topsoil and soil/bedrock. The specification will also provide placement and compaction requirements for any earthen or earthenlike (crushed tuff) materials. Materials requiring special preparation, such as the rooting media and the water storage zone material, will be contained within separate subsections. Design requirements for earthen materials are presented in the Cover System Design and Requirements Document (Dwyer et al. 2007, 096232, pp. 3-5–3-8).

31 5000 Aggregates and Rock Armor

This specification provides requirements for the size and placement of rip rap and any associated bedding material in ditches, on the side slopes, and in the biotic barrier layer. Rock armoring of steeper slopes and ditches is required based on Probable Maximum Precipitation stormwater calculations and the geometry of the cover system. Aggregates are required as bedding material at the interface between the rock and the surrounding soil because of the potential for higher gradients and saturated conditions resulting in tractive forces sufficient to cause erosion of the underlying soils.

31 6100 High-Density Polyethylene Geomembrane

This specification presents product and testing requirements for the flexible membrane liner material and installation of the lateral infiltration/biotic barrier. The flexible membrane liner serves to reduce the potential for lateral migration of shallow percolating water laterally into the waste and also serves as a biotic barrier for lateral invasion of roots and animals. High-density polyethylene (HDPE) is the de facto standard liner material used in RCRA mixed waste disposal cells for liners and covers.

31 6200 Geocomposite

This specification presents product and testing requirements for the geocomposite material and installation as part of the lateral infiltration/biotic barrier. A geocomposite material is composed of a geonet and nonwoven geotextile. The composite material manufacture simplifies installation. The geocomposite material is used to cushion the geomembrane liner material, acting as a separator and protecting the liner material, and acting as bedding material between the liner and the natural material.

31 6300 Geotextiles

This specification presents product and testing requirements for the geotextile used in the geocomposite material and also used as a separator between the cobble size biotic barrier and the surrounding finer grained material, and includes installation requirements. The geotextile selected is a nonwoven material and as a separator aids in construction by preventing finer grained soils from entering the voids of the cobble size rock. Because of the limited gradient potential of the cover system, there is no need for a filter layer at the interface between the biobarrier and the surrounding soils.

EXTERIOR IMPROVEMENTS:

32 3113 Chain Link Fences and Gates

This specification describes materials and installation of chain link fences and gates.

32 9219 Seeding

This specification provides requirements for seeding materials, installation requirements, and performance requirements for acceptance of the seeding following germination.

UTILITIES:

33 8000 Abandonment of Utilities

This specification provides requirements for abandonment of the gas pipeline, waste line between DP East and building 21-257, and water lines located within the final fence line of MDA A. Note: Some of these activities may be performed outside this construction package and would be excluded from the specification.

33 9000 Neutron Access Holes

This specification describes the installation requirements for the neutron access holes. Alternatively, the Laboratory may reserve these installations in Specification 01 1116.

9.5 Design Life

The design life of the preferred corrective measure depends on the ability of the site to withstand changes resulting from natural forces. These forces include the stability of the TA-21 mesa walls and top (cliff retreat) discussed in section 2, faulting of the mesa bedrock, erosion of the mesa top from rainfall events, regional erosion causing new or further incision into the mesa top in the area of MDA A, and volcanism discussed in section 2. Root causes for potential changes to the TA-21 mesa in the area of MDA A include severe weather events, wild land fire, short-term and long-term climate change, and regional or local seismic activity. The geomorphic study performed for TA-21 addresses most of these root causes by evaluating the mesa in the context of geologic formation coupled with measurements taken relative to the current geologic setting (Reneau 1995, 050143). Based on this assessment, the site should be stable over periods in excess of 10,000 yr. The long period since the last volcanic eruption and earthquakes indicates a low potential for recurrent activity. The MDA A site should be stable for a period of time exceeding 10,000 yr.

The design life of the preferred corrective measure depends on the service life of the proposed ET cover components and their ability to withstand natural forces, including wild land fire, seismic loads, rainfall events, stormwater runoff, and biointrusion. The proposed ET cover has engineered passive features that should last for hundreds to thousands of years. Little long-term performance data are available on geosynthetic materials used in the proposed cover design; however, where used, the most durable material commonly used in the design of hazardous waste landfills has been is proposed.

The ET portion of the cover will function indefinitely as long as it is present. Vegetation, if periodically disrupted or killed, will reestablish itself and restore function. The capillary barrier design of the biotic barrier will function to limit infiltration even when vegetation is absent. Erosion from rainfall will occur over time.

Minimal erosion will occur when vegetation is present and increase during periods when vegetation is not present. The upper portion of the ET cover is thicker than necessary in order to account for erosion potential. Erosion during extreme rainfall events will not occur because of the size of the surface soils and rock used on the cover.

Surface water that might infiltrate the ground adjacent to the cover and percolate laterally toward the waste through the jointed bedrock will be prevented by the geomembrane barrier.

Biotic intrusion will be minimized by the thick cover that prevents insects and shallower burrowing animals and plant roots from penetrating into the waste. The rock biobarrier will prevent burrowing animals and shallower rooting plants from penetrating below the moisture retention zone. Biotic intrusion from areas outside the cover toward the waste will be precluded by the geomembrane barrier and the great distance between the edge of the cover and the waste units.

Because the climax species for the site is presumed to be piñon-juniper with native deep-rooting plants such as chamisa, the ET cover cannot prevent the ultimate establishment of deep-rooting vegetation that could reach the waste. Therefore perpetual maintenance is required to keep these types of vegetation from becoming established.

With proper long-term maintenance, the proposed corrective measure should last for hundreds of years.

9.6 Postclosure Maintenance Requirements

Subject matter experts will be used to establish appropriate requirements for irrigating the cover. The Laboratory has had considerable success in establishing vegetation without using irrigation by planning to take advantage of the summer monsoon season. If irrigation is needed, it will be used during the 2 yr following construction to aid in the germination and establishment of the vegetative cover. Vegetation establishment will be offset by keeping infiltration below the storage capacity of the cover. The Laboratory will implement the irrigation plan.

During the first 2 yr after construction, the Laboratory will inspect the cover monthly and after significant precipitation events to identify erosion indicators on the cover. Any eroded areas will be repaired. After the cover is established, it will be inspected annually in the fall after the monsoon season has ended, and any cover erosion will be repaired.

9.7 Long-Term Monitoring Requirements

Groundwater monitoring of the regional aquifer beneath MDA A will be consolidated with the Laboratory-wide groundwater-monitoring program. No additional groundwater-monitoring wells are proposed. The vadose zone will be monitored for 30 yr using neutron probes in the proposed boreholes shown in Figure-6.3-1. The use of neutron access holes allows the monitoring of moisture content changes below the cover system, an indicator of the cover system performance. Because contaminant transport at MDA A is driven by the moisture flux below the waste units, an increase in moisture would indicate a downward movement of contaminants. The neutron access holes will be located close to the eastern waste units where there is a higher potential for chemical wastes and uncontrolled disposal practices, and they will extend approximately 20 ft below the maximum depth of contamination (LANL 2006, 095046).

Monitoring and inspecting for erosion on the top slopes, side slopes and ditches, and surrounding land surface will be performed during the 30 yr period following installation of the new cover system. Systematic inspection and installation of monitoring devices (Dwyer 2007, 096232, p. 3-5) will allow quantitative evaluation of erosion over time. Visual inspections with photographic documentation will allow qualitative assessment of the cover surface. These assessments will be performed on an annual basis (in addition to the initial assessments described in section 9.3) during the initial 30-yr period plus following an unusual natural event such as extreme rainfall events and earthquakes.

Additional monitoring will be performed for contaminants in dust and sediment in surface water runoff.

The data will be monitored for abnormal performance of the cover. If abnormal performance is detected (this could range from unusually deep or concentrated surface erosion to significant changes in the moisture content of the vadose zone), suitable corrective measures will be planned and carried out, including all notifications to NMED.

10.0 SCHEDULE

Section XI.F.13 of the Consent Order requires that a schedule for completion of activities be submitted in the CME report that includes specific and intermediate milestones. The remedy completion report is the only specific milestone stipulated in the Consent Order.

Table 10.0-1 shows the activities leading to completion of the corrective measure, including predesign studies and planning, design, construction of the ET cover; and installation and testing of monitoring systems. In addition to these intermediate milestones, the Consent Order requires the CME report to include a proposed schedule for related activities such as bench tests, pilot tests, and other remedial actions. The schedule shown in Table 10.0-1 identifies the duration of corrective action operations, the frequency of monitoring and sampling activities, and dates for submittal of inspection and monitoring reports to NMED, including all status reports and preliminary data. Intermediate milestones directly associated with the CME process that lead to the CMI plan are presented in Table 10.0-1 along with dates proposed for meeting the milestones.

10.1 CMI Milestones

Consent Order requirements related to a corrective measure include the following:

- NMED prepares a statement of basis after a public comment period.
- A CMI plan may identify additional documents and will have an associated schedule for deliverables. The schedule for CMI-identified documents that are beyond the scope of the CME report schedule include the following:
    - construction work plan
    - maintenance and monitoring plans
    - remedy pilot tests
    - waste management plan
    - Public Involvement Plan
    - progress reports

The schedule for inspection and monitoring report submittal to NMED is based on the long-term subsurface vapor-monitoring plan and sitewide groundwater-monitoring plans for the Laboratory. Inspection and monitoring reports will be submitted annually after the remedy is complete.

11.0 REFERENCES AND MAP DATA SOURCES

11.1 References

The following list includes all documents cited in this report. Parenthetical information following each reference provides the author(s), publication date, and ER ID number. This information is also included in text citations. ER ID numbers are assigned by the Environmental Programs Directorate's Records Processing Facility (RPF) and are used to locate the document at the RPF and, where applicable, in the master reference set.

Copies of the master reference set are maintained at the NMED Hazardous Waste Bureau; DOE–Los Alamos Site Office; EPA, Region 6; and the Directorate. The set was developed to ensure that the *administrative authority has all material needed to review this document, and it is updated with every document submitted to the administrative authority. Documents previously submitted to the administrative authority are not included.*

AEA (AEA Technology Engineering Services, Inc.), January 2004. "Demonstration of a System for In-Situ Tank Waste Heel Immobilization at LANL, Final Report," report prepared for the U.S. Department of Energy under International Agreement Number DE-G101-00EW56054, Mooresville, North Carolina. (AEA 2004, 102711)

AGS (Advanced Geological Services), December 4, 2003. "Geophysical Surveys of the Paleochannel beneath MDAs T, A and V at TA-21," Advanced Geological Services, Malvern, Pennsylvania. (AGS 2003, 081176)

Bowen, B.M., May 1990. "Los Alamos Climatology," Los Alamos National Laboratory report LA-11735-MS, Los Alamos, New Mexico, pp. 89-93. (Bowen 1990, 006899)

Broxton, D.E., and P.G. Eller (Eds.), June 1995. "Earth Science Investigations for Environmental Restoration—Los Alamos National Laboratory, Technical Area 21," Los Alamos National Laboratory report LA-12934-MS, Los Alamos, New Mexico. (Broxton and Eller 1995, 058207)

Broxton, D.E., G.H. Heiken, S.J. Chipera, and F.M. Byers, Jr., June 1995. "Stratigraphy, Petrography, and Mineralogy of Bandelier Tuff and Cerro Toledo Deposits," in *Earth Science Investigation for Environmental Restoration—Los Alamos National Laboratory, Technical Area 21*, Los Alamos National Laboratory report LA-12934-MS, Los Alamos, New Mexico, pp. 33-63. (Broxton et al. 1995, 050121)

Christensen, E.L., R. Garde, and A.M. Valentine, January 1975. "Demolition of Building 12, An Old Plutonium Filter Facility," Los Alamos Scientific Laboratory report LA-5755, Los Alamos, New Mexico. (Christensen et al. 1975, 005481)

Desilets, J.L., November 9, 1972. "Materials Disposal Area 'A', DP West," Los Alamos Scientific Laboratory memorandum to C.A. Reynolds from J.L. Desilets, Los Alamos, New Mexico. (Desilets 1972, 000484)

DOE (U.S. Department of Energy), June 13, 2000. "Procedure for the Release of Residual Radioactive Material from Real Property," U.S. Department of Energy memorandum to D. Glenn, I.R. Triay, M. Zamorski, E. Sellers, D. Gurule, and D. Bergman-Tabbert from C.L. Soden, Albuquerque, New Mexico. (DOE 2000, 067489)

DOE (U.S. Department of Energy), November 26, 2003. "New Categorization of Existing Nuclear Facilities at LANL," U.S. Department of Energy memorandum to J. Holt (Associate Laboratory Director of Operations/Los Alamos National Laboratory) from C.M. Steele (Senior Authorization Basis Manager/DOE-LASO), Los Alamos, New Mexico. (DOE 2003, 087047)

DOE (U.S. Department of Energy), May 2008. "Final Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico," DOE/EIS-0380, Los Alamos, New Mexico. (DOE 2008, 102731)

Dwyer, S.F., R.E. Rager, and J. Hopkins, April 2007. “Cover System Design Guidance and Requirements Document,” Los Alamos National Laboratory document LA-UR-06-4715, Los Alamos, New Mexico. (Dwyer et al. 2007, 096232)

Dwyer, S.F., B. Reavis, and G. Newman, October 2000. “Alternative Landfill Cover Demonstration, FY2000 Annual Data Report,” report SAND2000-2427, Sandia National Laboratories, Albuquerque, New Mexico. (Dwyer et al. 2000, 069673)

EPA (U.S. Environmental Protection Agency), December 1989. “Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part A), Interim Final,” EPA/540/1-89/002, Office of Emergency and Remedial Response, Washington, D.C. (EPA 1989, 008021)

EPA (U.S. Environmental Protection Agency), July 2000. “A Guide to Developing and Documenting Cost Estimates During the Feasibility Study,” EPA 540-R-00-002, prepared by the U.S. Army Corps of Engineers and the U.S. Environmental Protection Agency Office of Emergency and Remedial Response, Washington, D.C. (EPA 2000, 071540)

EPA (U.S. Environmental Protection Agency), November 2005. “EPA Region 6 Human Health Medium-Specific Screening Levels,” U.S. EPA Region 6, Dallas, Texas. (EPA 2005, 091002)

EPA (U.S. Environmental Protection Agency), December 2007. “EPA Region 6 Human Health Medium-Specific Screening Levels,” U.S. EPA Region 6, Dallas, Texas. (EPA 2007, 099314)

ERM Program Management Company, September 1997. “1994 Site Investigation Activities at Field Unit 1, TA-21, Material Disposal Area (MDA) U PRS 21-017(a-c),” field summary report, Los Alamos, New Mexico. (ERM Program Management Company 1997, 058979)

Geophex, September 1996. “Final Report on Geophysical Investigation of Material Disposal Areas A and T (TA-21-016[a-c] and TA-21-011[c]), Los Alamos, New Mexico,” report prepared for Los Alamos National Laboratory, Los Alamos, New Mexico. (Geophex 1996, 064694)

Gerety, M., J.W. Nyhan, and R. Oliver, October 1989. “History and Geophysical Description of Hazardous Waste Disposal Area A, Technical Area 21,” Los Alamos National Laboratory report LA-11591-MS, Los Alamos, New Mexico. (Gerety et al. 1989, 006893)

Goff, F., June 1995. “Geologic Map of Technical Area 21,” in *Earth Science Investigations for Environmental Restoration—Los Alamos National Laboratory, Technical Area 21*, Los Alamos National Laboratory report LA-12934-MS, Los Alamos, New Mexico, pp. 7–18. (Goff 1995, 049682)

Holdren, K.J., T.E. Bechtold, and B.D. Preussner, May 2007. “Feasibility Study for Operable Unit 7-13/14,” report no. DOE/ID-11268, prepared for the U.S. Department of Energy Idaho Operations Office, Idaho Falls, Idaho. (Holdren et al. 2007, 098642)

Hollis, D., E. Vold, R. Shuman, K.H. Birdsell, K. Bower, W.R. Hansen, D. Krier, P.A. Longmire, B. Newman, D.B. Rogers, and E.P. Springer, March 27, 1997. "Performance Assessment and Composite Analysis for Los Alamos National Laboratory Material Disposal Area G," Rev. 2.1, Los Alamos National Laboratory document LA-UR-97-85, Los Alamos, New Mexico. (Hollis et al. 1997, 063131)

Johnson, K.M., July 1999. "Magnetic Survey of MDA A, Los Alamos National Laboratory, New Mexico," unpublished report prepared for the Summer of Applied Geological Experience (SAGE), Los Alamos, New Mexico. (Johnson 1999, 087457)

Keenan, T.K., January 9, 1976. "Radioactive Waste Management Activities for 1975," Los Alamos Scientific Laboratory memorandum (H7-SW-680) to D. Davis, Jr., (Director/Nuclear Materials and Waste Management Division/Albuquerque Operations Office/Energy Research and Development Administration) from T.K. Keenan (H-7/Group Leader), Los Alamos, New Mexico. (Keenan 1976, 000507)

LANL (Los Alamos National Laboratory), January 28, 1994. "Phase Report 1B, TA-21 Operable Unit RCRA Facility Investigation, Operable Unit-Wide Surface Soil, Deposition Layer and Filter Building Investigation," Los Alamos National Laboratory document LA-UR-93-4390, Los Alamos, New Mexico. (LANL 1994, 026073)

LANL (Los Alamos National Laboratory), January 1995. "Phase Report Addendum 1B and 1C Operable Unit 1106 RCRA Facility Investigation," Los Alamos National Laboratory document LA-UR-94-4360, Los Alamos, New Mexico. (LANL 1995, 052350)

LANL (Los Alamos National Laboratory), May 22, 1998. "Hydrogeologic Workplan," Los Alamos National Laboratory document LA-UR-01-6511, Los Alamos, New Mexico. (LANL 1998, 059599)

LANL (Los Alamos National Laboratory), September 22, 1998. "Inorganic and Radionuclide Background Data for Soils, Canyon Sediments, and Bandelier Tuff at Los Alamos National Laboratory," Los Alamos National Laboratory document LA-UR-98-4847, Los Alamos, New Mexico. (LANL 1998, 059730)

LANL (Los Alamos National Laboratory), November 1998. "Installation Work Plan for Environmental Restoration Program," Rev. 7, Los Alamos National Laboratory document LA-UR-98-4652, Los Alamos, New Mexico. (LANL 1998, 062060)

LANL (Los Alamos National Laboratory), July 17, 2001. "Surface Water Site Assessment for PRS 21-014," Los Alamos National Laboratory, Los Alamos, New Mexico. (LANL 2001, 087375)

LANL (Los Alamos National Laboratory), September 2003. "IM Completion Report for the NTISV Hot Demonstration at SWMU 21-018(a)-99," Los Alamos National Laboratory document LA-UR-03-6494, Los Alamos, New Mexico. (LANL 2003, 080923)

LANL (Los Alamos National Laboratory), November 1, 2004. "Documented Safety Analysis for the Surveillance and Maintenance of Nuclear Environmental Sites at Los Alamos National Laboratory," Los Alamos National Laboratory document LA-UR-04-7505, Los Alamos, New Mexico. (LANL 2004, 088713.2)

LANL (Los Alamos National Laboratory), September 2004. "Ecorisk Database (Release 2.1)," on CD, LA-UR-04-7304, Los Alamos National Laboratory, Los Alamos, New Mexico. (LANL 2004, 087386)

LANL (Los Alamos National Laboratory), February 2004. "Investigation Work Plan for Material Disposal Area T at Technical Area 21, Solid Waste Management Unit 21-016(a)-99," Los Alamos National Laboratory document LA-UR-04-0559, Los Alamos, New Mexico. (LANL 2004, 085641)

LANL (Los Alamos National Laboratory), June 2004. "Investigation Work Plan for Consolidated Unit 21-018(a)-99, Material Disposal Area V, at Technical Area 21," Los Alamos National Laboratory document LA-UR-04-3699, Los Alamos, New Mexico. (LANL 2004, 087358)

LANL (Los Alamos National Laboratory), November 2004. "Investigation Work Plan for Material Disposal Area L, Solid Waste Management Unit 54-006 at Technical Area 54, Revision 2," Los Alamos National Laboratory document LA-UR-04-8245, Los Alamos, New Mexico. (LANL 2004, 087624)

LANL (Los Alamos National Laboratory), December 2004. "Screening-Level Ecological Risk Assessment Methods, Revision 2," Los Alamos National Laboratory document LA-UR-04-8246, Los Alamos, New Mexico. (LANL 2004, 087630)

LANL (Los Alamos National Laboratory), January 2005. "Historical Investigation Report for Material Disposal Area A at Technical Area 21, Solid Waste Management Unit 21-014," Los Alamos National Laboratory document LA-UR-05-0095, Los Alamos, New Mexico. (LANL 2005, 088052.5)

LANL (Los Alamos National Laboratory), January 2005. "Investigation Work Plan for Material Disposal Area A at Technical Area 21, Solid Waste Management Unit 21-014," Los Alamos National Laboratory document LA-UR-05-0094, Los Alamos, New Mexico. (LANL 2005, 088052.113)

LANL (Los Alamos National Laboratory), May 2005. "Derivation and Use of Radionuclide Screening Action Levels, Revision 1," Los Alamos National Laboratory document LA-UR-05-1849, Los Alamos, New Mexico. (LANL 2005, 088493)

LANL (Los Alamos National Laboratory), June 2005. "Response to the Notice of Disapproval for the Investigation Work Plan for Material Disposal Area A at Technical Area 21," Los Alamos National Laboratory document LA-UR-05-4762, Los Alamos, New Mexico. (LANL 2005, 089415)

LANL (Los Alamos National Laboratory), September 2005. "Investigation Report for Material Disposal Area G, Consolidated Unit 54-013(b)-99, at Technical Area 54," Los Alamos National Laboratory document LA-UR-05-6398, Los Alamos, New Mexico. (LANL 2005, 090513)

LANL (Los Alamos National Laboratory), September 2005. "Ecorisk Database (Release 2.2)," on CD, LA-UR-05-7424, Los Alamos National Laboratory, Los Alamos, New Mexico. (LANL 2005, 090032)

LANL (Los Alamos National Laboratory), February 2006. "Investigation Report for Material Disposal Area U, Consolidated Unit 21-017(a)-99, at Technical Area 21," Los Alamos National Laboratory document LA-UR-05-9564, Los Alamos, New Mexico. (LANL 2006, 092589)

LANL (Los Alamos National Laboratory), October 2006. “Investigation/Remediation Work Plan for Material Disposal Area B, Solid Waste Management Unit 21-015, at Technical Area 21, Revision 1,” Los Alamos National Laboratory document LA-UR-06-6918, Los Alamos, New Mexico. (LANL 2006, 095499)

LANL (Los Alamos National Laboratory), October 2006. “Supplemental Investigation Work Plan for Sampling at Material Disposal Area L, Solid Waste Management Unit 54-006,” Los Alamos National Laboratory document LA-UR-06-7348, Los Alamos, New Mexico. (LANL 2006, 094673)

LANL (Los Alamos National Laboratory), November 2006. “Investigation Report for Material Disposal Area A, Solid Waste Management Unit 21-014, at Technical Area 21,” Los Alamos National Laboratory document LA-UR-06-7902, Los Alamos, New Mexico. (LANL 2006, 095046)

LANL (Los Alamos National Laboratory), March 16, 2007. “Response to the 'Approval with Modifications for the Investigation Report for Material Disposal Area A at Technical Area 21, Solid Waste Management Unit 21-014',” Los Alamos National Laboratory document LA-UR-07-0137, Los Alamos, New Mexico. (LANL 2007, 098321)

LANL (Los Alamos National Laboratory), May 2007. “2007 Interim Facility-Wide Groundwater Monitoring Plan,” Los Alamos National Laboratory document LA-UR-07-3271, Los Alamos, New Mexico. (LANL 2007, 096665)

LANL (Los Alamos National Laboratory), May 2007. “Addendum to the Investigation Report for Material Disposal Area L, Solid Waste Management Unit 54-006, at Technical Area 54,” Los Alamos National Laboratory document LA-UR-07-3214, Los Alamos, New Mexico. (LANL 2007, 096409)

LANL (Los Alamos National Laboratory), October 2007. “Technical Area 54 Well Evaluation and Network Recommendations, Revision 1,” Los Alamos National Laboratory document LA-UR-07-6436, Los Alamos, New Mexico. (LANL 2007, 098548)

LANL (Los Alamos National Laboratory), December 2007. “Los Alamos and Pueblo Canyons Groundwater Monitoring Well Network Evaluation and Recommendations,” Los Alamos National Laboratory document LA-UR-07-8114, Los Alamos, New Mexico. (LANL 2007, 099936)

LANL (Los Alamos National Laboratory), December 2007. “Status Report for Supplemental Sampling at Material Disposal Area A, Technical Area 21,” Los Alamos National Laboratory document LA-UR-07-8107, Los Alamos, New Mexico. (LANL 2007, 100482)

Martin, B., and D. Hickmott, December 6, 1993. “Early S-Site History. L. Norman Interview,” Los Alamos National Laboratory memorandum (CST-ER/BM-93-061) to OU 1082 Files from B. Martin (CLS-6), and D. Hickmott (EES-1), Los Alamos, New Mexico. (Martin and Hickmott 1993, 059422)

Martin, M., July 1999. “A Qualitative Integration of Geophysical Methods,” unpublished report for the Summer of Applied Geological Experience (SAGE), Los Alamos, New Mexico. (Martin 1999, 087458)

Merrill, E.S., March 1990. “A History of Waste Disposal at Technical Area 21: 1943-1978,” Los Alamos National Laboratory, Los Alamos, New Mexico. (Merrill 1990, 011721)

Meyer, D., January 4, 1971. “Volume of Transuranium Wastes Buried at Los Alamos,” Los Alamos Scientific Laboratory memorandum to C.W. Christenson (H-7 Group Leader) from D. Meyer (H-1 Group Leader), Los Alamos, New Mexico. (Meyer 1971, 000517)

Meyer, D.D., January 31, 1952. “Location of Contaminated Waste Burial Pits (Area A, B, and C),” Los Alamos Scientific Laboratory memorandum to S.E. Russo (ENG-4) from D.D. Meyer (H-1), Los Alamos, New Mexico. (Meyer 1952, 028154)

MOTA Corporation, August 29, 2007. “Value Study, Final Report, TA-21 Material Disposal Area Capping Concepts and Strategies,” report prepared for Los Alamos National Laboratory, Los Alamos, New Mexico. (Mota Corporation 2007, 102709)

NMED (New Mexico Environment Department), June 2006. “Technical Background Document for Development of Soil Screening Levels, Revision 4.0, Volume 1, Tier 1: Soil Screening Guidance Technical Background Document,” New Mexico Environment Department, Hazardous Waste Bureau and Ground Water Quality Bureau Voluntary Remediation Program, Santa Fe, New Mexico. (NMED 2006, 092513)

NMED (New Mexico Environment Department), February 12, 2007. “Approval with Modifications, Investigation Report for Material Disposal Area A at Technical Area 21, Solid Waste Management Unit 21-014,” New Mexico Environment Department letter to D. Gregory (DOE LASO) and D. McInroy (LANL) from J.P. Bearzi (NMED HWB), Santa Fe, New Mexico. (NMED 2007, 095047)

NMED (New Mexico Environment Department), April 5, 2007. “Well Evaluations for Intermediate and Regional Wells,” New Mexico Environment Department letter to D. Gregory (DOE LASO) and D. McInroy (LANL) from J.P. Bearzi (NMED-HWB), Santa Fe, New Mexico. (NMED 2007, 095394)

NMED (New Mexico Environment Department), May 29, 2007. “Comments on the Response to the Approval with Modifications, Investigation Report for Material Disposal Area A at Technical Area 21, Solid Waste Management Unit 21-014,” New Mexico Environment Department letter to D. Gregory (DOE LASO) and D. McInroy (LANL) from J.P. Bearzi (NMED HWB), Santa Fe, New Mexico. (NMED 2007, 098322)

Nyhan, J.W., L.W. Hacker, T.E. Calhoun, and D.L. Young, June 1978. “Soil Survey of Los Alamos County, New Mexico,” Los Alamos Scientific Laboratory report LA-6779-MS, Los Alamos, New Mexico. (Nyhan et al. 1978, 005702)

Nyhan, J.W., J.A. Salazar, D.D. Breshears, and F.J. Barnes, June 1998. “A Water Balance Study of Four Landfill Cover Designs at Material Disposal Area B in Los Alamos, New Mexico,” Los Alamos National Laboratory report LA-13457-MS, Los Alamos, New Mexico. (Nyhan et al. 1998, 071345)

Office of Management and Budget, October 29, 1992. “Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs,” Circular No. A-94, Washington, D.C. (Office of Management and Budget 1992, 094804)

Olig, S.S., K.I. Kelson, J.N. Gardner, S.L. Reneau, and M. Hemphill-Haley, 1996. “The Earthquake Potential of the Pajarito Fault System, New Mexico,” New Mexico Geological Society Guidebook: 47th Field Conference, Jemez Mountains Region, New Mexico, pp. 143-152. (Olig et al. 1996, 057574)

Purtymun, W.D., June 30, 1969. “Materials Waste Pit, Area 'A', TA-21–Excavated April 1969,” United States Geological Survey (USGS) letter to W.R. Kennedy (H-6 Group Leader) from W.E. Hale (District Chief/USGS), prepared by W.D. Purtymun, Los Alamos, New Mexico. (Purtymun 1969, 000519)

Quesada, M., July 1999. “Seismic Refraction Data at the Los Alamos National Laboratory in the Vicinity of TA-21,” unpublished report prepared for the Summer of Applied Geological Experience (SAGE), Los Alamos, New Mexico. (Quesada 1999, 087456)

Reneau, S.L., June 1995. “Geomorphic Studies at DP Mesa and Vicinity,” in *Earth Science Investigation for Environmental Restoration—Los Alamos National Laboratory, Technical Area 21*, Los Alamos National Laboratory report LA-12934-MS, Los Alamos, New Mexico, pp. 65-92. (Reneau 1995, 050143)

Reneau, S.L., J.N. Gardner, and S.L. Forman, January 1996. “New Evidence for the Age of the Youngest Eruptions in the Valles Caldera, New Mexico,” *Geology,* Vol. 24, No. 1, pp. 7-10. (Reneau et al. 1996, 057002)

Rogers, M.A., June 1977. “History and Environmental Setting of LASL Near-Surface Land Disposal Facilities for Radioactive Wastes (Areas A, B, C, D, E, F, G, and T),” Vol. I, Los Alamos Scientific Laboratory report LA-6848-MS, Los Alamos, New Mexico. (Rogers 1977, 005707)

Schultz, L.I., and S.F. Weber, March 2003. “Guide to Computing and Reporting the Life-Cycle Cost of Environmental Management Projects,” National Institute of Standards and Technology report no. NISTIR 6968, Gaithersburg, Maryland. (Schultz and Weber 2003, 094782)

Shaw Environmental Inc., February 2006. “Geotechnical and Hydraulic Characterization at the Technical Area 61 Borrow Area,” report prepared for Los Alamos National Laboratory, Albuquerque, New Mexico. (Shaw Environmental, Inc. 2006, 091368)

Soll, W., and K. Birdsell, February 1998. “The Influence of Coatings and Fills on Flow in Fractured, Unsaturated Tuff Porous Media Systems,” *Water Resources Research,* Vol. 34, No. 2, pp. 193-202. (Soll and Birdsell 1998, 070011)

Stauffer, P.H., October 2003. “Summary of TA53 Borehole Tritium Analysis,” Los Alamos National Laboratory document LA-UR-07-5084, Los Alamos, New Mexico. (Stauffer 2003, 080930)

Stauffer, P.H., K.H. Birdsell, M.S. Witkowski, and J.K. Hopkins, 2005. “Vadose Zone Transport of 1,1,1-Trichloroethane: Conceptual Model Validation through Numerical Simulation,” *Vadose Zone Journal,* Vol. 4, pp. 760-773. (Stauffer et al. 2005, 090537)

Vold, E., July 16, 1996. “Errata #1 to 'LA-UR-96-973, An Analysis of Vapor Phase Transport in the Unsaturated Zone with Application to a Mesa Top Disposal Facility, Part I, draft 1, March 14, 1996' and to 'LA-UR-96-1848, Draft I - 052296, Determination of an In-Situ Vadose Zone Vapor Phase Diffusion Coefficient at a Mesa Top Waste Disposal Facility',” Los Alamos National Laboratory document, Los Alamos, New Mexico. (Vold 1996, 070155)

Wohletz, K.H., September 1995. “Fracture Characterization of the DP Tank Farm,” Draft, Los Alamos National Laboratory, Los Alamos, New Mexico. (Wohletz 1995, 058845)

Wong, I., K. Kelson, S. Olig, T. Kolbe, M. Hemphill-Haley, J. Bott, R. Green, H. Kanakari, J. Sawyer, W. Silva, C. Stark, C. Haraden, C. Fenton, J. Unruh, J. Gardner, S. Reneau, and L. House, February 25, 1995. “Seismic Hazards Evaluation of the Los Alamos National Laboratory,” Final Report, Vol. 1, Woodward Clyde Federal Services, Oakland, California. (Wong et al. 1995, 070097)

11.2 Map Data Sources

Average Water Table Elevation. Feature Class “wcontour_10ft,” Water Table Model 1; Velimir (Monty) Vesselinov, LANL EES-6, January 2008.

Fences. Security and Industrial Fences and Gates Feature Class; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 04 March 2008.

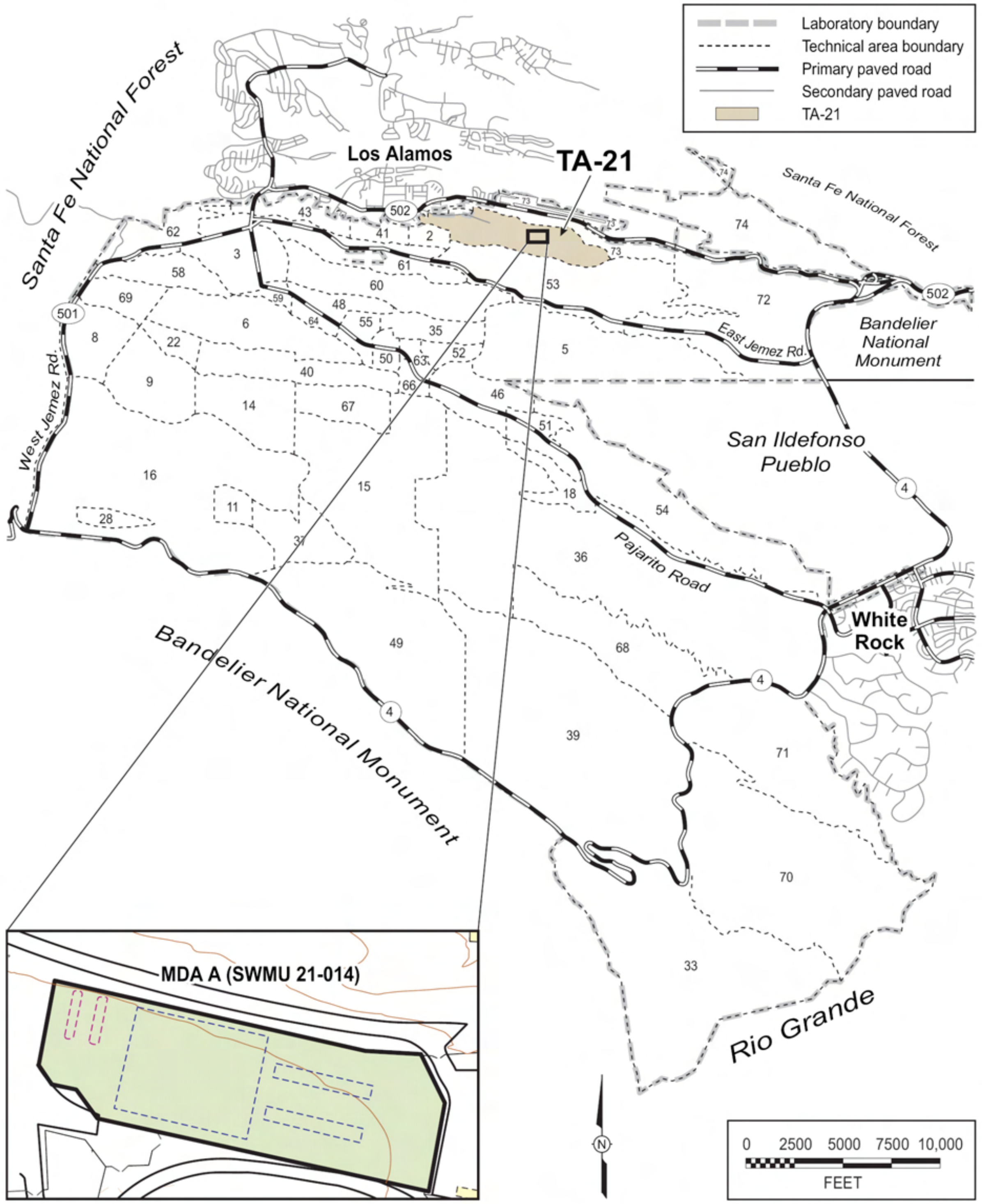
General’s Tanks, Concrete Slab and Vertical Shafts MDA A. “Investigation Report for Material Disposal Area A (MDA A), Solid Waste management unit 21-014 (SWMU) at Technical Area 21 (TA-21),” LANL Report LA-UR-06-7902, ERID-095046, EP2006-0835, November 2007. Waste Storage Features Feature Class, EP2007-0032, April 2007.

Hypsography. [1] “Bare Earth Digital Elevation Model (DEM), 1 Foot Resolution,’ LANL Manuscript LA-13892-MS, 2001. DEM tiles 772630, 772633, 774630 and 774633. [2] Hypsography Feature Classes, LANL Environmental Remediation and Surveillance Program; 1991.

Roads. [1] Paved Road Arcs Feature Class; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 04 March 2008. [2] Paved Parking Feature Class; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 12 August 2002; as published 04 March 2008. [3] Dirt Road Arcs Feature Class; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 04 March 2008.

Structures. [1] Structures Feature Class; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 04 March 2008. [2] Structures Feature Class; County of Los Alamos, Information Services; as published 29 October 2007.

Waste Disposal Units MDA A. [1] "Materials Disposal Areas Area A, DP Site, TA-21," LASL Drawing ENG-R-4457, Rev. 1, 24 March 1976. [2] “Geophysical Investigation of Material Disposal Area A,” ARM Group Inc., ARM Project No. 06195, prepared for Professional Project Services Inc., 2006.



FIMAD, G104997 8/9/96
Rev. for F1, MDA A IWP, 071504, ptm

Figure 1.0-1 Location of TA-21 and MDA A with respect to Laboratory technical areas

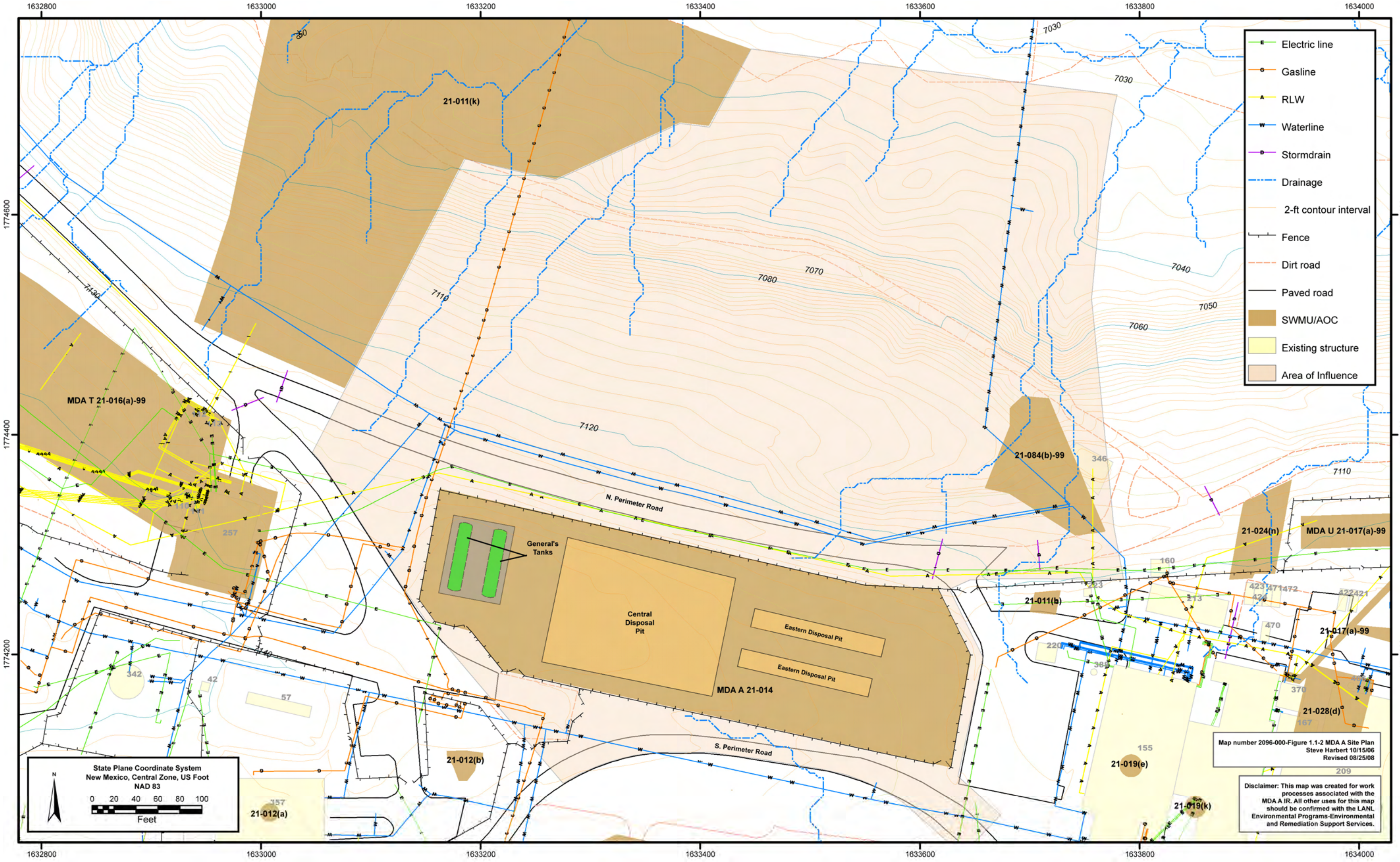
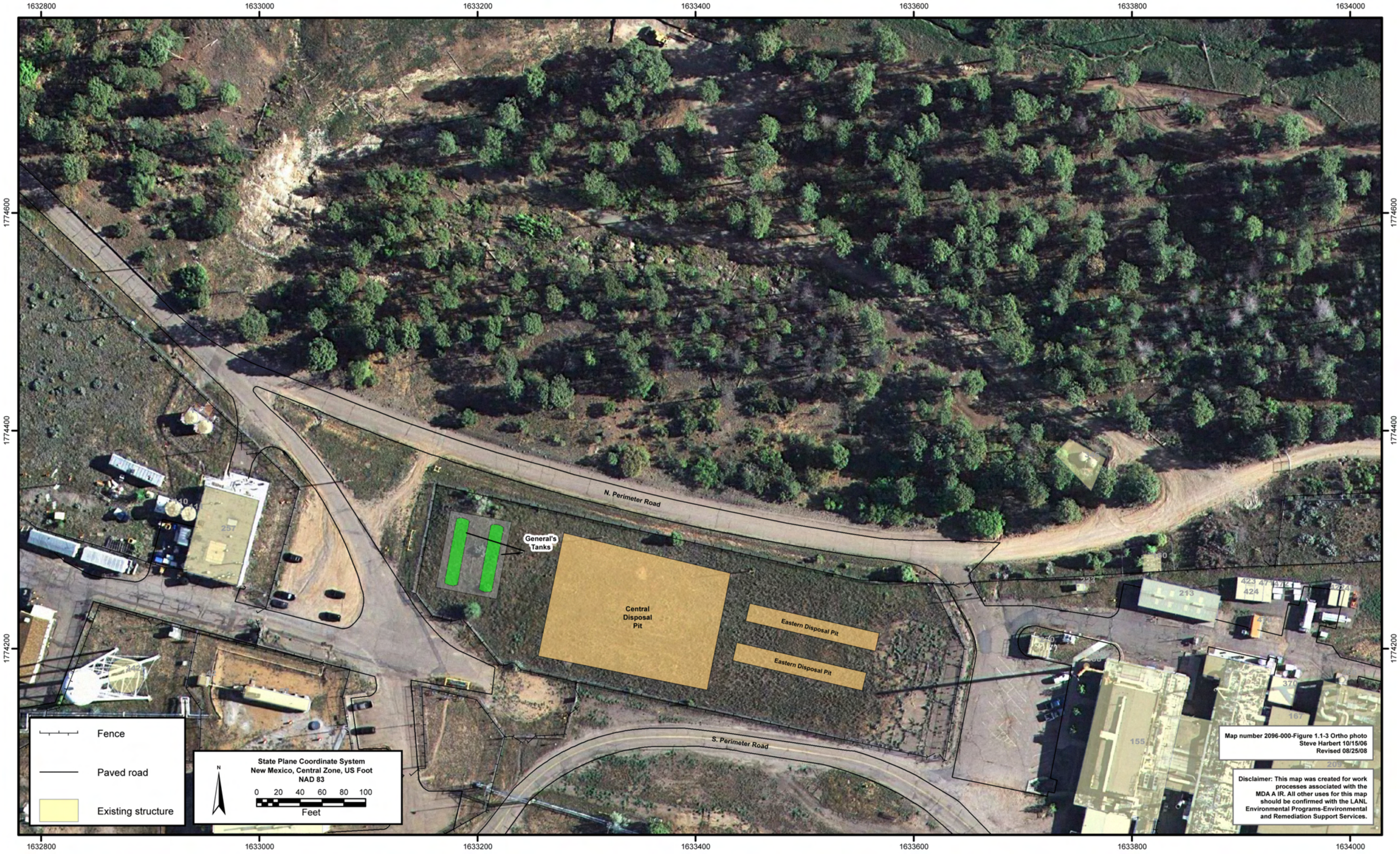


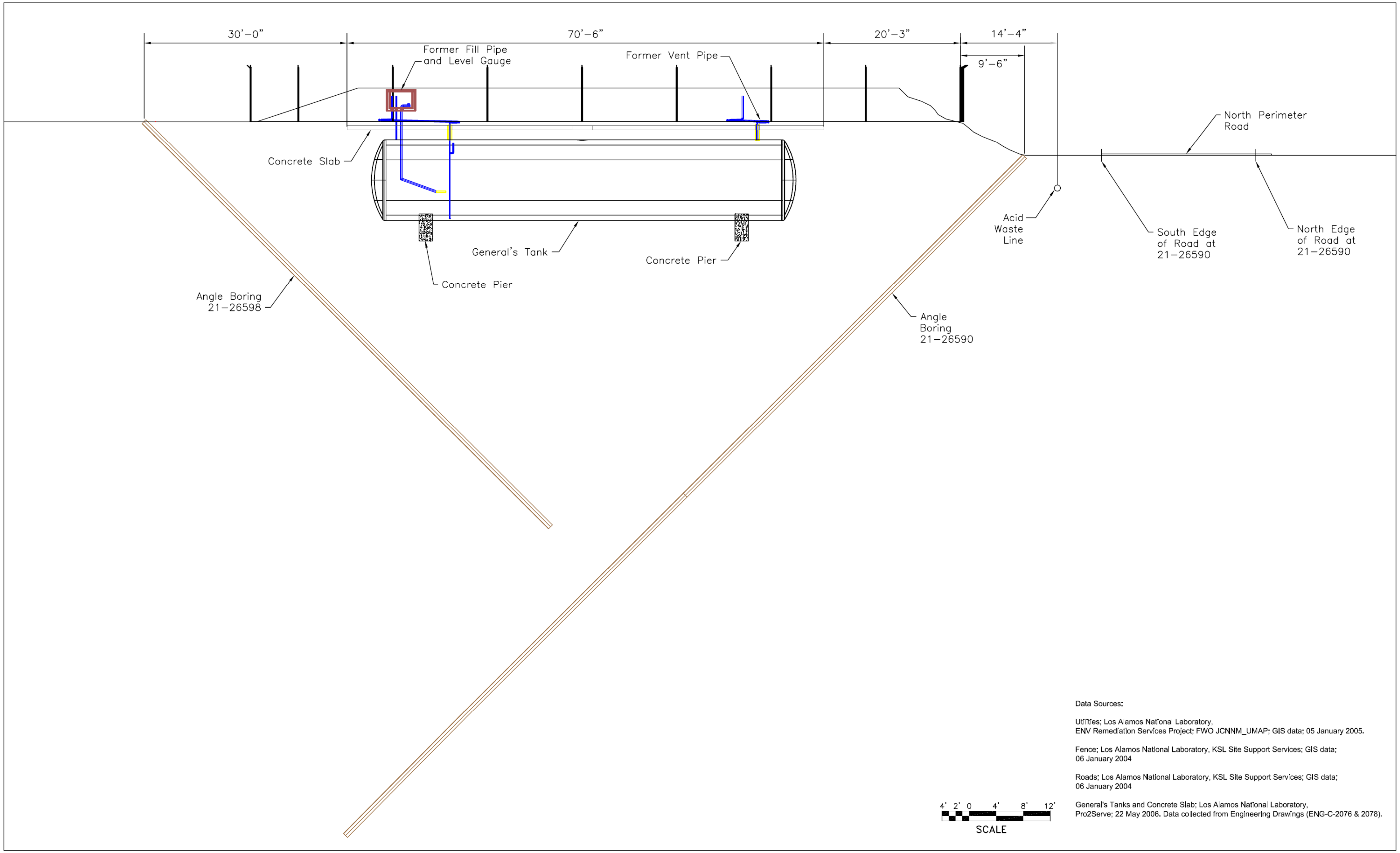
Figure 1.0-2 MDA A site plan



Map number 2096-000-Figure 1.1-3 Ortho photo
Steve Harbert 10/15/06
Revised 08/25/08

Disclaimer: This map was created for work processes associated with the MDA A IR. All other uses for this map should be confirmed with the LANL Environmental Programs-Environmental and Remediation Support Services.

Figure 1.0-3 MDA A site plan (orthophotograph)



Data Sources:

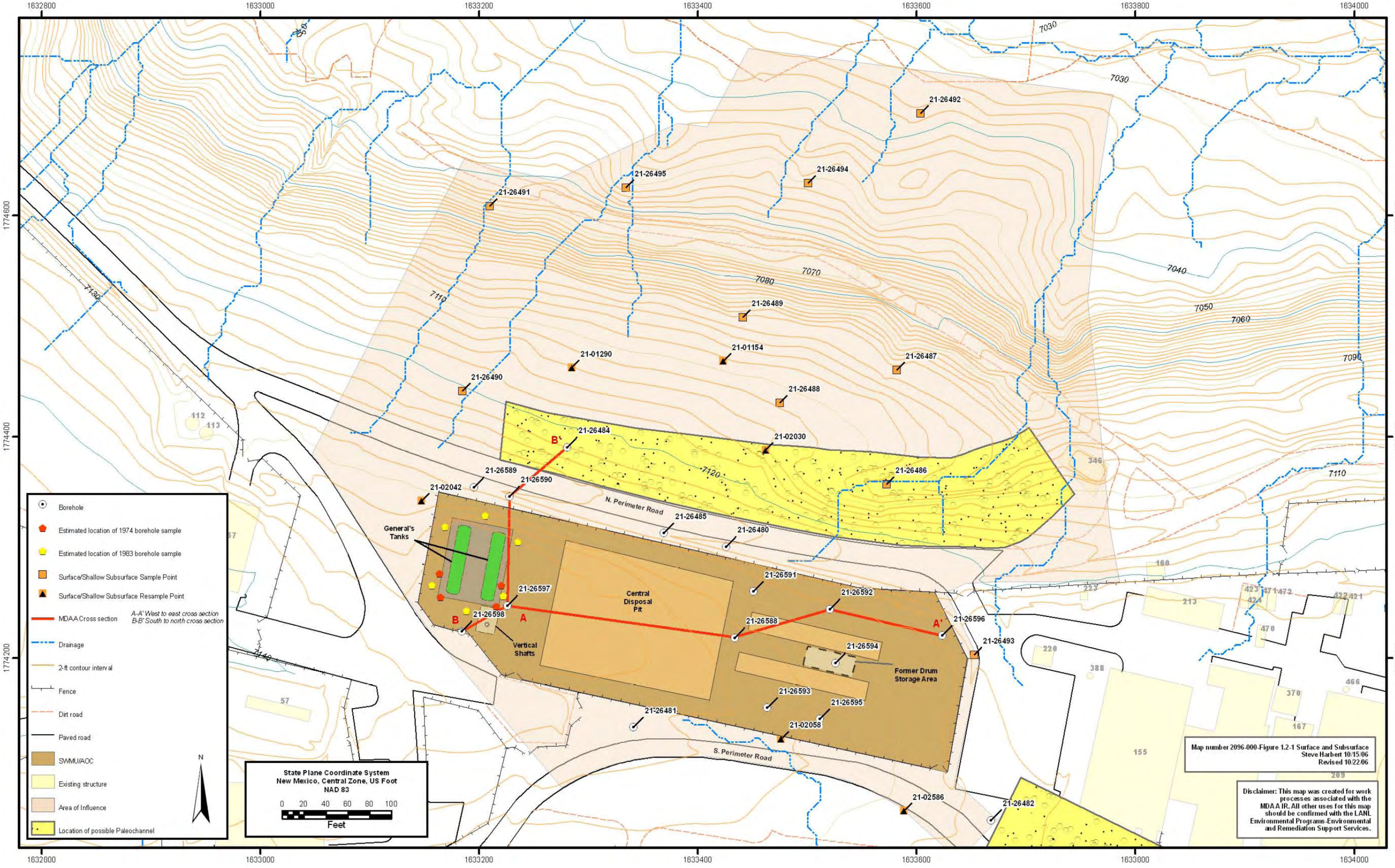
Utilities; Los Alamos National Laboratory,
ENV Remediation Services Project; FWO JCNNM_UMAP; GIS data; 05 January 2005.

Fence; Los Alamos National Laboratory, KSL Site Support Services; GIS data;
06 January 2004

Roads; Los Alamos National Laboratory, KSL Site Support Services; GIS data;
06 January 2004

General's Tanks and Concrete Slab; Los Alamos National Laboratory,
Pro2Serve; 22 May 2006. Data collected from Engineering Drawings (ENG-C-2076 & 2078).

Figure 2.1-1 Section view of General's Tanks at MDA A



Map number 2096-000-Figure 1.2-1 Surface and Subsurface
Steve Harbert 10/15/06
Revised 10/22/06

Disclaimer: This map was created for work processes associated with the MDA A IR. All other uses for this map should be confirmed with the LANL Environmental Programs-Environmental and Remediation Support Services.

Figure 2.3-1 **Surface and subsurface sampling locations for soil at MDA A**

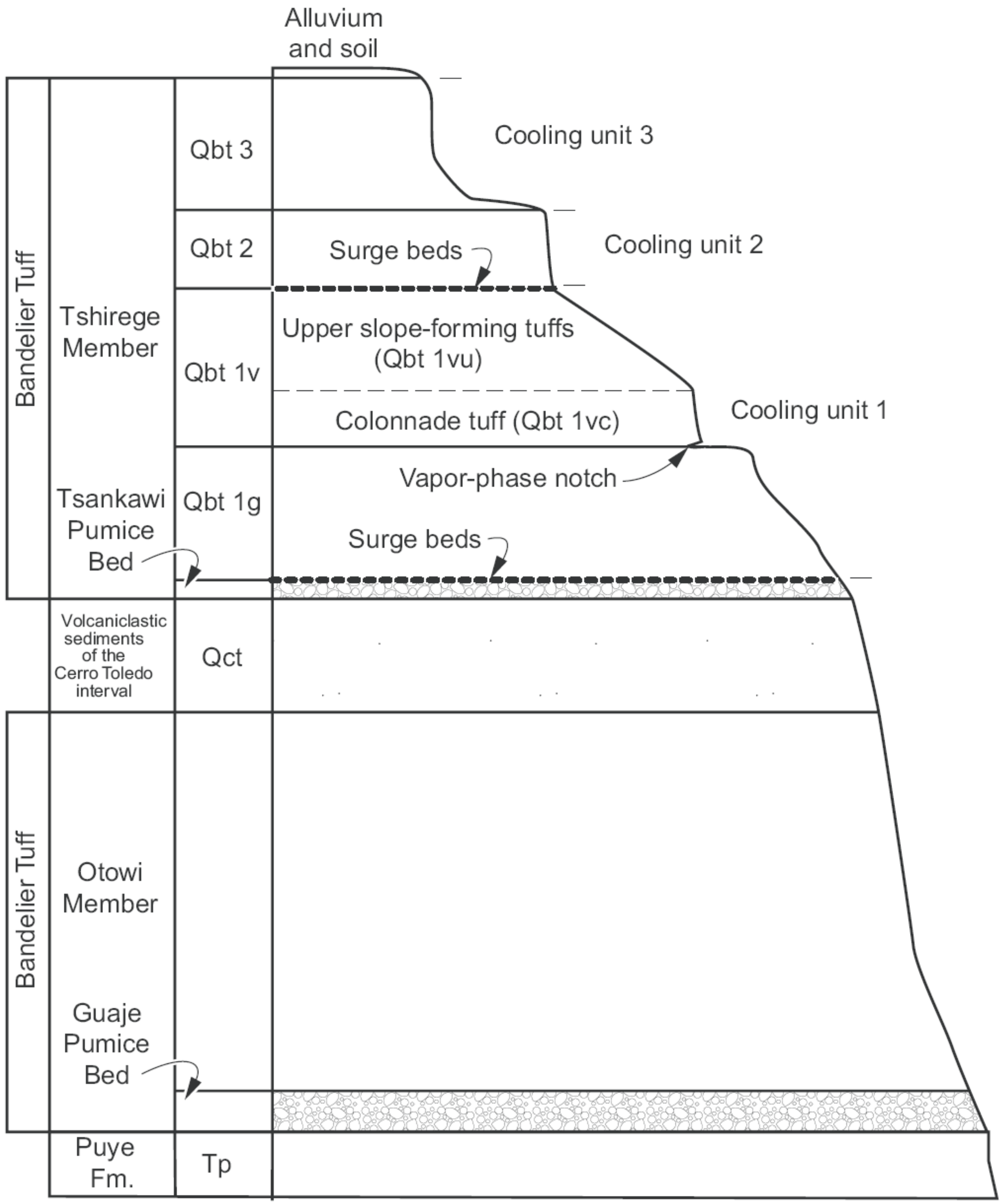


Figure 3.4-1 Generalized stratigraphy of TA-21

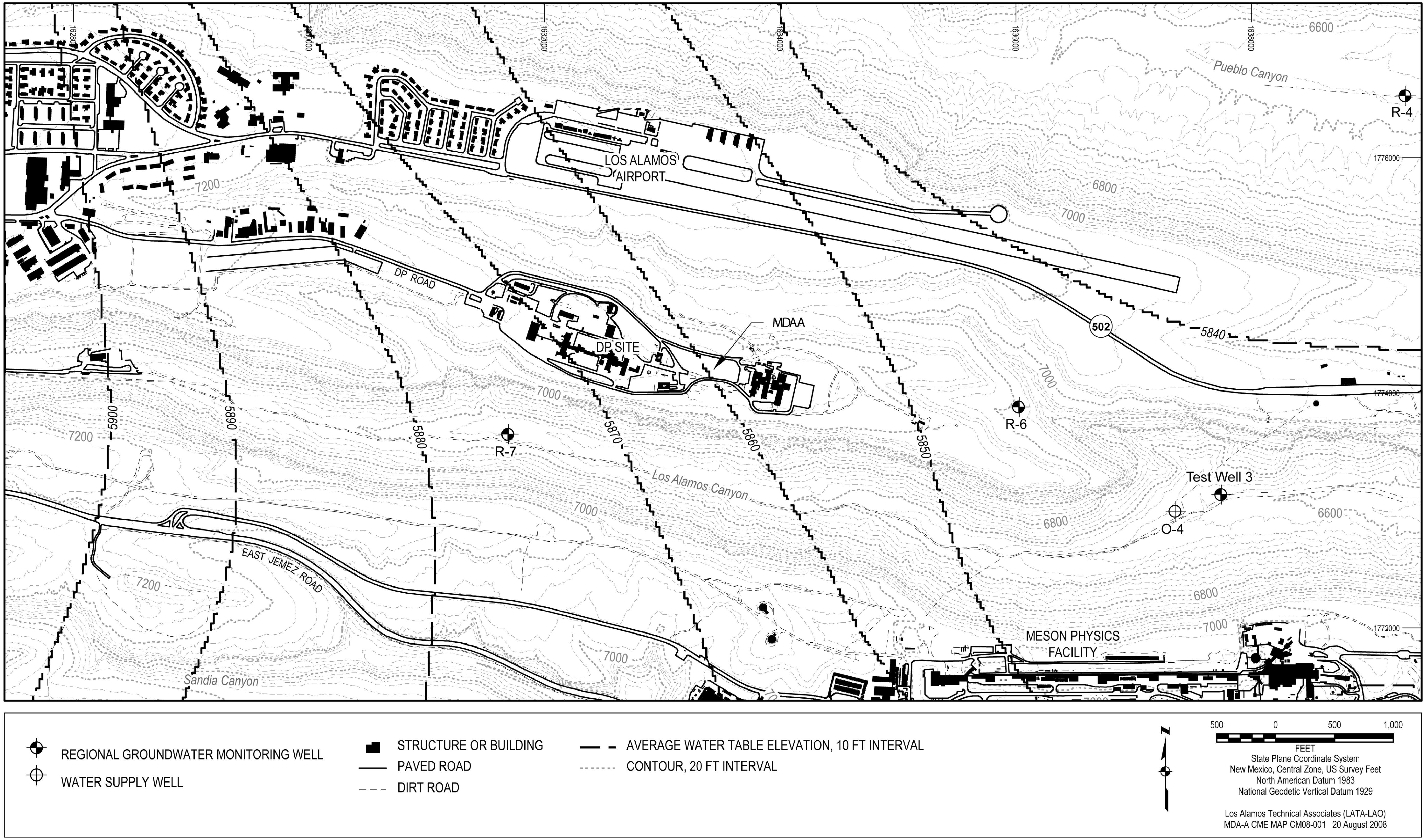
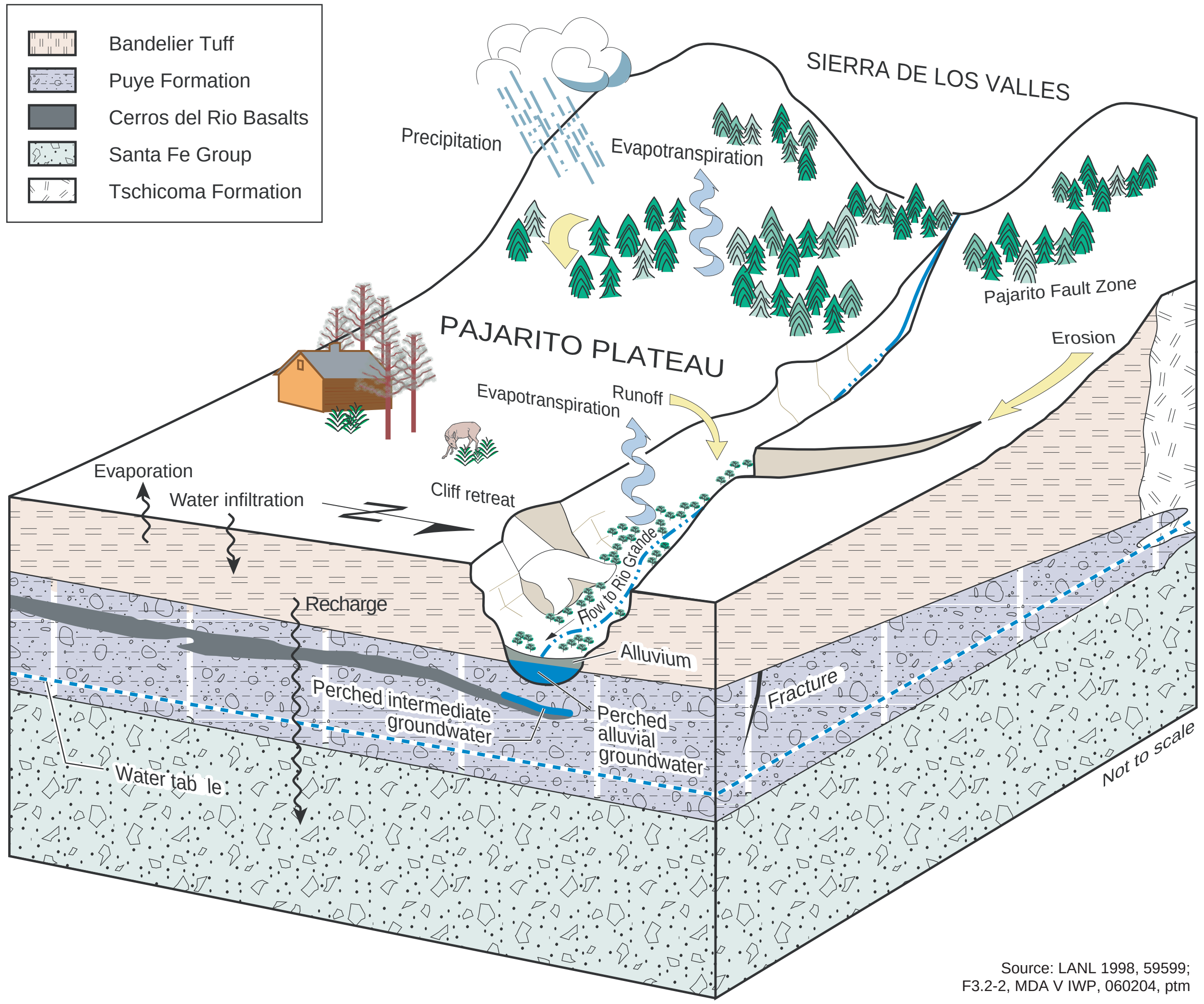


Figure 3.4-2 Locations of existing water-supply and regional wells and proposed locations for new wells and water-table contours



Source: LANL 1998, 59599;
F3.2-2, MDA V IWP, 060204, ptm

Figure 4.3-1 Conceptual site model

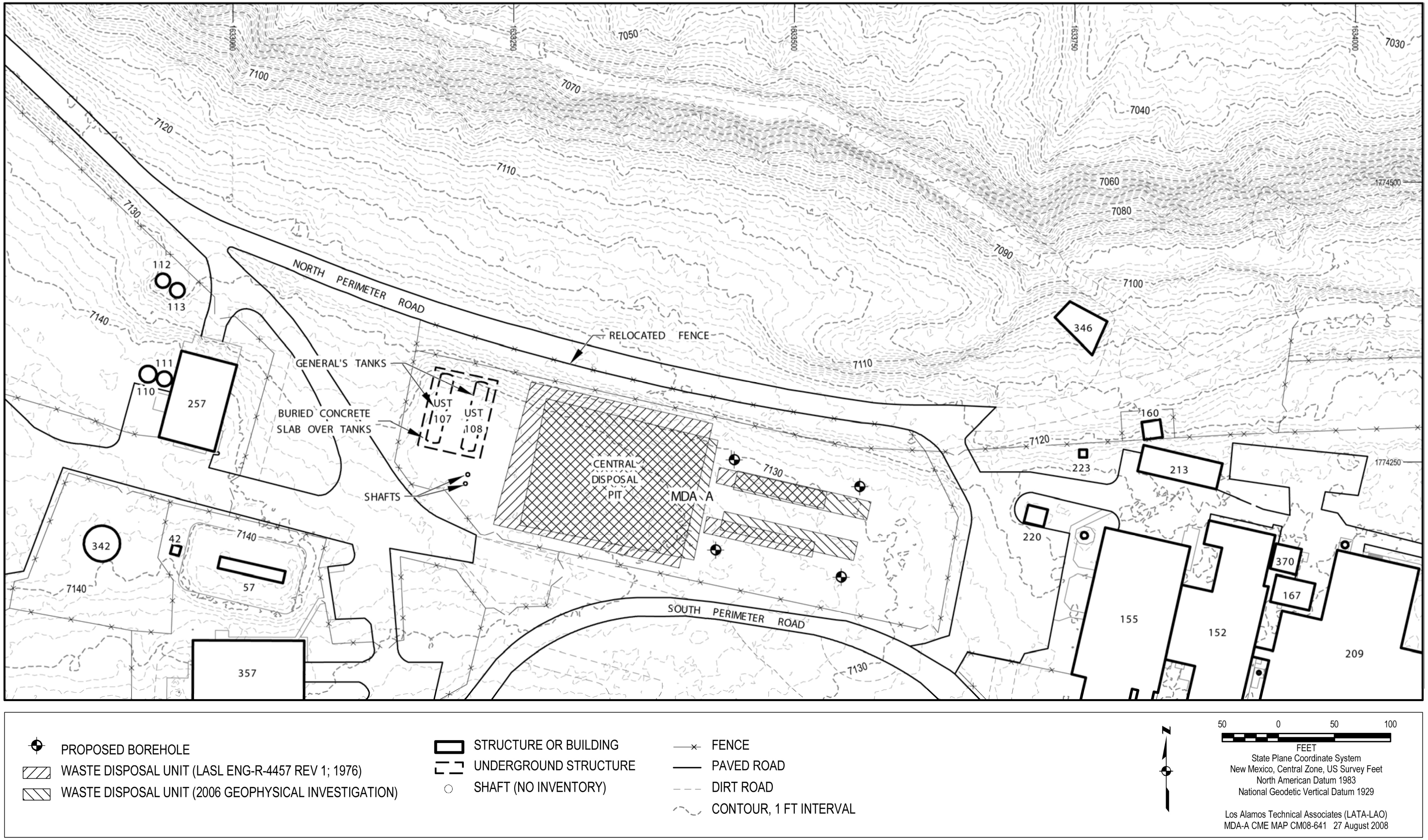


Figure 6.3-1 Alternative 1, no action with monitoring and maintenance plan

Figure 6.3-2 Alternative 2, ET cover with monitoring and maintenance plan

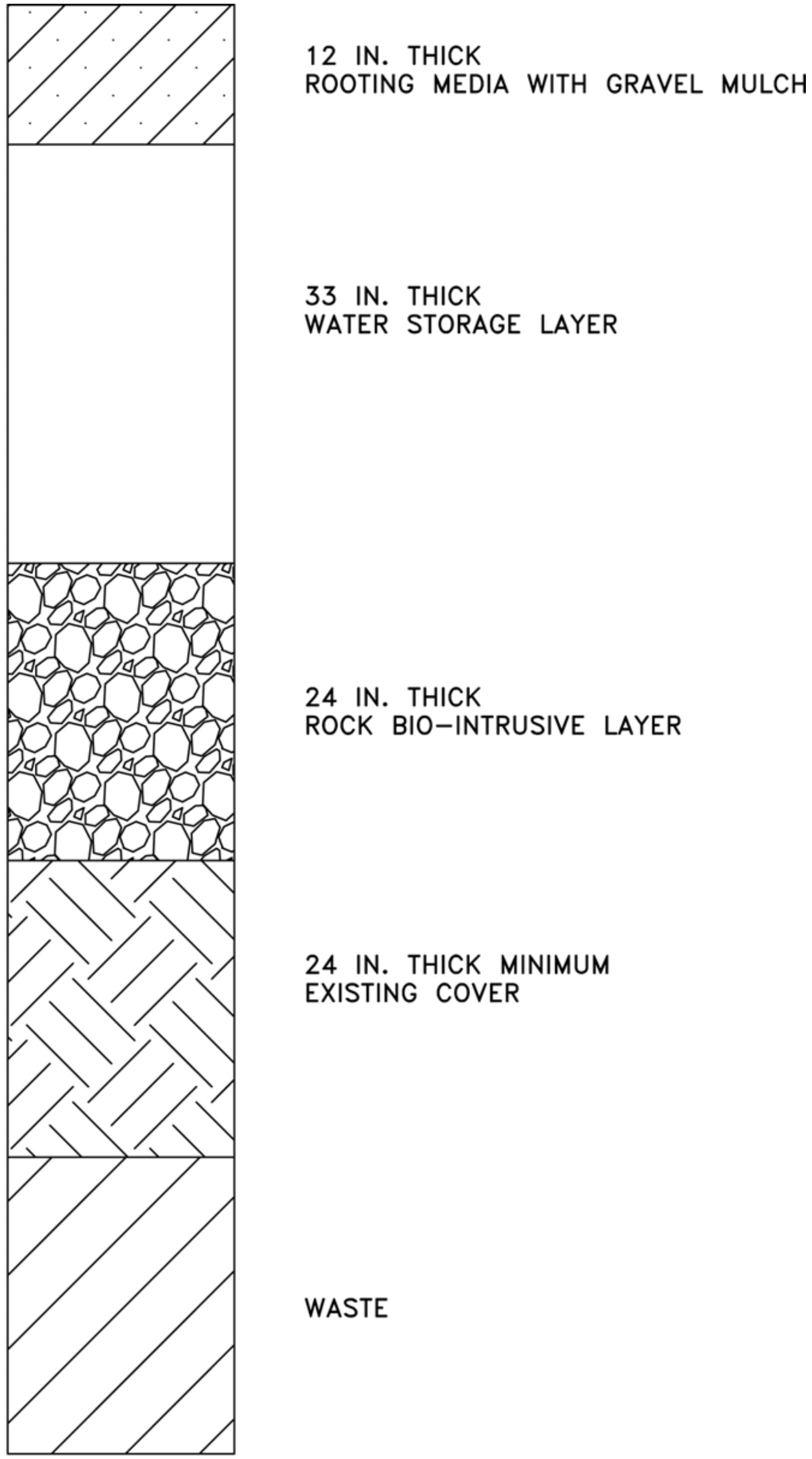


Figure 6.3-3 Alternative 2, ET cover detail

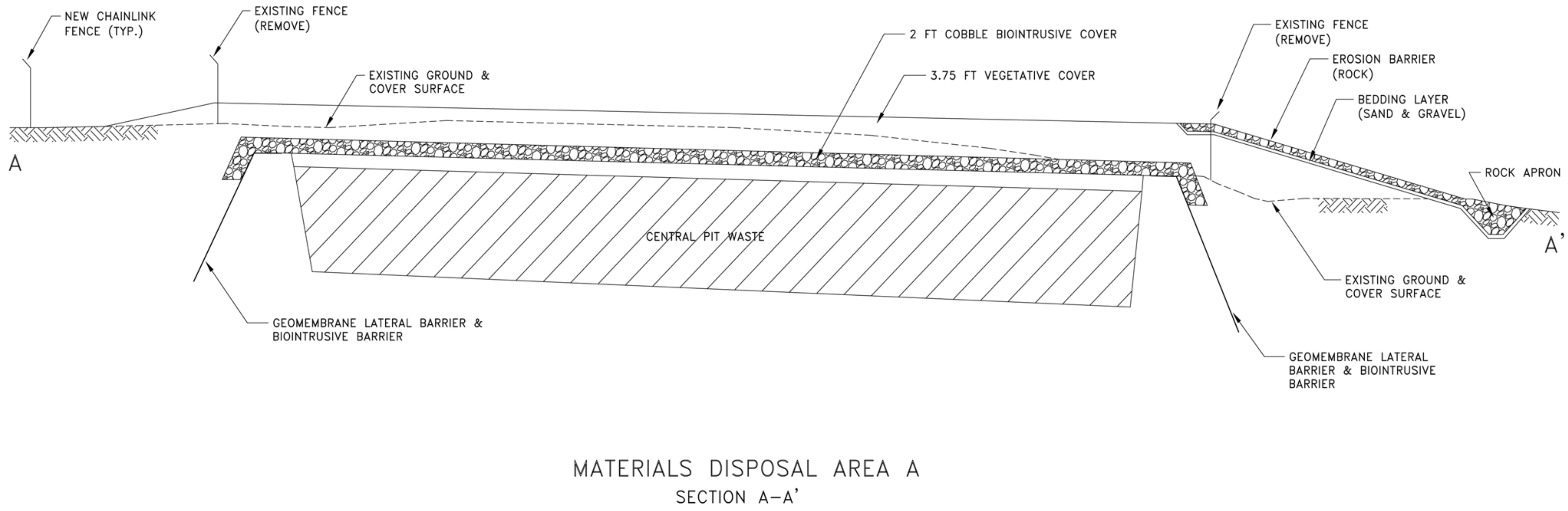


Figure 6.3-4 Alternative 2, cross section of MDA A with ET cover

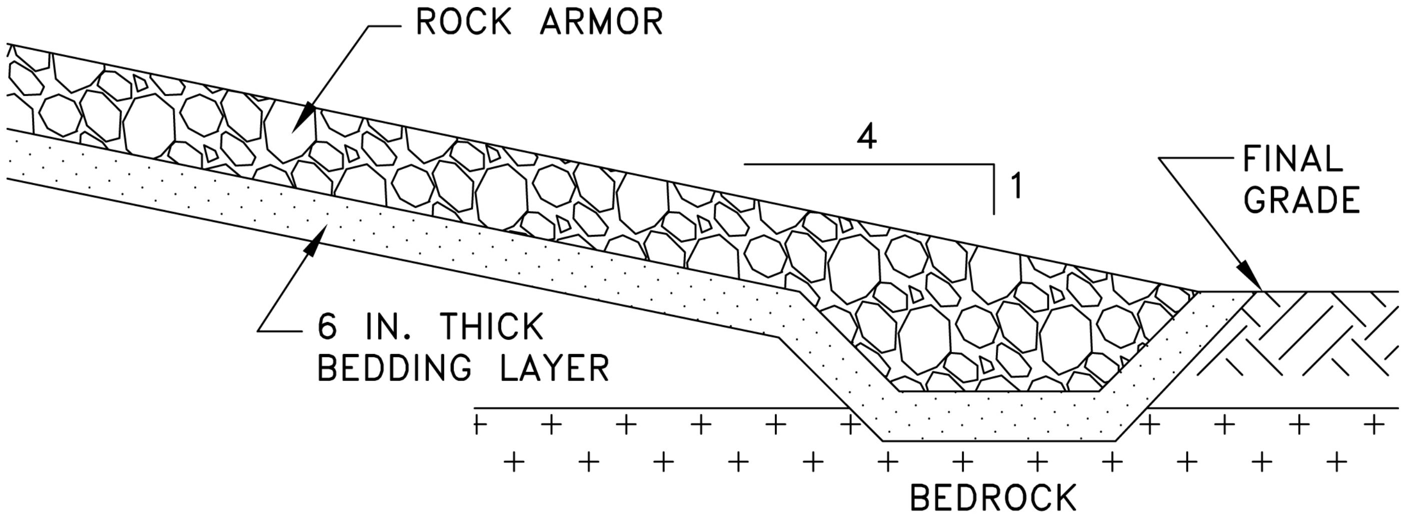


Figure 6.3-5 Alternative 2, rock armored side slope detail

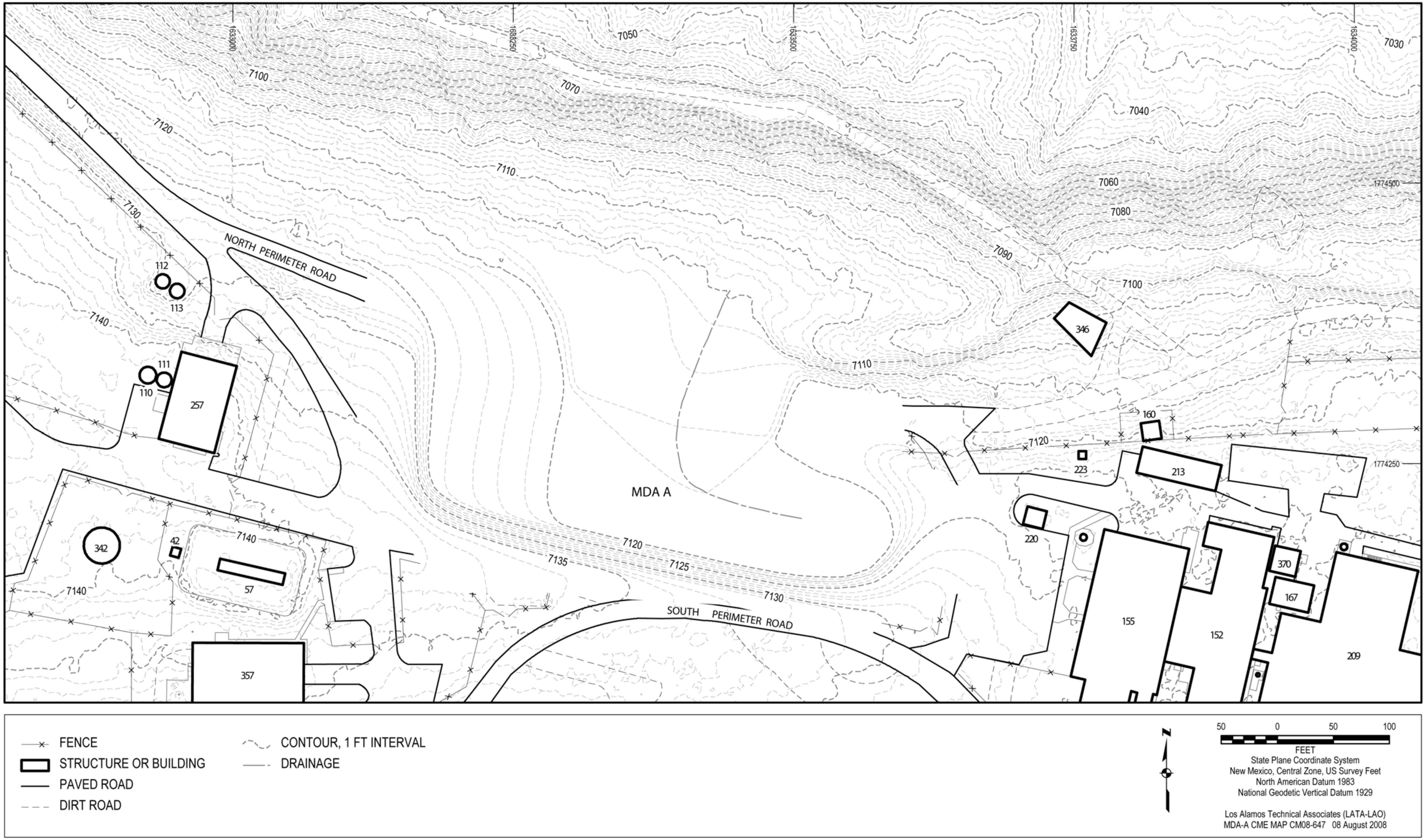


Figure 6.3-6 Alternative 3, full waste removal final grading plan

Table 1.0-1
Cross-Walk with Consent Order Requirements

No.	Consent Order Requirement	Consent Order Section Reference	CME Report Section
1	The Respondents shall follow the Corrective Measures Evaluation Report format outlined in Section XI.F of this Consent Order.	VII.D.2	Table of Contents
2	The corrective measures evaluation shall evaluate potential remedial alternatives and shall recommend a preferred remedy that will be protective of human health and the environment and attain the appropriate cleanup goals.	VII.D.2	Sections 6 to 9
3	1. A description of the location, status, and current use of the site.	VII.D.2	Sections 1.0, 2.0, 2.1
4	2. A description of the history of site operations and the history of releases of contaminants.	VII.D.2	Section 2.1
5	3. A description of site surface conditions.	VII.D.2	Section 3.1
6	4. A description of site subsurface conditions.	VII.D.2	Section 3.4
7	5. A description of on- and off-site contamination in all affected media.	VII.D.2	Sections 2.4, 2.5, 2.6, 4.1
8	6. An identification and description of all sources of contaminants.	VII.D.2	Sections 2.4, 2.5, 2.6, 4.1
9	7. An identification and description of contaminant migration pathways.	VII.D.2	Section 4.2
10	8. An identification and description of potential receptors.	VII.D.2	Section 4.2
11	9. A description of cleanup standards or other applicable regulatory criteria.	VII.D.2	Section 5
12	10. An identification and description of a range of remedy alternatives.	VII.D.2	Section 6
13	11. Remedial alternative pilot or bench scale testing results.	VII.D.2	Not applicable
14	12. A detailed evaluation and rating of each of the remedy alternatives, applying the criteria set forth in Section VII.D.4.	VII.D.2	Section 8 and Table 7.1-1
15	13. An identification of a proposed preferred remedy or remedies.	VII.D.2	Section 8
16	14. Design criteria of the selected remedy or remedies.	VII.D.2	Section 9
17	15. A proposed schedule for implementation of the preferred remedy.	VII.D.2	Section 10
18	The Respondents shall select corrective measures that are capable of achieving the cleanup standards and goals outlined in Section VIII of this Consent Order including, as applicable, approved alternate cleanup goals established by a risk assessment.	VII.D.3	Section 5 discusses goals but none were exceeded in the investigation report risk assessment

Table 1.0-1 (continued)

No.	Consent Order Requirement	Consent Order Section Reference	CME Report Section
19	The Respondents shall evaluate each of the remedy alternatives for the following threshold criteria. To be selected, the remedy alternative must: 1. Be protective of human health and the environment. 2. Attain media cleanup standards. 3. Control the source or sources of releases so as to reduce or eliminate, to the extent practicable, further releases of contaminants that may pose a threat to human health and the environment. 4. Comply with applicable standards for management of wastes.	VII.D.4.a	Section 7
20	The remedy shall be evaluated for long-term reliability and effectiveness. This factor includes consideration of the magnitude of risks that will remain after implementation of the remedy; the extent of long-term monitoring, or other management that will be required after implementation of the remedy; the uncertainties associated with leaving contaminants in place; and the potential for failure of the remedy. Respondents shall give preference to a remedy that reduces risks with little long-term management, and that has proven effective under similar conditions.	VII.D.4.b.i	Sections 7.1.3, 7.2.3, 7.3.3
21	The remedy shall be evaluated for its reduction in the toxicity, mobility, and volume of contaminants. Respondents shall give preference to remedy that uses treatment to more completely and permanently reduce the toxicity, mobility, and volume of contaminants.	VII.D.4.b.ii	Sections 7.1.5, 7.2.5, 7.3.5
22	The remedy shall be evaluated for its short-term effectiveness. This factor includes consideration of the short-term reduction in existing risks that the remedy would achieve; the time needed to achieve that reduction; and the short-term risks that might be posed to the community, workers, and the environment during implementation of the remedy. Respondents shall give preference to a remedy that quickly reduces short-term risks, without creating significant additional risks.	VII.D.4.b.iii	Sections 7.1.3, 7.2.3, 7.3.3
23	The remedy shall be evaluated for its implementability or the difficulty of implementing the remedy. This factor includes consideration of installation and construction difficulties; operation and maintenance difficulties; difficulties with cleanup technology; permitting and approvals; and the availability of necessary equipment, services, expertise, and storage and disposal capacity. Respondents shall give preference to a remedy that can be implemented quickly and easily, and poses fewer and lesser difficulties.	VII.D.4.b.iv	Sections 7.1.4, 7.2.4, 7.3.4

Table 1.0-1 (continued)

No.	Consent Order Requirement	Consent Order Section Reference	CME Report Section
24	The remedy shall be evaluated for its cost. This factor includes a consideration of both capital costs, and operation and maintenance costs. Capital costs shall include, without limitation, construction and installation costs; equipment costs; land development costs; and indirect costs including engineering costs, legal fees, permitting fees, startup and shakedown costs, and contingency allowances. Operation and maintenance costs shall include, without limitation, operating labor and materials costs; maintenance labor and materials costs; replacement costs; utilities; monitoring and reporting costs; administrative costs; indirect costs; and contingency allowances. All costs shall be calculated based on their net present value. Respondents shall give preference to a remedy that is less costly, but does not sacrifice protection of health and the environment.	VII.D.4.b.v	Sections 7.1.6, 7.2.6, 7.3.6
25	All investigation summaries, site condition descriptions, corrective action goals, corrective action options, remedial options selection criteria, and schedules shall be included in the corrective measures evaluations.	XI.F	Sections 2.4; 2.5, 2.6, 5
26	In general, interpretation of historical investigation data and discussions of prior interim activities shall be presented only in the background sections of the corrective measures evaluations.	XI.F	Section 2.3
27	At a minimum, detections of contaminants encountered during previous site investigations shall be presented in the corrective measures evaluations in table format with an accompanying site plan showing sample locations.	XI.F	Section 2.3, 2.4, 2.5, 2.6 Figures and Tables
28	The other text sections of the corrective measures evaluations shall be reserved for presentation of corrective action-related information regarding anticipated or potential site-specific corrective action options and methods relevant to the project.	XI.F	Section 7
29	The title page shall include the type of document; Facility name; TA designation; SWMU or AOC name, site, and any other unit name; and the submittal date. A signature block providing spaces for the name and title of the responsible DOE and University of California (or co-operator) representative shall be provided on the title page in accordance with 20.4.1.900 NMAC incorporating 40 C.F.R. 270.11(d)(1).	XI.F.1	Title Page
30	This executive summary or abstract shall provide a brief summary of the purpose and scope of the corrective measures evaluation to be conducted at the subject site. The executive summary or abstract shall also briefly summarize the conclusions of the evaluation. The SWMU, AOC, and site names, location, and TA designation shall be included in the executive summary.	XI.F.2	Executive Summary
31	The table of contents shall list all text sections, subsections, tables, figures, and appendices or attachments included in the corrective measures evaluation. The corresponding page numbers for the titles of each section of the report shall be included in the table of contents.	XI.F.3	Table of Contents

Table 1.0-1 (continued)

No.	Consent Order Requirement	Consent Order Section Reference	CME Report Section
32	The Introduction section shall include the Facility name, TA designation, site location, and site status (e.g., closed, corrective action). General information on the current site usage and status shall be included in this section. A brief description of the purpose of the corrective measures evaluation and the corrective action objectives for the project also shall be provided in this section.	XI.F.4	Section 1
33	The Background section shall describe the relevant background information. This section shall briefly summarize historical site uses by the U.S. Government and any other entity since the 1940s, including the locations of current and former site structures and features. A labeled figure shall be included in the document showing the locations of current and former site structures and features. The locations of any subsurface features such as pipelines, underground tanks, utility lines, and other subsurface structures shall be included in this section and labeled on the site plan, as appropriate.	XI.F.5	Section 2, Figures 1.0-1 and 1.0-3
34	This section shall include contaminant and waste characteristics, a brief summary of the history of contaminant releases, known and possible sources of contamination, and the vertical and lateral extent of contamination present in each medium. This section shall include brief summaries of results of previous investigations, including references to pertinent figures, data summary tables, and text in previous reports. References to previous reports shall include page, table, and figure numbers for referenced information. Summary tables and site plans showing relevant investigation locations shall be referenced and included in the Tables and Figures sections of the document, respectively.	XI.F.5	Section 2
35	A section on surface conditions shall describe current and historic site topography, features, and structures, including a description of topographic drainages, man-made drainages, vegetation, and erosional features. It shall also include a description of current uses of the site and any current operations at the site. This section shall also include a description of those features that could potentially influence corrective action option selection or implementation such as archeological sites, wetlands, or other features that may affect remedial activities. In addition, descriptions of features located in surrounding sites that may have an effect on the subject site regarding sediment transport, surface water runoff or contaminant transport shall be included in this section. A site plan displaying the locations of all pertinent surface features and structures shall be included in the Figures section of the corrective measures evaluation.	XI.F.6a	Section 3.1; Figures 1.0-2, 1.0-3

Table 1.0-1 (continued)

No.	Consent Order Requirement	Consent Order Section Reference	CME Report Section
36	A section on subsurface conditions shall describe the site conditions observed during previous subsurface investigations. It shall include relevant soil horizon and stratigraphic information, groundwater conditions, fracture data, and subsurface vapor information. A site plan displaying the locations of all borings and excavations advanced during previous investigations shall be included in the Figures section of the corrective measures evaluation. A brief description of the stratigraphic units anticipated to be present beneath the site may be included in this section if stratigraphic information is not available from previous investigations conducted at the site.	XI.F.6b	Section 3.2; Figure 2.3-1
37	A section shall provide a list of all sources of contamination at the subject site where corrective measures are to be considered or required. Sources that are no longer considered to be releasing contaminants at the site, but may be the point of origination for contaminants transported to other locations, shall be included in this section.	XI.F.7a	Section 4.1
38	A section shall describe potential migration pathways that could result in either acute or chronic exposures to contaminants. It shall include such pathways as utility trenches, paleochannels, surface exposures, surface drainages, stratigraphic units, fractures, structures, and other features. The migration pathways for each contaminant and each relevant medium should be tied to the potential receptors for each pathway. A discussion of contaminant characteristics relating to fate and transport of contaminants through each pathway shall also be included in this section.	XI.F.7b	Section 4.2
39	A section shall provide a listing and description of all anticipated potential receptors that could possibly be affected by the contamination present at the site. Potential receptors shall include human and ecological receptors, groundwater, and other features such as pathways that could divert or accelerate the transport of contamination to human receptors, ecological receptors, and groundwater.	XI.F.7c	Section 4
40	A section shall set forth the applicable cleanup standards, risk-based screening levels, and risk-based cleanup goals for each pertinent medium at the subject site. The appropriate cleanup levels for each site shall be included, if site-specific levels have been established at separate sites or units. A table summarizing the applicable cleanup standards or levels, or inclusion of applicable cleanup standards or levels in the summary data tables shall be included in the Tables section of the document. The risk assessment shall be presented in a separate document or in an appendix to this report. If cleanup or screening levels calculated in a risk evaluation are employed, the risk evaluation document shall be referenced including pertinent page numbers for referenced information.	XI.F.8	Section 5, Table 5.1-1; Risk Assessment: LANL 2006, 095046, Appendix I

Table 1.0-1 (continued)

No.	Consent Order Requirement	Consent Order Section Reference	CME Report Section
41	A section shall identify and describe potential corrective measures for source, pathway, and receptor controls. Corrective measures options shall include the range of available options including, but not limited to, a no action alternative, institutional controls, engineering controls, in-situ and on-site remediation alternatives, complete removal, and any combination of alternatives that would potentially achieve cleanup goals.	XI.F.9	Section 6.0
42	A section shall provide an evaluation of the corrective measures options identified in Section XI.F.9 above. The evaluation shall be based on the applicability, technical feasibility, effectiveness, implementability, impacts to human health and the environment, and cost of each option. A table summarizing the corrective measures alternatives and the criteria listed below shall be included in the Tables section of this document.	XI.F.10	Section 7.0
43	The assessment also shall include the anticipated duration for the technology to attain regulatory compliance. In general, all corrective measures described above will have the ability to mitigate the impacts of contamination at the site, but not all remedial options will be equally effective at achieving the desired cleanup goals to the degree and within the same time frame as other options. Each remedy shall be evaluated for both short-term and long-term effectiveness.	XI.F.10.c	Section 7.0
44	Implementability characterizes the degree of difficulty involved during the installation, construction, and operation of the corrective measure. Operation and maintenance of the alternative shall be addressed in this section.	XI.F.10.d	Section 7.0
45	This category evaluates the short-term (remedy installation-related) and long-term (remedy operation-related) hazards to human health and the environment of implementing the corrective measure. The assessment shall include whether the technology will create a hazard or increase existing hazards and the possible methods of hazard reduction.	XI.F.10.e	Section 7.0
46	This section shall discuss the anticipated cost of implementing the corrective measure. The costs shall be divided into: 1) capital costs associated with construction, installation, pilot testing, evaluation, permitting, and reporting of the effectiveness of the alternative; and 2) continuing costs associated with operating, maintaining, monitoring, testing, and reporting on the use and effectiveness of the technology.	XI.F.10.f	Section 7.0

Table 1.0-1 (continued)

No.	Consent Order Requirement	Consent Order Section Reference	CME Report Section
47	The Respondents shall propose the preferred corrective measure(s) at the site and provide a justification for the selection in this section. The proposal shall be based upon the ability of the remedial alternative to: (1) achieve cleanup objectives in a timely manner; (2) protect human and ecological receptors; (3) control or eliminate the sources of contamination; (4) control migration of released contaminants; and 5) manage remediation waste in accordance with State and Federal regulations. The justification shall include the supporting rationale for the remedy selection, based on the factors listed in Section XI.F.10 and a discussion of short- and long-term objectives for the site. The benefits and possible hazards of each potential corrective measure alternative shall be included in this section.	XI.F.11	Section 8.0
48	The Respondents shall present descriptions of the preliminary design for the selected corrective measures in this section. The description shall include appropriate preliminary plans and specifications to effectively illustrate the technology and the anticipated implementation of the remedial option at the subject area. The preliminary design shall include a discussion of the design life of the alternative and provide engineering calculations for proposed remediation systems.	XI.F.12	Section 9.0
49	A section shall set forth a proposed schedule for completion of remedy-related activities such as bench tests, pilot tests, construction, installation, remedial excavation, cap construction, installation of monitoring points, and other remedial actions. The anticipated duration of corrective action operations and the schedule for conducting monitoring and sampling activities shall also be presented. In addition, this section shall provide a schedule for submittal of reports and data to the Department, including a schedule for submitting all status reports and preliminary data.	XI.F.13	Section 10.0
50	1. A table summarizing regulatory criteria, background, and/or the applicable cleanup standards.	XI.F.14	Table 5.1-1
51	2. A table summarizing historical field survey location data.	XI.F.14	Not needed; see Figures 1.0-2 and 1.0-3
52	3. Tables summarizing historical field screening and field parameter measurements of soil, rock, sediments, groundwater, surface water, and air quality data.	XI.F.14	Tables 2.4-8 through 2.4-12 and LANL 2006, 095046, Appendix B
53	4. Tables summarizing historical soil, rock, or sediment laboratory analytical data. The summary tables shall include the analytical methods, detection limits, and significant data quality exceptions that would influence interpretation of the data.	XI.F.14	Tables 2.6-1 through 2.6-4
54	5. A table summarizing historical groundwater elevation and depth to groundwater data. The table shall include the monitoring well depths and the screened intervals in each well.	XI.F.14	Not applicable

Table 1.0-1 (continued)

No.	Consent Order Requirement	Consent Order Section Reference	CME Report Section
55	6. Tables summarizing historical groundwater laboratory analytical data. The analytical data tables shall include the analytical methods, detection limits, and significant data quality exceptions that would influence interpretation of the data.	XI.F.14	Not applicable; no groundwater encountered in any of historical site investigations
56	7. Tables summarizing historical surface water laboratory analytical data. The analytical data tables shall include the analytical methods, detection limits, and significant data quality exceptions that would influence interpretation of the data.	XI.F.14	Not applicable; no surface water at site
57	8. Tables summarizing historical air sample screening and analytical data. The data tables shall include the screening instruments used, laboratory analytical methods, detection limits, and significant data quality exceptions that would influence interpretation of the data.	XI.F.14	Tables 2.4-8 through 2.4-12
58	9. Tables summarizing historical pilot or other test data, if applicable, including units of measurement and types of instruments used to obtain measurements.	XI.F.14	Not applicable
59	10. A table summarizing the corrective measures alternatives and evaluation criteria.	XI.F.14	Table 7.1-1
60	11. A table presenting the schedule for installation, construction, implementation, and reporting of selected corrective measures.	XI.F.14	Table 10.0-1
61	A section shall present the following figures for each site, as appropriate. All figures must include an accurate bar scale and a north arrow. An explanation shall be provided on each figure for all abbreviations, symbols, acronyms, and qualifiers. All figures shall have a date.	XI.F.15	See below.
62	1. A vicinity map showing topography and the general location of the subject site relative to surrounding features or properties.	XI.F.15	Figure 1.0-1
63	2. A unit site plan that presents pertinent site features and structures, underground utilities, well locations, and remediation system locations and details. Off-site well locations and other relevant features shall be included on the site plan if practical. Additional site plans may be required to present the locations of relevant off-site well locations, structures, and features.	XI.F.15	Figures 1.0-2, 1.0-3
64	3. Figures showing historical soil boring or excavation locations and sampling locations.	XI.F.15	Figures 1.0-2, 1.0-3
65	4. Figures presenting historical soil sample field screening and laboratory analytical data, if appropriate.	XI.F.15	Description in LANL 2005, 088052, pp. 41, 45, 49
66	5. Figures showing all existing wells including vapor monitoring wells and piezometers. The figures shall present historical groundwater elevation data and indicate groundwater flow directions.	XI.F.15	Not applicable
67	6. Figures presenting historical groundwater laboratory analytical data including past data, if applicable. The analytical data corresponding to each sampling location may be presented as individual concentrations, in table form on the figure or as an isoconcentration map.	XI.F.15	Not applicable; groundwater not encountered in historical investigations.

Table 1.0-1 (continued)

No.	Consent Order Requirement	Consent Order Section Reference	CME Report Section
68	7. Figures presenting historical surface water sample locations and analytical data including past data, if applicable. The laboratory analytical data corresponding to each sampling location may be presented as individual concentrations or in table form on the figure.	XI.F.15	Not applicable, no surface water exists at site.
69	8. Figures presenting historical air sampling locations and presenting air quality data. The field screening or laboratory analytical data corresponding to each sampling location may be presented as individual concentrations, in table form on the figure or as an isoconcentration map.	XI.F.15	Not applicable
70	9. Figures presenting historical pilot or other test locations and data, where applicable, including site plans or graphic data presentation.	XI.F.15	Not applicable
71	10. Figures presenting geologic cross-sections based on outcrop and borehole data, if applicable.	XI.F.15	Figure 3.4-1
72	11. Figures presenting the locations of existing and proposed remediation systems.	XI.F.15	Not applicable
73	12. Figures presenting existing remedial system design and construction details.	XI.F.15	Not applicable
74	13. Figures presenting preliminary design and construction details for preferred corrective measures.	XI.F.15	Figures 6.3-1 through 6.3-6
75	Each corrective measures evaluation shall include, as appropriate, as an appendix, the management plan for waste, including investigation derived waste, generated as a result of construction, installation, or operation of remedial systems or activities conducted.	XI.F.16	Will be developed as part of CMI
76	Each corrective measures evaluation shall include additional appendices presenting relevant additional data, such as pilot or other test or investigation data, remediation system design specifications, system performance data, or cost analyses as necessary.	XI.F.16	Appendixes D–H

Table 2.0-1
Summary of Historical Activities at MDA A

Date	General's Tanks	Vertical Shafts	Eastern Pits	Central Pit	Former Drum Storage Area
1945	Two 50,000-gal. storage tanks (12-ft diameter, 62-ft-10 in. long) buried on the western end of MDA A to receive waste solutions containing plutonium-239, plutonium-240 and americium-241 (photo right)[a].		Construction of two pits on eastern end of MDA A (125 ft x 18 ft x 12.5 ft). Solid waste possibly containing mainly alpha contamination and some beta and gamma contamination placed into pits (photo right)[a].		
1946	No record of waste management activities.		Solid waste possibly containing mainly alpha contamination and some beta and gamma contamination placed into pits. Pits closed and crushed tuff used to backfill and cover the trenches.		
1947–1952					Late 1940s or early 1950s. Several hundred 55-gal. drums of sodium hydroxide solution and stable iodine waste, possibly containing plutonium and uranium, stored in area (photo left)[b].
1953–1959					No record of drum activity.
1960					Drums removed and area paved to immobilize contaminants.
1961					
1962					

Table 2.0-1 (continued)

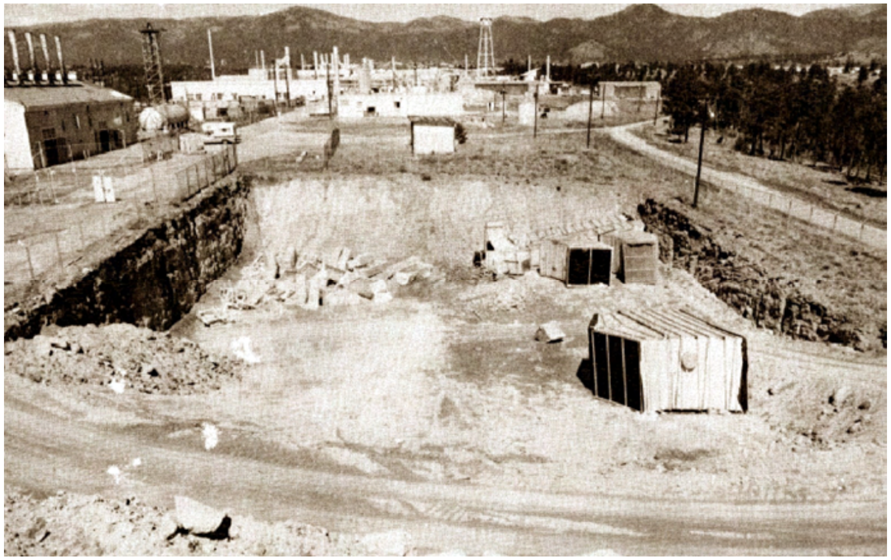
Date	General's Tanks	Vertical Shafts	Eastern Pits	Central Pit	Former Drum Storage Area
1963–1968					
1969				Construction of large pit (150 ft x 40 ft x 22 ft) in the center of MDA A to receive debris from demolition work at TA-21. May 9, 1969: A geologic reconnaissance was made of the central disposal pit by observing geology and taking measurements with a compass.	
1970–1971				Building debris from demolition work at TA-21 placed into pit.	
1972				Pit enlarged to 172 ft x 134 ft x 22 ft to receive building debris from demolition of Building 21-012.	
1973				Pit received plutonium-contaminated building debris from demolition of Building 21-012 (see photo at left)[c].	
1974	May 1974: Four holes were augered adjacent to the General's Tanks to a depth of 35 ft bgs, and composite samples were collected at 5-ft intervals.			Debris from TA-21 buildings and structures placed into pit.	

Table 2.0-1 (continued)

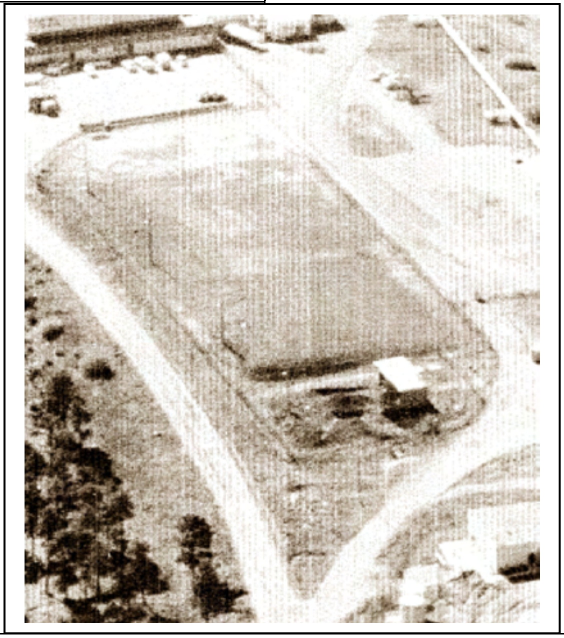
Date	General's Tanks	Vertical Shafts	Eastern Pits	Central Pit	Former Drum Storage Area
1975	June 19, 1975: Liquid waste (approximately 10,570 gal.) transferred from the western tank to Building 21-257 for processing.	December 3, 1975: Excavation of two 4-ft-diameter vertical shafts (~65 ft deep) adjacent to the General's Tanks for disposal of nonretrievable cement paste.		Waste of an unspecified nature placed in pit.	
1976					
1977		Shafts "grouted up" for closure.			
1978				May 1978: Pit decommissioned and soil cover (crushed tuff) placed over the pit.	
1979	Aerial photograph at right[d]				
1980	A-2 sampled at three depth intervals.			Sample A-1 at three depth intervals.	
1981					
1982					
1983	Liquid waste transferred from the tanks to Building 21-257 for processing. Six holes were drilled around the perimeter of the General's Tanks to a depth of 30 ft bgs, and subsurface soil profile samples were collected from 3-ft intervals.				
1984	A radiation field survey was conducted at approximately 100 locations with a phoswich detector analyzer and high-pressure ion chamber instrument. May–August 1984: Soil and vegetation samples were collected from 39 locations from the western third of MDA A.				

Table 2.0-1 (continued)

Date	General's Tanks	Vertical Shafts	Eastern Pits	Central Pit	Former Drum Storage Area
1985	Tops of the tanks sealed because of evidence of rain water seepage.				
	1st Quarter 1985: Seven locations were sampled for soils within and outside of MDA A at 0.03 ft to 0.33 ft and 0.33 ft to 0.98 ft.				
1986	A surface reconnaissance survey was performed, which addressed the general conditions of cover.				
1987–1988					
1989	Geophysical techniques were used, including magnetics, electromagnetics, resistivity, radar, and self-potential to determine pit geometry, accurately locate material, and determine the physical properties of sites and buried material.				
1990	October 1990: Surface soil was sampled within the boundaries of MDA A at approximately 20 locations.				
1991					
1992	March–May and June–July: Phase I RFI was performed across TA-21. Surface soil was sampled during two sampling events (Grid 1 and Grid 2).				
1993					
1994	August–September: A Phase I RFI was performed on the surface outside the MDA A fence and surface and near-surface within the associated drainage area. Activities included a radiation field survey (59 survey locations); collection of surface and near-surface samples (51 locations, sediment samples were collected from 0 ft to 0.25 ft, 0.25 ft to 0.5 ft, and 0.5 ft to 1 ft; all other surface samples were collected from 0 ft to 0.25 ft); field screening of samples with field instruments and a mobile laboratory; and analysis of samples at a fixed analytical laboratory.				
1995					
1996	June: An electromagnetic survey was conducted using a GEM-2.				
1997–1998					
1999	June: Geophysical surveys were conducted using GPR, magnetics, and electrical resistivity (students, faculty, and visitors of the Summer of Applied Geophysical Experience).				
2000–2002					
2003	September: An integrated geophysical survey was conducted using capacitively coupled electrical resistivity and digital GPR (Advanced Geological Services, Inc.)				
2004					
2005	January: Investigation work plan submitted to NMED. June: Plan approved by NMED.				

[a] Photograph 1945 or 1946 (Gerety et. al. 1989, 006893, p. 36).

[b] Aerial photograph January 1949 (Gerety et. al. 1989, 006893, p. 38).

[c] Photograph 1973 (Gerety et al. 1989, 006893, p. 44).

[d] Aerial photograph 1979 (Gerety et al. 1989, 006893, p. 50).

Table 2.5-1
PCB Field Screening Summary

Location ID	Borehole	Date Collected	Time Collected	Top Depth (ft bgs)	Bottom Depth ft bgs)	Extraction Date	Time Extracted	Screening Date	Time Screened	Screening Result (ppm)	Corr {r}[a]	%CV[b]	Control
21-26589	BH-01	9/11/2006	9:35	0	0.5	9/14/2006	13:23	9/14/2006	15:26	0.01nd[c]	0.9992	1.3–3.5	4.11
21-26589	BH-01	9/12/2006	8:42	7	9	9/14/2006	13:23	9/14/2006	15:26	0.00nd	0.9992	1.3–3.5	4.11
21-26589	BH-01	9/12/2006	9:45	17	19	9/14/2006	13:23	9/14/2006	15:26	0.00nd	0.9992	1.3–3.5	4.11
21-26589	BH-01	9/15/2006	14:15	47	52	9/18/2006	11:46	9/19/2006	12:22	0.07nd	0.9992	0.5–6.2	5.47
21-26589	BH-01	9/16/2006	12:10	78	80	9/18/2006	11:46	9/19/2006	12:22	0.00nd	0.9992	0.5–6.2	5.47
21-26589	BH-01	9/16/2006	15:40	92	94	9/18/2006	11:46	9/19/2006	12:22	0.00nd	0.9992	0.5–6.2	5.47
21-26589	BH-01	9/19/2006	10:10	138	140	9/19/2006	11:10	9/19/2006	12:22	0.04nd	0.9992	0.5–6.2	5.47
21-26597	BH-02	8/21/2006	13:30	0	0.5	8/31/2006	8:25	8/31/2006	11:53	0.02nd	1.0000	0.8–4.5	5.74
21-26597	BH-02	8/21/2006	13:35	1.5	3	8/31/2006	8:25	8/31/2006	11:53	0.10nd	1.0000	0.8–4.5	5.74
21-26597	BH-02	8/21/2006	14:00	12	15	8/31/2006	8:25	8/31/2006	11:53	0.04nd	1.0000	0.8–4.5	5.74
21-26597	BH-02	8/21/2006	14:25	23	25	8/31/2006	8:25	8/31/2006	11:53	0.09nd	1.0000	0.8–4.5	5.74
21-26597	BH-02	8/22/2006	9:01	80	85	8/31/2006	8:25	8/31/2006	11:53	0.06nd	1.0000	0.8–4.5	5.74
21-26485	BH-03	5/3/2006	NA[d]	NA	15	5/3/2006	13:36	5/3/2006	15:01	0.02nd	0.9999	0.2–5.1	5.49
21-26485	BH-03	5/3/2006	15:30	24	26	5/3/2006	18:40	5/4/2006	12:30	0.00nd	0.9946	0.8–1.9	5.3
21-26485	BH-03	5/3/2006	18:00	28	30	5/3/2006	18:40	5/4/2006	12:30	0.00nd	0.9946	0.8–1.9	5.3
21-26485	BH-03	5/3/2006	17:00	30	32	5/3/2006	18:40	5/4/2006	12:30	0.00nd	0.9946	0.8–1.9	5.3
21-26485	BH-03	5/3/2006	17:00	32	34	5/3/2006	18:40	5/4/2006	12:30	0.00nd	0.9946	0.8–1.9	5.3
21-26485	BH-03	5/3/2006	15:50	43	45	5/3/2006	18:40	5/4/2006	12:30	0.00nd	0.9946	0.8–1.9	5.3
21-26480	BH-04	5/4/2006	15:15	25	27	5/4/2006	17:42	5/5/2006	10:30	0.00nd	0.9885	0.1–17.6	8.38
21-26480	BH-04	5/4/2006	16:45	36	38.5	5/4/2006	17:42	5/5/2006	10:30	0.00nd	0.9885	0.1–17.6	8.38
21-26480	BH-04	5/4/2006	16:00	42	44	5/4/2006	17:42	5/5/2006	10:30	0.00nd	0.9885	0.1–17.6	8.38
21-26481	BH-05	5/1/2006	16:00	25	27	5/1/2006	16:24	5/3/2006	10:49	0.00nd	0.9960	2.2–4.7	0.00nd

Table 2.5-1 (continued)

Location ID	Borehole	Date Collected	Time Collected	Top Depth (ft bgs)	Bottom Depth ft bgs)	Extraction Date	Time Extracted	Screening Date	Time Screened	Screening Result (ppm)	Corr {r}[a]	%CV[b]	Control
21-26481	BH-05	5/1/2006	17:30	40.5	42	5/1/2006	16:30	5/3/2006	10:49	0.00nd	0.9960	2.2–4.7	0.00nd
21-26481	BH-05	5/1/2006	16:20	43	45	5/1/2006	16:24	5/3/2006	10:49	0.00nd	0.9960	2.2–4.7	0.00nd
21-26491	BH-06	8/14/2006	13:50	1.5	2.5	8/18/2006	12:57	8/18/2006	17:57	0.00nd	0.9949	1.0–2.5	1.4
21-26491	BH-06	8/15/2006	8:35	15	17	8/18/2006	12:57	8/18/2006	17:57	0.00nd	0.9949	1.0–2.5	1.4
21-26491	BH-06	8/15/2006	8:55	27	30	8/18/2006	12:57	8/18/2006	17:57	0.00nd	0.9949	1.0–2.5	1.4
21-26491	BH-06	8/15/2006	9:10	30	35	8/18/2006	12:57	8/18/2006	17:57	0.00nd	0.9949	1.0–2.5	1.4
21-26592	BH-07	8/15/2006	11:50	0	0.5	8/18/2006	12:57	8/18/2006	17:57	0.00nd	0.9949	1.0–2.5	1.4
21-26592	BH-07	8/15/2006	12:00	1.5	4	8/18/2006	12:57	8/18/2006	17:57	0.00nd	0.9949	1.0–2.5	1.4
21-26592	BH-07	8/15/2006	12:22	15	17	8/18/2006	12:57	8/18/2006	17:57	0.00nd	0.9949	1.0–2.5	1.4
21-26592	BH-07	8/15/2006	12:40	23	25	8/18/2006	12:57	8/18/2006	17:57	0.00nd	0.9949	1.0–2.5	1.4
21-26592	BH-07	8/15/2006	13:06	33	35	8/18/2006	14:06	8/18/2006	17:57	0.00nd	0.9949	1.0–2.5	1.4
21-26593	BH-08	8/12/2006	9:45	0	0.5	8/15/2006	16:00	8/16/2006	9:25	0.00nd	0.9979	1.6–5.2	3.87
21-26593	BH-08	8/12/2006	10:20	1.5	2	8/15/2006	16:00	8/16/2006	9:25	0.00nd	0.9979	1.6–5.2	3.87
21-26593	BH-08	8/13/2006	9:10	3	7	8/15/2006	16:00	8/16/2006	9:25	0.00nd	0.9979	1.6–5.2	3.87
21-26593	BH-08	8/13/2006	9:40	15	17	8/15/2006	16:00	8/16/2006	9:25	0.00nd	0.9979	1.6–5.2	3.87
21-26593	BH-08	8/13/2006	9:56	21	23	8/15/2006	16:00	8/16/2006	9:25	0.00nd	0.9979	1.6–5.2	3.87
21-26593	BH-08	8/13/2006	10:20	31	33	8/15/2006	16:00	8/16/2006	9:25	0.00nd	0.9979	1.6–5.2	3.87
21-26594	BH-09	8/16/2006	12:50	0	0.5	8/18/2006	14:06	8/18/2006	17:57	0.00nd	0.9949	1.0–2.5	1.4
21-26594	BH-09	8/16/2006	13:00	1.5	3	8/18/2006	14:06	8/18/2006	17:57	0.00nd	0.9949	1.0–2.5	1.4
21-26594	BH-09	8/16/2006	13:25	17	20	8/18/2006	14:06	8/18/2006	17:57	0.00nd	0.9949	1.0–2.5	1.4
21-26594	BH-09	8/16/2006	13:42	25	27	8/18/2006	14:06	8/18/2006	17:57	0.00nd	0.9949	1.0–2.5	1.4
21-26594	BH-09	8/16/2006	13:50	30	35	8/18/2006	14:06	8/18/2006	17:57	0.00nd	0.9949	1.0–2.5	1.4
21-26595	BH-10	8/14/2006	8:27	1.5	2	8/16/2006	11:22	8/16/2006	13:30	0.00nd	0.9936	0.0–7.8	5.07

Table 2.5-1 (continued)

Location ID	Borehole	Date Collected	Time Collected	Top Depth (ft bgs)	Bottom Depth ft bgs)	Extraction Date	Time Extracted	Screening Date	Time Screened	Screening Result (ppm)	Corr {r}[a]	%CV[b]	Control
21-26595	BH-10	8/14/2006	8:42	2	3.5	8/16/2006	11:22	8/16/2006	13:30	0.00nd	0.9936	0.0–7.8	5.07
21-26595	BH-10	8/14/2006	9:05	15	17	8/16/2006	11:22	8/16/2006	13:30	0.00nd	0.9936	0.0–7.8	5.07
21-26595	BH-10	8/14/2006	9:25	23	25	8/16/2006	11:22	8/16/2006	13:30	0.00nd	0.9936	0.0–7.8	5.07
21-26595	BH-10	8/14/2006	9:50	33	35	8/16/2006	11:22	8/16/2006	13:30	0.00nd	0.9936	0.0–7.8	5.07
21-26596	BH-11	8/15/2006	15:00	0	0.5	8/18/2006	14:53	8/18/2006	17:57	0.00nd	0.9949	1.0–2.5	1.4
21-26596	BH-11	8/15/2006	15:10	3	5	8/18/2006	14:53	8/18/2006	17:57	0.00nd	0.9949	1.0–2.5	1.4
21-26596	BH-11	8/15/2006	15:20	5	7	8/18/2006	14:53	8/18/2006	17:57	0.00nd	0.9949	1.0–2.5	1.4
21-26596	BH-11	8/16/2006	8:50	17	20	8/18/2006	14:53	8/18/2006	17:57	0.00nd	0.9949	1.0–2.5	1.4
21-26596	BH-11	8/15/2006	9:15	27	30	8/18/2006	14:53	8/18/2006	17:57	0.00nd	0.9949	1.0–2.5	1.4
21-26596	BH-11	8/16/2006	9:20	32	35	8/18/2006	14:53	8/18/2006	17:57	0.00nd	0.9949	1.0–2.5	1.4
21-26588	BH-12	8/13/2006	9:48	5.5	7	8/31/2006	9:48	8/31/2006	11:53	0.16nd	1.0000	0.8–4.5	5.74
21-26588	BH-12	8/13/2006	11:35	15	17.5	8/31/2006	9:48	8/31/2006	11:53	0.21nd	1.0000	0.8–4.5	5.74
21-26588	BH-12	8/14/2006	8:49	25	27.5	8/31/2006	9:48	8/31/2006	11:53	0.13nd	1.0000	0.8–4.5	5.74
21-26588	BH-12	8/14/2006	13:13	62.5	65	8/31/2006	9:48	8/31/2006	11:53	0.21nd	1.0000	0.8–4.5	5.74
21-26588	BH-12	8/15/2006	12:45	110	112.5	8/31/2006	9:48	8/31/2006	11:53	0.17nd	1.0000	0.8–4.5	5.74
21-26588	BH-12	8/23/2006	8:20	200	202.5	8/31/2006	9:48	8/31/2006	11:53	0.25nd	1.0000	0.8–4.5	5.74
21-26588	BH-12	8/25/2006	10:55	300	302.5	8/31/2006	9:48	8/31/2006	11:53	0.21nd	1.0000	0.8–4.5	5.74
21-26588	BH-12	8/29/2006	18:48	355	360	8/31/2006	9:48	8/31/2006	11:53	0.34nd	1.0000	0.8–4.5	5.74
21-26482	BH-13	4/28/2006	9:05	13.2	15	—[e]	—	4/28/2006	18:34	0.00nd	1.0000	0.3–21.2	5.95
21-26482	BH-13	4/28/2006	16:30	19	22	—	—	4/28/2006	18:34	0.00nd	1.0000	0.3–21.2	5.95
21-26482	BH-13	4/28/2006	15:35	30	32	—	—	4/28/2006	18:34	0.00nd	1.0000	0.3–21.2	5.95
21-26482	BH-13	4/28/2006	NA	NA	45	—	—	4/28/2006	18:34	0.00nd	1.0000	0.3–21.2	5.95
21-26482	BH-13	4/28/2006	17:15	49	50	—	—	4/28/2006	18:34	0.00nd	1.0000	0.3–21.2	5.95

Table 2.5-1 (continued)

Location ID	Borehole	Date Collected	Time Collected	Top Depth (ft bgs)	Bottom Depth ft bgs)	Extraction Date	Time Extracted	Screening Date	Time Screened	Screening Result (ppm)	Corr {r}[a]	%CV[b]	Control
21-26598	BH-14	9/5/2006	6:15	0	0.5	9/6/2006	16:02	9/6/2006	17:42	0.00nd	0.9997	1.2–2.5	6.88
21-26598	BH-14	9/5/2006	9:30	1.5	3	9/6/2006	16:02	9/6/2006	17:42	0.00nd	0.9997	1.2–2.5	6.88
21-26598	BH-14	9/5/2006	12:04	25	30	9/6/2006	16:02	9/6/2006	17:42	0.00nd	0.9997	1.2–2.5	6.88
21-26598	BH-14	9/6/2006	8:35	50	55	9/6/2006	16:02	9/6/2006	17:42	0.00nd	0.9997	1.2–2.5	6.88
21-26598	BH-14	9/6/2006	12:40	82.5	85	9/6/2006	16:02	9/6/2006	17:42	0.02nd	0.9997	1.2–2.5	6.88
21-26484	BH-15	5/2/2006	13:45	13	15	5/3/2006	11:28	5/3/2006	15:01	0.00nd	0.9999	0.2–5.1	5.49
21-26484	BH-15	5/2/2006	18:10	25	27	5/3/2006	11:28	5/3/2006	15:01	0.00nd	0.9999	0.2–5.1	5.49
21-26484	BH-15	5/2/2006	18:45	35	37	5/3/2006	11:28	5/3/2006	15:01	0.00nd	0.9999	0.2–5.1	5.49
21-26484	BH-15	5/2/2006	17:45	43	45	5/3/2006	11:28	5/3/2006	15:01	0.00nd	0.9999	0.2–5.1	5.49
21-26590	BH-16	9/7/2006	11:40	0	0.5	9/14/2006	13:23	9/14/2006	15:26	0.00nd	0.9992	1.3–3.5	4.11
21-26590	BH-16	9/8/2006	8:35	1.5	3	9/14/2006	13:23	9/14/2006	15:26	0.00nd	0.9992	1.3–3.5	4.11
21-26590	BH-16	9/8/2006	16:15	27	30	9/14/2006	13:23	9/14/2006	15:26	0.00nd	0.9992	1.3–3.5	4.11
21-26590	BH-16	9/9/2006	11:25	45	50	9/14/2006	13:23	9/14/2006	15:26	0.00nd	0.9992	1.3–3.5	4.11
21-26590	BH-16	9/10/2006	8:20	75	77	9/14/2006	13:23	9/14/2006	15:26	0.00nd	0.9992	1.3–3.5	4.11
21-26590	BH-16	9/10/2006	11:30	100	102	9/14/2006	13:23	9/14/2006	15:26	0.00nd	0.9992	1.3–3.5	4.11
21-26590	BH-16	9/11/2006	10:55	137	140	9/14/2006	13:23	9/14/2006	15:26	0.00nd	0.9992	1.3–3.5	4.11

[a] Corr{r} = Correlation coefficient (r value).

[b] %CV = Coefficient of variation in percent range.

[c] nd = Nondetect.

[d] NA = Not available.

[e] — = The data were not recorded.

Table 2.5-2
Radiological Field Screening Summary

Location ID	Borehole	Date	Scan Depth (ft bgs)	Background (dpm/100cm^2)		1-min. Pat Scan (dpm/100cm^2)		
				Alpha	Beta/Gamma	Scan Depth (ft bgs)	Alpha	Beta/Gamma
21-26589	1	9/11/06	0-2	34.9	2060	0.5	33.8	497
21-26589	1	9/11/06	2-7	34.9	2060	4	46.3	380
21-26589	1	9/12/06	7-12	10.2	1748	11	16.3	789
21-26589	1	9/12/06	12-17	10.2	1748	14	21.2	821
21-26589	1	9/12/06	17-22	10.2	1748	20	8.7	1034
21-26589	1	9/15/06	22-27	35.1	1320	24	2.59	967
21-26589	1	9/15/06	27-32	35.1	1320	29	46.6	1123
21-26589	1	9/15/06	32-37	35.1	1320	35	34	1019
21-26589	1	9/15/06	37-42	35.1	1320	41	21	954
21-26589	1	9/15/06	42-47	35.1	1320	46	0	721
21-26589	1	9/15/06	47-52	35.1	1320	49	24	1097
21-26589	1	9/15/06	52-57	35.1	1320	55	9	598
21-26589	1	9/15/06	57-62	35.1	1320	58	15	766
21-26589	1	9/15/06	62-67	35.1	1320	65	15	974
21-26589	1	9/16/06	67-72	25.3	1782	69	39	804
21-26589	1	9/16/06	72-77	25.3	1782	72	23	515
21-26589	1	9/16/06	77-82	25.3	1782	80	12	839
21-26589	1	9/16/06	82-87	25.3	1782	86	28	651
21-26589	1	9/16/06	87-92	25.3	1782	88	18	780
21-26589	1	9/16/06	92-97	25.3	1782	93	7	360
21-26589	1	9/16/06	97-102	25.3	1782	99	34	651
21-26589	1	9/17/06	102-107	17.26	2110	107	45	93
21-26589	1	9/17/06	107-112	17.26	2110	109	33	460
21-26589	1	9/17/06	112-117	17.26	2110	116	39	328

Table 2.5-2 (continued)

Location ID	Borehole	Date	Scan Depth (ft bgs)	Background (dpm/100cm^2)		1-min. Pat Scan (dpm/100cm^2)		
				Alpha	Beta/Gamma	Scan Depth (ft bgs)	Alpha	Beta/Gamma
21-26589	1	9/17/06	117–122	17.26	2110	118	33	961
21-26589	1	9/19/06	122–127	23.3	2200	124	35	264
21-26589	1	9/19/06	127–132	23.3	2200	131	35	345
21-26589	1	9/19/06	132–137	23.3	2200	135	17	659
21-26589	1	9/19/06	137–142	23.3	2200	140	5	213
21-26597	2	8/21/06	Surface	13.5	1468	0	0	123
21-26597	2	8/21/06	0–5	13.5	1468	2	0	0
21-26597	2	8/21/06	5–10	13.5	1468	10	0	523
21-26597	2	8/21/06	10–15	13.5	1468	12	0	0
21-26597	2	8/21/06	15–20	13.5	1468	17.5	0	0
21-26597	2	8/21/06	20–25	13.5	1468	13	0	816
21-26597	2	8/21/06	25–30	13.5	1468	15	0	0
21-26597	2	8/21/06	30–35	13.5	1468	33	0	0
21-26597	2	8/21/06	35–40	13.5	1468	37	0	557
21-26597	2	8/21/06	40–45	13.5	1468	45	0	0
21-26597	2	8/21/06	45–50	13.5	1468	47	0	0
21-26597	2	8/21/06	50–55	13.5	1468	55	0	0
21-26597	2	8/21/06	55–60	13.5	1468	60	0	0
21-26597	2	8/22/06	60–65	18.8	2180	61	0	1104
21-26597	2	8/22/06	65–70	18.8	2180	68	0	730
21-26597	2	8/22/06	70–75	18.8	2180	74	0	0
21-26597	2	8/22/06	75–80	18.8	2180	77	33	656
21-26597	2	8/22/06	80–85	18.8	2180	80	0	0
21-26485	3	5/3/06	0–5	35	1352	3.5	17	960
21-26485	3	5/3/06	5–10	35	1352	7.5	17	986

Table 2.5-2 (continued)

				Background (dpm/100cm^2)		1-min. Pat Scan (dpm/100cm^2)		
Location ID	Borehole	Date	Scan Depth (ft bgs)	Alpha	Beta/Gamma	Scan Depth (ft bgs)	Alpha	Beta/Gamma
21-26485	3	5/3/06	10–15	35	1352	10.2	5	877
21-26485	3	5/3/06	15–20	35	1352	19.5	24	1000
21-26485	3	5/3/06	20–25	35	1352	23	36	971
21-26485	3	5/3/06	25–30	35	1352	27.7	4	637
21-26485	3	5/3/06	30–35	35	1352	34	35	739
21-26485	3	5/3/06	35–40	35	1352	37.5	23	869
21-26485	3	5/3/06	40–45	35	1352	44	34	887
21-26480	4	5/4/06	0–5	55	1250	2.2	71	1145
21-26480	4	5/4/06	5–10	55	1250	9.9	1	946
21-26480	4	5/4/06	10–15	55	1250	—[a]	—	—
21-26480	4	5/4/06	15–20	55	1250	19.5	0	786
21-26480	4	5/4/06	20–25	55	1250	22	39	974
21-26480	4	5/4/06	25–30	55	1250	27	0	1028
21-26480	4	5/4/06	30–35	55	1250	—	—	—
21-26480	4	5/4/06	35–40	55	1250	35.5	37	868
21-26480	4	5/4/06	40–45	55	1250	41	25	890
21-26481	5	5/1/06	0–5	35	1330	—	50	739
21-26481	5	5/1/06	5–10	35	1330	—	0	971
21-26481	5	5/1/06	10–15	35	1330	10.8	62	1573
21-26481	5	5/1/06	15–20	35	1330	18.2	36	1080
21-26481	5	5/1/06	20–25	35	1330	22.5	50	1164
21-26481	5	5/1/06	25–30	35	1330	25.6	0	1203
21-26481	5	5/1/06	30–35	35	1330	29	29	1229
21-26481	5	5/1/06	35–40	35	1330	36.8	43	1186
21-26481	5	5/1/06	40–45	35	1330	40.5	5	1009

Table 2.5-2 (continued)

Location ID	Borehole	Date	Scan Depth (ft bgs)	Background (dpm/100cm^2)		1-min. Pat Scan (dpm/100cm^2)		
				Alpha	Beta/Gamma	Scan Depth (ft bgs)	Alpha	Beta/Gamma
21-26591	6	8/14/06	Surface	28.1	2550	0	7.4	568
21-26591	6	8/14/06	0–5	28.1	2550	4	19	2150
21-26591	6	8/14/06	5–10	28.1	2550	6.5	49	2400
21-26591	6	8/14/06	10–15	28.1	2550	14	46	2500
21-26591	6	8/14/06	15–20	28.1	2550	16	39	729
21-26591	6	8/14/06	20–25	28.1	2550	23.5	0	738
21-26591	6	8/14/06	25–30	28.1	2550	29	19	589
21-26591	6	8/14/06	30–35	28.1	2550	33.5	0	501
21-26592	7	8/15/06	Surface	53.6	2350	0	0	530
21-26592	7	8/15/06	0–5	53.6	2350	3	0	127
21-26592	7	8/15/06	5–10	53.6	2350	9	0	232
21-26592	7	8/15/06	10–15	53.6	2350	11	0	451
21-26592	7	8/15/06	15–20	53.6	2350	18.5	0	512
21-26592	7	8/15/06	20–25	53.6	2350	23	0	547
21-26592	7	8/15/06	25–30	53.6	2350	26.5	0	197
21-26592	7	8/15/06	30–35	53.6	2350	31	18.8	495
21-26593	8	8/13/06	0–5	14.55	1943	1	3[b]	309[b]
21-26593	8	8/13/06	5–10	14.55	1943	9	269[c]	1312[c]
21-26593	8	8/13/06	10–15	14.55	1943	12.5	175[c]	1080[c]
21-26593	8	8/13/06	15–20	14.55	1943	18	5	742
21-26593	8	8/13/06	20–25	14.55	1943	21	17	946
21-26593	8	8/13/06	25–30	14.55	1943	26	5	951
21-26593	8	8/13/06	30–35	14.55	1943	30	0	295
21-26594	9	8/16/06	0–5	13.5	1468	4	0	0
21-26594	9	8/16/06	5–10	13.5	1468	10	0	0

Table 2.5-2 (continued)

Location ID	Borehole	Date	Scan Depth (ft bgs)	Background (dpm/100cm^2)		1-min. Pat Scan (dpm/100cm^2)		
				Alpha	Beta/Gamma	Scan Depth (ft bgs)	Alpha	Beta/Gamma
21-26594	9	8/16/06	10–15	13.5	1468	15	0	325
21-26594	9	8/16/06	15–20	13.5	1468	20	0	522
21-26594	9	8/16/06	20–25	13.5	1468	25	0	0
21-26594	9	8/16/06	25–30	13.5	1468	30	0	53
21-26594	9	8/16/06	30–35	13.5	1468	34	0	1169
21-26595	10	8/14/06	0–5	34.7	1896	2.5	0	394
21-26595	10	8/14/06	5–10	34.7	1896	6	13.4	517
21-26595	10	8/14/06	10–15	34.7	1896	11.5	7.4	605
21-26595	10	8/14/06	15–20	34.7	1896	16	7.4	466
21-26595	10	8/14/06	20–25	34.7	1896	24	7.4	502
21-26595	10	8/14/06	25–30	34.7	1896	26	1.4	224
21-26595	10	8/14/06	30–35	34.7	1896	30.5	19.4	568
21-26596	11	8/15/06	Surface	54.3	2370	0	0	38
21-26596	11	8/15/06	0–5	54.3	2370	2	0	0
21-26596	11	8/15/06	5–10	54.3	2370	7	0	257
21-26596	11	8/16/06	10–15	13.5	1468	—	0	237
21-26596	11	8/16/06	15–20	13.5	1468	—	0	218
21-26596	11	8/16/06	20–25	13.5	1468	—	0	455
21-26596	11	8/16/06	25–30	13.5	1468	—	0	506
21-26596	11	8/16/06	30–35	13.5	1468	—	0	655
21-26588	12	8/13/06	0–5	18.55	1477	1.5	6	1200
21-26588	12	8/13/06	5–10	18.55	1477	—	16	2500
21-26588	12	8/13/06	10–15	18.55	1477	13	10	1581
21-26588	12	8/13/06	15–20	18.55	1477	19	5	1525
21-26588	12	8/14/06	20–25	22.8	2250	25	11	0

Table 2.5-2 (continued)

Location ID	Borehole	Date	Scan Depth (ft bgs)	Background (dpm/100cm^2)		1-min. Pat Scan (dpm/100cm^2)		
				Alpha	Beta/Gamma	Scan Depth (ft bgs)	Alpha	Beta/Gamma
21-26588	12	8/14/06	25–30	22.8	2250	39.5	7	0
21-26588	12	8/14/06	30–35	22.8	2250	31	0	0
21-26588	12	8/14/06	35–40	22.8	2250	39	0	0
21-26588	12	8/14/06	40–45	22.8	2250	43	0	0
21-26588	12	8/14/06	45–50	22.8	2250	50	0	0
21-26588	12	8/14/06	50–55	22.8	2250	51	0	0
21-26588	12	8/14/06	55–60	22.8	2250	56	5	0
21-26588	12	8/14/06	60–65	22.8	2250	65	0	0
21-26588	12	8/14/06	65–70	22.8	2250	70	0	0
21-26588	12	8/14/06	70–75	22.8	2250	74	0	0
21-26588	12	8/14/06	75–80	22.8	2250	78	0	0
21-26588	12	8/14/06	80–85	22.8	2250	84	0	0
21-26588	12	8/15/06	85–90	72	2080	87	65	560
21-26588	12	8/15/06	90–95	72	2080	95	6	870
21-26588	12	8/15/06	95–100	72	2080	97	52	580
21-26588	12	8/15/06	100–105	72	2080	102	26	460
21-26588	12	8/15/06	105–110	72	2080	108	65	480
21-26588	12	8/15/06	110–115	72	2080	115	32	310
21-26588	12	8/15/06	115–120	72	2080	120	13	500
21-26588	12	8/15/06	120–125	72	2080	124	19	640
21-26588	12	8/15/06	125–130	72	2080	130	0	570
21-26588	12	8/15/06	130–135	72	2080	134	52	410
21-26588	12	8/16/06	135–140	20.2	2160	136	58	1000
21-26588	12	8/16/06	140–145	20.2	2160	142	25	934
21-26588	12	8/16/06	145–150	20.2	2160	146	32	969

Table 2.5-2 (continued)

Location ID	Borehole	Date	Scan Depth (ft bgs)	Background (dpm/100cm²)		1-min. Pat Scan (dpm/100cm²)		
				Alpha	Beta/Gamma	Scan Depth (ft bgs)	Alpha	Beta/Gamma
21-26588	12	8/16/06	150–155	20.2	2160	152	12	1004
21-26588	12	8/22/06	150–155	55.6	2740	—	—	—
21-26588	12	8/22/06	155–160	55.6	2740	158	0	190
21-26588	12	8/22/06	160–165	55.6	2740	166	0	0
21-26588	12	8/22/06	165–170	55.6	2740	167	3	234
21-26588	12	8/22/06	170–175	55.6	2740	175	0	0
21-26588	12	8/22/06	175–180	55.6	2740	177	0	0
21-26588	12	8/22/06	180–185	55.6	2740	182	0	0
21-26588	12	8/22/06	185–190	55.6	2740	188	0	129
21-26588	12	8/22/06	190–195	55.6	2740	192	36	269
21-26588	12	8/22/06	195–200	55.6	2740	196	36	295
21-26588	12	8/23/06	200–205	13.5	1468	201	0	1515
21-26588	12	8/23/06	205–210	13.5	1468	210	0	1244
21-26588	12	8/23/06	210–215	13.5	1468	211	97	1234
21-26588	12	8/23/06	215–220	13.5	1468	219	48	913
21-26588	12	8/23/06	220–225	13.5	1468	223	41	943
21-26588	12	8/23/06	225–230	13.5	1468	226	48	716
21-26588	12	8/23/06	230–235	13.5	1468	231	88	760
21-26588	12	8/23/06	235–240	13.5	1468	236	0	812
21-26588	12	8/23/06	240–245	13.5	1468	242	19	190
21-26588	12	8/23/06	245–250	13.5	1468	246	0	650
21-26588	12	8/24/06	250–255	24.6	1990	252	14	882
21-26588	12	8/24/06	255–260	24.6	1990	259	1	1092
21-26588	12	8/24/06	260–265	24.6	1990	263	8	1057
21-26588	12	8/24/06	265–270	24.6	1990	267	0	893

Table 2.5-2 (continued)

Location ID	Borehole	Date	Scan Depth (ft bgs)	Background (dpm/100cm^2)		1-min. Pat Scan (dpm/100cm^2)		
				Alpha	Beta/Gamma	Scan Depth (ft bgs)	Alpha	Beta/Gamma
21-26588	12	8/24/06	270–275	24.6	1990	274	0	777
21-26588	12	8/24/06	275–280	24.6	1990	277	0	800
21-26588	12	8/25/06	280–285	12.7	2170	282	26	1296
21-26588	12	8/25/06	285–290	12.7	2170	287	33	1095
21-26588	12	8/25/06	290–295	12.7	2170	292	13	893
21-26588	12	8/25/06	295–300	12.7	2170	296	13	780
21-26588	12	8/25/06	300–305	12.7	2170	303	59	526
21-26588	12	8/25/06	305–310	12.7	2170	309	13	464
21-26588	12	8/25/06	310–315	12.7	2170	312	0	526
21-26588	12	8/29/06	315–320	13.5	1468	317	0	762
21-26588	12	8/29/06	320–325	13.5	1468	321	0	217
21-26588	12	8/29/06	325–330	13.5	1468	327	0	827
21-26588	12	8/29/06	330–335	13.5	1468	335	0	692
21-26588	12	8/29/06	335–340	13.5	1468	340	0	420
21-26588	12	8/29/06	340–345	13.5	1468	345	7	648
21-26588	12	8/29/06	345–350	13.5	1468	350	3	469
21-26588	12	8/29/06	350–355	13.5	1468	355	4	802
21-26588	12	8/29/06	355–360	13.5	1468	360	0	692
21-26482	13	4/27/06	0–5	30	1330	—	<2x Bk[d]	<2x Bk
21-26482	13	4/27/06	5–10	30	1330	—	<2x Bk	<2x Bk
21-26482	13	4/28/06	10–15	30	1330	—	<2x Bk	<2x Bk
21-26482	13	4/28/06	15–20	30	1330	—	<2x Bk	<2x Bk
21-26482	13	4/28/06	20–25	30	1330	—	<2x Bk	<2x Bk
21-26482	13	4/28/06	25–30	50	1500	—	<2x Bk	<2x Bk
21-26482	13	4/28/06	30–35	50	1500	—	<2x Bk	<2x Bk

Table 2.5-2 (continued)

Location ID	Borehole	Date	Scan Depth (ft bgs)	Background (dpm/100cm^2)		1-min. Pat Scan (dpm/100cm^2)		
				Alpha	Beta/Gamma	Scan Depth (ft bgs)	Alpha	Beta/Gamma
21-26482	13	4/28/06	35–40	50	1500	—	<2x Bk	<2x Bk
21-26482	13	4/28/06	40–45	50	1500	41	<2x Bk	<2x Bk
21-26482	13	4/28/06	45–50	50	1500	—	54	1007
21-26598	14	9/5/06	0–5	0	1741	4	0	430
21-26598	14	9/5/06	5–10	0	1741	9.5	0	268
21-26598	14	9/5/06	10–15	0	1741	13.5	0	103
21-26598	14	9/5/06	15–20	0	1741	18.5	0	400
21-26598	14	9/5/06	20–25	0	1741	21.5	0	288
21-26598	14	9/5/06	25–30	0	1741	25.5	0	361
21-26598	14	9/5/06	30–35	0	1741	31	0	181
21-26598	14	9/5/06	35–40	0	1741	38	2	814
21-26598	14	9/5/06	40–45	0	1741	41	3	224
21-26598	14	9/5/06	45–50	0	1741	48	1	658
21-26598	14	9/6/06	50–55	25	1429	54	0	845
21-26598	14	9/6/06	55–60	25	1429	57	0	818
21-26598	14	9/6/06	60–65	25	1429	61	6	779
21-26598	14	9/6/06	65–70	25	1429	66	18	695
21-26598	14	9/6/06	70–75	25	1429	71	16	727
21-26598	14	9/6/06	75–80	25	1429	76	25	977
21-26598	14	9/6/06	80–85	25	1429	80.5	13	608
21-26484	15	5/2/06	0–5	70	1400	1.3	55	711
21-26484	15	5/2/06	5–10	70	1400	5.8	30	700
21-26484	15	5/2/06	10–15	70	1400	13.5	17	1280
21-26484	15	5/2/06	15–20	70	1400	17	5	1092
21-26484	15	5/2/06	20–25	70	1400	20.5	30	905

Table 2.5-2 (continued)

				Background (dpm/100cm^2)		1-min. Pat Scan (dpm/100cm^2)		
Location ID	Borehole	Date	Scan Depth (ft bgs)	Alpha	Beta/Gamma	Scan Depth (ft bgs)	Alpha	Beta/Gamma
21-26484	15	5/2/06	25–30	70	1400	26.7	36	1131
21-26484	15	5/2/06	30–35	70	1400	32	43	938
21-26484	15	5/2/06	35–40	70	1400	35.5	24	1200
21-26484	15	5/2/06	40–45	70	1400	44	71	960
21-26590	16	9/8/06	Surface	18	1900	0	0	864
21-26590	16	9/8/06	0–5	18	1900	2	8	809
21-26590	16	9/8/06	5–10	18	1900	6	0	867
21-26590	16	9/8/06	10–15	18	1900	12	0	678
21-26590	16	9/8/06	15–20	18	1900	16	0	202
21-26590	16	9/8/06	20–25	18	1900	21	0	278
21-26590	16	9/8/06	25–30	18	1900	27.5	0	722
21-26590	16	9/8/06	30–35	18	1900	33	0	321
21-26590	16	9/8/06	35–40	18	1900	39	0	367
21-26590	16	9/8/06	40–45	18	1900	41	0	883
21-26590	16	9/9/06	45–50	0	1461	49	0	672
21-26590	16	9/9/06	50–55	0	1461	53	4	1095
21-26590	16	9/9/06	55–60	0	1461	56	3	1044
21-26590	16	9/9/06	60–65	0	1461	62.5	12	742
21-26590	16	9/9/06	65–70	0	1461	66	0	452
21-26590	16	9/9/06	70–75	0	1461	71	18	980
21-26590	16	9/10/06	75–80	0	1461	77.5	56	2050
21-26590	16	9/10/06	80–85	0	1461	84	56	4610
21-26590	16	9/10/06	85–90	0	1461	8	0	985
21-26590	16	9/10/06	90–95	0	1461	92	0	778
21-26590	16	9/10/06	95–100	0	1461	97	0	732

Table 2.5-2 (continued)

Location ID	Borehole	Date	Scan Depth (ft bgs)	Background (dpm/100cm^2)		1-min. Pat Scan (dpm/100cm^2)		
				Alpha	Beta/Gamma	Scan Depth (ft bgs)	Alpha	Beta/Gamma
21-26590	16	9/10/06	100–105	0	1461	102	0	747
21-26590	16	9/10/06	105–110	0	1461	107	0	698
21-26590	16	9/10/06	110–115	0	1461	112	0	667
21-26590	16	9/10/06	115–120	0	1461	116	0	637
21-26590	16	9/10/06	120–125	0	1461	121	0	940
21-26590	16	9/10/06	125–130	0	1461	127	0	1453
21-26590	16	9/11/06	130–135	14	1861	132	16	703
21-26590	16	9/11/06	135–140	14	1861	136	6	623

[a] — = The data were not recorded.

[b] Readings were direct-smear survey results.

[c] Results decayed to levels below detection.

[d] <2x Bk = Levels were below two times the background levels.

Table 2.5-3
VOC Field Screening Summary

Location ID	BH	Sample Depth (ft bgs)	Date	Time	Temp (°F)	Ambient (ppm)	Headspace Reading (ppm)
21-26589	1	0-2	9/11/2006	16:30	—*	—	2.5
21-26589	1	10	9/12/2006	8:55	—	0.1	0.2
21-26589	1	20	9/12/2006	10:15	—	—	1.1
21-26589	1	24	9/15/2006	9:20	—	—	0.0
21-26589	1	30	9/15/2006	10:10	—	—	1.8
21-26589	1	40	9/15/2006	14:45	—	—	0.0
21-26589	1	50	9/15/2006	14:45	—	—	0.0
21-26589	1	60	9/15/2006	16:10	—	—	0.0
21-26589	1	70	9/16/2006	9:00	—	0.3	0.5
21-26589	1	80	9/16/2006	12:30	—	0.3	0.8
21-26589	1	90	9/16/2006	15:20	—	—	0.2
21-26589	1	100	9/16/2006	16:30	—	—	1.4
21-26589	1	110	9/17/2006	10:50	—	0.2	0.4
21-26589	1	120	9/17/2006	12:10	—	0.2	0.6
21-26589	1	130	9/19/06	8:50	60	0.0	0.0
21-26589	1	140	9/19/06	10:20	63	0.0	0.0
21-26597	2	10	8/21/2006	14:08	84	0.0	3.4
21-26597	2	20	8/21/2006	14:28	82	0.0	0.2
21-26597	2	30	8/21/2006	15:06	83	0.0	2.4
21-26597	2	40	8/21/2006	15:55	87	0.0	2.0
21-26597	2	50	8/21/2006	16:29	79	0.0	0.0
21-26597	2	60	8/22/2006	8:07	64	0.0	0.4
21-26597	2	70	8/22/2006	8:39	64	0.0	2.6
21-26597	2	80	8/22/2006	9:26	72	0.0	3.1
21-26485	3	10	5/3/2006	13:10	75	—	0.5
21-26485	3	20	5/3/2006	13:10	75	—	0.0
21-26485	3	30	5/3/2006	15:00	77	—	1.7
21-26485	3	40	5/3/2006	15:00	77	—	0.0
21-26480	4	10	5/4/2006	13:45	73	—	0.7
21-26480	4	20	5/4/2006	13:45	73	—	0.7
21-26480	4	30	5/4/2006	15:15	74	—	0.0
21-26480	4	38.5	5/4/2006	15:15	74	—	0.0
21-26481	5	10	5/1/2006	13:00	68	—	0.0
21-26481	5	20	5/1/2006	13:00	68	—	0.0
21-26481	5	30	5/1/2006	16:00	68	—	0.0
21-26481	5	40	5/1/2006	16:00	68	—	0.0

Table 2.5-3 (continued)

Location ID	BH	Sample Depth (ft bgs)	Date	Time	Temp (°F)	Ambient (ppm)	Headspace Reading (ppm)
21-26591	6	10	8/14/2006	14:27	73	0.0	0.8
21-26591	6	20	8/15/2006	8:49	63	0.0	1.1
21-26591	6	30	8/15/2006	9:21	65	0.0	0.7
21-26592	7	10	8/15/2006	12:18	87	0.0	0.0
21-26592	7	20	8/15/2006	12:42	86	0.0	0.8
21-26592	7	30	8/15/2006	13:07	91	0.0	0.9
21-26593	8	10	8/13/2006	—	77	0.0	0.0
21-26593	8	20	8/13/2006	—	77	0.0	0.0
21-26593	8	30	8/13/2006	—	80	0.0	0.0
21-26594	9	10	8/16/2006	13:24	80	0.0	4.1
21-26594	9	20	8/16/2006	13:35	74	0.0	4.0
21-26594	9	30	8/16/2006	13:46	72	0.0	2.5
21-26595	10	10	8/14/2006	—	67	0.0	6.5
21-26595	10	20	8/14/2006	—	70	0.0	4.5
21-26595	10	30	8/14/2006	—	70	0.0	4.0
21-26595	10	35	8/14/2006	10:23	71	0.0	3.1
21-26596	11	10	8/16/2006	8:53	68	0.0	2.4
21-26596	11	20	8/16/2006	9:17	70	0.0	3.0
21-26596	11	30	8/16/2006	9:43	72	0.0	2.1
21-26588	12	10	8/13/2006	—	—	0.0	0.0
21-26588	12	20	8/13/2006	—	—	0.0	0.0
21-26588	12	30	8/13/2006	—	—	0.0	0.1
21-26588	12	40	8/13/2006	10:29	—	0.0	3.0
21-26588	12	50	8/13/2006	14:21	—	0.0	1.4
21-26588	12	60	8/13/2006	13:53	—	0.0	4.0
21-26588	12	70	8/13/2006	14:24	—	0.0	1.7
21-26588	12	90	8/15/2006	9:31	68	0.0	0.9
21-26588	12	100	8/15/2006	12:09	82	0.0	0.9
21-26588	12	110	8/15/2006	12:36	82	0.0	2.7
21-26588	12	120	8/15/2006	13:32	86	0.0	1.2
21-26588	12	130	8/15/2006	15:28	84	0.0	0.9
21-26588	12	140	8/16/2006	9:18	70	0.0	3.8
21-26588	12	150	8/16/2006	10:05	74	0.0	2.6
21-26588	12	160	8/22/2006	11:41	83	0.0	3.2
21-26588	12	170	8/22/2006	15:12	79	0.0	2.3
21-26588	12	180	8/22/2006	15:30	82	0.0	2.0
21-26588	12	190	8/22/2006	16:17	82	0.0	2.9
21-26588	12	200	8/23/2006	8:25	68	0.0	3.3

Table 2.5-3 (continued)

Location ID	BH	Sample Depth (ft bgs)	Date	Time	Temp (°F)	Ambient (ppm)	Headspace Reading (ppm)
21-26588	12	210	8/23/2006	9:21	72	0.0	2.9
21-26588	12	220	8/23/2006	11:32	80	0.0	2.5
21-26588	12	230	8/23/2006	12:25	82	0.0	0.8
21-26588	12	240	8/23/2006	14:03	78	0.0	0.6
21-26588	12	250	8/24/2006	9:00	75	0.0	0.6
21-26588	12	260	8/24/2006	10:09	81	0.0	0.4
21-26588	12	270	8/24/2006	11:16	83	0.0	39.0
21-26588	12	280	8/25/2006	7:30	68	0.0	2.0
21-26588	12	290	8/25/2006	9:45	72	0.0	1.1
21-26588	12	300	8/26/2006	10:50	78	0.0	2.8
21-26588	12	310	8/26/2006	11:30	80	0.0	1.6
21-26588	12	320	8/29/2006	12:00	78	0.0	1.1
21-26588	12	330	8/29/2006	12:57	80	0.0	6.5
21-26588	12	340	8/29/2006	15:04	81	0.0	3.5
21-26588	12	350	8/29/2006	17:54	83	0.0	3.1
21-26482	13	7.5	4/27/2006	15:45	74	—	<1
21-26482	13	20	4/27/2006	17:30	72	—	4.6
21-26482	13	30	4/28/2006	11:15	63	—	0.0
21-26482	13	40	4/28/2006	16:15	61	—	0.0
21-26598	14	10	9/5/2006	10:31	78	0.0	2.8
21-26598	14	20	9/5/2006	11:47	81	0.0	1.9
21-26598	14	30	9/5/2006	12:30	83	0.0	0.9
21-26598	14	40	9/5/2006	15:55	80	0.0	0.0
21-26598	14	50	9/6/2006	8:45	70	0.0	2.4
21-26598	14	60	9/6/2006	10:15	79	0.0	3.4
21-26598	14	70	9/6/2006	11:25	80	0.0	0.4
21-26598	14	80	9/6/2006	12:50	79	0.0	0.6
21-26484	15	10	5/2/2006	12:20	67	—	0.9
21-26484	15	18	5/2/2006	12:20	68	—	0.0
21-26484	15	18.5	5/2/2006	17:00	68	—	0.0
21-26484	15	40	5/2/2006	17:00	68	—	0.0
21-26590	16	10	9/8/2006	14:45	64	0.0	0.5
21-26590	16	20	9/8/2006	16:20	61	0.0	0.5
21-26590	16	30	9/8/2006	16:40	62	0.0	0.3
21-26590	16	40	9/8/2006	17:15	60	0.0	0.2
21-26590	16	50	9/9/2006	12:00	60	—	3.0
21-26590	16	60	9/9/2006	14:30	—	—	2.3
21-26590	16	70	9/9/2006	14:15	—	—	4.4

Table 2.5-3 (continued)

Location ID	BH	Sample Depth (ft bgs)	Date	Time	Temp (°F)	Ambient (ppm)	Headspace Reading (ppm)
21-26590	16	80	9/10/2006	8:45	—	1.4	2.9
21-26590	16	90	9/10/2006	10:00	—	—	3.9
21-26590	16	100	9/10/2006	11:45	—	—	3.1
21-26590	16	110	9/10/2006	15:40	—	—	2.2
21-26590	16	120	9/10/2006	16:40	—	—	4.0
21-26590	16	130	9/11/2006	10:15	—	—	3.0
21-26590	16	140	9/11/2006	11:05	—	3.8	5.2

* — = Data were not recorded.

Table 2.5-4
Pore-Gas Screening Results

Sample Date	Time	BH #	Location ID	Sample ID	Depth (ft)	CO_2 %	O_2 %	CH_4 %	Pressure (mb) Max/Min[a]	Sampled By
5/15/2006	15:20	4	21-26480	MD21-06-70738	25–27	1.30%	19.80%	0.00%	784.6mb	WCS
5/15/2006	12:42	4	21-26480	MD21-06-70863 [b]	36–38.5	1.20%	19.90%	0.00%	784.6mb	WCS
5/15/2006	12:42	4	21-26480	MD21-06-70737	36–38.5	1.20%	19.90%	0.00%	784.6mb	WCS
8/11/2006	15:40	4	21-26480	MD21-06-73141	42–44	1.1	20.3	0.0	800.7/805.3	WCS
5/5/2006	9:40	4	21-26480	MD21-06-70736	48–49ft	1.50%	19.70%	0.00%	774.8mb	WCS
5/9/2006	15:35	5	21-26481	MD21-06-70755	25–27	0.60%	20.60%	0.00%	772.3mb	WCS
8/11/2006	13:35	5	21-26481	MD21-06-73144	40.5–42	0.2	21.6	0.0	800.7/805.3	WCS
5/2/2006	9:15	5	21-26481	MD21-06-70754	45–46	1.10%	19.90%	0.00%	776.7mb	WCS
5/9/2006	10:50	13	21-26482	MD21-06-70784	13.2–15	0.20%	20.90%	0.00%	772.3mb	WCS
5/8/2006	18:00	13	21-26482	MD21-06-70783	19–22	0.00%	21.10%	0.00%	773.6mb	WCS
5/8/2006	12:20	13	21-26482	MD21-06-70782	30–32	0.50%	20.50%	0.00%	773.6mb	WCS
5/1/2006	13:37	13	21-26482	MD21-06-70800	40–41ft	0.50%	20.50%	0.00%	776.7mb	WCS
8/10/2006	15:16	13	21-26482	MD21-06-73147	49–50	0.0	22.3	0.0	803.0/806.5	WCS
5/11/2006	15:00	15	21-26484	MD21-06-70831	13–15	0.00%	20.80%	0.00%	782.6mb	WCS
5/10/2006	18:12	15	21-26484	MD21-06-70830	25–27	0.20%	20.90%	0.00%	777.6mb	WCS
5/10/2006	14:55	15	21-26484	MD21-06-70829	35–37	0.20%	20.80%	0.00%	777.6mb	WCS
8/11/2006	11:42	15	21-26484	MD21-06-73150	43–45	0.1	22.2	0.0	800.7/805.3	WCS
5/3/2006	13:05	15	21-26484	MD21-06-70828	48–49	0.80%	19.80%	0.00%	776.1mb	WCS
5/12/2006	16:00	3	21-26485	MD21-06-70850	24–26	1.90%	19.50%	0.00%	777.6mb	WCS
5/12/2006	13:12	3	21-26485	MD21-06-70849	28–30	2.00%	19.50%	0.00%	777.6mb	WCS
5/12/2006	10:00	3	21-26485	MD21-06-70848	30–32	2.20%	19.40%	0.10%	777.6mb	WCS
5/11/2006	18:30	3	21-26485	MD21-06-70847	32–34	1.60%	19.80%	0.00%	782.6mb	WCS
9/27/2006	14:43	3	2126485	MD21-06-73722	43–45	1.5	19.1	0.1	803.2/807.2	WCS
5/3/2006	16:55	3	21-26485	MD21-06-70846	48–49	2.00%	19.20%	0.00%	776.1mb	WCS
9/14/2006	10:58	12	21-26588	MD21-06-71311	5.5–7	1.1	19.8	0.0	795.8/800.5	WCS
9/13/2006	15:43	12	21-26588	MD21-06-71310	15–17.5	1.7	18.8	0.1	800.2/807.1	WCS

Table 2.5-4 (continued)

Sample Date	Time	BH #	Location ID	Sample ID	Depth (ft)	CO_2 %	O_2 %	CH_4 %	Pressure (mb) Max/Min[a]	Sampled By
9/13/2006	12:26	12	21-26588	MD21-06-71309	25–27.5	1.6	19.1	0.0	800.2/807.1	WCS
9/13/2006	10:05	12	21-26588	MD21-06-31708	62.5–65	1.7	19.3	0.0	800.2/807.1	WCS
9/12/2006	16:55	12	21-26588	MD21-06-71307	110–112.5	0.6	20.3	0.0	804.8/808.6	WCS
9/12/2006	12:38	12	21-26588	MD21-06-71306	200–202.5	0.5	20.6	0.0	804.8/808.6	WCS
9/12/2006	8:23	12	21-26588	MD21-06-71305	300–302	0.6	20.4	0.0	804.8/808.6	WCS
8/31/2006	12:32	12	21-26588	MD21-06-71304	359–360	0.1	21.9	0.0	805.3/808.2	WCS
9/26/2006	15:02	1	21-26589	MD21-06-73509	7–9	0.2	20.6	0.0	804.9/808.9	WCS
9/26/2006	13:17	1	21-26589	MD21-06-73510	17–19	0.6	20.4	0.0	804.9/808.9	WCS
9/26/2006	10:33	1	21-26589	MD21-06-71332	47–52	1.2	20.2	0.0	804.9/808.9	WCS
9/21/2006	14:01	1	21-26589	MD21-06-71331	78–80	1.1	19.8	0.0	791.8/795.7	WCS
9/21/2006	11:42	1	21-26589	MD21-06-71330	92–94	1.3	19.8	0.0	791.8/795.7	WCS
9/19/2006	14:42	1	21-26589	MD21-06-71329 [b]	139–140	0.8	20.3	0.0	801.6/806.7	WCS
9/26/2006	10:41	16	21-26590	MD21-06-71508	1.5–3	0.5	20.5	0.1	804.9/808.9	WCS
9/21/2006	15:00	16	21-26590	MD21-06-71507 [b]	27–30	0.9	19.7	0.1	791.8/795.7	WCS
9/21/2006	11:22	16	21-26590	MD21-06-71336	45–50	1.0	20.2	0.0	791.8/795.7	WCS
9/20/2006	13:18	16	21-26590	MD21-06-71335	75–77	1.1	20.2	0.0	792.2/802.2	WCS
9/20/2006	10:54	16	21-26590	MD21-06-71334	100–102	1.2	20.3	0.0	792.2/802.2	WCS
9/11/2006	14:20	16	21-26590	MD21-06-71333	139–140	0.7	20.3	0.0	804.1/807.4	WCS
9/6/2006	10:00	6	21-26591	MD21-06-71375	1.5–2.5	2.1	20.4	0.0	804.0/808.9	WCS
9/5/2006	16:11	6	21-26591	MD21-06-71374	15–17	1.6	19.9	0.0	806.4/811.4	WCS
9/5/2006	12:06	6	21-26591	MD21-06-71373 [b]	27–30	1.1	21.0	0.0	806.4/811.4	WCS
8/15/2006	14:10	6	21-26591	MD21-06-71372	34–35	0.8	21.4	0.0	803.1/806.3	WCS
9/5/2006	10:43	7	21-26592	MD21-06-71379	1.5–4	1.1	21.3	0.0	806.4/811.4	WCS
8/29/2006	11:47	7	21-26592	MD21-06-71378	15–17	1.3	21.3	0.0	802.9/804.9	WCS
8/28/2006	15:51	7	21-26592	MD21-06-71377	23–25	1.1	21.0	0.0	800.9/805.4	WCS
8/16/2006	13:50	7	21-26592	MD21-06-71376	34–35	0.6	21.8	0.0	802.4/805.5	WCS

Table 2.5-4 (continued)

Sample Date	Time	BH #	Location ID	Sample ID	Depth (ft)	CO_2 %	O_2 %	CH_4 %	Pressure (mb) Max/Min[a]	Sampled By
8/23/2006	12:30	8	21-26593	MD21-06-71407	3–4	1.3	20.6	0.0	802.9[c]	WCS
8/22/2006	14:13	8	21-26593	MD21-06-71406	15–17	1.6	20.4	0.0	800.0/804.8	WCS
8/22/2006	10:20	8	21-26593	MD21-06-71405	20–23	0.6	21.5	0.0	800.0/804.8	WCS
8/13/2006	13:47	8	21-26593	MD21-06-71404	34–35	0.8	21.3	0.0	800.7/806.5	WCS
9/6/2006	9:51	9	21-26594	MD21-06-71411	1.5–3	0.6	22.1	0.0	804.0/808.9	WCS
9/5/2006	16:56	9	21-26594	MD21-06-71410	17–20	0.9	20.5	0.0	806.4/811.4	WCS
9/5/2006	14:18	9	21-26594	MD21-06-71409	25–27	1.0	20.1	0.0	806.4/811.4	WCS
8/21/2006	16:30	9	21-26594	MD21-06-71408	34–35	0.5	21.5	0.0	804.3/809.3	WCS
8/28/2006	11:30	10	21-26595	MD21-06-71439	2–4	0.0	22.0	0.0	800.9/805.4	WCS
8/26/2006	12:40	10	21-26595	MD21-06-71438	15–17	0.8	21.1	0.0	804.2/807.5	WCS
8/26/2006	10:10	10	21-26595	MD21-06-71437	23–25	1.0	21.5	0.0	804.2/807.5	WCS
8/15/2006	9:30	10	21-26595	MD21-06-71436	34–35	0.2	22.5	0.0	803.1/806.3	WCS
9/8/2006	10:47	11	21-26596	MD21-06-71443	5–7	0.2	21.6	0.0	799.9/802.9	WCS
9/6/2006	15:39	11	21-26596	MD21-06-71442	17–20	0.5	21.2	0.0	804.0/808.9	WCS
9/6/2006	12:31	11	21-26596	MD21-06-71441	27–30	0.8	19.8	0.0	804.0/808.9	WCS
8/21/2006	13:15	11	21-26596	MD21-06-71440	34–35	0.6	21.7	0.0	804.3/809.3	WCS
9/15/2006	8:52	2	21-26597	MD21-06-71471	1.5–3	1.2	20.1	0.0	795.7/799.9	WCS
9/14/2006	15:32	2	21-26597	MD21-06-71470	12–15	1.2	19.4	0.0	795.8/800.5	WCS
9/14/2006	13:31	2	21-26597	MD21-06-71469	23–25	1.3	19.4	0.1	795.8/800.5	WCS
8/24/2006	11:05	2	21-26597	MD21-06-71468	84–85	0.7	21.2	0.0	800.3/803.6	WCS
9/27/2006	13:05	14	21-26598	MD21-06-71475	1.5–3	0.4	20.5	0.0	803.2/807.2	WCS
9/27/2006	11:20	14	21-26598	MD21-06-71474 [b]	25–30	1.7	19.3	0.0	803.2/807.2	WCS
9/20/2006	16:12	14	21-26598	MD21-06-71473	50–55	1.6	19.7	0.1	792.2/802.2	WCS
9/7/2006	11:03	14	21-26598	MD21-06-71472	84–85	1.6	20.7	0.0	801.3/805.3	WCS
5/17/2006	9:44	n/a[d]	n/a	MD21-06-70859 [e]	n/a	n/a	n/a	n/a	780.5mb	WCS
9/28/2006	10:13	n/a	n/a	MD21-06-73724 [f]	n/a	n/a	n/a	n/a	n/a	WCS

Table 2.5-4 (continued)

Sample Date	Time	BH #	Location ID	Sample ID	Depth (ft)	CO_2 %	O_2 %	CH_4 %	Pressure (mb) Max/Min[a]	Sampled By
9/28/2006	10:20	n/a	n/a	MD21-06-73723[f]	n/a	n/a	n/a	n/a	n/a	WCS

[a] Pressure recorded at TA-54.

[b] Sample is a field duplicate.

[c] Maximum pressure only.

[d] n/a = Not applicable.

[e] Sample is an equipment duplicate.

[f] Sample is a field equipment blank.

Table 2.5-5
Borehole and Surface/Shallow-Subsurface Sampling Locations by MDA A Area

Location IDs	Borehole/Surface Sample #	Length (ft)
Hillslope Surface and Shallow-Subsurface Sample Area		
21-01154	SS-7	n/a
21-01290	SS-9	n/a
21-02030	SS-5	n/a
21-26486	SS-3	n/a
21-26487	SS-4	n/a
21-26488	SS-6	n/a
21-26489	SS-8	n/a
21-26490	SS-10	n/a
21-26491	SS-11	n/a
21-26492	SS-12	n/a
21-26493	SS-13	n/a
21-26494	SS-15	n/a
21-26495	SS-16	n/a
Eastern Disposal Pit Area		
21-26591	BH-6	35
21-26592	BH-7	35
21-26593	BH-8	35
21-26594	BH-9	35
21-26595	BH-10	35
21-26596	BH-11	35
21-26482	BH-13	50
21-02586	SS-1	n/a
21-02058	SS-2	n/a
Central Disposal Pit Area		
21-26597	BH-2	85
21-26485	BH-3	45
21-26480	BH-4	44
21-26481	BH-5	45
21-26588	BH-12	360
General's Tanks Area		
21-26589	BH-1	140
21-26590	BH-16	140
21-26598	BH-14	85
21-02042	SS-14	n/a
21-26484	BH-15	45

Table 2.5-6
MDA A Sample Collection and Analysis Summary

Sample ID	Location ID	Borehole	Depth Interval (ft)	Sample Justification	Cyanide (SW-846 9012A)	Nitrates (EPA Method 300.0)	Perchlorate (SW-846 6850)	TAL Metals, (SW-846 6010B SW-846 6020, and SW-846 7471A)	Total Iodide (EPA Method 345.1)	Total Uranium (SW-846 6020)	Americium-241 (HASL-300)	Gamma Spectroscopy (EPA Method 901.1)	Isotopic Plutonium (HASL-300)	Isotopic Uranium (HASL-300)	Strontium-90 (EPA Method 905)	High Explosives (SW-846 8321A_MOD and SW-846 8330)	PCBs (SW-846 8082)	SVOCs (SW-846 8270C)	VOCs (SW-846 8260B)	Dioxins/Furans (SW-846 8290)	Tritium (H3, EPA Method 906)	VOCs (TO15)	pH (SW-846 9045C)
MD21-06-70727	21-26480	BH-4	0–0.5	Surface Sample	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—[a]	—	X
MD21-06-70728	21-26480	BH-4	25–27	Base of Central Pit (CP[b])	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-70729	21-26480	BH-4	42–44	Total Depth	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-70730	21-26480	BH-4	36–38.5	Observed Iron Staining	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-70736	21-26480	BH-4	48–49	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-70737	21-26480	BH-4	36–38.5	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-70738	21-26480	BH-4	25–27	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-70745	21-26481	BH-5	0–0.5	Surface Sample	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-70746	21-26481	BH-5	25–27	Base of Central Pit	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-70747	21-26481	BH-5	43–45	Sample	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-70748	21-26481	BH-5	40.5–42	Observed Fracture	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-70749	21-26481	BH-5	27.5–29	Elevated (2X) Radionuclide-Only Sample	—	—	—	—	—	X	X	X	X	X	X	—	—	—	—	—	—	—	—
MD21-06-70754	21-16481	BH-5	45–46	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-70755	21-26481	BH-5	25–27	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-70763	n/a[c]	BH-4	n/a	Rinsate	X	—	X	X	—	X	—	—	—	—	—	—	—	—	—	—	—	—	—
MD21-06-70765	n/a	BH-13	n/a	Trip Blank	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—
MD21-06-70773	21-26482	BH-13	0–0.5	Surface Sample	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-70774	21-26482	BH-13	13.2–15	Base of Eastern Pits	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-70775	21-26482	BH-13	30–32	Permeability	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-70776	21-26482	BH-13	19–22	Observed Moisture Zone	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-70777	21-26482	BH-13	49–50	Total Depth	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-70778	21-26482	BH-13	47.3–49	Observed Fracture	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-70779	21-26482	BH-13	15–17	Co-located	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-70780	21-26482	BH-13	22–25	Field Duplicate	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-70782	21-26482	BH-13	30–32	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-70783	21-26482	BH-13	13–22	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-70784	21-26482	BH-13	13.2–15	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-70800	21-26482	BH-13	40–41	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-70810	21-26482	BH-13	n/a	Rinsate	X	—	X	X	—	X	—	—	—	—	—	—	—	—	—	—	—	—	—
MD21-06-70819	21-26484	BH-15	0–0.5	Surface Sample	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-70820	21-26484	BH-15	13–15	Base of General's Tanks	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-70821	21-26484	BH-15	43–45	Total Depth	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X

Table 2.5-6 (continued)

Sample ID	Location ID	Borehole	Depth Interval (ft)	Sample Justification	Cyanide (SW-846 9012A)	Nitrates (EPA Method 300.0)	Perchlorate (SW-846 6850)	TAL Metals, (SW-846 6010B SW-846 6020, and SW-846 7471A)	Total Iodide (EPA Method 345.1)	Total Uranium (SW-846 6020)	Americium-241 (HASL-300)	Gamma Spectroscopy (EPA Method 901.1)	Isotopic Plutonium (HASL-300)	Isotopic Uranium (HASL-300)	Strontium-90 (EPA Method 905)	High Explosives (SW-846 8321A_MOD and SW-846 8330)	PCBs (SW-846 8082)	SVOCs (SW-846 8270C)	VOCs (SW-846 8260B)	Dioxins/Furans (SW-846 8290)	Tritium (H3, EPA Method 906)	VOCs (TO15)	pH (SW-846 9045C)
MD21-06-70822	21-26484	BH-15	25–27	Paleochannel	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-70823	21-26484	BH-15	35–37	Observed Iron Staining	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-70828	21-26484	BH-15	48–49	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-70829	21-26484	BH-15	35–37	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-70830	21-26484	BH-15	25–27	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-70831	21-26484	BH-15	13–15	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-70837	21-26485	BH-3	0–0.5	Surface Sample	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-70838	21-26485	BH-3	24–26	Base of Central Pit	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-70839	21-26485	BH-3	43–45	Total Depth	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-70840	21-26485	BH-3	30–32	Observed Fracture Matrix	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-70841	21-26485	BH-3	32–34	Observed Fracture Fill	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-70842	21-26485	BH-3	28–30	Observed Fracture	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-70846	21-26485	BH-3	48–49	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-70847	21-26485	BH-3	32–34	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-70848	21-26485	BH-3	30–32	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-70849	21-26485	BH-3	28–30	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-70850	21-26485	BH-3	24–26	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-70859	n/a	n/a	n/a	Field Blank	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-70863	21-26480	BH-4	36–38.5	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-70892	21-01154	SS-7[d]	0–0.5	Surface	X	—	X	X	X	X	X	X	X	X	X	X	—	X	—	—	—	—	X
MD21-06-70893	21-01154	SS-7	1.5–2	Shallow Subsurface	X	—	X	X	X	X	X	X	X	X	X	X	—	X	—	—	—	—	X
MD21-06-70900	21-02030	SS-5	0–0.5	Surface	X	—	X	X	X	X	X	X	X	X	X	X	—	X	—	—	—	—	X
MD21-06-70901	21-02030	SS-5	1.5–2	Shallow Subsurface	X	—	X	X	X	X	X	X	X	X	X	X	—	X	—	—	—	—	X
MD21-06-70908	21-01290	SS-9	0–0.5	Surface	X	—	X	X	X	X	X	X	X	X	X	X	—	X	—	—	—	—	X
MD21-06-70909	21-01290	SS-9	1.5–2	Shallow Subsurface	X	—	X	X	X	X	X	X	X	X	X	X	—	X	—	—	—	—	X
MD21-06-70916	21-02586	SS-1	0–0.5	Surface	X	—	X	X	X	X	X	X	X	X	X	X	—	X	—	—	—	—	X
MD21-06-70917	21-02586	SS-1	1.5–2	Shallow Subsurface	X	—	X	X	X	X	X	X	X	X	X	X	—	X	—	—	—	—	X
MD21-06-70924	21-02058	SS-2	0–0.5	Surface	X	—	X	X	X	X	X	X	X	X	X	X	—	X	—	—	—	—	X
MD21-06-70925	21-02058	SS-2	1.5–2	Shallow Subsurface	X	—	X	X	X	X	X	X	X	X	X	X	—	X	—	—	—	—	X
MD21-06-70932	21-02042	SS-14	0–0.5	Surface	X	—	X	X	X	X	X	X	X	X	X	X	—	X	—	—	—	—	X
MD21-06-70933	21-02042	SS-14	1.5–2	Shallow Subsurface	X	—	X	X	X	X	X	X	X	X	X	X	—	X	—	—	—	—	X
MD21-06-70944	n/a	n/a	n/a	Field Blank	—	—	X	X	—	X	—	—	—	—	—	—	—	—	—	—	—	—	—
MD21-06-70946	21-26486	SS-3	0–0.5	Surface	X	—	X	X	X	X	X	X	X	X	X	X	—	X	—	—	—	—	X
MD21-06-70947	21-26486	SS-3	1.5–2	Shallow Subsurface	X	—	X	X	X	X	X	X	X	X	X	X	—	X	—	—	—	—	X

Table 2.5-6 (continued)

Sample ID	Location ID	Borehole	Depth Interval (ft)	Sample Justification	Cyanide (SW-846 9012A)	Nitrates (EPA Method 300.0)	Perchlorate (SW-846 6850)	TAL Metals, (SW-846 6010B SW-846 6020, and SW-846 7471A)	Total Iodide (EPA Method 345.1)	Total Uranium (SW-846 6020)	Americium-241 (HASL-300)	Gamma Spectroscopy (EPA Method 901.1)	Isotopic Plutonium (HASL-300)	Isotopic Uranium (HASL-300)	Strontium-90 (EPA Method 905)	High Explosives (SW-846 8321A_MOD and SW-846 8330)	PCBs (SW-846 8082)	SVOCs (SW-846 8270C)	VOCs (SW-846 8260B)	Dioxins/Furans (SW-846 8290)	Tritium (H3, EPA Method 906)	VOCs (TO15)	pH (SW-846 9045C)
MD21-06-70954	21-26487	SS-4	0–0.5	Surface	X	—	X	X	X	X	X	X	X	X	X	X	—	X	—	—	—	—	X
MD21-06-70955	21-26487	SS-4	1.5–2	Shallow Subsurface	X	—	X	X	X	X	X	X	X	X	X	X	—	X	—	—	—	—	X
MD21-06-70962	21-26488	SS-6	0–0.5	Surface	X	—	X	X	X	X	X	X	X	X	X	X	—	X	—	—	—	—	X
MD21-06-70963	21-26488	SS-6	1.5–2	Shallow Subsurface	X	—	X	X	X	X	X	X	X	X	X	X	—	X	—	—	—	—	X
MD21-06-70970	21-26489	SS-8	0–0.5	Surface	X	—	X	X	X	X	X	X	X	X	X	X	—	X	—	—	—	—	X
MD21-06-70971	21-26489	SS-8	1.5–2	Shallow Subsurface	X	—	X	X	X	X	X	X	X	X	X	X	—	X	—	—	—	—	X
MD21-06-70978	21-26490	SS-10	0–0.5	Surface	X	—	X	X	X	X	X	X	X	X	X	X	—	X	—	—	—	—	X
MD21-06-70979	21-26490	SS-10	1.5–2	Shallow Subsurface	X	—	X	X	X	X	X	X	X	X	X	X	—	X	—	—	—	—	X
MD21-06-70992	21-26491	SS-11	0–0.5	Surface	X	—	X	X	X	X	X	X	X	X	X	X	—	X	—	—	—	—	X
MD21-06-70993	21-26491	SS-11	1.5–2	Shallow Subsurface	X	—	X	X	X	X	X	X	X	X	X	X	—	X	—	—	—	—	X
MD21-06-70996	21-16492	SS-12	0–0.5	Surface	X	—	X	X	X	X	X	X	X	X	X	X	—	X	—	—	—	—	X
MD21-06-70997	21-26492	SS-12	1.5–2	Shallow Subsurface	X	—	X	X	X	X	X	X	X	X	X	X	—	X	—	—	—	—	X
MD21-06-71000	21-26493	SS-13	0–0.5	Surface	X	—	X	X	X	X	X	X	X	X	X	X	—	X	—	—	—	—	X
MD21-06-71001	21-26493	SS-13	1.5–2	Shallow Subsurface	X	—	X	X	X	X	X	X	X	X	X	X	—	X	—	—	—	—	X
MD21-06-71004	21-16494	SS-15	0–0.5	Surface	X	—	X	X	X	X	X	X	X	X	X	X	—	X	—	—	—	—	X
MD21-06-71005	21-26494	SS-15	1.5–	Shallow Subsurface	X	—	X	X	X	X	X	X	X	X	X	X	—	X	—	—	—	—	X
MD21-06-71008	21-26495	SS-16	0–0.5	Surface	X	—	X	X	X	X	X	X	X	X	X	X	—	X	—	—	—	—	X
MD21-06-71009	21-26495	SS-16	1.5–2	Shallow Subsurface	X	—	X	X	X	X	X	X	X	X	X	X	—	X	—	—	—	—	X
MD21-06-71014	n/a	n/a	n/a	Rinsate	X	—	X	X	—	X	—	—	—	—	—	—	—	—	—	—	—	—	—
MD21-06-71021	21-02586	SS-1	0–0.5	Field Duplicate	X	—	X	X	X	X	X	X	X	X	X	X	—	X	—	—	—	—	X
MD21-06-71022	21-26486	SS-3	1.5–2	Field Duplicate	X	—	X	X	X	X	X	X	X	X	X	X	—	X	—	—	—	—	X
MD21-06-71023	21-26488	SS-6	0–0.5	Field Duplicate	X	—	X	X	X	X	X	X	X	X	X	X	—	X	—	—	—	—	X
MD21-06-71024	21-26489	SS-8	1.5–2	Field Duplicate	X	—	X	X	X	X	X	X	X	X	X	X	—	X	—	—	—	—	X
MD21-06-71027	n/a	n/a	n/a	Rinsate	X	—	X	X	—	X	—	—	—	—	—	—	—	—	—	—	—	—	—
MD21-06-71028	n/a	n/a	n/a	Rinsate	X	—	X	X	—	X	—	—	—	—	—	—	—	—	—	—	—	—	—
MD21-06-71029	n/a	n/a	n/a	Rinsate	X	—	X	X	—	X	—	—	—	—	—	—	—	—	—	—	—	—	—
MD21-06-71030	n/a	n/a	n/a	Rinsate	X	—	X	X	—	X	—	—	—	—	—	—	—	—	—	—	—	—	—
MD21-06-71031	n/a	n/a	n/a	Rinsate	X	—	X	X	—	X	—	—	—	—	—	—	—	—	—	—	—	—	—
MD21-06-71032	n/a	n/a	n/a	Rinsate	X	—	X	X	—	X	—	—	—	—	—	—	—	—	—	—	—	—	—
MD21-06-71293	21-26588	BH-12	0–0.5	Surface Sample	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71294	21-26588	BH-12	5.5–7	Cover Sample	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71295	21-26588	BH-12	15–17.5	Base of Eastern Pits	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71296	21-26588	BH-12	25–27.5	Base of Central Pit	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71297	21-26588	BH-12	62.5–65	Observed Permeable Zone	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X

Table 2.5-6 (continued)

Sample ID	Location ID	Borehole	Depth Interval (ft)	Sample Justification	Cyanide (SW-846 9012A)	Nitrates (EPA Method 300.0)	Perchlorate (SW-846 6850)	TAL Metals, (SW-846 6010B SW-846 6020, and SW-846 7471A)	Total Iodide (EPA Method 345.1)	Total Uranium (SW-846 6020)	Americium-241 (HASL-300)	Gamma Spectroscopy (EPA Method 901.1)	Isotopic Plutonium (HASL-300)	Isotopic Uranium (HASL-300)	Strontium-90 (EPA Method 905)	High Explosives (SW-846 8321A_MOD and SW-846 8330)	PCBs (SW-846 8082)	SVOCs (SW-846 8270C)	VOCs (SW-846 8260B)	Dioxins/Furans (SW-846 8290)	Tritium (H3, EPA Method 906)	VOCs (TO15)	pH (SW-846 9045C)
MD21-06-71298	21-26588	BH-12	110–112.5	Qbt 3/Qbt 2 Contact	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71299	21-26588	BH-12	200–202.5	Observed Permeable Zone	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71300	21-26588	BH-12	300–302.5	Observed Permeable Zone	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71301	21-26588	BH-12	355–360	Total Depth	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71304	21-26588	BH-12	359–360	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-71305	21-26588	BH-12	300–302	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-71306	21-26588	BH-12	200–202.5	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-71307	21-26588	BH-12	110–112.5	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-71308	21-26588	BH-12	62.5–65	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-71309	21-26588	BH-12	25–27.5	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-71310	21-26588	BH-12	15–17.5	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-71311	21-26588	BH-12	5.5–7	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-71314	21-26588	BH-12	355–360	Field Duplicate	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71316	n/a	BH-12	n/a	Rinsate	X	—	X	X	—	X	—	—	—	—	—	—	—	—	—	—	—	—	—
MD21-06-71317	n/a	BH-12	n/a	Rinsate	X	—	X	X	—	X	—	—	—	—	—	—	—	—	—	—	—	—	—
MD21-06-71318	n/a	BH-12	n/a	Trip Blank	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—
MD21-06-71319	n/a	BH-12	n/a	Trip Blank	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—
MD21-06-71320	21-26589	BH-1	0–0.5	Surface Sample	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71321	21-26589	BH-1	7–9	Cover Evaluation	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71322	21-26589	BH-1	17–19	Observed Staining	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71323	21-26589	BH-1	47–52	Base of Tank	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71324	21-26589	BH-1	78–80	Below Former Tank Opening	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71325	21-26589	BH-1	92–94	Observed Permeable Zone	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71326	21-26589	BH-1	138–140	Total Depth	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71329	21-26589	BH-1	139–140	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-71330	21-26589	BH-1	92–94	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-71331	21-26589	BH-1	78–80	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-71332	21-26589	BH-1	47–52	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-71333	21-26590	BH-16	139–140	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-71334	21-26590	BH-16	100–102	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-71335	21-26590	BH-16	75–77	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-71336	21-26590	BH-16	45–50	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-71337	21-26590	BH-16	0–0.5	Surface Sample	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71338	21-26590	BH-16	1.5–3	Cover Evaluation	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X

Table 2.5-6 (continued)

Sample ID	Location ID	Borehole	Depth Interval (ft)	Sample Justification	Cyanide (SW-846 9012A)	Nitrates (EPA Method 300.0)	Perchlorate (SW-846 6850)	TAL Metals, (SW-846 6010B SW-846 6020, and SW-846 7471A)	Total Iodide (EPA Method 345.1)	Total Uranium (SW-846 6020)	Americium-241 (HASL-300)	Gamma Spectroscopy (EPA Method 901.1)	Isotopic Plutonium (HASL-300)	Isotopic Uranium (HASL-300)	Strontium-90 (EPA Method 905)	High Explosives (SW-846 8321A_MOD and SW-846 8330)	PCBs (SW-846 8082)	SVOCs (SW-846 8270C)	VOCs (SW-846 8260B)	Dioxins/Furans (SW-846 8290)	Tritium (H3, EPA Method 906)	VOCs (TO15)	pH (SW-846 9045C)
MD21-06-71339	21-26590	BH-16	27–30	Observed Permeable Zone	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71340	21-26590	BH-16	45–50	Base of Tank	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71341	21-26590	BH-16	75–77	Below Former Tank Opening	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71342	21-26590	BH-16	100–102	Observed Permeable Zone	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71343	21-26590	BH-16	137–140	Total Depth	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71346	21-26589	BH-1	47–52	Field Duplicate	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71347	21-26590	BH-16	45–50	Field Duplicate	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71349	n/a	n/a	n/a	Rinsate	X	—	X	X	—	X	—	—	—	—	—	—	—	—	—	—	—	—	—
MD21-06-71350	n/a	n/a	n/a	Trip Blank	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—
MD21-06-71351	n/a	n/a	n/a	Trip Blank	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—
MD21-06-71352	21-26591	BH-6	0–0.5	Surface Sample	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71353	21-26591	BH-6	1.5–2.5	Cover Evaluation	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71354	21-26591	BH-6	15–17	Base of Eastern Pit	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71355	21-26591	BH-6	27–30	Base of Central Pit	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71356	21-26591	BH-6	30–35	Total Depth	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71361	21-26592	BH-7	0–0.5	Surface Sample	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71362	21-26592	BH-7	1.5–4	Cover Evaluation	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71363	21-26592	BH-7	15–17	Observed Fracture	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71364	21-26592	BH-7	23–25	Observed Fracture	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71365	21-26592	BH-7	33–35	Total Depth	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71370	21-26591	BH-6	30–35	Field Duplicate	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71372	21-26591	BH-6	34–35	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-71373	21-26591	BH-6	27–30	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-71374	21-26591	BH-6	15–17	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-71375	21-26591	BH-6	1.5–2.5	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-71376	21-26592	BH-7	34–35	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-71377	21-26592	BH-7	23–25	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-71378	21-26592	BH-7	15–17	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-71379	21-26592	BH-7	1.5–4	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-71380	n/a	n/a	n/a	Rinsate	X	—	X	X	—	X	—	—	—	—	—	—	—	—	—	—	—	—	—
MD21-06-71381	n/a	n/a	n/a	Rinsate	X	—	X	X	—	X	—	—	—	—	—	—	—	—	—	—	—	—	—
MD21-06-71382	n/a	n/a	n/a	Trip Blank	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—
MD21-06-71383	n/a	n/a	n/a	Trip Blank	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—
MD21-06-71384	21-26593	BH-8	3–7	Cover Evaluation	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X

Table 2.5-6 (continued)

Sample ID	Location ID	Borehole	Depth Interval (ft)	Sample Justification	Cyanide (SW-846 9012A)	Nitrates (EPA Method 300.0)	Perchlorate (SW-846 6850)	TAL Metals, (SW-846 6010B SW-846 6020, and SW-846 7471A)	Total Iodide (EPA Method 345.1)	Total Uranium (SW-846 6020)	Americium-241 (HASL-300)	Gamma Spectroscopy (EPA Method 901.1)	Isotopic Plutonium (HASL-300)	Isotopic Uranium (HASL-300)	Strontium-90 (EPA Method 905)	High Explosives (SW-846 8321A_MOD and SW-846 8330)	PCBs (SW-846 8082)	SVOCs (SW-846 8270C)	VOCs (SW-846 8260B)	Dioxins/Furans (SW-846 8290)	Tritium (H3, EPA Method 906)	VOCs (TO15)	pH (SW-846 9045C)
MD21-06-71385	21-26593	BH-8	15–17	Base of Eastern Pits	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71386	21-26593	BH-8	21–23	Observed Fracture/Base of CP[b]	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71387	21-26593	BH-8	33–35	Total Depth	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71388	21-26593	BH-8	0–0.5	Surface Sample	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71389	21-26593	BH-8	1.5–2	Cover Evaluation	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71393	21-26594	BH-9	0–0.5	Surface Sample	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71394	21-26594	BH-9	1.5–3	Cover Evaluation	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71395	21-26594	BH-9	17–20	Base of Eastern Pits	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71396	21-26594	BH-9	25–27	Observed Permeable Zone	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71397	21-26594	BH-9	30–35	Total Depth	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71403	21-26594	BH-9	30–35	Field Duplicate	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71404	21-26593	BH-8	34–35	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-71405	21-26593	BH-8	20–22	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-71406	21-26593	BH-8	15–17	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-71407	21-26593	BH-8	3–4	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-71408	21-26594	BH-9	34–35	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-71409	21-26594	BH-9	25–27	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-71410	21-26594	BH-9	17–20	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-71411	21-26594	BH-9	1.5–3	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-71414	n/a	n/a	n/a	Trip Blank	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—
MD21-06-71415	n/a	n/a	n/a	Trip Blank	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—
MD21-06-71416	21-26595	BH-10	0–0.5	Surface Sample	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71417	21-26595	BH-10	1.5–2	Cover Evaluation	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71418	21-26595	BH-10	2–3.5	Cover Evaluation	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71419	21-26595	BH-10	15–17	Base of Eastern Pits	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71420	21-26595	BH-10	23–25	Observed Permeable Zone	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71421	21-26595	BH-10	33–35	Total Depth	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71425	21-26596	BH-11	0–0.5	Surface Sample	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71426	21-26596	BH-11	3–5	Cover Evaluation	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71427	21-26596	BH-11	5–7	Observed Permeable Zone/Qbt 3	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71428	21-26596	BH-11	17–20	Base of Eastern Pits	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71429	21-26596	BH-11	27–30	Observed Permeable Zone	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71430	21-26596	BH-11	32–35	Total Depth	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71436	21-26595	BH-10	34–35	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—

Table 2.5-6 (continued)

Sample ID	Location ID	Borehole	Depth Interval (ft)	Sample Justification	Cyanide (SW-846 9012A)	Nitrates (EPA Method 300.0)	Perchlorate (SW-846 6850)	TAL Metals, (SW-846 6010B SW-846 6020, and SW-846 7471A)	Total Iodide (EPA Method 345.1)	Total Uranium (SW-846 6020)	Americium-241 (HASL-300)	Gamma Spectroscopy (EPA Method 901.1)	Isotopic Plutonium (HASL-300)	Isotopic Uranium (HASL-300)	Strontium-90 (EPA Method 905)	High Explosives (SW-846 8321A_MOD and SW-846 8330)	PCBs (SW-846 8082)	SVOCs (SW-846 8270C)	VOCs (SW-846 8260B)	Dioxins/Furans (SW-846 8290)	Tritium (H3, EPA Method 906)	VOCs (TO15)	pH (SW-846 9045C)
MD21-06-71437	21-26595	BH-10	23–25	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-71438	21-26595	BH-10	15–17	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-71439	21-26595	BH-10	2–4	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-71440	21-26596	BH-11	34–35	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-71441	21-26596	BH-11	27–30	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-71442	21-26596	BH-11	17–20	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-71443	21-26596	BH-11	5–7	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-71444	n/a	n/a	n/a	Rinsate	X	—	X	X	—	X	—	—	—	—	—	—	—	—		—	—	—	—
MD21-06-71446	n/a	n/a	n/a	Trip Blank	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—
MD21-06-71447	n/a	n/a	n/a	Trip Blank	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—
MD21-06-71448	21-26597	BH-2	0–0.5	Surface Sample	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71449	21-26597	BH-2	1.5–3	Cover Evaluation	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71450	21-26597	BH-2	12–15	Base of General’s Tanks	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71451	21-26597	BH-2	23–25	Base of Central Pit	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71452	21-26597	BH-2	80–85	Total Depth	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71457	21-26598	BH-14	0–0.5	Surface Sample	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71458	21-26598	BH-14	1.5–3	Cover Evaluation	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71459	21-26598	BH-14	25–30	Observed Fracture	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71460	21-26598	BH-14	50–55	Observed Moisture Zone	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71461	21-26598	BH-14	82.5–85	Total Depth	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71466	21-26597	BH-2	80–85	Field Duplicate	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71467	21-26598	BH-14	25–30	Field Duplicate	X	—	X	X	X	X	X	X	X	X	X	X	X	X	X	X	—	—	X
MD21-06-71468	21-26597	BH-2	84–85	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-71469	21-26597	BH-2	23–25	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-71470	21-26597	BH-2	12–15	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-71471	21-26597	BH-2	1.5–3	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-71472	21-26598	BH-14	84–85	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-71473	21-26598	BH-14	50–51	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-71474	21-26598	BH-14	25–30	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-71475	21-26598	BH-14	1.5–3	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-71476	n/a	n/a	n/a	Trip Blank	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—
MD21-06-71477	n/a	n/a	n/a	Trip Blank	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—
MD21-06-71478	n/a	n/a	n/a	Rinsate	X	—	X	X	—	X	—	—	—	—	—	—	—	—	—	—	—	—	—
MD21-06-71479	n/a	n/a	n/a	Rinsate	X	—	X	X	—	X	—	—	—	—	—	—	—	—	—	—	n/a	—	—

Table 2.5-6 (continued)

Sample ID	Location ID	Borehole	Depth Interval (ft)	Sample Justification	Cyanide (SW-846 9012A)	Nitrates (EPA Method 300.0)	Perchlorate (SW-846 6850)	TAL Metals, (SW-846 6010B SW-846 6020, and SW-846 7471A)	Total Iodide (EPA Method 345.1)	Total Uranium (SW-846 6020)	Americium-241 (HASL-300)	Gamma Spectroscopy (EPA Method 901.1)	Isotopic Plutonium (HASL-300)	Isotopic Uranium (HASL-300)	Strontium-90 (EPA Method 905)	High Explosives (SW-846 8321A_MOD and SW-846 8330)	PCBs (SW-846 8082)	SVOCs (SW-846 8270C)	VOCs (SW-846 8260B)	Dioxins/Furans (SW-846 8290)	Tritium (H3, EPA Method 906)	VOCs (TO15)	pH (SW-846 9045C)
MD21-06-73141	21-26480	BH-4	42–44	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-73144	21-26481	BH-5	40.5–42	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-73147	21-26482	BH-13	49–50	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-73150	21-26484	BH-15	43–45	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-73507	21-26590	BH-16	27–30	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-73508	21-26590	BH-16	1.5–3	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-73509	21-26589	BH-1	7–9	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-73510	21-26589	BH-1	17–19	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-73511	21-26598	BH-14	25–30	Field Duplicate	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-73512	21-26590	BH-16	27–30	Field Duplicate	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-73513	21-26589	BH-1	139–140	Field Duplicate	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-73514	21-26591	BH-6	27–30	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-73515	n/a	BH-1	n/a	Trip Blank	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—
MD21-06-73516	n/a	BH-1	n/a	Trip Blank	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—
MD21-06-73517	n/a	BH-1	n/a	Trip Blank	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—
MD21-06-73518	n/a	BH-1	n/a	Trip Blank	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—
MD21-06-73722	21-26485	BH-3	43–45	Pore gas	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-73723	n/a	n/a	0–0	Field Blank	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—
MD21-06-73724	n/a	n/a	0–0	Field Blank	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—

[a] — = The analysis was not requested.

[b] CP = Central pits.

[c] n/a = Not applicable.

[d] SS = Samples were surface or subsurface samples.

Table 2.5-7
Summary of COPCs for MDA A and DP Canyon Slope by Media

Soil and Fill	Qbt3	Qbt2	Qbt1v	Qbt1g	Qbo	Pore Gas	
Inorganic Chemicals							
Antimony Barium Cobalt Iodide Lead Manganese Mercury Nitrate Perchlorate Selenium Silver Thallium Zinc	Aluminum Arsenic Barium Beryllium Cyanide (Total) Iodide Nitrate Perchlorate Selenium	Iodide Perchlorate Selenium	Selenium	Arsenic Barium Cadmium Selenium	Aluminum Arsenic Barium Cadmium Chromium Copper Iron Manganese Nickel Selenium Vanadium	n/a*	
Organic Chemicals							
Acenaphthene Acetone Anthracene Aroclor-1254 Aroclor-1260 Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Benzo(g,h,i)perylene Benzo(k)fluoranthene Benzoic acid Bis(2-ethylhexyl)phthalate Chrysene Dichlorobenzene[1,4-] Fluoranthene Fluorene Indeno(1,2,3-cd)pyrene Isopropyltoluene[4-] Methylene chloride Phenanthrene Pyrene Toluene	Acetone Bis(2-ethylhexyl)phthalate Methyl-2-pentanone[4-] Nitroaniline[2-] Toluene Isopropyltoluene[4-]	Arolcor-1254 Aroclor-1260	n/a	Bis(2-ethylhexyl)phthalate	n/a	Acetone Benzene Bromodichloromethane Butanol[1-] Butanone[2-] Carbon disulfide Carbon tetrachloride Chloroethane Chloroform Chloromethane Dichlorobenzene[1,4-] Dichlorodifluoromethane Dichloroethane[1,1-] Dichloroethane[1,2-] Dichloroethene[1,1-] Dichloropropane[1,2-] Ethanol Ethylbenzene Ethyltoluene[4-] Hexane Hexanone[2-] Methanol	Methyl-2-pentanone[4-] Methylene chloride n-Heptane Propanol[2-] Propylene Styrene Tetrachloroethene Toluene Trichloro-1,2,2-trifluoroethane[1,1,2-] Trichloroethane[1,1,1-] Trichloroethene Trichlorofluoromethane Trimethylbenzene[1,2,4-] Trimethylbenzene[1,3,5-] Xylene (Total) Xylene[1,2-] Xylene[1,3-]+Xylene[1,4-]
Dioxins/Furans							
Heptachlorodibenzodioxin [1,2,3,4,6,7,8-] Heptachlorodibenzodioxins (Total) Heptachlorodibenzofuran [1,2,3,4,6,7,8-]	Heptachlorodibenzodioxin [1,2,3,4,6,7,8-] Heptachlorodibenzodioxins (Total) Heptachlorodibenzofuran [1,2,3,4,6,7,8-]	n/a	n/a	n/a	Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-] Pentachlorodibenzodioxins (Total)	n/a	

Table 2.5-7 (continued)

Soil and Fill	Qbt3	Qbt2	Qbt1v	Qbt1g	Qbo	Pore Gas
Heptachlorodibenzofuran [1,2,3,4,7,8,9-] Heptachlorodibenzofurans (Total) Hexachlorodibenzodioxin [1,2,3,4,7,8-] Hexachlorodibenzodioxin [1,2,3,6,7,8-] Hexachlorodibenzodioxin [1,2,3,7,8,9-] Hexachlorodibenzodioxins (Total) Hexachlorodibenzofuran [1,2,3,4,7,8-] Hexachlorodibenzofuran [1,2,3,6,7,8-] Hexachlorodibenzofuran [1,2,3,7,8,9-] Hexachlorodibenzofuran [2,3,4,6,7,8-] Hexachlorodibenzofurans (Total) Octachlorodibenzodioxin [1,2,3,4,6,7,8,9-] Octachlorodibenzofuran [1,2,3,4,6,7,8,9-] Pentachlorodibenzodioxin [1,2,3,7,8-] Pentachlorodibenzodioxins (Total) Pentachlorodibenzofuran [1,2,3,7,8-] Pentachlorodibenzofuran [2,3,4,7,8-] Pentachlorodibenzofurans (Totals) Tetrachlorodibenzodioxin [2,3,7,8-] Tetrachlorodibenzodioxins (Total) Tetrachlorodibenzofuran [2,3,7,8-] Tetrachlorodibenzofurans (Total)	Heptachlorodibenzofuran [1,2,3,4,7,8,9-] Heptachlorodibenzofurans (Total) Hexachlorodibenzodioxin [1,2,3,4,7,8-] Hexachlorodibenzodioxin [1,2,3,6,7,8-] Hexachlorodibenzodioxin [1,2,3,7,8,9-] Hexachlorodibenzodioxins (Total) Hexachlorodibenzofuran [1,2,3,4,7,8-] Hexachlorodibenzofuran [1,2,3,6,7,8-] Hexachlorodibenzofuran [1,2,3,7,8,9-] Hexachlorodibenzofuran [2,3,4,6,7,8-] Hexachlorodibenzofurans (Total) Octachlorodibenzodioxin [1,2,3,4,6,7,8,9-] Octachlorodibenzofuran [1,2,3,4,6,7,8,9-] Pentachlorodibenzodioxin [1,2,3,7,8-] Pentachlorodibenzodioxins (Total) Pentachlorodibenzofuran [1,2,3,7,8-] Pentachlorodibenzofurans (Totals) Tetrachlorodibenzodioxin [2,3,7,8-] Tetrachlorodibenzodioxins (Total) Tetrachlorodibenzofurans (Total)					
Radionuclides						
Americium-241 Cesium-137 Plutonium-238 Plutonium-239 Strontium-92	Cesium-137 Uranium-235 Plutonium-238 Plutonium-239	n/a	n/a	Uranium-235	n/a	Tritium

* n/a = Not applicable.

Table 2.5-8
Summary of Inorganic Chemicals Detected above Background Values at MDA A and DP Canyon Slope

Sample ID	Location ID	Depth (ft)	Media	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium
Soil/Fill Background Value				**29200**	**0.83**	**8.17**	**295**	**1.83**	**0.4**	**6120**
Qbt 2,3,4 Background Value				**7340**	**0.5**	**2.79**	**46**	**1.21**	**1.63**	**2200**
Qbt 1v Background Value				**8170**	**0.5**	**1.81**	**26.5**	**1.7**	**0.4**	**3700**
Qbt 1g, Qct, Qbo Background Value				**3560**	**0.5**	**0.56**	**25.7**	**1.44**	**0.4**	**1900**
Industrial Soil Screening Levels[a]				**100000**	**454**	**17.7**	**78300**	**2250**	**564**	**na**[b]
Residential Soil Screening Levels[a]				**77800**	**31.3**	**3.9**	**15600**	**156**	**39**	**na**
MD21-06-70892	21-01154	0.00–0.50	Soil	—[c]	—	—	—	—	—	—
MD21-06-70893	21-01154	1.50–2.00	Soil	—	—	—	—	—	0.507 (U)	—
MD21-06-70908	21-01290	0.00–0.50	Soil	—	—	—	—	—	—	—
MD21-06-70909	21-01290	1.50–2.00	Soil	—	—	—	—	—	0.542 (U)	—
MD21-06-70900	21-02030	0.00–0.50	Soil	—	—	—	—	—	—	—
MD21-06-70901	21-02030	1.50–2.00	Soil	—	—	—	—	—	0.5 (U)	—
MD21-06-70932	21-02042	0.00–0.50	Soil	—	—	—	—	—	—	—
MD21-06-70933	21-02042	1.50–2.00	Soil	—	—	—	—	—	—	—
MD21-06-70924	21-02058	0.00–0.50	Soil	—	—	—	—	—	—	—
MD21-06-70925	21-02058	1.50–2.00	Soil	—	—	—	—	—	—	—
MD21-06-70916	21-02586	0.00–0.50	Soil	—	—	—	—	—	—	—
MD21-06-70917	21-02586	1.50–2.00	Soil	—	—	—	—	—	0.56 (U)	—
MD21-06-70727	21-26480	0.00–0.50	Soil	—	—	—	—	—	—	—
MD21-06-70728	21-26480	25.00–27.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-70730	21-26480	36.00–38.50	Qbt 3	—	—	2.84 (U)	—	—	—	—
MD21-06-70729	21-26480	42.00–44.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-70745	21-26481	0.00–0.50	Soil	—	—	—	—	—	—	—
MD21-06-70746	21-26481	25.00–27.00	Qbt 3	15600	—	3.65	95.4	—	—	—

Table 2.5-8 (continued)

Sample ID	Location ID	Depth (ft)	Media	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium
Soil/Fill Background Value				**29200**	**0.83**	**8.17**	**295**	**1.83**	**0.4**	**6120**
Qbt 2,3,4 Background Value				**7340**	**0.5**	**2.79**	**46**	**1.21**	**1.63**	**2200**
Qbt 1v Background Value				**8170**	**0.5**	**1.81**	**26.5**	**1.7**	**0.4**	**3700**
Qbt 1g, Qct, Qbo Background Value				**3560**	**0.5**	**0.56**	**25.7**	**1.44**	**0.4**	**1900**
Industrial Soil Screening Levels[a]				**100000**	**454**	**17.7**	**78300**	**2250**	**564**	**na**[b]
Residential Soil Screening Levels[a]				**77800**	**31.3**	**3.9**	**15600**	**156**	**39**	**na**
MD21-06-70748	21-26481	40.50–42.00	Qbt 3	—	—	3.76	—	—	—	—
MD21-06-70747	21-26481	43.00–45.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-70773	21-26482	0.00–0.50	Soil	—	—	—	—	—	—	—
MD21-06-70774	21-26482	13.20–15.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-70776	21-26482	19.00–22.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-70775	21-26482	30.00–32.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-70778	21-26482	47.30–49.00	Qbt 3	—	—	2.88	—	—	—	—
MD21-06-70777	21-26482	49.00–50.00	Qbt 3	7880	—	3.44	—	1.27 (J)	—	—
MD21-06-70819	21-26484	0.00–0.50	Soil	—	—	—	—	—	—	—
MD21-06-70820	21-26484	13.00–15.00	Qbt 3	9580 (J+)	—	—	—	—	—	—
MD21-06-70822	21-26484	25.00–27.00	Qbt 3	11800 (J+)	—	6.76	—	—	—	—
MD21-06-70823	21-26484	35.00–37.00	Qbt 3	—	—	3.38 (U)	—	—	—	—
MD21-06-70821	21-26484	43.00–45.00	Qbt 3	—	—	2.89 (U)	—	—	—	—
MD21-06-70837	21-26485	0.00–0.50	Soil	—	—	—	—	—	—	—
MD21-06-70838	21-26485	24.00–26.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-70842	21-26485	28.00–30.00	Qbt 3	—	—	3 (U)	—	—	—	—
MD21-06-70840	21-26485	30.00–32.00	Qbt 3	15400 (J+)	—	4.62	48.7	1.85	—	—
MD21-06-70841	21-26485	32.00–34.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-70839	21-26485	43.00–45.00	Qbt 3	—	—	—	—	—	—	—

Table 2.5-8 (continued)

Sample ID	Location ID	Depth (ft)	Media	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium
Soil/Fill Background Value				**29200**	**0.83**	**8.17**	**295**	**1.83**	**0.4**	**6120**
Qbt 2,3,4 Background Value				**7340**	**0.5**	**2.79**	**46**	**1.21**	**1.63**	**2200**
Qbt 1v Background Value				**8170**	**0.5**	**1.81**	**26.5**	**1.7**	**0.4**	**3700**
Qbt 1g, Qct, Qbo Background Value				**3560**	**0.5**	**0.56**	**25.7**	**1.44**	**0.4**	**1900**
Industrial Soil Screening Levels[a]				**100000**	**454**	**17.7**	**78300**	**2250**	**564**	**na**[b]
Residential Soil Screening Levels[a]				**77800**	**31.3**	**3.9**	**15600**	**156**	**39**	**na**
MD21-06-70946	21-26486	0.00–0.50	Soil	—	—	—	—	—	—	—
MD21-06-70947	21-26486	1.50–2.00	Soil	—	—	—	—	—	—	—
MD21-06-70954	21-26487	0.00–0.50	Soil	—	—	—	—	—	—	—
MD21-06-70955	21-26487	1.50–2.00	Soil	—	—	—	—	—	0.513 (U)	—
MD21-06-70962	21-26488	0.00–0.50	Soil	—	—	—	—	—	—	—
MD21-06-70963	21-26488	1.50–2.00	Soil	—	2.16 (UJ)	—	—	—	0.547 (U)	—
MD21-06-70970	21-26489	0.00–0.50	Soil	—	—	—	—	—	—	—
MD21-06-70971	21-26489	1.50–2.00	Soil	—	—	—	—	—	0.494 (U)	—
MD21-06-70978	21-26490	0.00–0.50	Soil	—	—	—	—	—	—	—
MD21-06-70979	21-26490	1.50–2.00	Soil	—	—	—	—	—	—	—
MD21-06-70992	21-26491	0.00–0.50	Soil	—	—	—	—	—	—	—
MD21-06-70993	21-26491	1.50–2.00	Soil	—	—	—	—	—	0.542 (U)	—
MD21-06-70996	21-26492	0.00–0.50	Soil	—	—	—	—	—	0.495 (U)	—
MD21-06-70997	21-26492	1.50–2.00	Soil	—	—	—	—	—	0.537 (U)	—
MD21-06-71000	21-26493	0.00–0.50	Soil	—	—	—	—	—	0.554 (U)	—
MD21-06-71001	21-26493	1.50–2.00	Soil	—	—	—	—	—	0.529 (U)	—
MD21-06-71004	21-26494	0.00–0.50	Soil	—	—	—	—	—	0.537 (U)	—
MD21-06-71005	21-26494	1.50–2.00	Soil	31400 (J+)	—	—	512	—	0.537 (U)	6150 (J+)
MD21-06-71008	21-26495	0.00–0.50	Soil	—	—	—	—	—	0.506 (U)	—

Table 2.5-8 (continued)

Sample ID	Location ID	Depth (ft)	Media	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium
Soil/Fill Background Value				**29200**	**0.83**	**8.17**	**295**	**1.83**	**0.4**	**6120**
Qbt 2,3,4 Background Value				**7340**	**0.5**	**2.79**	**46**	**1.21**	**1.63**	**2200**
Qbt 1v Background Value				**8170**	**0.5**	**1.81**	**26.5**	**1.7**	**0.4**	**3700**
Qbt 1g, Qct, Qbo Background Value				**3560**	**0.5**	**0.56**	**25.7**	**1.44**	**0.4**	**1900**
Industrial Soil Screening Levels[a]				**100000**	**454**	**17.7**	**78300**	**2250**	**564**	**na**[b]
Residential Soil Screening Levels[a]				**77800**	**31.3**	**3.9**	**15600**	**156**	**39**	**na**
MD21-06-71009	21-26495	1.50–2.00	Soil	—	—	—	—	—	0.554 (U)	—
MD21-06-71293	21-26588	0.00–0.50	Fill	—	—	—	—	—	0.552 (U)	—
MD21-06-71294	21-26588	5.50–7.00	Fill	—	—	—	—	—	—	—
MD21-06-71295	21-26588	15.00–17.50	Qbt 3	—	—	—	—	—	—	—
MD21-06-71296	21-26588	25.00–27.50	Qbt 3	—	—	—	—	—	—	—
MD21-06-71297	21-26588	62.50–65.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-71298	21-26588	110.00–112.00	Qbt 2	—	—	—	—	—	—	—
MD21-06-71299	21-26588	200.00–202.50	Qbt 1v	—	—	—	—	—	—	—
MD21-06-71300	21-26588	300.00–302.50	Qbt 1g	—	—	1.56 (U)	30.5	—	0.521 (U)	—
MD21-06-71301	21-26588	355.00–360.00	Qbo	9110	—	0.793 (J)	31.3	—	0.529 (U)	—
MD21-06-71320	21-26589	0.00–0.50	Soil	—	—	—	—	—	0.548 (U)	—
MD21-06-71321	21-26589	7.00–9.00	Soil	—	—	—	—	—	0.551 (U)	11900
MD21-06-71322	21-26589	17.00–19.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-71323	21-26589	47.00–52.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-71324	21-26589	78.00–80.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-71325	21-26589	92.00–94.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-71326	21-26589	138.00–140.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-71337	21-26590	0.00–0.50	Fill	—	—	—	—	—	—	—
MD21-06-71338	21-26590	1.50–3.00	Fill	—	—	—	—	—	—	—

Table 2.5-8 (continued)

Sample ID	Location ID	Depth (ft)	Media	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium
Soil/Fill Background Value				**29200**	**0.83**	**8.17**	**295**	**1.83**	**0.4**	**6120**
Qbt 2,3,4 Background Value				**7340**	**0.5**	**2.79**	**46**	**1.21**	**1.63**	**2200**
Qbt 1v Background Value				**8170**	**0.5**	**1.81**	**26.5**	**1.7**	**0.4**	**3700**
Qbt 1g, Qct, Qbo Background Value				**3560**	**0.5**	**0.56**	**25.7**	**1.44**	**0.4**	**1900**
Industrial Soil Screening Levels[a]				**100000**	**454**	**17.7**	**78300**	**2250**	**564**	**na**[b]
Residential Soil Screening Levels[a]				**77800**	**31.3**	**3.9**	**15600**	**156**	**39**	**na**
MD21-06-71339	21-26590	27.00–30.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-71340	21-26590	45.00–50.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-71341	21-26590	75.00–77.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-71342	21-26590	100.00–102.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-71343	21-26590	137.00–140.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-71352	21-26591	0.00–0.50	Fill	—	—	—	—	—	0.599 (U)	—
MD21-06-71353	21-26591	1.50–2.50	Fill	—	—	—	—	—	0.52 (U)	—
MD21-06-71354	21-26591	15.00–17.00	Qbt 3	—	—	3.01	—	—	—	—
MD21-06-71355	21-26591	27.00–30.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-71356	21-26591	30.00–35.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-71361	21-26592	0.00–0.50	Fill	—	—	—	—	—	0.575 (U)	—
MD21-06-71362	21-26592	1.50–4.00	Fill	—	—	—	—	—	0.514 (U)	—
MD21-06-71363	21-26592	15.00–17.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-71364	21-26592	23.00–25.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-71365	21-26592	33.00–35.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-71388	21-26593	0.00–0.50	Fill	—	—	—	—	—	—	—
MD21-06-71389	21-26593	1.50–2.00	Fill	—	—	—	—	—	0.559 (U)	—
MD21-06-71384	21-26593	3.00–7.00	Fill	—	—	—	—	—	—	—
MD21-06-71385	21-26593	15.00–17.00	Qbt 3	—	—	—	—	—	—	—

Table 2.5-8 (continued)

Sample ID	Location ID	Depth (ft)	Media	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium
Soil/Fill Background Value				**29200**	**0.83**	**8.17**	**295**	**1.83**	**0.4**	**6120**
Qbt 2,3,4 Background Value				**7340**	**0.5**	**2.79**	**46**	**1.21**	**1.63**	**2200**
Qbt 1v Background Value				**8170**	**0.5**	**1.81**	**26.5**	**1.7**	**0.4**	**3700**
Qbt 1g, Qct, Qbo Background Value				**3560**	**0.5**	**0.56**	**25.7**	**1.44**	**0.4**	**1900**
Industrial Soil Screening Levels[a]				**100000**	**454**	**17.7**	**78300**	**2250**	**564**	**na**[b]
Residential Soil Screening Levels[a]				**77800**	**31.3**	**3.9**	**15600**	**156**	**39**	**na**
MD21-06-71386	21-26593	21.00–23.00	Qbt 3	—	—	—	53.6	—	—	—
MD21-06-71387	21-26593	33.00–35.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-71393	21-26594	0.00–0.50	Fill	—	—	—	—	—	—	—
MD21-06-71394	21-26594	1.50–3.00	Fill	—	—	—	—	—	0.542 (U)	6220 (J+)
MD21-06-71395	21-26594	17.00–20.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-71396	21-26594	25.00–27.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-71397	21-26594	30.00–35.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-71416	21-26595	0.00–0.50	Fill	—	—	—	—	—	—	—
MD21-06-71417	21-26595	1.50–2.00	Fill	—	—	—	—	—	—	—
MD21-06-71418	21-26595	2.00–3.50	Fill	—	—	—	—	—	0.522 (U)	—
MD21-06-71419	21-26595	15.00–17.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-71420	21-26595	23.00–25.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-71421	21-26595	33.00–35.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-71425	21-26596	0.00–0.50	Fill	—	—	—	—	—	—	—
MD21-06-71426	21-26596	3.00–5.00	Fill	—	—	—	—	—	—	—
MD21-06-71427	21-26596	5.00–7.50	Qbt 3	7940	—	3.08	73 (J-)	—	—	—
MD21-06-71428	21-26596	17.00–20.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-71429	21-26596	27.00–30.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-71430	21-26596	32.00–35.00	Qbt 3	—	—	—	—	—	—	—

Table 2.5-8 (continued)

Sample ID	Location ID	Depth (ft)	Media	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium
Soil/Fill Background Value				**29200**	**0.83**	**8.17**	**295**	**1.83**	**0.4**	**6120**
Qbt 2,3,4 Background Value				**7340**	**0.5**	**2.79**	**46**	**1.21**	**1.63**	**2200**
Qbt 1v Background Value				**8170**	**0.5**	**1.81**	**26.5**	**1.7**	**0.4**	**3700**
Qbt 1g, Qct, Qbo Background Value				**3560**	**0.5**	**0.56**	**25.7**	**1.44**	**0.4**	**1900**
Industrial Soil Screening Levels[a]				**100000**	**454**	**17.7**	**78300**	**2250**	**564**	**na**[b]
Residential Soil Screening Levels[a]				**77800**	**31.3**	**3.9**	**15600**	**156**	**39**	**na**
MD21-06-71448	21-26597	0.00–0.50	Fill	—	—	—	—	—	0.597 (U)	—
MD21-06-71449	21-26597	1.50–3.00	Fill	—	—	—	—	—	0.522 (U)	—
MD21-06-71450	21-26597	12.00–15.00	Qbt 3	—	—	3.48	—	—	—	—
MD21-06-71451	21-26597	23.00–25.00	Qbt 3	11200 (J+)	—	—	—	—	—	—
MD21-06-71452	21-26597	80.00–85.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-71457	21-26598	0.00–0.50	Fill	—	—	—	—	—	—	—
MD21-06-71458	21-26598	1.50–3.00	Fill	—	—	—	—	—	—	—
MD21-06-71459	21-26598	25.00–30.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-71460	21-26598	50.00–55.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-71461	21-26598	82.50–85.00	Qbt 3	—	—	—	—	—	—	—

Table 2.5-8 (continued)

Sample ID	Location ID	Depth (ft)	Media	Chromium	Cobalt	Copper	Cyanide (Total)	Iodide	Iron	Lead
Soil/Fill Background Value				**19.3**	**8.64**	**14.7**	**0.5**	**na**	**21500**	**22.3**
Qbt 2,3,4 Background Value				**7.14**	**3.14**	**4.66**	**0.5**	**na**	**14500**	**11.2**
Qbt 1v Background Value				**2.24**	**1.78**	**3.26**	**0.5**	**na**	**9900**	**18.4**
Qbt 1g, Qct, Qbo Background Value				**2.6**	**8.89**	**3.96**	**0.5**	**na**	**3700**	**13.5**
Industrial Soil Screening Levels[a]				**5000**[d]	**2050**	**45400**	**13700**	**1494**[e]	**100000**	**800**
Residential Soil Screening Levels[a]				**2100**[d]	**1520**	**3130**	**1220**	**205**[e]	**23500**	**400**
MD21-06-70892	21-01154	0.00–0.50	Soil	—	—	—	—	1.169	—	—
MD21-06-70893	21-01154	1.50–2.00	Soil	—	—	—	—	0.246	—	—
MD21-06-70908	21-01290	0.00–0.50	Soil	—	—	—	—	1.034	—	—
MD21-06-70909	21-01290	1.50–2.00	Soil	—	—	—	—	0.099 (J)	—	—
MD21-06-70900	21-02030	0.00–0.50	Soil	—	—	—	—	1.916	—	—
MD21-06-70901	21-02030	1.50–2.00	Soil	—	—	—	—	0.424	—	—
MD21-06-70932	21-02042	0.00–0.50	Soil	—	—	—	—	2.067	—	—
MD21-06-70933	21-02042	1.50–2.00	Soil	—	—	—	—	3.111	—	—
MD21-06-70924	21-02058	0.00–0.50	Soil	—	—	—	—	0.428	—	40.9
MD21-06-70925	21-02058	1.50–2.00	Soil	—	13.1	—	—	5.771	—	—
MD21-06-70916	21-02586	0.00–0.50	Soil	—	—	—	—	0.347	—	—
MD21-06-70917	21-02586	1.50–2.00	Soil	—	—	—	—	2.381	—	—
MD21-06-70727	21-26480	0.00–0.50	Soil	—	—	—	—	0.569	—	—
MD21-06-70728	21-26480	25.00–27.00	Qbt 3	—	—	—	2.06	—	—	—
MD21-06-70730	21-26480	36.00–38.50	Qbt 3	—	—	—	—	0.05 (J)	—	—
MD21-06-70729	21-26480	42.00–44.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-70745	21-26481	0.00–0.50	Soil	—	—	—	—	0.266 (J)	—	—
MD21-06-70746	21-26481	25.00–27.00	Qbt 3	7.63	—	4.88	—	0.431	—	—
MD21-06-70748	21-26481	40.50–42.00	Qbt 3	—	—	—	—	0.496	—	—

Table 2.5-8 (continued)

Sample ID	Location ID	Depth (ft)	Media	Chromium	Cobalt	Copper	Cyanide (Total)	Iodide	Iron	Lead
Soil/Fill Background Value				**19.3**	**8.64**	**14.7**	**0.5**	**na**	**21500**	**22.3**
Qbt 2,3,4 Background Value				**7.14**	**3.14**	**4.66**	**0.5**	**na**	**14500**	**11.2**
Qbt 1v Background Value				**2.24**	**1.78**	**3.26**	**0.5**	**na**	**9900**	**18.4**
Qbt 1g, Qct, Qbo Background Value				**2.6**	**8.89**	**3.96**	**0.5**	**na**	**3700**	**13.5**
Industrial Soil Screening Levels[a]				**5000**[d]	**2050**	**45400**	**13700**	**1494**[e]	**100000**	**800**
Residential Soil Screening Levels[a]				**2100**[d]	**1520**	**3130**	**1220**	**205**[e]	**23500**	**400**
MD21-06-70747	21-26481	43.00–45.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-70773	21-26482	0.00–0.50	Soil	—	—	—	—	0.743	—	—
MD21-06-70774	21-26482	13.20–15.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-70776	21-26482	19.00–22.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-70775	21-26482	30.00–32.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-70778	21-26482	47.30–49.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-70777	21-26482	49.00–50.00	Qbt 3	—	—	—	—	0.715	—	—
MD21-06-70819	21-26484	0.00–0.50	Soil	—	—	—	—	1.16	—	—
MD21-06-70820	21-26484	13.00–15.00	Qbt 3	—	—	—	—	0.7	—	—
MD21-06-70822	21-26484	25.00–27.00	Qbt 3	—	—	—	—	0.738	—	12.4
MD21-06-70823	21-26484	35.00–37.00	Qbt 3	—	—	—	—	0.346	—	—
MD21-06-70821	21-26484	43.00–45.00	Qbt 3	—	—	—	—	0.419	—	—
MD21-06-70837	21-26485	0.00–0.50	Soil	—	—	—	—	2.5	—	—
MD21-06-70838	21-26485	24.00–26.00	Qbt 3	—	—	—	—	0.038 (J)	—	—
MD21-06-70842	21-26485	28.00–30.00	Qbt 3	—	—	—	—	0.168 (J)	—	—
MD21-06-70840	21-26485	30.00–32.00	Qbt 3	8.18	—	6.16	—	0.693	—	13.5
MD21-06-70841	21-26485	32.00–34.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-70839	21-26485	43.00–45.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-70946	21-26486	0.00–0.50	Soil	—	—	—	—	1.441	—	—

Table 2.5-8 (continued)

Sample ID	Location ID	Depth (ft)	Media	Chromium	Cobalt	Copper	Cyanide (Total)	Iodide	Iron	Lead
Soil/Fill Background Value				**19.3**	**8.64**	**14.7**	**0.5**	**na**	**21500**	**22.3**
Qbt 2,3,4 Background Value				**7.14**	**3.14**	**4.66**	**0.5**	**na**	**14500**	**11.2**
Qbt 1v Background Value				**2.24**	**1.78**	**3.26**	**0.5**	**na**	**9900**	**18.4**
Qbt 1g, Qct, Qbo Background Value				**2.6**	**8.89**	**3.96**	**0.5**	**na**	**3700**	**13.5**
Industrial Soil Screening Levels[a]				**5000**[d]	**2050**	**45400**	**13700**	**1494**[e]	**100000**	**800**
Residential Soil Screening Levels[a]				**2100**[d]	**1520**	**3130**	**1220**	**205**[e]	**23500**	**400**
MD21-06-70947	21-26486	1.50–2.00	Soil	—	—	—	—	2.694	—	—
MD21-06-70954	21-26487	0.00–0.50	Soil	—	—	—	—	0.448	—	—
MD21-06-70955	21-26487	1.50–2.00	Soil	—	—	—	—	0.431	—	23.5
MD21-06-70962	21-26488	0.00–0.50	Soil	—	—	—	—	2.014	—	45.7
MD21-06-70963	21-26488	1.50–2.00	Soil	—	—	—	—	2.355	—	598
MD21-06-70970	21-26489	0.00–0.50	Soil	—	—	—	—	1.589	—	31.6
MD21-06-70971	21-26489	1.50–2.00	Soil	—	—	—	—	0.39	—	67.6
MD21-06-70978	21-26490	0.00–0.50	Soil	—	—	—	—	1.779	—	—
MD21-06-70979	21-26490	1.50–2.00	Soil	—	—	—	—	0.984	—	—
MD21-06-70992	21-26491	0.00–0.50	Soil	—	—	—	—	1.43	—	—
MD21-06-70993	21-26491	1.50–2.00	Soil	—	—	—	—	1.891	—	—
MD21-06-70996	21-26492	0.00–0.50	Soil	—	—	—	—	1.216	—	—
MD21-06-70997	21-26492	1.50–2.00	Soil	—	—	—	—	1.473	—	—
MD21-06-71000	21-26493	0.00–0.50	Soil	—	—	—	—	5.481	—	—
MD21-06-71001	21-26493	1.50–2.00	Soil	—	—	—	—	0.142 (J)	—	—
MD21-06-71004	21-26494	0.00–0.50	Soil	—	—	—	—	3.132	—	—
MD21-06-71005	21-26494	1.50–2.00	Soil	—	—	—	—	4.079	—	—
MD21-06-71008	21-26495	0.00–0.50	Soil	—	—	—	—	1.307	—	—
MD21-06-71009	21-26495	1.50–2.00	Soil	—	—	—	—	2.113	—	—

Table 2.5-8 (continued)

Sample ID	Location ID	Depth (ft)	Media	Chromium	Cobalt	Copper	Cyanide (Total)	Iodide	Iron	Lead
Soil/Fill Background Value				**19.3**	**8.64**	**14.7**	**0.5**	**na**	**21500**	**22.3**
Qbt 2,3,4 Background Value				**7.14**	**3.14**	**4.66**	**0.5**	**na**	**14500**	**11.2**
Qbt 1v Background Value				**2.24**	**1.78**	**3.26**	**0.5**	**na**	**9900**	**18.4**
Qbt 1g, Qct, Qbo Background Value				**2.6**	**8.89**	**3.96**	**0.5**	**na**	**3700**	**13.5**
Industrial Soil Screening Levels[a]				**5000**[d]	**2050**	**45400**	**13700**	**1494**[e]	**100000**	**800**
Residential Soil Screening Levels[a]				**2100**[d]	**1520**	**3130**	**1220**	**205**[e]	**23500**	**400**
MD21-06-71293	21-26588	0.00–0.50	Fill	—	—	—	—	1.79	—	—
MD21-06-71294	21-26588	5.50–7.00	Fill	—	—	—	—	0.11 (J)	—	—
MD21-06-71295	21-26588	15.00–17.50	Qbt 3	—	—	—	—	0.04 (J)	—	—
MD21-06-71296	21-26588	25.00–27.50	Qbt 3	—	—	—	—	—	—	—
MD21-06-71297	21-26588	62.50–65.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-71298	21-26588	110.00–112.00	Qbt 2	—	—	—	—	0.28	—	—
MD21-06-71299	21-26588	200.00–202.50	Qbt 1v	—	—	—	—	—	—	—
MD21-06-71300	21-26588	300.00–302.50	Qbt 1g	—	—	—	—	—	—	—
MD21-06-71301	21-26588	355.00–360.00	Qbo	10.1 (J)	—	4.09	—	—	8020	—
MD21-06-71320	21-26589	0.00–0.50	Soil	—	—	—	—	2.49	—	—
MD21-06-71321	21-26589	7.00–9.00	Soil	—	—	—	—	1.48	—	—
MD21-06-71322	21-26589	17.00–19.00	Qbt 3	—	—	—	—	0.151 (J)	—	—
MD21-06-71323	21-26589	47.00–52.00	Qbt 3	—	—	—	—	0.134 (J)	—	—
MD21-06-71324	21-26589	78.00–80.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-71325	21-26589	92.00–94.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-71326	21-26589	138.00–140.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-71337	21-26590	0.00–0.50	Fill	—	—	—	—	0.637	—	—
MD21-06-71338	21-26590	1.50–3.00	Fill	—	—	—	—	1.981	—	—
MD21-06-71339	21-26590	27.00–30.00	Qbt 3	—	—	—	—	—	—	—

Table 2.5-8 (continued)

Sample ID	Location ID	Depth (ft)	Media	Chromium	Cobalt	Copper	Cyanide (Total)	Iodide	Iron	Lead
Soil/Fill Background Value				**19.3**	**8.64**	**14.7**	**0.5**	**na**	**21500**	**22.3**
Qbt 2,3,4 Background Value				**7.14**	**3.14**	**4.66**	**0.5**	**na**	**14500**	**11.2**
Qbt 1v Background Value				**2.24**	**1.78**	**3.26**	**0.5**	**na**	**9900**	**18.4**
Qbt 1g, Qct, Qbo Background Value				**2.6**	**8.89**	**3.96**	**0.5**	**na**	**3700**	**13.5**
Industrial Soil Screening Levels[a]				**5000**[d]	**2050**	**45400**	**13700**	**1494**[e]	**100000**	**800**
Residential Soil Screening Levels[a]				**2100**[d]	**1520**	**3130**	**1220**	**205**[e]	**23500**	**400**
MD21-06-71340	21-26590	45.00–50.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-71341	21-26590	75.00–77.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-71342	21-26590	100.00–102.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-71343	21-26590	137.00–140.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-71352	21-26591	0.00–0.50	Fill	—	—	—	—	1.8	—	—
MD21-06-71353	21-26591	1.50–2.50	Fill	—	—	—	—	2.72	—	—
MD21-06-71354	21-26591	15.00–17.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-71355	21-26591	27.00–30.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-71356	21-26591	30.00–35.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-71361	21-26592	0.00–0.50	Fill	—	—	—	—	2.01	—	—
MD21-06-71362	21-26592	1.50–4.00	Fill	—	—	—	—	4.33	—	—
MD21-06-71363	21-26592	15.00–17.00	Qbt 3	—	—	—	—	0.04 (J)	—	—
MD21-06-71364	21-26592	23.00–25.00	Qbt 3	—	—	—	—	0.6	—	—
MD21-06-71365	21-26592	33.00–35.00	Qbt 3	—	—	—	—	0.17 (J)	—	—
MD21-06-71388	21-26593	0.00–0.50	Fill	—	—	—	—	1.48	—	—
MD21-06-71389	21-26593	1.50–2.00	Fill	—	—	—	—	2.35	—	—
MD21-06-71384	21-26593	3.00–7.00	Fill	—	13.6	—	—	5.19	—	—
MD21-06-71385	21-26593	15.00–17.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-71386	21-26593	21.00–23.00	Qbt 3	—	—	—	—	0.67	—	—

Table 2.5-8 (continued)

Sample ID	Location ID	Depth (ft)	Media	Chromium	Cobalt	Copper	Cyanide (Total)	Iodide	Iron	Lead
Soil/Fill Background Value				**19.3**	**8.64**	**14.7**	**0.5**	**na**	**21500**	**22.3**
Qbt 2,3,4 Background Value				**7.14**	**3.14**	**4.66**	**0.5**	**na**	**14500**	**11.2**
Qbt 1v Background Value				**2.24**	**1.78**	**3.26**	**0.5**	**na**	**9900**	**18.4**
Qbt 1g, Qct, Qbo Background Value				**2.6**	**8.89**	**3.96**	**0.5**	**na**	**3700**	**13.5**
Industrial Soil Screening Levels[a]				**5000**[d]	**2050**	**45400**	**13700**	**1494**[e]	**100000**	**800**
Residential Soil Screening Levels[a]				**2100**[d]	**1520**	**3130**	**1220**	**205**[e]	**23500**	**400**
MD21-06-71387	21-26593	33.00–35.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-71393	21-26594	0.00–0.50	Fill	—	—	—	—	16.25	—	—
MD21-06-71394	21-26594	1.50–3.00	Fill	—	—	—	—	156.47	—	—
MD21-06-71395	21-26594	17.00–20.00	Qbt 3	—	—	—	—	28.97	—	—
MD21-06-71396	21-26594	25.00–27.00	Qbt 3	—	—	—	—	57.75	—	—
MD21-06-71397	21-26594	30.00–35.00	Qbt 3	—	—	—	—	54.12	—	—
MD21-06-71416	21-26595	0.00–0.50	Fill	—	—	—	—	2.15	—	—
MD21-06-71417	21-26595	1.50–2.00	Fill	—	10.7	—	—	6.28	—	—
MD21-06-71418	21-26595	2.00–3.50	Fill	—	—	—	—	1.66	—	—
MD21-06-71419	21-26595	15.00–17.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-71420	21-26595	23.00–25.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-71421	21-26595	33.00–35.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-71425	21-26596	0.00–0.50	Fill	—	—	—	—	0.35	—	—
MD21-06-71426	21-26596	3.00–5.00	Fill	—	—	—	—	2.11	—	—
MD21-06-71427	21-26596	5.00–7.50	Qbt 3	—	—	—	—	0.73	—	—
MD21-06-71428	21-26596	17.00–20.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-71429	21-26596	27.00–30.00	Qbt 3	—	—	—	—	0.04 (J)	—	—
MD21-06-71430	21-26596	32.00–35.00	Qbt 3	—	—	—	—	0.07 (J)	—	—
MD21-06-71448	21-26597	0.00–0.50	Fill	—	—	—	—	2.55	—	—

Table 2.5-8 (continued)

Sample ID	Location ID	Depth (ft)	Media	Chromium	Cobalt	Copper	Cyanide (Total)	Iodide	Iron	Lead
Soil/Fill Background Value				**19.3**	**8.64**	**14.7**	**0.5**	**na**	**21500**	**22.3**
Qbt 2,3,4 Background Value				**7.14**	**3.14**	**4.66**	**0.5**	**na**	**14500**	**11.2**
Qbt 1v Background Value				**2.24**	**1.78**	**3.26**	**0.5**	**na**	**9900**	**18.4**
Qbt 1g, Qct, Qbo Background Value				**2.6**	**8.89**	**3.96**	**0.5**	**na**	**3700**	**13.5**
Industrial Soil Screening Levels[a]				**5000**[d]	**2050**	**45400**	**13700**	**1494**[e]	**100000**	**800**
Residential Soil Screening Levels[a]				**2100**[d]	**1520**	**3130**	**1220**	**205**[e]	**23500**	**400**
MD21-06-71449	21-26597	1.50–3.00	Fill	—	—	—	—	1.93	—	—
MD21-06-71450	21-26597	12.00–15.00	Qbt 3	—	—	—	—	0.44	—	—
MD21-06-71451	21-26597	23.00–25.00	Qbt 3	—	—	—	—	1.23	—	—
MD21-06-71452	21-26597	80.00–85.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-71457	21-26598	0.00–0.50	Fill	—	—	—	—	0.897	—	—
MD21-06-71458	21-26598	1.50–3.00	Fill	—	—	—	—	0.815	—	—
MD21-06-71459	21-26598	25.00–30.00	Qbt 3	—	—	—	—	0.039 (J)	—	—
MD21-06-71460	21-26598	50.00–55.00	Qbt 3	—	—	—	—	—	—	—
MD21-06-71461	21-26598	82.50–85.00	Qbt 3	—	—	—	—	—	—	—

Table 2.5-8 (continued)

Sample ID	Location ID	Depth (ft)	Media	Magnesium	Manganese	Mercury	Nickel	Nitrate	Perchlorate	Selenium
Soil/Fill Background Value				**4610**	**671**	**0.1**	**15.4**	**na**	**na**	**1.52**
Qbt 2,3,4 Background Value				**1690**	**482**	**0.1**	**6.58**	**na**	**na**	**0.3**
Qbt 1v Background Value				**780**	**408**	**0.1**	**2**	**na**	**na**	**0.3**
Qbt 1g, Qct, Qbo Background Value				**739**	**189**	**0.1**	**2**	**na**	**na**	**0.3**
Industrial Soil Screening Levels[a]				**na**	**48400**	**340**[d]	**22700**	**100000**	**790**[d]	**5680**
Residential Soil Screening Levels[a]				**na**	**3590**	**23**[d]	**1560**	**100000**	**55**[d]	**391**
MD21-06-70892	21-01154	0.00–0.50	Soil	—	—	—	—	—	0.00072 (J)	—
MD21-06-70893	21-01154	1.50–2.00	Soil	—	—	—	—	—	—	—
MD21-06-70908	21-01290	0.00–0.50	Soil	—	—	—	—	—	—	—
MD21-06-70909	21-01290	1.50–2.00	Soil	—	—	—	—	—	—	1.63 (U)
MD21-06-70900	21-02030	0.00–0.50	Soil	—	—	—	—	—	—	—
MD21-06-70901	21-02030	1.50–2.00	Soil	—	—	—	—	—	—	—
MD21-06-70932	21-02042	0.00–0.50	Soil	—	—	—	—	—	—	—
MD21-06-70933	21-02042	1.50–2.00	Soil	—	—	—	—	—	0.00103 (J)	1.6 (U)
MD21-06-70924	21-02058	0.00–0.50	Soil	—	—	—	—	—	—	—
MD21-06-70925	21-02058	1.50–2.00	Soil	—	953	—	—	—	—	—
MD21-06-70916	21-02586	0.00–0.50	Soil	—	—	—	—	—	—	—
MD21-06-70917	21-02586	1.50–2.00	Soil	—	—	—	—	—	—	1.68 (U)
MD21-06-70727	21-26480	0.00–0.50	Soil	—	—	—	—	0.978 (J)	—	1.54 (U)
MD21-06-70728	21-26480	25.00–27.00	Qbt 3	—	—	—	—	0.95 (J)	—	1.53 (U)
MD21-06-70730	21-26480	36.00–38.50	Qbt 3	—	—	—	—	0.97 (J)	—	1.58 (U)
MD21-06-70729	21-26480	42.00–44.00	Qbt 3	—	—	—	—	0.953 (J)	—	1.52 (U)
MD21-06-70745	21-26481	0.00–0.50	Soil	—	—	—	—	0.99 (J)	—	—
MD21-06-70746	21-26481	25.00–27.00	Qbt 3	1850	—	—	—	2.47	—	1.13 (J)
MD21-06-70748	21-26481	40.50–42.00	Qbt 3	—	—	—	—	1.94	0.000912 (J)	1.59 (U)

Table 2.5-8 (continued)

Sample ID	Location ID	Depth (ft)	Media	Magnesium	Manganese	Mercury	Nickel	Nitrate	Perchlorate	Selenium
Soil/Fill Background Value				**4610**	**671**	**0.1**	**15.4**	**na**	**na**	**1.52**
Qbt 2,3,4 Background Value				**1690**	**482**	**0.1**	**6.58**	**na**	**na**	**0.3**
Qbt 1v Background Value				**780**	**408**	**0.1**	**2**	**na**	**na**	**0.3**
Qbt 1g, Qct, Qbo Background Value				**739**	**189**	**0.1**	**2**	**na**	**na**	**0.3**
Industrial Soil Screening Levels[a]				**na**	**48400**	**340**[d]	**22700**	**100000**	**790**[d]	**5680**
Residential Soil Screening Levels[a]				**na**	**3590**	**23**[d]	**1560**	**100000**	**55**[d]	**391**
MD21-06-70747	21-26481	43.00–45.00	Qbt 3	—	—	—	—	1.49	—	1.55 (U)
MD21-06-70773	21-26482	0.00–0.50	Soil	—	—	—	—	2.34	—	—
MD21-06-70774	21-26482	13.20–15.00	Qbt 3	—	—	—	—	1.01 (J)	—	1.5 (U)
MD21-06-70776	21-26482	19.00–22.00	Qbt 3	—	—	—	—	0.95 (J)	—	1.51 (U)
MD21-06-70775	21-26482	30.00–32.00	Qbt 3	—	—	—	—	0.967 (J)	—	1.52 (U)
MD21-06-70778	21-26482	47.30–49.00	Qbt 3	—	—	—	—	1.32	—	1.88 (U)
MD21-06-70777	21-26482	49.00–50.00	Qbt 3	—	—	—	—	1.25	—	1.58 (U)
MD21-06-70819	21-26484	0.00–0.50	Soil	—	—	0.146	—	0.929 (J)	—	—
MD21-06-70820	21-26484	13.00–15.00	Qbt 3	—	—	—	—	0.957 (J)	0.000581 (J)	1.54 (U)
MD21-06-70822	21-26484	25.00–27.00	Qbt 3	—	—	—	—	0.972 (J)	0.00379	1.58 (U)
MD21-06-70823	21-26484	35.00–37.00	Qbt 3	—	—	—	—	0.96 (J)	0.00238	1.57 (U)
MD21-06-70821	21-26484	43.00–45.00	Qbt 3	—	—	—	—	0.999 (J)	0.00104 (J)	1.51 (U)
MD21-06-70837	21-26485	0.00–0.50	Soil	—	—	—	—	1.05	—	1.56 (U)
MD21-06-70838	21-26485	24.00–26.00	Qbt 3	—	—	—	—	0.942 (J)	—	1.51 (U)
MD21-06-70842	21-26485	28.00–30.00	Qbt 3	—	—	—	—	0.954 (J)	0.000643 (J)	1.5 (U)
MD21-06-70840	21-26485	30.00–32.00	Qbt 3	2520 (J+)	—	—	—	0.977 (J)	—	1.63 (U)
MD21-06-70841	21-26485	32.00–34.00	Qbt 3	—	—	—	—	0.932 (J)	—	1.49 (U)
MD21-06-70839	21-26485	43.00–45.00	Qbt 3	—	—	—	—	0.954 (J)	—	1.53 (U)
MD21-06-70946	21-26486	0.00–0.50	Soil	—	—	—	—	—	—	—

Table 2.5-8 (continued)

Sample ID	Location ID	Depth (ft)	Media	Magnesium	Manganese	Mercury	Nickel	Nitrate	Perchlorate	Selenium
Soil/Fill Background Value				**4610**	**671**	**0.1**	**15.4**	**na**	**na**	**1.52**
Qbt 2,3,4 Background Value				**1690**	**482**	**0.1**	**6.58**	**na**	**na**	**0.3**
Qbt 1v Background Value				**780**	**408**	**0.1**	**2**	**na**	**na**	**0.3**
Qbt 1g, Qct, Qbo Background Value				**739**	**189**	**0.1**	**2**	**na**	**na**	**0.3**
Industrial Soil Screening Levels[a]				**na**	**48400**	**340**[d]	**22700**	**100000**	**790**[d]	**5680**
Residential Soil Screening Levels[a]				**na**	**3590**	**23**[d]	**1560**	**100000**	**55**[d]	**391**
MD21-06-70947	21-26486	1.50–2.00	Soil	—	—	—	—	—	—	1.62 (U)
MD21-06-70954	21-26487	0.00–0.50	Soil	—	—	—	—	—	—	—
MD21-06-70955	21-26487	1.50–2.00	Soil	—	—	—	—	—	—	1.54 (U)
MD21-06-70962	21-26488	0.00–0.50	Soil	—	—	—	—	—	—	1.6 (U)
MD21-06-70963	21-26488	1.50–2.00	Soil	—	1500	—	—	—	—	—
MD21-06-70970	21-26489	0.00–0.50	Soil	—	—	—	—	—	—	1.61 (U)
MD21-06-70971	21-26489	1.50–2.00	Soil	—	—	—	—	—	—	—
MD21-06-70978	21-26490	0.00–0.50	Soil	—	—	—	—	—	—	—
MD21-06-70979	21-26490	1.50–2.00	Soil	—	—	—	—	—	0.000534 (J)	1.53 (U)
MD21-06-70992	21-26491	0.00–0.50	Soil	—	—	—	—	—	—	1.79 (U)
MD21-06-70993	21-26491	1.50–2.00	Soil	—	—	—	—	—	0.000925 (J)	1.63 (U)
MD21-06-70996	21-26492	0.00–0.50	Soil	—	—	—	—	—	—	—
MD21-06-70997	21-26492	1.50–2.00	Soil	—	—	—	—	—	0.000861 (J)	1.61 (U)
MD21-06-71000	21-26493	0.00–0.50	Soil	—	—	—	—	—	—	—
MD21-06-71001	21-26493	1.50–2.00	Soil	—	—	—	—	—	—	1.59 (U)
MD21-06-71004	21-26494	0.00–0.50	Soil	—	—	—	—	—	—	—
MD21-06-71005	21-26494	1.50–2.00	Soil	—	—	—	—	—	0.00285	—
MD21-06-71008	21-26495	0.00–0.50	Soil	—	—	—	—	—	—	—
MD21-06-71009	21-26495	1.50–2.00	Soil	—	—	—	—	—	0.000699 (J)	—

Table 2.5-8 (continued)

Sample ID	Location ID	Depth (ft)	Media	Magnesium	Manganese	Mercury	Nickel	Nitrate	Perchlorate	Selenium
Soil/Fill Background Value				**4610**	**671**	**0.1**	**15.4**	**na**	**na**	**1.52**
Qbt 2,3,4 Background Value				**1690**	**482**	**0.1**	**6.58**	**na**	**na**	**0.3**
Qbt 1v Background Value				**780**	**408**	**0.1**	**2**	**na**	**na**	**0.3**
Qbt 1g, Qct, Qbo Background Value				**739**	**189**	**0.1**	**2**	**na**	**na**	**0.3**
Industrial Soil Screening Levels[a]				**na**	**48400**	**340**[d]	**22700**	**100000**	**790**[d]	**5680**
Residential Soil Screening Levels[a]				**na**	**3590**	**23**[d]	**1560**	**100000**	**55**[d]	**391**
MD21-06-71293	21-26588	0.00–0.50	Fill	—	—	—	—	—	0.000792 (J)	1.66 (U)
MD21-06-71294	21-26588	5.50–7.00	Fill	—	—	—	—	—	0.000606 (J)	1.6 (U)
MD21-06-71295	21-26588	15.00–17.50	Qbt 3	—	—	—	—	—	0.00052 (J)	1.53 (U)
MD21-06-71296	21-26588	25.00–27.50	Qbt 3	—	—	—	—	—	0.000846 (J)	1.55 (U)
MD21-06-71297	21-26588	62.50–65.00	Qbt 3	—	—	—	—	—	—	1.55 (U)
MD21-06-71298	21-26588	110.00–112.00	Qbt 2	—	—	—	—	—	0.00761	1.52 (U)
MD21-06-71299	21-26588	200.00–202.50	Qbt 1v	—	—	—	—	—	—	1.51 (U)
MD21-06-71300	21-26588	300.00–302.50	Qbt 1g	—	—	—	—	—	—	1.56 (U)
MD21-06-71301	21-26588	355.00–360.00	Qbo	—	342	—	4.22	—	—	0.716 (J)
MD21-06-71320	21-26589	0.00–0.50	Soil	—	—	—	—	—	0.000819 (J)	1.87
MD21-06-71321	21-26589	7.00–9.00	Soil	—	—	—	—	—	—	1.65 (U)
MD21-06-71322	21-26589	17.00–19.00	Qbt 3	—	—	—	—	—	—	0.716 (J)
MD21-06-71323	21-26589	47.00–52.00	Qbt 3	—	—	—	—	—	—	1.48 (U)
MD21-06-71324	21-26589	78.00–80.00	Qbt 3	—	—	—	—	—	0.00163 (J)	1.53 (U)
MD21-06-71325	21-26589	92.00–94.00	Qbt 3	—	—	—	—	—	0.00172 (J)	1.56 (U)
MD21-06-71326	21-26589	138.00–140.00	Qbt 3	—	—	—	—	—	—	1.54 (U)
MD21-06-71337	21-26590	0.00–0.50	Fill	—	—	—	—	—	—	1.61 (U)
MD21-06-71338	21-26590	1.50–3.00	Fill	—	—	—	—	—	—	—
MD21-06-71339	21-26590	27.00–30.00	Qbt 3	—	—	—	—	—	—	1.49 (U)

Table 2.5-8 (continued)

Sample ID	Location ID	Depth (ft)	Media	Magnesium	Manganese	Mercury	Nickel	Nitrate	Perchlorate	Selenium
Soil/Fill Background Value				**4610**	**671**	**0.1**	**15.4**	**na**	**na**	**1.52**
Qbt 2,3,4 Background Value				**1690**	**482**	**0.1**	**6.58**	**na**	**na**	**0.3**
Qbt 1v Background Value				**780**	**408**	**0.1**	**2**	**na**	**na**	**0.3**
Qbt 1g, Qct, Qbo Background Value				**739**	**189**	**0.1**	**2**	**na**	**na**	**0.3**
Industrial Soil Screening Levels[a]				**na**	**48400**	**340**[d]	**22700**	**100000**	**790**[d]	**5680**
Residential Soil Screening Levels[a]				**na**	**3590**	**23**[d]	**1560**	**100000**	**55**[d]	**391**
MD21-06-71340	21-26590	45.00–50.00	Qbt 3	—	—	—	—	—	—	1.54 (U)
MD21-06-71341	21-26590	75.00–77.00	Qbt 3	—	—	—	—	—	—	1.46 (U)
MD21-06-71342	21-26590	100.00–102.00	Qbt 3	—	—	—	—	—	0.00077 (J+)	1.53 (U)
MD21-06-71343	21-26590	137.00–140.00	Qbt 3	—	—	—	—	—	—	0.839 (J)
MD21-06-71352	21-26591	0.00–0.50	Fill	—	—	—	—	—	0.00083 (J)	1.8 (U)
MD21-06-71353	21-26591	1.50–2.50	Fill	—	—	—	—	—	0.00324	1.56 (U)
MD21-06-71354	21-26591	15.00–17.00	Qbt 3	—	—	—	—	—	—	1.51 (U)
MD21-06-71355	21-26591	27.00–30.00	Qbt 3	—	—	—	—	—	—	1.5 (U)
MD21-06-71356	21-26591	30.00–35.00	Qbt 3	—	—	—	—	—	—	1.49 (U)
MD21-06-71361	21-26592	0.00–0.50	Fill	—	—	—	—	—	0.0401	1.73 (U)
MD21-06-71362	21-26592	1.50–4.00	Fill	—	—	—	—	—	0.0461	1.54 (U)
MD21-06-71363	21-26592	15.00–17.00	Qbt 3	—	—	—	—	—	0.00273	1.49 (U)
MD21-06-71364	21-26592	23.00–25.00	Qbt 3	—	—	—	—	—	0.006	1.49 (U)
MD21-06-71365	21-26592	33.00–35.00	Qbt 3	—	—	—	—	—	0.121	1.56 (U)
MD21-06-71388	21-26593	0.00–0.50	Fill	—	—	—	—	—	—	1.64 (U)
MD21-06-71389	21-26593	1.50–2.00	Fill	—	—	—	—	—	0.00164 (J)	1.68 (U)
MD21-06-71384	21-26593	3.00–7.00	Fill	—	1010	—	—	—	0.00921	—
MD21-06-71385	21-26593	15.00–17.00	Qbt 3	—	—	—	—	—	0.000956 (J)	1.48 (U)
MD21-06-71386	21-26593	21.00–23.00	Qbt 3	—	—	—	—	—	0.000824 (J)	1.58 (U)

Table 2.5-8 (continued)

Sample ID	Location ID	Depth (ft)	Media	Magnesium	Manganese	Mercury	Nickel	Nitrate	Perchlorate	Selenium
Soil/Fill Background Value				**4610**	**671**	**0.1**	**15.4**	**na**	**na**	**1.52**
Qbt 2,3,4 Background Value				**1690**	**482**	**0.1**	**6.58**	**na**	**na**	**0.3**
Qbt 1v Background Value				**780**	**408**	**0.1**	**2**	**na**	**na**	**0.3**
Qbt 1g, Qct, Qbo Background Value				**739**	**189**	**0.1**	**2**	**na**	**na**	**0.3**
Industrial Soil Screening Levels[a]				**na**	**48400**	**340**[d]	**22700**	**100000**	**790**[d]	**5680**
Residential Soil Screening Levels[a]				**na**	**3590**	**23**[d]	**1560**	**100000**	**55**[d]	**391**
MD21-06-71387	21-26593	33.00–35.00	Qbt 3	—	—	—	—	—	—	1.5 (U)
MD21-06-71393	21-26594	0.00–0.50	Fill	—	—	—	—	—	—	—
MD21-06-71394	21-26594	1.50–3.00	Fill	—	—	—	—	—	0.000612 (J)	—
MD21-06-71395	21-26594	17.00–20.00	Qbt 3	—	—	—	—	—	—	1.55 (U)
MD21-06-71396	21-26594	25.00–27.00	Qbt 3	—	—	—	—	—	—	1.5 (U)
MD21-06-71397	21-26594	30.00–35.00	Qbt 3	—	—	—	—	—	—	1.55 (U)
MD21-06-71416	21-26595	0.00–0.50	Fill	—	—	—	—	—	—	1.74 (U)
MD21-06-71417	21-26595	1.50–2.00	Fill	—	916 (J)	—	—	—	0.00105 (J)	—
MD21-06-71418	21-26595	2.00–3.50	Fill	—	—	—	—	—	0.00207 (J)	1.57 (U)
MD21-06-71419	21-26595	15.00–17.00	Qbt 3	—	—	—	—	—	0.00122 (J)	1.51 (U)
MD21-06-71420	21-26595	23.00–25.00	Qbt 3	—	—	—	—	—	0.00112 (J)	1.5 (U)
MD21-06-71421	21-26595	33.00–35.00	Qbt 3	—	—	—	—	—	0.00122 (J)	1.53 (U)
MD21-06-71425	21-26596	0.00–0.50	Fill	—	—	—	—	—	—	—
MD21-06-71426	21-26596	3.00–5.00	Fill	—	—	—	—	—	—	1.63 (U)
MD21-06-71427	21-26596	5.00–7.50	Qbt 3	—	—	—	—	—	—	0.685 (J)
MD21-06-71428	21-26596	17.00–20.00	Qbt 3	—	—	—	—	—	—	1.6 (U)
MD21-06-71429	21-26596	27.00–30.00	Qbt 3	—	—	—	—	—	—	1.56 (U)
MD21-06-71430	21-26596	32.00–35.00	Qbt 3	—	—	—	—	—	—	1.55 (U)
MD21-06-71448	21-26597	0.00–0.50	Fill	—	—	—	—	—	—	—

Table 2.5-8 (continued)

Sample ID	Location ID	Depth (ft)	Media	Magnesium	Manganese	Mercury	Nickel	Nitrate	Perchlorate	Selenium
Soil/Fill Background Value				**4610**	**671**	**0.1**	**15.4**	**na**	**na**	**1.52**
Qbt 2,3,4 Background Value				**1690**	**482**	**0.1**	**6.58**	**na**	**na**	**0.3**
Qbt 1v Background Value				**780**	**408**	**0.1**	**2**	**na**	**na**	**0.3**
Qbt 1g, Qct, Qbo Background Value				**739**	**189**	**0.1**	**2**	**na**	**na**	**0.3**
Industrial Soil Screening Levels[a]				**na**	**48400**	**340**[d]	**22700**	**100000**	**790**[d]	**5680**
Residential Soil Screening Levels[a]				**na**	**3590**	**23**[d]	**1560**	**100000**	**55**[d]	**391**
MD21-06-71449	21-26597	1.50–3.00	Fill	—	—	—	—	—	—	1.57 (U)
MD21-06-71450	21-26597	12.00–15.00	Qbt 3	—	—	—	—	—	—	1.56 (U)
MD21-06-71451	21-26597	23.00–25.00	Qbt 3	—	—	—	—	—	0.000778 (J)	1.56 (U)
MD21-06-71452	21-26597	80.00–85.00	Qbt 3	—	—	—	—	—	0.000598 (J)	1.53 (U)
MD21-06-71457	21-26598	0.00–0.50	Fill	—	—	—	—	—	—	1.55 (U)
MD21-06-71458	21-26598	1.50–3.00	Fill	—	—	—	—	—	—	1.66 (U)
MD21-06-71459	21-26598	25.00–30.00	Qbt 3	—	—	—	—	—	—	1.52 (U)
MD21-06-71460	21-26598	50.00–55.00	Qbt 3	—	—	—	—	—	—	1.56 (U)
MD21-06-71461	21-26598	82.50–85.00	Qbt 3	—	—	—	—	—	—	1.49 (U)

Table 2.5-8 (continued)

Sample ID	Location ID	Depth (ft)	Media	Silver	Sodium	Thallium	Uranium	Vanadium	Zinc
Soil/Fill Background Value				**1**	**915**	**0.73**	**1.82**	**39.6**	**48.8**
Qbt 2,3,4 Background Value				**1**	**2770**	**1.1**	**2.4**	**17**	**63.5**
Qbt 1v Background Value				**1**	**6330**	**1.24**	**6.22**	**4.48**	**84.6**
Qbt 1g, Qct, Qbo Background Value				**1**	**4350**	**1.22**	**0.72**	**4.59**	**40**
Industrial Soil Screening Levels[a]				**5680**	**na**	**74.9**	**200**[f]	**1140**	**100000**
Residential Soil Screening Levels[a]				**391**	**na**	**5.16**	**16**[f]	**78.2**	**23500**
MD21-06-70892	21-01154	0.00–0.50	Soil	—	—	—	—	—	—
MD21-06-70893	21-01154	1.50–2.00	Soil	—	—	—	—	—	—
MD21-06-70908	21-01290	0.00–0.50	Soil	—	—	—	—	—	—
MD21-06-70909	21-01290	1.50–2.00	Soil	—	—	1.13 (U)	—	—	—
MD21-06-70900	21-02030	0.00–0.50	Soil	—	—	—	—	—	—
MD21-06-70901	21-02030	1.50–2.00	Soil	—	—	—	—	—	—
MD21-06-70932	21-02042	0.00–0.50	Soil	—	—	—	—	—	—
MD21-06-70933	21-02042	1.50–2.00	Soil	—	—	—	—	—	—
MD21-06-70924	21-02058	0.00–0.50	Soil	—	—	—	—	—	95.9
MD21-06-70925	21-02058	1.50–2.00	Soil	—	—	—	—	—	—
MD21-06-70916	21-02586	0.00–0.50	Soil	—	—	—	—	—	—
MD21-06-70917	21-02586	1.50–2.00	Soil	—	—	—	—	—	—
MD21-06-70727	21-26480	0.00–0.50	Soil	—	—	—	—	—	59.9
MD21-06-70728	21-26480	25.00–27.00	Qbt 3	—	—	—	—	—	—
MD21-06-70730	21-26480	36.00–38.50	Qbt 3	—	—	—	—	—	—
MD21-06-70729	21-26480	42.00–44.00	Qbt 3	—	—	—	—	—	—
MD21-06-70745	21-26481	0.00–0.50	Soil	—	—	—	—	—	—
MD21-06-70746	21-26481	25.00–27.00	Qbt 3	—	—	—	—	—	—
MD21-06-70748	21-26481	40.50–42.00	Qbt 3	—	—	—	—	—	—

Table 2.5-8 (continued)

Sample ID	Location ID	Depth (ft)	Media	Silver	Sodium	Thallium	Uranium	Vanadium	Zinc
Soil/Fill Background Value				**1**	**915**	**0.73**	**1.82**	**39.6**	**48.8**
Qbt 2,3,4 Background Value				**1**	**2770**	**1.1**	**2.4**	**17**	**63.5**
Qbt 1v Background Value				**1**	**6330**	**1.24**	**6.22**	**4.48**	**84.6**
Qbt 1g, Qct, Qbo Background Value				**1**	**4350**	**1.22**	**0.72**	**4.59**	**40**
Industrial Soil Screening Levels[a]				**5680**	**na**	**74.9**	**200**[f]	**1140**	**100000**
Residential Soil Screening Levels[a]				**391**	**na**	**5.16**	**16**[f]	**78.2**	**23500**
MD21-06-70747	21-26481	43.00–45.00	Qbt 3	—	—	—	—	—	—
MD21-06-70773	21-26482	0.00–0.50	Soil	—	—	—	—	—	—
MD21-06-70774	21-26482	13.20–15.00	Qbt 3	—	—	—	—	—	—
MD21-06-70776	21-26482	19.00–22.00	Qbt 3	—	—	—	—	—	—
MD21-06-70775	21-26482	30.00–32.00	Qbt 3	—	—	—	—	—	—
MD21-06-70778	21-26482	47.30–49.00	Qbt 3	—	—	—	—	—	—
MD21-06-70777	21-26482	49.00–50.00	Qbt 3	—	—	—	—	—	—
MD21-06-70819	21-26484	0.00–0.50	Soil	—	—	—	—	—	—
MD21-06-70820	21-26484	13.00–15.00	Qbt 3	—	—	—	—	—	—
MD21-06-70822	21-26484	25.00–27.00	Qbt 3	—	—	—	—	19.8	—
MD21-06-70823	21-26484	35.00–37.00	Qbt 3	—	—	—	—	—	—
MD21-06-70821	21-26484	43.00–45.00	Qbt 3	—	—	—	—	—	—
MD21-06-70837	21-26485	0.00–0.50	Soil	—	—	—	—	—	60.4
MD21-06-70838	21-26485	24.00–26.00	Qbt 3	—	—	—	—	—	—
MD21-06-70842	21-26485	28.00–30.00	Qbt 3	—	—	—	—	—	—
MD21-06-70840	21-26485	30.00–32.00	Qbt 3	—	—	—	—	—	—
MD21-06-70841	21-26485	32.00–34.00	Qbt 3	—	—	—	—	—	—
MD21-06-70839	21-26485	43.00–45.00	Qbt 3	—	—	—	—	—	—
MD21-06-70946	21-26486	0.00–0.50	Soil	—	—	—	—	—	—

Table 2.5-8 (continued)

Sample ID	Location ID	Depth (ft)	Media	Silver	Sodium	Thallium	Uranium	Vanadium	Zinc
Soil/Fill Background Value				**1**	**915**	**0.73**	**1.82**	**39.6**	**48.8**
Qbt 2,3,4 Background Value				**1**	**2770**	**1.1**	**2.4**	**17**	**63.5**
Qbt 1v Background Value				**1**	**6330**	**1.24**	**6.22**	**4.48**	**84.6**
Qbt 1g, Qct, Qbo Background Value				**1**	**4350**	**1.22**	**0.72**	**4.59**	**40**
Industrial Soil Screening Levels[a]				**5680**	**na**	**74.9**	**200**[f]	**1140**	**100000**
Residential Soil Screening Levels[a]				**391**	**na**	**5.16**	**16**[f]	**78.2**	**23500**
MD21-06-70947	21-26486	1.50–2.00	Soil	—	—	—	—	—	—
MD21-06-70954	21-26487	0.00–0.50	Soil	—	—	—	—	—	—
MD21-06-70955	21-26487	1.50–2.00	Soil	—	—	—	—	—	—
MD21-06-70962	21-26488	0.00–0.50	Soil	—	—	—	—	—	—
MD21-06-70963	21-26488	1.50–2.00	Soil	1.08 (U)	—	1.9	—	—	283
MD21-06-70970	21-26489	0.00–0.50	Soil	—	—	—	2.25	—	—
MD21-06-70971	21-26489	1.50–2.00	Soil	—	—	—	—	—	—
MD21-06-70978	21-26490	0.00–0.50	Soil	—	—	—	—	—	—
MD21-06-70979	21-26490	1.50–2.00	Soil	—	—	—	—	—	—
MD21-06-70992	21-26491	0.00–0.50	Soil	—	—	—	—	—	—
MD21-06-70993	21-26491	1.50–2.00	Soil	—	—	—	—	—	—
MD21-06-70996	21-26492	0.00–0.50	Soil	—	—	—	—	—	—
MD21-06-70997	21-26492	1.50–2.00	Soil	—	—	—	—	—	—
MD21-06-71000	21-26493	0.00–0.50	Soil	—	—	—	—	—	—
MD21-06-71001	21-26493	1.50–2.00	Soil	—	—	—	—	—	—
MD21-06-71004	21-26494	0.00–0.50	Soil	—	—	—	—	—	—
MD21-06-71005	21-26494	1.50–2.00	Soil	—	951	—	—	—	—
MD21-06-71008	21-26495	0.00–0.50	Soil	—	—	—	—	—	—
MD21-06-71009	21-26495	1.50–2.00	Soil	—	—	—	—	—	—

Table 2.5-8 (continued)

Sample ID	Location ID	Depth (ft)	Media	Silver	Sodium	Thallium	Uranium	Vanadium	Zinc
Soil/Fill Background Value				**1**	**915**	**0.73**	**1.82**	**39.6**	**48.8**
Qbt 2,3,4 Background Value				**1**	**2770**	**1.1**	**2.4**	**17**	**63.5**
Qbt 1v Background Value				**1**	**6330**	**1.24**	**6.22**	**4.48**	**84.6**
Qbt 1g, Qct, Qbo Background Value				**1**	**4350**	**1.22**	**0.72**	**4.59**	**40**
Industrial Soil Screening Levels[a]				**5680**	**na**	**74.9**	**200**[f]	**1140**	**100000**
Residential Soil Screening Levels[a]				**391**	**na**	**5.16**	**16**[f]	**78.2**	**23500**
MD21-06-71293	21-26588	0.00–0.50	Fill	—	—	—	—	—	—
MD21-06-71294	21-26588	5.50–7.00	Fill	—	—	—	—	—	—
MD21-06-71295	21-26588	15.00–17.50	Qbt 3	—	—	—	—	—	—
MD21-06-71296	21-26588	25.00–27.50	Qbt 3	—	—	—	—	—	—
MD21-06-71297	21-26588	62.50–65.00	Qbt 3	—	—	—	—	—	—
MD21-06-71298	21-26588	110.00–112.00	Qbt 2	—	—	—	—	—	—
MD21-06-71299	21-26588	200.00–202.50	Qbt 1v	—	—	—	—	—	—
MD21-06-71300	21-26588	300.00–302.50	Qbt 1g	—	—	—	—	—	—
MD21-06-71301	21-26588	355.00–360.00	Qbo	—	—	—	—	10.3	—
MD21-06-71320	21-26589	0.00–0.50	Soil	—	—	—	—	—	—
MD21-06-71321	21-26589	7.00–9.00	Soil	—	—	—	—	—	—
MD21-06-71322	21-26589	17.00–19.00	Qbt 3	—	—	—	—	—	—
MD21-06-71323	21-26589	47.00–52.00	Qbt 3	—	—	—	—	—	—
MD21-06-71324	21-26589	78.00–80.00	Qbt 3	—	—	—	—	—	—
MD21-06-71325	21-26589	92.00–94.00	Qbt 3	—	—	—	—	—	—
MD21-06-71326	21-26589	138.00–140.00	Qbt 3	—	—	—	—	—	—
MD21-06-71337	21-26590	0.00–0.50	Fill	—	—	—	—	—	—
MD21-06-71338	21-26590	1.50–3.00	Fill	—	—	—	—	—	—
MD21-06-71339	21-26590	27.00–30.00	Qbt 3	—	—	—	—	—	—

Table 2.5-8 (continued)

Sample ID	Location ID	Depth (ft)	Media	Silver	Sodium	Thallium	Uranium	Vanadium	Zinc
Soil/Fill Background Value				**1**	**915**	**0.73**	**1.82**	**39.6**	**48.8**
Qbt 2,3,4 Background Value				**1**	**2770**	**1.1**	**2.4**	**17**	**63.5**
Qbt 1v Background Value				**1**	**6330**	**1.24**	**6.22**	**4.48**	**84.6**
Qbt 1g, Qct, Qbo Background Value				**1**	**4350**	**1.22**	**0.72**	**4.59**	**40**
Industrial Soil Screening Levels[a]				**5680**	**na**	**74.9**	**200**[f]	**1140**	**100000**
Residential Soil Screening Levels[a]				**391**	**na**	**5.16**	**16**[f]	**78.2**	**23500**
MD21-06-71340	21-26590	45.00–50.00	Qbt 3	—	—	—	—	—	—
MD21-06-71341	21-26590	75.00–77.00	Qbt 3	—	—	—	—	—	—
MD21-06-71342	21-26590	100.00–102.00	Qbt 3	—	—	—	—	—	—
MD21-06-71343	21-26590	137.00–140.00	Qbt 3	—	—	—	—	—	—
MD21-06-71352	21-26591	0.00–0.50	Fill	—	—	—	—	—	—
MD21-06-71353	21-26591	1.50–2.50	Fill	—	—	—	—	—	—
MD21-06-71354	21-26591	15.00–17.00	Qbt 3	—	—	—	—	—	—
MD21-06-71355	21-26591	27.00–30.00	Qbt 3	—	—	—	—	—	—
MD21-06-71356	21-26591	30.00–35.00	Qbt 3	—	—	—	—	—	—
MD21-06-71361	21-26592	0.00–0.50	Fill	—	—	—	—	—	—
MD21-06-71362	21-26592	1.50–4.00	Fill	—	—	—	—	—	—
MD21-06-71363	21-26592	15.00–17.00	Qbt 3	—	—	—	—	—	—
MD21-06-71364	21-26592	23.00–25.00	Qbt 3	—	—	—	—	—	—
MD21-06-71365	21-26592	33.00–35.00	Qbt 3	—	—	—	—	—	—
MD21-06-71388	21-26593	0.00–0.50	Fill	—	—	—	—	—	—
MD21-06-71389	21-26593	1.50–2.00	Fill	—	—	—	—	—	—
MD21-06-71384	21-26593	3.00–7.00	Fill	—	—	—	2.53	—	—
MD21-06-71385	21-26593	15.00–17.00	Qbt 3	—	—	—	—	—	—
MD21-06-71386	21-26593	21.00–23.00	Qbt 3	—	—	—	—	—	—

Table 2.5-8 (continued)

Sample ID	Location ID	Depth (ft)	Media	Silver	Sodium	Thallium	Uranium	Vanadium	Zinc
Soil/Fill Background Value				**1**	**915**	**0.73**	**1.82**	**39.6**	**48.8**
Qbt 2,3,4 Background Value				**1**	**2770**	**1.1**	**2.4**	**17**	**63.5**
Qbt 1v Background Value				**1**	**6330**	**1.24**	**6.22**	**4.48**	**84.6**
Qbt 1g, Qct, Qbo Background Value				**1**	**4350**	**1.22**	**0.72**	**4.59**	**40**
Industrial Soil Screening Levels[a]				**5680**	**na**	**74.9**	**200**[f]	**1140**	**100000**
Residential Soil Screening Levels[a]				**391**	**na**	**5.16**	**16**[f]	**78.2**	**23500**
MD21-06-71387	21-26593	33.00–35.00	Qbt 3	—	—	—	—	—	—
MD21-06-71393	21-26594	0.00–0.50	Fill	—	—	—	—	—	—
MD21-06-71394	21-26594	1.50–3.00	Fill	—	—	—	—	—	—
MD21-06-71395	21-26594	17.00–20.00	Qbt 3	—	—	—	—	—	—
MD21-06-71396	21-26594	25.00–27.00	Qbt 3	—	—	—	—	—	—
MD21-06-71397	21-26594	30.00–35.00	Qbt 3	—	—	—	—	—	—
MD21-06-71416	21-26595	0.00–0.50	Fill	—	—	—	—	—	—
MD21-06-71417	21-26595	1.50–2.00	Fill	—	—	—	—	—	—
MD21-06-71418	21-26595	2.00–3.50	Fill	—	—	—	—	—	—
MD21-06-71419	21-26595	15.00–17.00	Qbt 3	—	—	—	—	—	—
MD21-06-71420	21-26595	23.00–25.00	Qbt 3	—	—	—	—	—	—
MD21-06-71421	21-26595	33.00–35.00	Qbt 3	—	—	—	—	—	—
MD21-06-71425	21-26596	0.00–0.50	Fill	—	—	—	—	—	—
MD21-06-71426	21-26596	3.00–5.00	Fill	—	—	—	—	—	—
MD21-06-71427	21-26596	5.00–7.50	Qbt 3	—	—	—	—	—	—
MD21-06-71428	21-26596	17.00–20.00	Qbt 3	—	—	—	—	—	—
MD21-06-71429	21-26596	27.00–30.00	Qbt 3	—	—	—	—	—	—
MD21-06-71430	21-26596	32.00–35.00	Qbt 3	—	—	—	—	—	—
MD21-06-71448	21-26597	0.00–0.50	Fill	—	—	—	—	—	—

Table 2.5-8 (continued)

Sample ID	Location ID	Depth (ft)	Media	Silver	Sodium	Thallium	Uranium	Vanadium	Zinc
Soil/Fill Background Value				**1**	**915**	**0.73**	**1.82**	**39.6**	**48.8**
Qbt 2,3,4 Background Value				**1**	**2770**	**1.1**	**2.4**	**17**	**63.5**
Qbt 1v Background Value				**1**	**6330**	**1.24**	**6.22**	**4.48**	**84.6**
Qbt 1g, Qct, Qbo Background Value				**1**	**4350**	**1.22**	**0.72**	**4.59**	**40**
Industrial Soil Screening Levels[a]				**5680**	**na**	**74.9**	**200**[f]	**1140**	**100000**
Residential Soil Screening Levels[a]				**391**	**na**	**5.16**	**16**[f]	**78.2**	**23500**
MD21-06-71449	21-26597	1.50–3.00	Fill	—	—	—	—	—	—
MD21-06-71450	21-26597	12.00–15.00	Qbt 3	—	—	—	—	—	—
MD21-06-71451	21-26597	23.00–25.00	Qbt 3	—	—	—	—	—	—
MD21-06-71452	21-26597	80.00–85.00	Qbt 3	—	—	—	—	—	—
MD21-06-71457	21-26598	0.00–0.50	Fill	—	—	—	—	—	—
MD21-06-71458	21-26598	1.50–3.00	Fill	—	—	—	—	—	—
MD21-06-71459	21-26598	25.00–30.00	Qbt 3	—	—	—	—	—	—
MD21-06-71460	21-26598	50.00–55.00	Qbt 3	—	—	—	—	—	—
MD21-06-71461	21-26598	82.50–85.00	Qbt 3	—	—	—	—	—	—

Notes: Units are mg/kg. BVs from LANL 1998, 059730.

[a] SSLs from NMED 2006, 092513, unless otherwise indicated.

[b] na = Not available.

[c] — = The analyte was not detected above the background value.

[d] SSLs fromEPA Region 6 (EPA 2005, 091002).

[e] SSLs calculated using NMED parameters and the ATSDR minimal risk level.

[f] SSLs from EPA Region 9 (http:/www.epa.gov/region09/waste/sfund/prg/files/04prgtable.pdf)

Table 2.5-9
Summary of VOCs, SVOCs, and PCBs Detected at MDA A and DP Canyon Slope

Sample ID	Location ID	Depth (ft)	Media	Acenaphthene	Acetone	Anthracene	Aroclor-1254	Aroclor-1260	Benzo(a)anthracene
Industrial Soil Screening Levels[a]				**33500**	**100000**	**100000**	**8.26**	**8.26**	**23.4**
Residential Soil Screening Levels[a]				**3730**	**28100**	**22000**	**1.12**	**1.12**	**6.21**
MD21-06-70892	21-01154	0.00–0.50	Soil	—[b]	—	—	—	—	—
MD21-06-70900	21-02030	0.00–0.50	Soil	—	—	0.00814 (J)	—	—	—
MD21-06-70932	21-02042	0.00–0.50	Soil	—	—	—	—	—	—
MD21-06-70924	21-02058	0.00–0.50	Soil	—	—	—	—	—	—
MD21-06-70727	21-26480	0.00–0.50	Soil	—	—	0.00808 (J)	—	—	—
MD21-06-70730	21-26480	36.00–38.50	Qbt 3	—	0.00284 (J)	—	—	—	—
MD21-06-70729	21-26480	42.00–44.00	Qbt 3	—	0.00362 (J)	—	—	—	—
MD21-06-70745	21-26481	0.00–0.50	Soil	—	—	—	—	0.0136 (J-)	—
MD21-06-70746	21-26481	25.00–27.00	Qbt 3	—	0.0112	—	—	—	—
MD21-06-70748	21-26481	40.50–42.00	Qbt 3	—	0.00843	—	—	—	—
MD21-06-70747	21-26481	43.00–45.00	Qbt 3	—	0.00808	—	—	—	—
MD21-06-70773	21-26482	0.00–0.50	Soil	—	—	—	0.0241 (J)	—	—
MD21-06-70774	21-26482	13.20–15.00	Qbt 3	—	0.00692	—	—	—	—
MD21-06-70776	21-26482	19.00–22.00	Qbt 3	—	0.00564	—	—	—	—
MD21-06-70775	21-26482	30.00–32.00	Qbt 3	—	0.00902	—	—	—	—
MD21-06-70778	21-26482	47.30–49.00	Qbt 3	—	0.00957	—	—	—	—
MD21-06-70777	21-26482	49.00–50.00	Qbt 3	—	0.00434 (J)	—	—	—	—
MD21-06-70819	21-26484	0.00–0.50	Soil	—	—	—	—	—	—
MD21-06-70820	21-26484	13.00–15.00	Qbt 3	—	0.00302 (J)	—	—	—	—
MD21-06-70821	21-26484	43.00–45.00	Qbt 3	—	0.0033 (J)	—	—	—	—

Table 2.5-9 (continued)

Sample ID	Location ID	Depth (ft)	Media	Acenaphthene	Acetone	Anthracene	Aroclor-1254	Aroclor-1260	Benzo(a)anthracene
Industrial Soil Screening Levels[a]				**33500**	**100000**	**100000**	**8.26**	**8.26**	**23.4**
Residential Soil Screening Levels[a]				**3730**	**28100**	**22000**	**1.12**	**1.12**	**6.21**
MD21-06-70837	21-26485	0.00–0.50	Soil	—	—	—	—	—	—
MD21-06-70838	21-26485	24.00–26.00	Qbt 3	—	0.00528 (J)	—	—	—	—
MD21-06-70842	21-26485	28.00–30.00	Qbt 3	—	0.00387 (J)	—	—	—	—
MD21-06-70840	21-26485	30.00–32.00	Qbt 3	—	0.00525 (J)	—	—	—	—
MD21-06-70841	21-26485	32.00–34.00	Qbt 3	—	0.00334 (J)	—	—	—	—
MD21-06-70839	21-26485	43.00–45.00	Qbt 3	—	0.00329 (J)	—	—	—	—
MD21-06-70946	21-26486	0.00–0.50	Soil	—	—	—	—	—	0.0329 (J)
MD21-06-70954	21-26487	0.00–0.50	Soil	—	—	—	—	—	—
MD21-06-70962	21-26488	0.00–0.50	Soil	—	—	—	—	—	—
MD21-06-70970	21-26489	0.00–0.50	Soil	—	—	—	—	—	—
MD21-06-70978	21-26490	0.00–0.50	Soil	0.0139 (J)	—	0.0274 (J)	—	—	0.0596
MD21-06-70992	21-26491	0.00–0.50	Soil	—	—	—	—	—	—
MD21-06-70993	21-26491	1.50–2.00	Soil	—	—	—	—	—	—
MD21-06-71008	21-26495	0.00–0.50	Soil	—	—	—	—	—	—
MD21-06-71293	21-26588	0.00–0.50	Fill	—	—	—	0.0206	0.138	—
MD21-06-71298	21-26588	110.00–112.00	Qbt 2	—	—	—	0.0033 (J-)	0.0015 (J-)	—
MD21-06-71300	21-26588	300.00–302.50	Qbt 1g	—	—	—	—	—	—
MD21-06-71320	21-26589	0.00–0.50	Soil	—	—	0.0105 (J)	—	0.0054	—
MD21-06-71324	21-26589	78.00–80.00	Qbt 3	—	—	—	—	—	—
MD21-06-71339	21-26590	27.00–30.00	Qbt 3	—	0.00715	—	—	—	—
MD21-06-71340	21-26590	45.00–50.00	Qbt 3	—	0.00414 (J)	—	—	—	—

Table 2.5-9 (continued)

Sample ID	Location ID	Depth (ft)	Media	Acenaphthene	Acetone	Anthracene	Aroclor-1254	Aroclor-1260	Benzo(a)anthracene
Industrial Soil Screening Levels[a]				**33500**	**100000**	**100000**	**8.26**	**8.26**	**23.4**
Residential Soil Screening Levels[a]				**3730**	**28100**	**22000**	**1.12**	**1.12**	**6.21**
MD21-06-71352	21-26591	0.00–0.50	Fill	0.032 (J)	—	0.0506	—	0.0095 (J-)	0.109
MD21-06-71354	21-26591	15.00–17.00	Qbt 3	—	0.00393 (J)	—	—	—	—
MD21-06-71361	21-26592	0.00–0.50	Fill	0.0183 (J)	—	0.0257 (J)	0.0307 (J)	0.22	—
MD21-06-71362	21-26592	1.50–4.00	Fill	—	0.00458 (J)	—	—	—	—
MD21-06-71388	21-26593	0.00–0.50	Fill	—	—	0.00895 (J)	0.0058	0.0084	—
MD21-06-71389	21-26593	1.50–2.00	Fill	0.0345 (J)	—	—	—	0.0111	—
MD21-06-71384	21-26593	3.00–7.00	Fill	0.0734	—	—	—	—	—
MD21-06-71393	21-26594	0.00–0.50	Fill	—	—	—	—	0.0063	—
MD21-06-71416	21-26595	0.00–0.50	Fill	—	—	0.00859 (J)	—	0.0124	—
MD21-06-71425	21-26596	0.00–0.50	Fill	—	—	—	—	—	—
MD21-06-71426	21-26596	3.00–5.00	Fill	—	—	—	—	—	—
MD21-06-71427	21-26596	5.00–7.50	Qbt 3	—	—	—	—	—	—
MD21-06-71448	21-26597	0.00–0.50	Fill	—	—	—	—	0.0043	—
MD21-06-71449	21-26597	1.50–3.00	Fill	—	—	0.0757	—	0.0132	0.0685
MD21-06-71459	21-26598	25.00–30.00	Qbt 3	—	0.0159	—	—	—	—

Table 2.5-9 (continued)

Sample ID	Location ID	Depth (ft)	Media	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Benzoic acid	Bis(2-ethyhexyl) phthalate
Industrial Soil Screening Levels[a]				**2.34**	**23.4**	**30900[c]**	**234**	**100000[d]**	**1370**
Residential Soil Screening Levels[a]				**0.621**	**6.21**	**2290[c]**	**62.1**	**100000[d]**	**347**
MD21-06-70892	21-01154	0.00–0.50	Soil	—	—	—	—	—	—
MD21-06-70900	21-02030	0.00–0.50	Soil	—	—	—	—	—	—
MD21-06-70932	21-02042	0.00–0.50	Soil	—	—	—	—	—	—
MD21-06-70924	21-02058	0.00–0.50	Soil	—	—	—	—	—	—
MD21-06-70727	21-26480	0.00–0.50	Soil	0.103	0.308 (J)	0.0797 (J)	—	—	—
MD21-06-70730	21-26480	36.00–38.50	Qbt 3	—	—	—	—	—	—
MD21-06-70729	21-26480	42.00–44.00	Qbt 3	—	—	—	—	—	—
MD21-06-70745	21-26481	0.00–0.50	Soil	—	—	—	—	—	—
MD21-06-70746	21-26481	25.00–27.00	Qbt 3	—	—	—	—	—	0.148 (J)
MD21-06-70748	21-26481	40.50–42.00	Qbt 3	—	—	—	—	—	—
MD21-06-70747	21-26481	43.00–45.00	Qbt 3	—	—	—	—	—	—
MD21-06-70773	21-26482	0.00–0.50	Soil	—	—	—	—	—	—
MD21-06-70774	21-26482	13.20–15.00	Qbt 3	—	—	—	—	—	0.0726 (J)
MD21-06-70776	21-26482	19.00–22.00	Qbt 3	—	—	—	—	—	—
MD21-06-70775	21-26482	30.00–32.00	Qbt 3	—	—	—	—	—	—
MD21-06-70778	21-26482	47.30–49.00	Qbt 3	—	—	—	—	—	—
MD21-06-70777	21-26482	49.00–50.00	Qbt 3	—	—	—	—	—	—
MD21-06-70819	21-26484	0.00–0.50	Soil	0.0348	0.199	—	0.0269 (J)	—	—
MD21-06-70820	21-26484	13.00–15.00	Qbt 3	—	—	—	—	—	—

Table 2.5-9 (continued)

Sample ID	Location ID	Depth (ft)	Media	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Benzoic acid	Bis(2-ethyhexyl) phthalate
Industrial Soil Screening Levels[a]				**2.34**	**23.4**	**30900**[c]	**234**	**100000**[d]	**1370**
Residential Soil Screening Levels[a]				**0.621**	**6.21**	**2290**[c]	**62.1**	**100000**[d]	**347**
MD21-06-70821	21-26484	43.00–45.00	Qbt 3	—	—	—	—	—	—
MD21-06-70837	21-26485	0.00–0.50	Soil	—	—	—	—	—	—
MD21-06-70838	21-26485	24.00–26.00	Qbt 3	—	—	—	—	—	—
MD21-06-70842	21-26485	28.00–30.00	Qbt 3	—	—	—	—	—	—
MD21-06-70840	21-26485	30.00–32.00	Qbt 3	—	—	—	—	—	—
MD21-06-70841	21-26485	32.00–34.00	Qbt 3	—	—	—	—	—	—
MD21-06-70839	21-26485	43.00–45.00	Qbt 3	—	—	—	—	—	—
MD21-06-70946	21-26486	0.00–0.50	Soil	0.0237 (J)	0.0336 (J)	0.0877	0.0183 (J)	—	—
MD21-06-70954	21-26487	0.00–0.50	Soil	—	—	—	—	—	—
MD21-06-70962	21-26488	0.00–0.50	Soil	—	—	—	—	—	—
MD21-06-70970	21-26489	0.00–0.50	Soil	—	0.0631 (J)	—	—	—	0.102 (J)
MD21-06-70978	21-26490	0.00–0.50	Soil	0.0477	0.0907	0.0944	—	—	—
MD21-06-70992	21-26491	0.00–0.50	Soil	—	0.21 (J)	—	—	—	—
MD21-06-70993	21-26491	1.50–2.00	Soil	—	—	—	—	0.496 (J)	—
MD21-06-71008	21-26495	0.00–0.50	Soil	0.0152 (J)	0.19 (J)	—	—	—	—
MD21-06-71293	21-26588	0.00–0.50	Fill	0.0258 (J)	0.0439 (J)	—	—	—	—
MD21-06-71298	21-26588	110.00–112.00	Qbt 2	—	—	—	—	—	—
MD21-06-71300	21-26588	300.00–302.50	Qbt 1g	—	—	—	—	—	0.134 (J)
MD21-06-71320	21-26589	0.00–0.50	Soil	—	—	—	—	—	—

Table 2.5-9 (continued)

Sample ID	Location ID	Depth (ft)	Media	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Benzoic acid	Bis(2-ethyhexyl) phthalate
Industrial Soil Screening Levels[a]				**2.34**	**23.4**	**30900**[c]	**234**	**100000**[d]	**1370**
Residential Soil Screening Levels[a]				**0.621**	**6.21**	**2290**[c]	**62.1**	**100000**[d]	**347**
MD21-06-71324	21-26589	78.00–80.00	Qbt 3	—	—	—	—	—	—
MD21-06-71339	21-26590	27.00–30.00	Qbt 3	—	—	—	—	—	—
MD21-06-71340	21-26590	45.00–50.00	Qbt 3	—	—	—	—	—	—
MD21-06-71352	21-26591	0.00–0.50	Fill	0.0995	—	—	—	—	—
MD21-06-71354	21-26591	15.00–17.00	Qbt 3	—	—	—	—	—	—
MD21-06-71361	21-26592	0.00–0.50	Fill	0.0777	0.0955	—	—	—	—
MD21-06-71362	21-26592	1.50–4.00	Fill	—	—	—	—	—	—
MD21-06-71388	21-26593	0.00–0.50	Fill	0.0272 (J)	0.0432	0.0144 (J)	—	—	—
MD21-06-71389	21-26593	1.50–2.00	Fill	—	—	—	—	—	—
MD21-06-71384	21-26593	3.00–7.00	Fill	—	—	—	—	—	—
MD21-06-71393	21-26594	0.00–0.50	Fill	—	—	—	—	—	—
MD21-06-71416	21-26595	0.00–0.50	Fill	0.0318 (J)	0.0523	0.0182 (J)	—	—	—
MD21-06-71425	21-26596	0.00–0.50	Fill	—	—	—	—	—	—
MD21-06-71426	21-26596	3.00–5.00	Fill	—	—	—	—	—	—
MD21-06-71427	21-26596	5.00–7.50	Qbt 3	—	—	—	—	—	—
MD21-06-71448	21-26597	0.00–0.50	Fill	—	—	—	—	—	—
MD21-06-71449	21-26597	1.50–3.00	Fill	0.178	0.206	—	—	—	—
MD21-06-71459	21-26598	25.00–30.00	Qbt 3	—	—	—	—	—	—

Table 2.5-9 (continued)

Sample ID	Location ID	Depth (ft)	Media	Chrysene	Dichlorobenzene[1,4-]	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Isopropyltoluene[4-]
Industrial Soil Screening Levels[a]				**2310**	**103**	**24400**	**26500**	**23.4**	**389**[e]
Residential Soil Screening Levels[a]				**615**	**39.5**	**2290**	**2660**	**6.21**	**271**[e]
MD21-06-70892	21-01154	0.00–0.50	Soil	—	—	0.0142 (J)	—	—	—
MD21-06-70900	21-02030	0.00–0.50	Soil	—	—	0.0159 (J)	—	—	—
MD21-06-70932	21-02042	0.00–0.50	Soil	—	—	0.0256 (J)	—	—	—
MD21-06-70924	21-02058	0.00–0.50	Soil	—	—	0.0315 (J)	—	—	—
MD21-06-70727	21-26480	0.00–0.50	Soil	0.111	—	0.155	—	0.157	—
MD21-06-70730	21-26480	36.00–38.50	Qbt 3	—	—	—	—	—	—
MD21-06-70729	21-26480	42.00–44.00	Qbt 3	—	—	—	—	—	—
MD21-06-70745	21-26481	0.00–0.50	Soil	—	—	—	—	—	—
MD21-06-70746	21-26481	25.00–27.00	Qbt 3	—	—	—	—	—	—
MD21-06-70748	21-26481	40.50–42.00	Qbt 3	—	—	—	—	—	—
MD21-06-70747	21-26481	43.00–45.00	Qbt 3	—	—	—	—	—	—
MD21-06-70773	21-26482	0.00–0.50	Soil	—	—	—	—	—	—
MD21-06-70774	21-26482	13.20–15.00	Qbt 3	—	—	—	—	—	—
MD21-06-70776	21-26482	19.00–22.00	Qbt 3	—	—	—	—	—	—
MD21-06-70775	21-26482	30.00–32.00	Qbt 3	—	—	—	—	—	—
MD21-06-70778	21-26482	47.30–49.00	Qbt 3	—	—	—	—	—	—
MD21-06-70777	21-26482	49.00–50.00	Qbt 3	—	—	—	—	—	—
MD21-06-70819	21-26484	0.00–0.50	Soil	0.0399	—	0.0502	—	—	0.000298 (J)
MD21-06-70820	21-26484	13.00–15.00	Qbt 3	—	—	—	—	—	—
MD21-06-70821	21-26484	43.00–45.00	Qbt 3	—	—	—	—	—	—

Table 2.5-9 (continued)

Sample ID	Location ID	Depth (ft)	Media	Chrysene	Dichlorobenzene[1,4-]	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Isopropyltoluene[4-]
Industrial Soil Screening Levels[a]				**2310**	**103**	**24400**	**26500**	**23.4**	**389**[e]
Residential Soil Screening Levels[a]				**615**	**39.5**	**2290**	**2660**	**6.21**	**271**[e]
MD21-06-70837	21-26485	0.00–0.50	Soil	0.0151 (J)	—	0.0133 (J)	—	—	—
MD21-06-70838	21-26485	24.00–26.00	Qbt 3	—	—	—	—	—	—
MD21-06-70842	21-26485	28.00–30.00	Qbt 3	—	—	—	—	—	—
MD21-06-70840	21-26485	30.00–32.00	Qbt 3	—	—	—	—	—	—
MD21-06-70841	21-26485	32.00–34.00	Qbt 3	—	—	—	—	—	—
MD21-06-70839	21-26485	43.00–45.00	Qbt 3	—	—	—	—	—	—
MD21-06-70946	21-26486	0.00–0.50	Soil	0.0348	—	0.0579	—	0.0978	—
MD21-06-70954	21-26487	0.00–0.50	Soil	—	—	0.0102 (J)	—	—	—
MD21-06-70962	21-26488	0.00–0.50	Soil	—	—	0.0175 (J)	—	—	—
MD21-06-70970	21-26489	0.00–0.50	Soil	—	—	0.0437	—	—	—
MD21-06-70978	21-26490	0.00–0.50	Soil	0.0587	—	0.129	0.0128 (J)	0.104	—
MD21-06-70992	21-26491	0.00–0.50	Soil	—	—	0.0198 (J)	—	—	—
MD21-06-70993	21-26491	1.50–2.00	Soil	—	—	—	—	—	—
MD21-06-71008	21-26495	0.00–0.50	Soil	—	—	0.0192 (J)	—	—	—
MD21-06-71293	21-26588	0.00–0.50	Fill	0.0243 (J)	—	0.0467	—	0.0129 (J)	—
MD21-06-71298	21-26588	110.00–112.00	Qbt 2	—	—	—	—	—	—
MD21-06-71300	21-26588	300.00–302.50	Qbt 1g	—	—	—	—	—	—
MD21-06-71320	21-26589	0.00–0.50	Soil	—	—	0.0185 (J)	—	—	—
MD21-06-71324	21-26589	78.00–80.00	Qbt 3	—	—	—	—	—	—
MD21-06-71339	21-26590	27.00–30.00	Qbt 3	—	—	—	—	—	—

Table 2.5-9 (continued)

Sample ID	Location ID	Depth (ft)	Media	Chrysene	Dichlorobenzene[1,4-]	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Isopropyltoluene[4-]
Industrial Soil Screening Levels[a]				**2310**	**103**	**24400**	**26500**	**23.4**	**389**[e]
Residential Soil Screening Levels[a]				**615**	**39.5**	**2290**	**2660**	**6.21**	**271**[e]
MD21-06-71340	21-26590	45.00–50.00	Qbt 3	—	—	—	—	—	—
MD21-06-71352	21-26591	0.00–0.50	Fill	0.119	0.000273 (J)	0.259	0.0248 (J)	—	0.00664
MD21-06-71354	21-26591	15.00–17.00	Qbt 3	—	—	—	—	—	—
MD21-06-71361	21-26592	0.00–0.50	Fill	0.0839	—	0.166	—	—	—
MD21-06-71362	21-26592	1.50–4.00	Fill	—	—	—	—	—	0.000559 (J)
MD21-06-71388	21-26593	0.00–0.50	Fill	0.0343 (J)	—	0.0626	—	0.0123 (J)	—
MD21-06-71389	21-26593	1.50–2.00	Fill	—	—	0.0138 (J)	—	—	—
MD21-06-71384	21-26593	3.00–7.00	Fill	—	—	—	—	—	—
MD21-06-71393	21-26594	0.00–0.50	Fill	—	—	0.0246 (J)	—	—	—
MD21-06-71416	21-26595	0.00–0.50	Fill	0.0355 (J)	—	0.068	—	—	—
MD21-06-71425	21-26596	0.00–0.50	Fill	—	—	—	—	—	—
MD21-06-71426	21-26596	3.00–5.00	Fill	—	—	—	—	—	—
MD21-06-71427	21-26596	5.00–7.50	Qbt 3	—	—	—	—	—	0.000582 (J)
MD21-06-71448	21-26597	0.00–0.50	Fill	—	—	0.019 (J)	—	—	—
MD21-06-71449	21-26597	1.50–3.00	Fill	0.0658	—	0.0983	—	—	—
MD21-06-71459	21-26598	25.00–30.00	Qbt 3	—	—	—	—	—	—

Table 2.5-9 (continued)

Sample ID	Location ID	Depth (ft)	Media	Methyl-2-pentanone[4-]	Methylene Chloride	Nitroaniline[2-]	Phenanthrene	Pyrene	Toluene
Industrial Soil Screening Levels[a]				**7010**	**490**	**2000**[d]	**20500**	**30900**	**252**[f]
Residential Soil Screening Levels[a]				**5510**	**182**	**180**[d]	**1830**	**2290**	**252**
MD21-06-70892	21-01154	0.00–0.50	Soil	—	—	—	—	—	—
MD21-06-70900	21-02030	0.00–0.50	Soil	—	—	—	—	0.0124 (J)	—
MD21-06-70932	21-02042	0.00–0.50	Soil	—	—	—	0.0161 (J)	0.0256 (J)	—
MD21-06-70924	21-02058	0.00–0.50	Soil	—	—	—	0.0217 (J)	0.0418	—
MD21-06-70727	21-26480	0.00–0.50	Soil	—	—	—	0.0637	0.185	0.00112
MD21-06-70730	21-26480	36.00–38.50	Qbt 3	—	—	—	—	—	—
MD21-06-70729	21-26480	42.00–44.00	Qbt 3	—	—	—	—	—	—
MD21-06-70745	21-26481	0.00–0.50	Soil	—	—	—	—	—	—
MD21-06-70746	21-26481	25.00–27.00	Qbt 3	0.00146 (J)	—	—	—	—	—
MD21-06-70748	21-26481	40.50–42.00	Qbt 3	0.0015 (J)	—	—	—	—	—
MD21-06-70747	21-26481	43.00–45.00	Qbt 3	0.00117 (J)	—	—	—	—	—
MD21-06-70773	21-26482	0.00–0.50	Soil	—	—	—	—	—	0.00111
MD21-06-70774	21-26482	13.20–15.00	Qbt 3	—	—	—	—	—	—
MD21-06-70776	21-26482	19.00–22.00	Qbt 3	—	—	—	—	—	—
MD21-06-70775	21-26482	30.00–32.00	Qbt 3	—	—	—	—	—	—
MD21-06-70778	21-26482	47.30–49.00	Qbt 3	—	—	—	—	—	—
MD21-06-70777	21-26482	49.00–50.00	Qbt 3	—	—	—	—	—	—
MD21-06-70819	21-26484	0.00–0.50	Soil	—	—	—	0.023 (J)	0.0663	0.000546 (J)
MD21-06-70820	21-26484	13.00–15.00	Qbt 3	—	—	—	—	—	—
MD21-06-70821	21-26484	43.00–45.00	Qbt 3	—	—	—	—	—	—
MD21-06-70837	21-26485	0.00–0.50	Soil	—	—	—	—	0.0177 (J)	—

Table 2.5-9 (continued)

Sample ID	Location ID	Depth (ft)	Media	Methyl-2-pentanone[4-]	Methylene Chloride	Nitroaniline[2-]	Phenanthrene	Pyrene	Toluene
Industrial Soil Screening Levels[a]				**7010**	**490**	**2000**[d]	**20500**	**30900**	**252**[f]
Residential Soil Screening Levels[a]				**5510**	**182**	**180**[d]	**1830**	**2290**	**252**
MD21-06-70838	21-26485	24.00–26.00	Qbt 3	—	—	—	—	—	—
MD21-06-70842	21-26485	28.00–30.00	Qbt 3	—	—	—	—	—	—
MD21-06-70840	21-26485	30.00–32.00	Qbt 3	0.00163 (J)	—	—	—	—	—
MD21-06-70841	21-26485	32.00–34.00	Qbt 3	0.00128 (J)	—	—	—	—	—
MD21-06-70839	21-26485	43.00–45.00	Qbt 3	—	—	—	—	—	—
MD21-06-70946	21-26486	0.00–0.50	Soil	—	—	—	0.0357	0.0572	—
MD21-06-70954	21-26487	0.00–0.50	Soil	—	—	—	—	0.0127 (J)	—
MD21-06-70962	21-26488	0.00–0.50	Soil	—	—	—	0.0112 (J)	0.0141 (J)	—
MD21-06-70970	21-26489	0.00–0.50	Soil	—	—	—	0.0266 (J)	—	—
MD21-06-70978	21-26490	0.00–0.50	Soil	—	—	—	0.111	0.14	—
MD21-06-70992	21-26491	0.00–0.50	Soil	—	—	—	0.0143 (J)	0.0248 (J)	—
MD21-06-70993	21-26491	1.50–2.00	Soil	—	—	—	—	—	—
MD21-06-71008	21-26495	0.00–0.50	Soil	—	—	—	0.0107 (J)	0.0357	—
MD21-06-71293	21-26588	0.00–0.50	Fill	—	—	—	0.0275 (J)	0.0527	—
MD21-06-71298	21-26588	110.00–112.00	Qbt 2	—	—	—	—	—	—
MD21-06-71300	21-26588	300.00–302.50	Qbt 1g	—	—	—	—	—	—
MD21-06-71320	21-26589	0.00–0.50	Soil	—	—	—	—	0.0187 (J)	—
MD21-06-71324	21-26589	78.00–80.00	Qbt 3	—	—	0.176 (J)	—	—	—
MD21-06-71339	21-26590	27.00–30.00	Qbt 3	—	—	—	—	—	—
MD21-06-71340	21-26590	45.00–50.00	Qbt 3	—	—	—	—	—	—
MD21-06-71352	21-26591	0.00–0.50	Fill	—	—	—	0.194	0.251	—

Table 2.5-9 (continued)

Sample ID	Location ID	Depth (ft)	Media	Methyl-2-pentanone[4-]	Methylene Chloride	Nitroaniline[2-]	Phenanthrene	Pyrene	Toluene
Industrial Soil Screening Levels[a]				**7010**	**490**	**2000**[d]	**20500**	**30900**	**252**[f]
Residential Soil Screening Levels[a]				**5510**	**182**	**180**[d]	**1830**	**2290**	**252**
MD21-06-71354	21-26591	15.00–17.00	Qbt 3	—	—	—	—	—	—
MD21-06-71361	21-26592	0.00–0.50	Fill	—	—	—	0.119	0.196	—
MD21-06-71362	21-26592	1.50–4.00	Fill	—	—	—	—	—	0.000959 (J)
MD21-06-71388	21-26593	0.00–0.50	Fill	—	—	—	0.041	0.06	0.000485 (J)
MD21-06-71389	21-26593	1.50–2.00	Fill	—	—	—	—	0.0126 (J)	0.000688 (J)
MD21-06-71384	21-26593	3.00–7.00	Fill	—	0.00577 (J)	—	—	—	—
MD21-06-71393	21-26594	0.00–0.50	Fill	—	—	—	0.0171 (J)	0.028 (J)	—
MD21-06-71416	21-26595	0.00–0.50	Fill	—	—	—	0.0412	0.0719	—
MD21-06-71425	21-26596	0.00–0.50	Fill	—	—	—	—	—	0.00173
MD21-06-71426	21-26596	3.00–5.00	Fill	—	—	—	—	—	0.00239
MD21-06-71427	21-26596	5.00–7.50	Qbt 3	—	—	—	—	—	0.00102 (J)
MD21-06-71448	21-26597	0.00–0.50	Fill	—	—	—	—	0.0145 (J)	—
MD21-06-71449	21-26597	1.50–3.00	Fill	—	—	—	0.055	0.127	—
MD21-06-71459	21-26598	25.00–30.00	Qbt 3	—	—	—	—	—	—

Note: Units are mg/kg.

[a] SSLs from NMED 2006, 092513, unless otherwise indicated.

[b] — = The analyte was not detected.

[c] Pyrene used as a surrogate based on structural similarity.

[d] SSLs from EPA Region 6 (EPA 2005, 091002).

[e] Isopropylbenzene used as a surrogate based on structural similarity.

[f] SSL is the saturation limit not risk-based.

Table 2.5-10
Summary of Dioxins/Furans Detected at MDA A

Sample ID	Location ID	Depth (ft)	Media	Heptachloro-dibenzodioxin [1,2,3,4,6,7,8-]	Heptachloro-dibenzodioxins (Total)	Heptachloro-dibenzofuran [1,2,3,4,6,7,8-]	Heptachloro-dibenzofuran [1,2,3,4,7,8,9-]	Heptachloro-dibenzofurans (Total)
Industrial Soil Screening Levels				**na**[a]	**na**	**na**	**na**	**na**
Residential Soil Screening Levels				**na**	**na**	**na**	**na**	**na**
MD21-06-70727	21-26480	0.00–0.50	Soil	0.0000181	0.000032	3.98E-06 (J)	3.59E-07 (J)	8.15E-06 (J)
MD21-06-70728	21-26480	25.00–27.00	Qbt 3	—[b]	1.17E-07	—	1.05E-07 (J)	—
MD21-06-70730	21-26480	36.00–38.50	Qbt 3	—	—	—	—	—
MD21-06-70729	21-26480	42.00–44.00	Qbt 3	—	—	—	—	—
MD21-06-70745	21-26481	0.00–0.50	Soil	0.000092	0.00016	0.0000156 (J)	9.76E-07 (J)	0.0000426 (J)
MD21-06-70746	21-26481	25.00–27.00	Qbt 3	—	—	—	—	—
MD21-06-70748	21-26481	40.50–42.00	Qbt 3	—	6.17E-07	—	—	—
MD21-06-70747	21-26481	43.00–45.00	Qbt 3	—	—	—	—	—
MD21-06-70773	21-26482	0.00–0.50	Soil	9.05E-06	0.0000161	0.0000042 (J)	—	0.0000082 (J)
MD21-06-70775	21-26482	30.00–32.00	Qbt 3	2.78E-07 (J)	2.78E-07	—	—	—
MD21-06-70777	21-26482	49.00–50.00	Qbt 3	—	—	—	—	—
MD21-06-70819	21-26484	0.00–0.50	Soil	0.000013	0.000027	2.81E-06 (J)	2.59E-07 (J)	0.0000073 (J)
MD21-06-70820	21-26484	13.00–15.00	Qbt 3	—	—	—	—	—
MD21-06-70822	21-26484	25.00–27.00	Qbt 3	—	2.03E-07	—	—	—
MD21-06-70823	21-26484	35.00–37.00	Qbt 3	—	—	—	—	—
MD21-06-70821	21-26484	43.00–45.00	Qbt 3	—	—	—	—	—
MD21-06-70837	21-26485	0.00–0.50	Soil	9.05E-06	0.0000169	2.36E-06 (J)	2.43E-07 (J)	5.24E-06 (J)
MD21-06-70838	21-26485	24.00–26.00	Qbt 3	—	4.97E-08	—	—	—
MD21-06-70842	21-26485	28.00–30.00	Qbt 3	—	—	—	1.38E-07 (J)	—

Table 2.5-10 (continued)

Sample ID	Location ID	Depth (ft)	Media	Heptachloro-dibenzodioxin [1,2,3,4,6,7,8-]	Heptachloro-dibenzodioxins (Total)	Heptachloro-dibenzofuran [1,2,3,4,6,7,8-]	Heptachloro-dibenzofuran [1,2,3,4,7,8,9-]	Heptachloro-dibenzofurans (Total)
Industrial Soil Screening Levels				**na**	**na**	**na**	**na**	**na**
Residential Soil Screening Levels				**na**	**na**	**na**	**na**	**na**
MD21-06-70840	21-26485	30.00–32.00	Qbt 3	2.25E-07 (J)	3.58E-07	—	—	—
MD21-06-70841	21-26485	32.00–34.00	Qbt 3	—	—	—	—	—
MD21-06-70839	21-26485	43.00–45.00	Qbt 3	—	6.48E-08	—	—	—
MD21-06-71293	21-26588	0.00–0.50	Fill	0.0000339	0.000063	7.74E-06	0.0000011 (J)	0.0000237
MD21-06-71294	21-26588	5.50–7.00	Fill	—	—	—	—	—
MD21-06-71296	21-26588	25.00–27.50	Qbt 3	—	—	—	—	—
MD21-06-71301	21-26588	355.00–360.00	Qbo	—	—	—	—	—
MD21-06-71320	21-26589	0.00–0.50	Soil	8.83E-06	0.0000186	1.96E-06 (J)	—	3.75E-06
MD21-06-71321	21-26589	7.00–9.00	Soil	1.4E-07 (J)	1.40E-07	—	—	—
MD21-06-71326	21-26589	138.00–140.00	Qbt 3	—	—	—	—	—
MD21-06-71337	21-26590	0.00–0.50	Fill	2.74E-06	5.12E-06	0.0000009 (J)	—	1.72E-06
MD21-06-71338	21-26590	1.50–3.00	Fill	—	—	—	—	—
MD21-06-71340	21-26590	45.00–50.00	Qbt 3	—	—	—	—	—
MD21-06-71352	21-26591	0.00–0.50	Fill	0.000423	0.000681	0.0000964 (J)	8.31E-06	0.000197
MD21-06-71353	21-26591	1.50–2.50	Fill	1.75E-06 (J)	3.79E-06	—	—	1.15E-06
MD21-06-71354	21-26591	15.00–17.00	Qbt 3	0.0000004 (J)	0.0000004	—	—	—
MD21-06-71361	21-26592	0.00–0.50	Fill	0.0000199	0.0000343	6.85E-06 (J)	8.7E-07 (J)	0.0000124 (J)
MD21-06-71362	21-26592	1.50–4.00	Fill	0.0000006 (J)	1.25E-06	—	—	—
MD21-06-71363	21-26592	15.00–17.00	Qbt 3	6.7E-07 (J)	6.70E-07	—	—	—
MD21-06-71364	21-26592	23.00–25.00	Qbt 3	2.5E-07 (J)	2.50E-07	—	—	—
MD21-06-71388	21-26593	0.00–0.50	Fill	9.42E-06	0.0000193	2.18E-06 (J)	1.6E-07 (J)	6.36E-06

Table 2.5-10 (continued)

Sample ID	Location ID	Depth (ft)	Media	Heptachloro-dibenzodioxin [1,2,3,4,6,7,8-]	Heptachloro-dibenzodioxins (Total)	Heptachloro-dibenzofuran [1,2,3,4,6,7,8-]	Heptachloro-dibenzofuran [1,2,3,4,7,8,9-]	Heptachloro-dibenzofurans (Total)
Industrial Soil Screening Levels				**na**	**na**	**na**	**na**	**na**
Residential Soil Screening Levels				**na**	**na**	**na**	**na**	**na**
MD21-06-71389	21-26593	1.50–2.00	Fill	3.55E-06	7.78E-06	7.7E-07 (J)	—	1.79E-06
MD21-06-71384	21-26593	3.00–7.00	Fill	8.6E-07 (J)	2.01E-06	0.0000004 (J)	—	8.80E-07
MD21-06-71386	21-26593	21.00–23.00	Qbt 3	—	—	—	—	—
MD21-06-71393	21-26594	0.00–0.50	Fill	3.56E-06	6.87E-06	—	—	2.36E-06 (J)
MD21-06-71394	21-26594	1.50–3.00	Fill	—	—	—	—	—
MD21-06-71395	21-26594	17.00–20.00	Qbt 3	0.0000155	0.0000213	—	1.46E-06 (J)	2.39E-06 (J)
MD21-06-71396	21-26594	25.00–27.00	Qbt 3	3.2E-07 (J)	3.20E-07	—	—	—
MD21-06-71416	21-26595	0.00–0.50	Fill	4.38E-06	9.79E-06	1.21E-06 (J)	—	2.56E-06
MD21-06-71417	21-26595	1.50–2.00	Fill	9.8E-07 (J)	2.23E-06	—	—	—
MD21-06-71425	21-26596	0.00–0.50	Fill	1.94E-06 (J)	3.96E-06	—	—	2.28E-06 (J)
MD21-06-71426	21-26596	3.00–5.00	Fill	0.0000005 (J)	0.0000005	—	—	—
MD21-06-71427	21-26596	5.00–7.50	Qbt 3	—	—	—	—	—
MD21-06-71428	21-26596	17.00–20.00	Qbt 3	—	—	—	—	—
MD21-06-71429	21-26596	27.00–30.00	Qbt 3	8.7E-07 (J)	1.12E-06	—	—	—
MD21-06-71430	21-26596	32.00–35.00	Qbt 3	—	—	—	—	—
MD21-06-71448	21-26597	0.00–0.50	Fill	0.0000111	0.0000226	2.32E-06 (J)	—	5.52E-06
MD21-06-71449	21-26597	1.50–3.00	Fill	4.06E-06	0.0000075	1.01E-06 (J)	—	2.84E-06
MD21-06-71450	21-26597	12.00–15.00	Qbt 3	0.0000006 (J)	0.0000006	2.1E-07 (J)	0.0000004 (J)	0.0000009
MD21-06-71451	21-26597	23.00–25.00	Qbt 3	—	—	—	—	—
MD21-06-71457	21-26598	0.00–0.50	Fill	5.46E-06	0.0000101	—	—	9.30E-07
MD21-06-71458	21-26598	1.50–3.00	Fill	4.8E-07 (J)	9.20E-07	—	—	—
MD21-06-71459	21-26598	25.00–30.00	Qbt 3	—	—	—	—	—

Table 2.5-10 (continued)

Sample ID	Location ID	Depth (ft)	Media	Hexachloro-dibenzodioxin [1,2,3,4,7,8-]	Hexachloro-dibenzodioxin [1,2,3,6,7,8-]	Hexachloro-dibenzodioxin [1,2,3,7,8,9-]	Hexachloro-dibenzodioxins (Total)	Hexachloro-dibenzofuran [1,2,3,4,7,8-]
Industrial Soil Screening Levels				**na**	**na**	**na**	**0.00031**	**na**
Residential Soil Screening Levels				**na**	**na**	**na**	**0**	**na**
MD21-06-70727	21-26480	0.00–0.50	Soil	5.87E-07 (J)	9.97E-07 (J)	1.08E-06 (J)	8.51E-06	2.9E-07 (J)
MD21-06-70728	21-26480	25.00–27.00	Qbt 3	—	—	—	—	9.18E-08 (J)
MD21-06-70730	21-26480	36.00–38.50	Qbt 3	—	—	—	—	—
MD21-06-70729	21-26480	42.00–44.00	Qbt 3	—	—	—	—	—
MD21-06-70745	21-26481	0.00–0.50	Soil	8.32E-07 (J)	3.47E-06	1.36E-06 (J)	0.0000194	3.02E-06 (J)
MD21-06-70746	21-26481	25.00–27.00	Qbt 3	—	—	—	—	—
MD21-06-70748	21-26481	40.50–42.00	Qbt 3	—	—	—	—	—
MD21-06-70747	21-26481	43.00–45.00	Qbt 3	—	—	—	—	—
MD21-06-70773	21-26482	0.00–0.50	Soil	—	4.84E-07 (J)	3.05E-07 (J)	0.0000037	—
MD21-06-70775	21-26482	30.00–32.00	Qbt 3	—	—	—	—	—
MD21-06-70777	21-26482	49.00–50.00	Qbt 3	—	—	—	—	—
MD21-06-70819	21-26484	0.00–0.50	Soil	1.79E-07 (J)	5.79E-07 (J)	4.03E-07 (J)	4.91E-06	3.69E-07 (J)
MD21-06-70820	21-26484	13.00–15.00	Qbt 3	—	—	—	—	—
MD21-06-70822	21-26484	25.00–27.00	Qbt 3	—	—	—	—	1.11E-07 (J)
MD21-06-70823	21-26484	35.00–37.00	Qbt 3	—	—	—	—	—
MD21-06-70821	21-26484	43.00–45.00	Qbt 3	—	—	—	—	—
MD21-06-70837	21-26485	0.00–0.50	Soil	1.77E-07 (J)	4.21E-07 (J)	4.53E-07 (J)	3.87E-06	—
MD21-06-70838	21-26485	24.00–26.00	Qbt 3	—	—	—	—	—
MD21-06-70842	21-26485	28.00–30.00	Qbt 3	—	—	—	—	—
MD21-06-70840	21-26485	30.00–32.00	Qbt 3	—	—	—	1.36E-07	—
MD21-06-70841	21-26485	32.00–34.00	Qbt 3	—	—	—	—	—

Table 2.5-10 (continued)

Sample ID	Location ID	Depth (ft)	Media	Hexachloro-dibenzodioxin [1,2,3,4,7,8-]	Hexachloro-dibenzodioxin [1,2,3,6,7,8-]	Hexachloro-dibenzodioxin [1,2,3,7,8,9-]	Hexachloro-dibenzodioxins (Total)	Hexachloro-dibenzofuran [1,2,3,4,7,8-]
Industrial Soil Screening Levels				**na**	**na**	**na**	**0.00031**	**na**
Residential Soil Screening Levels				**na**	**na**	**na**	**0**	**na**
MD21-06-70839	21-26485	43.00–45.00	Qbt 3	—	—	—	—	—
MD21-06-71293	21-26588	0.00–0.50	Fill	4.9E-07 (J)	1.18E-06 (J)	8.9E-07 (J)	0.0000077	1.59E-06 (J)
MD21-06-71294	21-26588	5.50–7.00	Fill	—	—	—	—	—
MD21-06-71296	21-26588	25.00–27.50	Qbt 3	—	—	—	—	—
MD21-06-71301	21-26588	355.00–360.00	Qbo	—	—	—	—	—
MD21-06-71320	21-26589	0.00–0.50	Soil	—	3.6E-07 (J)	2.8E-07 (J)	2.77E-06	1.4E-07 (J)
MD21-06-71321	21-26589	7.00–9.00	Soil	—	—	—	—	—
MD21-06-71326	21-26589	138.00–140.00	Qbt 3	—	—	—	—	—
MD21-06-71337	21-26590	0.00–0.50	Fill	—	—	—	9.60E-07	—
MD21-06-71338	21-26590	1.50–3.00	Fill	—	—	—	—	—
MD21-06-71340	21-26590	45.00–50.00	Qbt 3	—	—	—	—	—
MD21-06-71352	21-26591	0.00–0.50	Fill	0.0000142	0.0000251	0.0000273	0.000182	5.95E-06
MD21-06-71353	21-26591	1.50–2.50	Fill	—	—	—	5.90E-07	—
MD21-06-71354	21-26591	15.00–17.00	Qbt 3	—	—	—	—	—
MD21-06-71361	21-26592	0.00–0.50	Fill	6.1E-07 (J)	1.12E-06 (J)	0.0000012 (J)	7.89E-06	1.45E-06 (J)
MD21-06-71362	21-26592	1.50–4.00	Fill	—	—	—	—	—
MD21-06-71363	21-26592	15.00–17.00	Qbt 3	—	—	—	—	—
MD21-06-71364	21-26592	23.00–25.00	Qbt 3	9E-08 (J)	2.5E-07 (J)	3.2E-07 (J)	0.0000008	—
MD21-06-71388	21-26593	0.00–0.50	Fill	2.5E-07 (J)	4.6E-07 (J)	—	3.16E-06	2.1E-07 (J)
MD21-06-71389	21-26593	1.50–2.00	Fill	—	—	—	5.50E-07	—
MD21-06-71384	21-26593	3.00–7.00	Fill	—	—	—	1.80E-07	—

Table 2.5-10 (continued)

Sample ID	Location ID	Depth (ft)	Media	Hexachloro-dibenzodioxin [1,2,3,4,7,8-]	Hexachloro-dibenzodioxin [1,2,3,6,7,8-]	Hexachloro-dibenzodioxin [1,2,3,7,8,9-]	Hexachloro-dibenzodioxins (Total)	Hexachloro-dibenzofuran [1,2,3,4,7,8-]
Industrial Soil Screening Levels				**na**	**na**	**na**	**0.00031**	**na**
Residential Soil Screening Levels				**na**	**na**	**na**	**0**	**na**
MD21-06-71386	21-26593	21.00–23.00	Qbt 3	—	—	—	—	—
MD21-06-71393	21-26594	0.00–0.50	Fill	2.2E-07 (J)	—	0.0000002 (J)	1.61E-06	—
MD21-06-71394	21-26594	1.50–3.00	Fill	—	—	—	—	—
MD21-06-71395	21-26594	17.00–20.00	Qbt 3	—	1.01E-06 (J)	9.8E-07 (J)	5.89E-06	—
MD21-06-71396	21-26594	25.00–27.00	Qbt 3	—	—	1.1E-07 (J)	1.55E-06	—
MD21-06-71416	21-26595	0.00–0.50	Fill	—	—	—	1.61E-06	—
MD21-06-71417	21-26595	1.50–2.00	Fill	—	—	—	1.50E-07	—
MD21-06-71425	21-26596	0.00–0.50	Fill	—	—	—	0.0000005	—
MD21-06-71426	21-26596	3.00–5.00	Fill	—	—	—	—	—
MD21-06-71427	21-26596	5.00–7.50	Qbt 3	—	—	—	—	—
MD21-06-71428	21-26596	17.00–20.00	Qbt 3	—	—	—	—	—
MD21-06-71429	21-26596	27.00–30.00	Qbt 3	—	—	—	—	1.8E-07 (J)
MD21-06-71430	21-26596	32.00–35.00	Qbt 3	—	—	—	—	3.2E-07 (J)
MD21-06-71448	21-26597	0.00–0.50	Fill	—	4.5E-07 (J)	0.0000004 (J)	3.08E-06	4.7E-07 (J)
MD21-06-71449	21-26597	1.50–3.00	Fill	—	1.9E-07 (J)	—	8.30E-07	1.6E-07 (J)
MD21-06-71450	21-26597	12.00–15.00	Qbt 3	—	2.3E-07 (J)	2.4E-07 (J)	1.51E-06	8.4E-07 (J)
MD21-06-71451	21-26597	23.00–25.00	Qbt 3	—	—	—	—	—
MD21-06-71457	21-26598	0.00–0.50	Fill	—	—	3.5E-07 (J)	0.0000025	—
MD21-06-71458	21-26598	1.50–3.00	Fill	—	—	—	—	—
MD21-06-71459	21-26598	25.00–30.00	Qbt 3	—	—	—	—	—

Table 2.5-10 (continued)

Sample ID	Location ID	Depth (ft)	Media	Hexachloro-dibenzofuran [1,2,3,6,7,8-]	Hexachloro-dibenzofuran [1,2,3,7,8,9-]	Hexachloro-dibenzofuran [2,3,4,6,7,8-]	Hexachloro-dibenzofurans (Total)	Octachloro-dibenzodioxin [1,2,3,4,6,7,8,9-]
Industrial Soil Screening Levels				**na**	**na**	**na**	**na**	**na**
Residential Soil Screening Levels				**na**	**na**	**na**	**na**	**na**
MD21-06-70727	21-26480	0.00–0.50	Soil	2.63E-07 (J)	—	3.04E-07 (J)	4.38E-06 (J)	0.000135
MD21-06-70728	21-26480	25.00–27.00	Qbt 3	7.23E-08 (J)	—	—	—	2.76E-07 (J)
MD21-06-70730	21-26480	36.00–38.50	Qbt 3	—	—	—	—	4.12E-07 (J)
MD21-06-70729	21-26480	42.00–44.00	Qbt 3	—	—	—	—	2.22E-07 (J)
MD21-06-70745	21-26481	0.00–0.50	Soil	1.27E-06 (J)	1.15E-06 (J)	1.51E-06 (J)	0.0000406 (J)	0.00119
MD21-06-70746	21-26481	25.00–27.00	Qbt 3	—	—	—	—	7.34E-07 (J)
MD21-06-70748	21-26481	40.50–42.00	Qbt 3	—	—	—	—	9.14E-06
MD21-06-70747	21-26481	43.00–45.00	Qbt 3	—	—	—	—	4.62E-07 (J)
MD21-06-70773	21-26482	0.00–0.50	Soil	2.33E-07 (J)	—	3.59E-07 (J)	6.14E-06 (J)	0.0000617
MD21-06-70775	21-26482	30.00–32.00	Qbt 3	—	—	—	—	4.48E-07 (J)
MD21-06-70777	21-26482	49.00–50.00	Qbt 3	—	—	—	—	0.0000015 (J)
MD21-06-70819	21-26484	0.00–0.50	Soil	1.92E-07 (J)	1.14E-07 (J)	2.27E-07 (J)	4.35E-06 (J)	0.000123
MD21-06-70820	21-26484	13.00–15.00	Qbt 3	—	—	—	—	1.04E-06 (J)
MD21-06-70822	21-26484	25.00–27.00	Qbt 3	—	—	—	—	6.67E-07 (J)
MD21-06-70823	21-26484	35.00–37.00	Qbt 3	—	—	—	—	4.86E-07 (J)
MD21-06-70821	21-26484	43.00–45.00	Qbt 3	—	—	—	—	4.59E-07 (J)
MD21-06-70837	21-26485	0.00–0.50	Soil	1.63E-07 (J)	—	2.05E-07 (J)	2.83E-06 (J)	0.0000685
MD21-06-70838	21-26485	24.00–26.00	Qbt 3	—	—	—	—	3.22E-07 (J)
MD21-06-70842	21-26485	28.00–30.00	Qbt 3	—	—	—	—	—
MD21-06-70840	21-26485	30.00–32.00	Qbt 3	—	—	—	—	9.2E-07 (J)

Table 2.5-10 (continued)

Sample ID	Location ID	Depth (ft)	Media	Hexachloro-dibenzofuran [1,2,3,6,7,8-]	Hexachloro-dibenzofuran [1,2,3,7,8,9-]	Hexachloro-dibenzofuran [2,3,4,6,7,8-]	Hexachloro-dibenzofurans (Total)	Octachloro-dibenzodioxin [1,2,3,4,6,7,8,9-]
Industrial Soil Screening Levels				**na**	**na**	**na**	**na**	**na**
Residential Soil Screening Levels				**na**	**na**	**na**	**na**	**na**
MD21-06-70841	21-26485	32.00–34.00	Qbt 3	—	—	—	—	2.31E-07 (J)
MD21-06-70839	21-26485	43.00–45.00	Qbt 3	—	—	—	—	3.15E-07 (J)
MD21-06-71293	21-26588	0.00–0.50	Fill	4.6E-07 (J)	—	5.3E-07 (J)	0.00001	0.000334
MD21-06-71294	21-26588	5.50–7.00	Fill	—	—	—	—	1.39E-06 (J)
MD21-06-71296	21-26588	25.00–27.50	Qbt 3	—	—	—	—	7.3E-07 (J)
MD21-06-71301	21-26588	355.00–360.00	Qbo	—	—	—	—	2.7E-07 (J)
MD21-06-71320	21-26589	0.00–0.50	Soil	—	—	1.4E-07 (J)	1.48E-06	0.0000816
MD21-06-71321	21-26589	7.00–9.00	Soil	—	—	—	—	1.21E-06 (J)
MD21-06-71326	21-26589	138.00–140.00	Qbt 3	2E-08 (J)	—	—	—	—
MD21-06-71337	21-26590	0.00–0.50	Fill	—	—	—	1.13E-06	0.0000166
MD21-06-71338	21-26590	1.50–3.00	Fill	—	—	—	—	0.0000013 (J)
MD21-06-71340	21-26590	45.00–50.00	Qbt 3	—	—	—	—	2.7E-07 (J)
MD21-06-71352	21-26591	0.00–0.50	Fill	6.48E-06	7.6E-07 (J)	6.22E-06	0.0000957	0.00356 (J)
MD21-06-71353	21-26591	1.50–2.50	Fill	—	—	—	1.70E-07	0.0000127 (J)
MD21-06-71354	21-26591	15.00–17.00	Qbt 3	—	—	—	—	2.67E-06 (J)
MD21-06-71361	21-26592	0.00–0.50	Fill	0.0000007 (J)	—	5.4E-07 (J)	8.27E-06 (J)	0.000167 (J)
MD21-06-71362	21-26592	1.50–4.00	Fill	—	—	—	—	5.25E-06 (J)
MD21-06-71363	21-26592	15.00–17.00	Qbt 3	—	—	—	—	0.000001 (J)
MD21-06-71364	21-26592	23.00–25.00	Qbt 3	—	—	—	—	—
MD21-06-71388	21-26593	0.00–0.50	Fill	1.3E-07 (J)	—	1.6E-07 (J)	2.65E-06 (J)	0.0000965
MD21-06-71389	21-26593	1.50–2.00	Fill	—	—	—	—	0.0000225

Table 2.5-10 (continued)

Sample ID	Location ID	Depth (ft)	Media	Hexachloro-dibenzofuran [1,2,3,6,7,8-]	Hexachloro-dibenzofuran [1,2,3,7,8,9-]	Hexachloro-dibenzofuran [2,3,4,6,7,8-]	Hexachloro-dibenzofurans (Total)	Octachloro-dibenzodioxin [1,2,3,4,6,7,8,9-]
Industrial Soil Screening Levels				**na**	**na**	**na**	**na**	**na**
Residential Soil Screening Levels				**na**	**na**	**na**	**na**	**na**
MD21-06-71384	21-26593	3.00–7.00	Fill	—	—	—	—	7.16E-06 (J)
MD21-06-71386	21-26593	21.00–23.00	Qbt 3	—	—	—	—	6.2E-07 (J)
MD21-06-71393	21-26594	0.00–0.50	Fill	8E-08 (J)	—	—	1.31E-06 (J)	0.000029 (J)
MD21-06-71394	21-26594	1.50–3.00	Fill	—	—	—	—	3.08E-06 (J)
MD21-06-71395	21-26594	17.00–20.00	Qbt 3	1.2E-07 (J)	—	8E-08 (J)	—	—
MD21-06-71396	21-26594	25.00–27.00	Qbt 3	—	—	—	—	—
MD21-06-71416	21-26595	0.00–0.50	Fill	—	—	—	1.32E-06	0.0000331
MD21-06-71417	21-26595	1.50–2.00	Fill	—	—	—	—	8.02E-06 (J)
MD21-06-71425	21-26596	0.00–0.50	Fill	2.2E-07 (J)	—	—	4.81E-06 (J)	0.0000159 (J)
MD21-06-71426	21-26596	3.00–5.00	Fill	—	—	—	—	4.47E-06 (J)
MD21-06-71427	21-26596	5.00–7.50	Qbt 3	—	—	—	—	1.07E-06 (J)
MD21-06-71428	21-26596	17.00–20.00	Qbt 3	—	—	—	—	1.07E-06 (J)
MD21-06-71429	21-26596	27.00–30.00	Qbt 3	—	—	—	1.80E-07	8.3E-07 (J)
MD21-06-71430	21-26596	32.00–35.00	Qbt 3	—	—	—	3.20E-07	4.9E-07 (J)
MD21-06-71448	21-26597	0.00–0.50	Fill	—	—	1.9E-07 (J)	2.99E-06	0.0000842
MD21-06-71449	21-26597	1.50–3.00	Fill	8E-08 (J)	—	7E-08 (J)	1.35E-06	0.0000297
MD21-06-71450	21-26597	12.00–15.00	Qbt 3	3.9E-07 (J)	1.2E-07 (J)	0.0000002 (J)	2.24E-06	6.4E-07 (J)
MD21-06-71451	21-26597	23.00–25.00	Qbt 3	—	—	—	—	7E-08 (J)
MD21-06-71457	21-26598	0.00–0.50	Fill	—	—	—	1.38E-06	0.0000307
MD21-06-71458	21-26598	1.50–3.00	Fill	—	—	—	—	3.26E-06 (J)
MD21-06-71459	21-26598	25.00–30.00	Qbt 3	—	—	—	—	0.0000002 (J)

Table 2.5-10 (continued)

Sample ID	Location ID	Depth (ft)	Media	Octachloro-dibenzofuran [1,2,3,4,6,7,8,9-]	Pentachloro-dibenzodioxin [1,2,3,7,8-]	Pentachloro-dibenzodioxins (Total)	Pentachloro-dibenzofuran [1,2,3,7,8-]	Pentachloro-dibenzofuran [2,3,4,7,8-]
Industrial Soil Screening Levels				**na**	**na**	**na**	**na**	**na**
Residential Soil Screening Levels				**na**	**na**	**na**	**na**	**na**
MD21-06-70727	21-26480	0.00–0.50	Soil	7.16E-06 (J)	3.89E-07 (J)	1.72E-06	9.23E-08 (J)	1.95E-07 (J)
MD21-06-70728	21-26480	25.00–27.00	Qbt 3	—	—	—	—	—
MD21-06-70730	21-26480	36.00–38.50	Qbt 3	—	—	—	—	—
MD21-06-70729	21-26480	42.00–44.00	Qbt 3	—	—	—	—	—
MD21-06-70745	21-26481	0.00–0.50	Soil	0.0000116	—	0.0000023	6.35E-07 (J)	2.11E-06 (J)
MD21-06-70746	21-26481	25.00–27.00	Qbt 3	—	—	—	—	—
MD21-06-70748	21-26481	40.50–42.00	Qbt 3	—	—	—	—	—
MD21-06-70747	21-26481	43.00–45.00	Qbt 3	—	—	—	—	—
MD21-06-70773	21-26482	0.00–0.50	Soil	6.18E-06	—	—	—	5.41E-07 (J)
MD21-06-70775	21-26482	30.00–32.00	Qbt 3	—	—	—	—	—
MD21-06-70777	21-26482	49.00–50.00	Qbt 3	—	—	—	—	—
MD21-06-70819	21-26484	0.00–0.50	Soil	6.25E-06 (J)	—	9.11E-07	1.25E-07 (J)	2.62E-07 (J)
MD21-06-70820	21-26484	13.00–15.00	Qbt 3	—	—	—	—	—
MD21-06-70822	21-26484	25.00–27.00	Qbt 3	—	—	—	—	—
MD21-06-70823	21-26484	35.00–37.00	Qbt 3	—	—	—	—	—
MD21-06-70821	21-26484	43.00–45.00	Qbt 3	—	—	—	—	—
MD21-06-70837	21-26485	0.00–0.50	Soil	0.0000058 (J)	1.46E-07 (J)	9.24E-07	—	2.36E-07 (J)
MD21-06-70838	21-26485	24.00–26.00	Qbt 3	—	—	—	—	—
MD21-06-70842	21-26485	28.00–30.00	Qbt 3	—	—	—	—	—
MD21-06-70840	21-26485	30.00–32.00	Qbt 3	—	—	—	—	—

Table 2.5-10 (continued)

Sample ID	Location ID	Depth (ft)	Media	Octachloro-dibenzofuran [1,2,3,4,6,7,8,9-]	Pentachloro-dibenzodioxin [1,2,3,7,8-]	Pentachloro-dibenzodioxins (Total)	Pentachloro-dibenzofuran [1,2,3,7,8-]	Pentachloro-dibenzofuran [2,3,4,7,8-]
Industrial Soil Screening Levels				**na**	**na**	**na**	**na**	**na**
Residential Soil Screening Levels				**na**	**na**	**na**	**na**	**na**
MD21-06-70841	21-26485	32.00–34.00	Qbt 3	—	—	—	—	—
MD21-06-70839	21-26485	43.00–45.00	Qbt 3	—	—	—	—	—
MD21-06-71293	21-26588	0.00–0.50	Fill	0.0000243	—	—	2.4E-07 (J)	8.4E-07 (J)
MD21-06-71294	21-26588	5.50–7.00	Fill	—	—	—	—	—
MD21-06-71296	21-26588	25.00–27.50	Qbt 3	—	—	—	—	—
MD21-06-71301	21-26588	355.00–360.00	Qbo	—	—	6.00E-08	—	—
MD21-06-71320	21-26589	0.00–0.50	Soil	5.09E-06 (J)	—	—	—	9E-08 (J)
MD21-06-71321	21-26589	7.00–9.00	Soil	—	—	—	—	—
MD21-06-71326	21-26589	138.00–140.00	Qbt 3	—	—	—	—	—
MD21-06-71337	21-26590	0.00–0.50	Fill	1.43E-06 (J)	—	—	—	—
MD21-06-71338	21-26590	1.50–3.00	Fill	—	—	—	—	—
MD21-06-71340	21-26590	45.00–50.00	Qbt 3	—	—	—	—	—
MD21-06-71352	21-26591	0.00–0.50	Fill	0.000185	0.0000112	0.0000341	8.4E-07 (J)	1.36E-06 (J)
MD21-06-71353	21-26591	1.50–2.50	Fill	1.03E-06 (J)	—	—	—	—
MD21-06-71354	21-26591	15.00–17.00	Qbt 3	2.7E-07 (J)	—	—	—	—
MD21-06-71361	21-26592	0.00–0.50	Fill	0.0000134	4.4E-07 (J)	7.10E-07	—	1.12E-06 (J)
MD21-06-71362	21-26592	1.50–4.00	Fill	5.3E-07 (J)	—	—	—	—
MD21-06-71363	21-26592	15.00–17.00	Qbt 3	—	—	—	—	—
MD21-06-71364	21-26592	23.00–25.00	Qbt 3	—	—	—	—	—
MD21-06-71388	21-26593	0.00–0.50	Fill	7.65E-06	1.7E-07 (J)	5.60E-07	—	1.7E-07 (J)
MD21-06-71389	21-26593	1.50–2.00	Fill	1.38E-06 (J)	—	—	—	—

Table 2.5-10 (continued)

Sample ID	Location ID	Depth (ft)	Media	Octachloro-dibenzofuran [1,2,3,4,6,7,8,9-]	Pentachloro-dibenzodioxin [1,2,3,7,8-]	Pentachloro-dibenzodioxins (Total)	Pentachloro-dibenzofuran [1,2,3,7,8-]	Pentachloro-dibenzofuran [2,3,4,7,8-]
Industrial Soil Screening Levels				**na**	**na**	**na**	**na**	**na**
Residential Soil Screening Levels				**na**	**na**	**na**	**na**	**na**
MD21-06-71384	21-26593	3.00–7.00	Fill	7.5E-07 (J)	—	—	—	—
MD21-06-71386	21-26593	21.00–23.00	Qbt 3	—	—	—	—	—
MD21-06-71393	21-26594	0.00–0.50	Fill	2.08E-06 (J)	—	—	—	1.9E-07 (J)
MD21-06-71394	21-26594	1.50–3.00	Fill	—	—	—	—	—
MD21-06-71395	21-26594	17.00–20.00	Qbt 3	—	—	—	—	—
MD21-06-71396	21-26594	25.00–27.00	Qbt 3	—	—	0.0000033	—	—
MD21-06-71416	21-26595	0.00–0.50	Fill	1.94E-06 (J)	—	—	—	—
MD21-06-71417	21-26595	1.50–2.00	Fill	8.1E-07 (J)	—	—	—	—
MD21-06-71425	21-26596	0.00–0.50	Fill	1.52E-06 (J)	—	—	—	—
MD21-06-71426	21-26596	3.00–5.00	Fill	5.4E-07 (J)	—	—	—	—
MD21-06-71427	21-26596	5.00–7.50	Qbt 3	—	—	—	—	—
MD21-06-71428	21-26596	17.00–20.00	Qbt 3	—	—	—	—	—
MD21-06-71429	21-26596	27.00–30.00	Qbt 3	—	—	—	—	—
MD21-06-71430	21-26596	32.00–35.00	Qbt 3	—	—	—	—	—
MD21-06-71448	21-26597	0.00–0.50	Fill	7.07E-06	8E-08 (J)	8.00E-08	—	—
MD21-06-71449	21-26597	1.50–3.00	Fill	3.87E-06 (J)	—	—	—	—
MD21-06-71450	21-26597	12.00–15.00	Qbt 3	—	—	1.90E-07	4.6E-07 (J)	—
MD21-06-71451	21-26597	23.00–25.00	Qbt 3	—	—	—	—	—
MD21-06-71457	21-26598	0.00–0.50	Fill	1.39E-06 (J)	—	—	—	—
MD21-06-71458	21-26598	1.50–3.00	Fill	—	—	—	—	—
MD21-06-71459	21-26598	25.00–30.00	Qbt 3	—	—	—	—	—

Table 2.5-10 (continued)

Sample ID	Location ID	Depth (ft)	Media	Pentachloro-dibenzofurans (Totals)	Tetrachloro-dibenzodioxin [2,3,7,8-]	Tetrachloro-dibenzodioxins (Total)	Tetrachloro-dibenzofuran [2,3,7,8-]	Tetrachloro-dibenzofurans (Total)
Industrial Soil Screening Levels				**na**	**1.77E-05**	**na**	**na**	**na**
Residential Soil Screening Levels				**na**	**0**	**na**	**na**	**na**
MD21-06-70727	21-26480	0.00–0.50	Soil	2.59E-06	—	1.14E-06	2.2E-07 (J)	3.06E-06
MD21-06-70728	21-26480	25.00–27.00	Qbt 3	—	—	—	—	—
MD21-06-70730	21-26480	36.00–38.50	Qbt 3	—	—	—	—	—
MD21-06-70729	21-26480	42.00–44.00	Qbt 3	—	—	—	—	—
MD21-06-70745	21-26481	0.00–0.50	Soil	0.0000219	—	2.39E-06	1.25E-06	0.0000146
MD21-06-70746	21-26481	25.00–27.00	Qbt 3	—	—	—	—	—
MD21-06-70748	21-26481	40.50–42.00	Qbt 3	—	—	—	—	—
MD21-06-70747	21-26481	43.00–45.00	Qbt 3	—	—	—	—	—
MD21-06-70773	21-26482	0.00–0.50	Soil	0.0000075	—	9.20E-07	—	0.0000049
MD21-06-70775	21-26482	30.00–32.00	Qbt 3	—	—	—	—	—
MD21-06-70777	21-26482	49.00–50.00	Qbt 3	—	—	—	—	—
MD21-06-70819	21-26484	0.00–0.50	Soil	3.01E-06	—	1.95E-07	2.72E-07 (J)	0.0000025
MD21-06-70820	21-26484	13.00–15.00	Qbt 3	—	—	—	—	—
MD21-06-70822	21-26484	25.00–27.00	Qbt 3	—	—	—	—	—
MD21-06-70823	21-26484	35.00–37.00	Qbt 3	—	—	—	—	—
MD21-06-70821	21-26484	43.00–45.00	Qbt 3	—	—	—	—	—
MD21-06-70837	21-26485	0.00–0.50	Soil	2.39E-06	—	0.0000013	2.96E-07 (J)	3.75E-06
MD21-06-70838	21-26485	24.00–26.00	Qbt 3	6.27E-08	—	—	—	—
MD21-06-70842	21-26485	28.00–30.00	Qbt 3	—	—	—	—	—
MD21-06-70840	21-26485	30.00–32.00	Qbt 3	1.85E-07	—	—	—	—
MD21-06-70841	21-26485	32.00–34.00	Qbt 3	7.29E-08	—	—	—	—
MD21-06-70839	21-26485	43.00–45.00	Qbt 3	8.63E-08	—	—	—	—

Table 2.5-10 (continued)

Sample ID	Location ID	Depth (ft)	Media	Pentachloro-dibenzofurans (Totals)	Tetrachloro-dibenzodioxin [2,3,7,8-]	Tetrachloro-dibenzodioxins (Total)	Tetrachloro-dibenzofuran [2,3,7,8-]	Tetrachloro-dibenzofurans (Total)
Industrial Soil Screening Levels				**na**	**1.77E-05**	**na**	**na**	**na**
Residential Soil Screening Levels				**na**	**0**	**na**	**na**	**na**
MD21-06-71293	21-26588	0.00–0.50	Fill	4.88E-06	—	2.50E-07	8.10E-07	0.0000024
MD21-06-71294	21-26588	5.50–7.00	Fill	—	—	—	—	—
MD21-06-71296	21-26588	25.00–27.50	Qbt 3	—	—	—	—	—
MD21-06-71301	21-26588	355.00–360.00	Qbo	—	—	—	—	—
MD21-06-71320	21-26589	0.00–0.50	Soil	1.12E-06	—	5.60E-07	1.8E-07 (J)	1.12E-06
MD21-06-71321	21-26589	7.00–9.00	Soil	—	—	—	—	—
MD21-06-71326	21-26589	138.00–140.00	Qbt 3	—	1.3E-07 (J)	1.30E-07	—	—
MD21-06-71337	21-26590	0.00–0.50	Fill	5.30E-07	—	—	—	0.0000004
MD21-06-71338	21-26590	1.50–3.00	Fill	—	—	—	—	—
MD21-06-71340	21-26590	45.00–50.00	Qbt 3	—	—	—	—	—
MD21-06-71352	21-26591	0.00–0.50	Fill	0.0000309	1.24E-06	0.0000047	4.8E-07 (J)	8.34E-06
MD21-06-71353	21-26591	1.50–2.50	Fill	2.70E-07	—	—	—	0.0000003
MD21-06-71354	21-26591	15.00–17.00	Qbt 3	—	—	—	—	—
MD21-06-71361	21-26592	0.00–0.50	Fill	7.59E-06	—	1.80E-07	9.20E-07	4.68E-06
MD21-06-71362	21-26592	1.50–4.00	Fill	1.60E-07	—	—	—	—
MD21-06-71363	21-26592	15.00–17.00	Qbt 3	—	—	—	—	—
MD21-06-71364	21-26592	23.00–25.00	Qbt 3	—	—	—	—	9.00E-08
MD21-06-71388	21-26593	0.00–0.50	Fill	1.13E-06	—	1.90E-07	3.3E-07 (J)	1.11E-06
MD21-06-71389	21-26593	1.50–2.00	Fill	1.70E-07	—	—	6E-08 (J)	2.70E-07
MD21-06-71384	21-26593	3.00–7.00	Fill	5.60E-07	—	—	—	—
MD21-06-71386	21-26593	21.00–23.00	Qbt 3	—	—	—	—	—
MD21-06-71393	21-26594	0.00–0.50	Fill	2.16E-06	—	0.0000001	9E-08 (J)	0.0000011

Table 2.5-10 (continued)

Sample ID	Location ID	Depth (ft)	Media	Pentachloro-dibenzofurans (Totals)	Tetrachloro-dibenzodioxin [2,3,7,8-]	Tetrachloro-dibenzodioxins (Total)	Tetrachloro-dibenzofuran [2,3,7,8-]	Tetrachloro-dibenzofurans (Total)
Industrial Soil Screening Levels				**na**	**1.77E-05**	**na**	**na**	**na**
Residential Soil Screening Levels				**na**	**0**	**na**	**na**	**na**
MD21-06-71394	21-26594	1.50–3.00	Fill	—	—	—	—	—
MD21-06-71395	21-26594	17.00–20.00	Qbt 3	—	—	—	—	—
MD21-06-71396	21-26594	25.00–27.00	Qbt 3	1.60E-07	—	4.90E-07	—	—
MD21-06-71416	21-26595	0.00–0.50	Fill	1.14E-06	—	2.60E-07	3.3E-07 (J)	1.14E-06
MD21-06-71417	21-26595	1.50–2.00	Fill	6.20E-07	—	—	—	—
MD21-06-71425	21-26596	0.00–0.50	Fill	0.0000141	—	—	—	0.000003
MD21-06-71426	21-26596	3.00–5.00	Fill	9.80E-07	—	—	—	—
MD21-06-71427	21-26596	5.00–7.50	Qbt 3	—	—	—	—	5.40E-07
MD21-06-71428	21-26596	17.00–20.00	Qbt 3	—	—	—	—	—
MD21-06-71429	21-26596	27.00–30.00	Qbt 3	—	—	—	—	—
MD21-06-71430	21-26596	32.00–35.00	Qbt 3	—	—	—	—	—
MD21-06-71448	21-26597	0.00–0.50	Fill	1.56E-06	—	—	2.6E-07 (J)	8.60E-07
MD21-06-71449	21-26597	1.50–3.00	Fill	3.30E-07	—	—	—	7.00E-08
MD21-06-71450	21-26597	12.00–15.00	Qbt 3	0.000001	—	—	—	—
MD21-06-71451	21-26597	23.00–25.00	Qbt 3	—	—	—	—	—
MD21-06-71457	21-26598	0.00–0.50	Fill	9.10E-07	—	—	—	—
MD21-06-71458	21-26598	1.50–3.00	Fill	—	—	—	—	—
MD21-06-71459	21-26598	25.00–30.00	Qbt 3	—	—	—	—	—

Note: Units are mg/kg.

[a] na = Not available; SSLs for individual congeners and totals are not available, just for 2,3,7,8-TCDD.

[b] — = The analyte was not detected.

Table 2.5-11
Summary of Radionuclides Detected above Background/Fallout Values at MDA A and DP Canyon Slope

Sample ID	Location ID	Depth (ft)	Media	Americium-241	Cesium-137	Plutonium-238	Plutonium-239	Strontium-90	Uranium-235
Soil Background Value				**0.013**[a]	**1.65**[a]	**0.023**[a]	**0.054**[a]	**1.31**[a]	**0.2**
Qbt 2,3,4 Background Value				**na**[b]	**na**	**na**	**na**	**na**	**0.09**
Qbt 1g, Qct, Qbo Background Value				**na**	**na**	**na**	**na**	**na**	**0.18**
Industrial Screening Action Level[c]				**180**	**23**	**240**	**210**	**1900**	**87**
Residential Screening Action Level[c]				**30**	**5.6**	**37**	**33**	**5.7**	**17**
MD21-06-70892	21-01154	0.00–0.50	Soil	0.171	—[d]	0.0416	3.06 (J)	—	—
MD21-06-70893	21-01154	1.50–2.00	Soil	—	—	—	0.0339 (J)	—	—
MD21-06-70908	21-01290	0.00–0.50	Soil	0.168	—	0.032	1.78 (J)	—	—
MD21-06-70909	21-01290	1.50–2.00	Soil	—	—	—	—	0.113	—
MD21-06-70900	21-02030	0.00–0.50	Soil	0.347	—	0.0544	10.2 (J)	—	—
MD21-06-70901	21-02030	1.50–2.00	Soil	—	—	—	0.142 (J)	0.127	—
MD21-06-70932	21-02042	0.00–0.50	Soil	0.154	—	—	4.04 (J)	—	—
MD21-06-70933	21-02042	1.50–2.00	Soil	—	—	—	0.141 (J)	—	—
MD21-06-70924	21-02058	0.00–0.50	Soil	0.287	—	0.0242	2.1 (J)	—	—
MD21-06-70925	21-02058	1.50–2.00	Soil	—	—	—	—	0.133	—
MD21-06-70916	21-02586	0.00–0.50	Soil	—	—	—	2.69 (J)	—	—
MD21-06-70917	21-02586	1.50–2.00	Soil	—	—	—	0.101 (J)	0.262	—
MD21-06-70727	21-26480	0.00–0.50	Soil	0.213	—	0.0381	4.45	—	—
MD21-06-70745	21-26481	0.00–0.50	Soil	0.115	—	—	1.13	—	—

Table 2.5-11 (continued)

Sample ID	Location ID	Depth (ft)	Media	Americium-241	Cesium-137	Plutonium-238	Plutonium-239	Strontium-90	Uranium-235
Soil Background Value				**0.013**[a]	**1.65**[a]	**0.023**[a]	**0.054**[a]	**1.31**[a]	**0.2**
Qbt 2,3,4 Background Value				**na**[b]	**na**	**na**	**na**	**na**	**0.09**
Qbt 1g, Qct, Qbo Background Value				**na**	**na**	**na**	**na**	**na**	**0.18**
Industrial Screening Action Level[c]				**180**	**23**	**240**	**210**	**1900**	**87**
Residential Screening Action Level[c]				**30**	**5.6**	**37**	**33**	**5.7**	**17**
MD21-06-70773	21-26482	0.00–0.50	Soil	—	—	—	0.307	—	—
MD21-06-70819	21-26484	0.00–0.50	Soil	0.429	—	0.0528	0.707	—	—
MD21-06-70837	21-26485	0.00–0.50	Soil	0.273	—	0.0561	8.67	—	—
MD21-06-70838	21-26485	24.00–26.00	Qbt 3	—	—	—	—	—	0.0961
MD21-06-70946	21-26486	0.00–0.50	Soil	0.445	—	0.0927	16.6	—	—
MD21-06-70947	21-26486	1.50–2.00	Soil	0.0374	—	—	1.41	—	—
MD21-06-70954	21-26487	0.00–0.50	Soil	0.242	—	0.047	9.21	—	—
MD21-06-70955	21-26487	1.50–2.00	Soil	—	—	—	0.13	—	—
MD21-06-70962	21-26488	0.00–0.50	Soil	0.827	—	0.105	14.7	—	—
MD21-06-70963	21-26488	1.50–2.00	Soil	—	—	—	0.091	1.74	—
MD21-06-70970	21-26489	0.00–0.50	Soil	0.856	—	0.0908	16	2.01	—
MD21-06-70971	21-26489	1.50–2.00	Soil	—	—	—	0.0543	—	—
MD21-06-70978	21-26490	0.00–0.50	Soil	0.131	—	—	0.744	—	—
MD21-06-70979	21-26490	1.50–2.00	Soil	—	—	—	0.176	—	—
MD21-06-70992	21-26491	0.00–0.50	Soil	0.351	—	—	2.14	—	—
MD21-06-70996	21-26492	0.00–0.50	Soil	0.051	—	—	0.97	—	—
MD21-06-71004	21-26494	0.00–0.50	Soil	0.039	—	—	0.831	—	—
MD21-06-71005	21-26494	1.50–2.00	Soil	—	—	—	0.0322	—	—
MD21-06-71008	21-26495	0.00–0.50	Soil	0.417	—	0.0437	4.44	—	—

Table 2.5-11 (continued)

Sample ID	Location ID	Depth (ft)	Media	Americium-241	Cesium-137	Plutonium-238	Plutonium-239	Strontium-90	Uranium-235
Soil Background Value				**0.013**[a]	**1.65**[a]	**0.023**[a]	**0.054**[a]	**1.31**[a]	**0.2**
Qbt 2,3,4 Background Value				**na**[b]	**na**	**na**	**na**	**na**	**0.09**
Qbt 1g, Qct, Qbo Background Value				**na**	**na**	**na**	**na**	**na**	**0.18**
Industrial Screening Action Level[c]				**180**	**23**	**240**	**210**	**1900**	**87**
Residential Screening Action Level[c]				**30**	**5.6**	**37**	**33**	**5.7**	**17**
MD21-06-71009	21-26495	1.50–2.00	Soil	—	—	—	0.132	—	—
MD21-06-71293	21-26588	0.00–0.50	Fill	—	—	—	0.181	—	—
MD21-06-71300	21-26588	300.00–302.50	Qbt 1g	—	—	—	—	—	0.183 (J+)
MD21-06-71320	21-26589	0.00–0.50	Soil	0.275	—	—	1.68	—	—
MD21-06-71326	21-26589	138.00–140.00	Qbt 3	—	0.709	—	—	—	—
MD21-06-71337	21-26590	0.00–0.50	Fill	0.0482	—	—	0.583	—	—
MD21-06-71353	21-26591	1.50–2.50	Fill	0.0663	0.0653	—	1.53	—	—
MD21-06-71361	21-26592	0.00–0.50	Fill	0.0418	—	—	0.609	—	—
MD21-06-71362	21-26592	1.50–4.00	Fill	0.107	—	—	4.19	—	—
MD21-06-71389	21-26593	1.50–2.00	Fill	—	—	0.047	5.5	—	—
MD21-06-71393	21-26594	0.00–0.50	Fill	—	—	1.81	0.162	—	—
MD21-06-71394	21-26594	1.50–3.00	Fill	—	—	—	0.25	—	—
MD21-06-71396	21-26594	25.00–27.00	Qbt 3	—	—	1.43	0.0499	—	—
MD21-06-71416	21-26595	0.00–0.50	Fill	—	—	—	0.0685	—	—
MD21-06-71417	21-26595	1.50–2.00	Fill	0.142	—	—	2.71	—	—
MD21-06-71425	21-26596	0.00–0.50	Fill	0.0294	—	—	2.57	—	—
MD21-06-71426	21-26596	3.00–5.00	Fill	—	—	—	0.158	—	—
MD21-06-71428	21-26596	17.00–20.00	Qbt 3	—	—	—	—	—	0.0934
MD21-06-71449	21-26597	1.50–3.00	Fill	0.238	—	0.0473	9.22	—	—

Table 2.5-11 (continued)

Sample ID	Location ID	Depth (ft)	Media	Americium-241	Cesium-137	Plutonium-238	Plutonium-239	Strontium-90	Uranium-235
Soil Background Value				**0.013**[a]	**1.65**[a]	**0.023**[a]	**0.054**[a]	**1.31**[a]	**0.2**
Qbt 2,3,4 Background Value				**na**[b]	**na**	**na**	**na**	**na**	**0.09**
Qbt 1g, Qct, Qbo Background Value				**na**	**na**	**na**	**na**	**na**	**0.18**
Industrial Screening Action Level[c]				**180**	**23**	**240**	**210**	**1900**	**87**
Residential Screening Action Level[c]				**30**	**5.6**	**37**	**33**	**5.7**	**17**
MD21-06-71450	21-26597	12.00–15.00	Qbt 3	—	—	—	—	—	0.107
MD21-06-71451	21-26597	23.00–25.00	Qbt 3	—	—	—	—	—	0.113
MD21-06-71452	21-26597	80.00–85.00	Qbt 3	—	—	—	—	—	0.104
MD21-06-71457	21-26598	0.00–0.50	Fill	0.159 (J-)	—	—	1.52	—	—
MD21-06-71458	21-26598	1.50–3.00	Fill	—	—	—	0.0452	—	—

Note: Units are in pCi/g. BVs from LANL 1998, 059730.

[a] Fallout value applies only to samples collected from 0–0.5 ft.

[b] na = Not available.

[c] SALs from LANL 2005, 088493.

[d] — = The analyte was not detected or not detected above the background or fallout values.

Table 2.5-12
Summary of VOCs and Tritium Detected in Pore Gas at MDA A

Sample ID	Location ID	Depth (ft)	Acetone	Benzene	Bromodichloromethane	Butanol[1-]	Butanone[2-]	Carbon disulfide
MD21-06-70736	21-26480	48.00–49.00	120	—*	—	—	—	—
MD21-06-70737	21-26480	36.00–38.50	120	4.4	—	—	16	—
MD21-06-70738	21-26480	25.00–27.00	110	4.8	—	—	10	—
MD21-06-70754	21-26481	45.00–46.00	290	5.9	—	—	35	—
MD21-06-70755	21-26481	25.00–27.00	60	—	—	—	—	—
MD21-06-70782	21-26482	30.00–32.00	63	—	—	—	7.4	—
MD21-06-70783	21-26482	19.00–22.00	53	—	—	—	3.1	—
MD21-06-70784	21-26482	13.20–15.00	100	—	—	—	—	—
MD21-06-70800	21-26482	40.00–41.00	520	—	6.7	—	16	—
MD21-06-70828	21-26484	48.00–49.00	680	26	—	0	73	—
MD21-06-70829	21-26484	35.00–37.00	—	—	—	—	3.3	—
MD21-06-70830	21-26484	25.00–27.00	—	—	—	—	4.1	—
MD21-06-70831	21-26484	13.00–15.00	0	0.69	—	—	5.8	—
MD21-06-70846	21-26485	48.00–49.00	62	—	—	—	7.6	24
MD21-06-70847	21-26485	32.00–34.00	0	1.5	—	—	6.5	—
MD21-06-70848	21-26485	30.00–32.00	0	1.7	—	—	6	—
MD21-06-70849	21-26485	28.00–30.00	0	2.9	—	—	7	—
MD21-06-70850	21-26485	24.00–26.00	31	—	—	—	4.5	11
MD21-06-71304	21-26588	359.00–360.00	50	1.4	—	—	6	15
MD21-06-71305	21-26588	300.00–302.00	220	7.9	—	—	24	4.2

Table 2.5-12 (continued)

Sample ID	Location ID	Depth (ft)	Acetone	Benzene	Bromodichloromethane	Butanol[1-]	Butanone[2-]	Carbon disulfide
MD21-06-71306	21-26588	200.00–202.50	59	3.4	1.7	—	6.2	11
MD21-06-71307	21-26588	110.00–112.50	26	2.7	1.7	—	3.2	7.3
MD21-06-71308	21-26588	62.50–65.00	63	4.8	2.2	—	10	10
MD21-06-71309	21-26588	25.00–27.50	46	—	—	—	—	—
MD21-06-71310	21-26588	15.00–17.50	60	4.6	—	—	—	—
MD21-06-71311	21-26588	5.50–7.00	34	2.5	—	—	6.5	6.5
MD21-06-71329	21-26589	139.00–140.00	56	1.7	—	—	6.5	—
MD21-06-71330	21-26589	92.00–94.00	180	7.3	—	—	24	—
MD21-06-71331	21-26589	78.00–80.00	140	8	—	—	72	—
MD21-06-71332	21-26589	47.00–52.00	170	5.3	—	—	—	—
MD21-06-71333	21-26590	139.00–140.00	98	0.9	—	—	7.5	—
MD21-06-71334	21-26590	100.00–102.00	290	10	—	—	68	3.4
MD21-06-71335	21-26590	75.00–77.00	330	11	—	—	46	—
MD21-06-71336	21-26590	45.00–50.00	96	3.4	—	—	21	21
MD21-06-71372	21-26591	34.00–35.00	89	2.5	—	—	13	3.7
MD21-06-71373	21-26591	27.00–30.00	210	6.9	—	—	22	—
MD21-06-71374	21-26591	15.00–17.00	130	11	—	—	22	—
MD21-06-71375	21-26591	1.50–2.50	93	5.8	—	—	13	—
MD21-06-71376	21-26592	34.00–35.00	130	2.9	—	—	18	—
MD21-06-71377	21-26592	23.00–25.00	320	11	—	—	37	—
MD21-06-71378	21-26592	15.00–17.00	100	5.5	—	—	13	—
MD21-06-71379	21-26592	1.50–4.00	28	4.4	—	—	—	4.3

Table 2.5-12 (continued)

Sample ID	Location ID	Depth (ft)	Acetone	Benzene	Bromodichloromethane	Butanol[1-]	Butanone[2-]	Carbon disulfide
MD21-06-71404	21-26593	34.00–35.00	170	6.4	—	—	28	5.3
MD21-06-71405	21-26593	20.00–22.00	80	4.3	—	—	4.6	—
MD21-06-71406	21-26593	15.00–17.00	45	1.5	—	—	4.3	—
MD21-06-71407	21-26593	3.00–4.00	53	4.1	—	—	—	6.7
MD21-06-71408	21-26594	34.00–35.00	50	0.68	—	—	—	4.6
MD21-06-71409	21-26594	25.00–27.00	57	2.3	—	—	3.9	9.1
MD21-06-71410	21-26594	17.00–20.00	35	1.5	—	—	5.4	—
MD21-06-71411	21-26594	1.50–3.00	110	4.8	—	—	8.1	14
MD21-06-71436	21-26595	34.00–35.00	160	2.5	—	—	24	—
MD21-06-71437	21-26595	23.00–25.00	110	12	—	—	13	8.5
MD21-06-71438	21-26595	15.00–17.00	61	5.3	—	—	7	—
MD21-06-71439	21-26595	2.00–4.00	200	8.2	—	—	20	—
MD21-06-71440	21-26596	34.00–35.00	68	1.4	—	—	—	—
MD21-06-71441	21-26596	27.00–30.00	110	8.2	—	—	17	33
MD21-06-71442	21-26596	17.00–20.00	90	4.6	—	—	12	4.4
MD21-06-71443	21-26596	5.00–7.00	130	8.9	—	—	17	5
MD21-06-71468	21-26597	84.00–85.00	160	0.96	—	—	9.6	—
MD21-06-71469	21-26597	23.00–25.00	58	3.4	—	—	7.8	—
MD21-06-71470	21-26597	12.00–15.00	29	2.9	—	—	6.6	4.9
MD21-06-71471	21-26597	1.50–3.00	24	3.5	—	—	5.1	—
MD21-06-71472	21-26598	84.00–85.00	56	3.6	—	—	3.4	—
MD21-06-71473	21-26598	50.00–51.00	51	0.79	—	—	5.7	21

Table 2.5-12 (continued)

Sample ID	Location ID	Depth (ft)	Acetone	Benzene	Bromodichloromethane	Butanol[1-]	Butanone[2-]	Carbon disulfide
MD21-06-71474	21-26598	25.00–30.00	41	1.7	—	—	6.4	13
MD21-06-71475	21-26598	1.50–3.00	27	2.3	—	—	7.7	—
MD21-06-73141	21-26480	42.00–44.00	110	—	—	—	—	—
MD21-06-73144	21-26481	40.50–42.00	420	—	—	—	—	—
MD21-06-73147	21-26482	49.00–50.00	440	—	—	—	—	36
MD21-06-73150	21-26484	43.00–45.00	280	—	—	—	—	—
MD21-06-73507	21-26590	27.00–30.00	79	2.9	—	—	11	25
MD21-06-73508	21-26590	1.50–3.00	21	2.3	—	—	4.2	—
MD21-06-73509	21-26589	7.00–9.00	23	3.2	—	—	5.3	—
MD21-06-73510	21-26589	17.00–19.00	30	3	—	—	4.6	9.4
MD21-06-73722	21-26485	43.00–45.00	24	5.4	—	—	—	—

Table 2.5-12 (continued)

Sample ID	Location ID	Depth (ft)	Acetone	Benzene	Bromodichloromethane	Butanol[1-]	Butanone[2-]	Carbon disulfide
MD21-06-70736	21-26480	48.00–49.00	120	—	—	—	—	—
MD21-06-70737	21-26480	36.00–38.50	120	4.4	—	—	16	—
MD21-06-70738	21-26480	25.00–27.00	110	4.8	—	—	10	—
MD21-06-70754	21-26481	45.00–46.00	290	5.9	—	—	35	—
MD21-06-70755	21-26481	25.00–27.00	60	—	—	—	—	—
MD21-06-70782	21-26482	30.00–32.00	63	—	—	—	7.4	—
MD21-06-70783	21-26482	19.00–22.00	53	—	—	—	3.1	—
MD21-06-70784	21-26482	13.20–15.00	100	—	—	—	—	—
MD21-06-70800	21-26482	40.00–41.00	520	—	6.7	—	16	—
MD21-06-70828	21-26484	48.00–49.00	680	26	—	0	73	—
MD21-06-70829	21-26484	35.00–37.00	—	—	—	—	3.3	—
MD21-06-70830	21-26484	25.00–27.00	—	—	—	—	4.1	—
MD21-06-70831	21-26484	13.00–15.00	0	0.69	—	—	5.8	—
MD21-06-70846	21-26485	48.00–49.00	62	—	—	—	7.6	24
MD21-06-70847	21-26485	32.00–34.00	0	1.5	—	—	6.5	—
MD21-06-70848	21-26485	30.00–32.00	0	1.7	—	—	6	—
MD21-06-70849	21-26485	28.00–30.00	0	2.9	—	—	7	—
MD21-06-70850	21-26485	24.00–26.00	31	—	—	—	4.5	11
MD21-06-71304	21-26588	359.00–360.00	50	1.4	—	—	6	15
MD21-06-71305	21-26588	300.00–302.00	220	7.9	—	—	24	4.2
MD21-06-71306	21-26588	200.00–202.50	59	3.4	1.7	—	6.2	11
MD21-06-71307	21-26588	110.00–112.50	26	2.7	1.7	—	3.2	7.3

Table 2.5-12 (continued)

Sample ID	Location ID	Depth (ft)	Acetone	Benzene	Bromodichloromethane	Butanol[1-]	Butanone[2-]	Carbon disulfide
MD21-06-71308	21-26588	62.50–65.00	63	4.8	2.2	—	10	10
MD21-06-71309	21-26588	25.00–27.50	46	—	—	—	—	—
MD21-06-71310	21-26588	15.00–17.50	60	4.6	—	—	—	—
MD21-06-71311	21-26588	5.50–7.00	34	2.5	—	—	6.5	6.5
MD21-06-71329	21-26589	139.00–140.00	56	1.7	—	—	6.5	—
MD21-06-71330	21-26589	92.00–94.00	180	7.3	—	—	24	—
MD21-06-71331	21-26589	78.00–80.00	140	8	—	—	72	—
MD21-06-71332	21-26589	47.00–52.00	170	5.3	—	—	—	—
MD21-06-71333	21-26590	139.00–140.00	98	0.9	—	—	7.5	—
MD21-06-71334	21-26590	100.00–102.00	290	10	—	—	68	3.4
MD21-06-71335	21-26590	75.00–77.00	330	11	—	—	46	—
MD21-06-71336	21-26590	45.00–50.00	96	3.4	—	—	21	21
MD21-06-71372	21-26591	34.00–35.00	89	2.5	—	—	13	3.7
MD21-06-71373	21-26591	27.00–30.00	210	6.9	—	—	22	—
MD21-06-71374	21-26591	15.00–17.00	130	11	—	—	22	—
MD21-06-71375	21-26591	1.50–2.50	93	5.8	—	—	13	—
MD21-06-71376	21-26592	34.00–35.00	130	2.9	—	—	18	—
MD21-06-71377	21-26592	23.00–25.00	320	11	—	—	37	—
MD21-06-71378	21-26592	15.00–17.00	100	5.5	—	—	13	—
MD21-06-71379	21-26592	1.50–4.00	28	4.4	—	—	—	4.3
MD21-06-71404	21-26593	34.00–35.00	170	6.4	—	—	28	5.3
MD21-06-71405	21-26593	20.00–22.00	80	4.3	—	—	4.6	—

Table 2.5-12 (continued)

Sample ID	Location ID	Depth (ft)	Acetone	Benzene	Bromodichloromethane	Butanol[1-]	Butanone[2-]	Carbon disulfide
MD21-06-71406	21-26593	15.00–17.00	45	1.5	—	—	4.3	—
MD21-06-71407	21-26593	3.00–4.00	53	4.1	—	—	—	6.7
MD21-06-71408	21-26594	34.00–35.00	50	0.68	—	—	—	4.6
MD21-06-71409	21-26594	25.00–27.00	57	2.3	—	—	3.9	9.1
MD21-06-71410	21-26594	17.00–20.00	35	1.5	—	—	5.4	—
MD21-06-71411	21-26594	1.50–3.00	110	4.8	—	—	8.1	14
MD21-06-71436	21-26595	34.00–35.00	160	2.5	—	—	24	—
MD21-06-71437	21-26595	23.00–25.00	110	12	—	—	13	8.5
MD21-06-71438	21-26595	15.00–17.00	61	5.3	—	—	7	—
MD21-06-71439	21-26595	2.00–4.00	200	8.2	—	—	20	—
MD21-06-71440	21-26596	34.00–35.00	68	1.4	—	—	—	—
MD21-06-71441	21-26596	27.00–30.00	110	8.2	—	—	17	33
MD21-06-71442	21-26596	17.00–20.00	90	4.6	—	—	12	4.4
MD21-06-71443	21-26596	5.00–7.00	130	8.9	—	—	17	5
MD21-06-71468	21-26597	84.00–85.00	160	0.96	—	—	9.6	—
MD21-06-71469	21-26597	23.00–25.00	58	3.4	—	—	7.8	—
MD21-06-71470	21-26597	12.00–15.00	29	2.9	—	—	6.6	4.9
MD21-06-71471	21-26597	1.50–3.00	24	3.5	—	—	5.1	—
MD21-06-71472	21-26598	84.00–85.00	56	3.6	—	—	3.4	—
MD21-06-71473	21-26598	50.00–51.00	51	0.79	—	—	5.7	21
MD21-06-71474	21-26598	25.00–30.00	41	1.7	—	—	6.4	13
MD21-06-71475	21-26598	1.50–3.00	27	2.3	—	—	7.7	—

Table 2.5-12 (continued)

Sample ID	Location ID	Depth (ft)	Acetone	Benzene	Bromodichloromethane	Butanol[1-]	Butanone[2-]	Carbon disulfide
MD21-06-73141	21-26480	42.00–44.00	110	—	—	—	—	—
MD21-06-73144	21-26481	40.50–42.00	420	—	—	—	—	—
MD21-06-73147	21-26482	49.00–50.00	440	—	—	—	—	36
MD21-06-73150	21-26484	43.00–45.00	280	—	—	—	—	—
MD21-06-73507	21-26590	27.00–30.00	79	2.9	—	—	11	25
MD21-06-73508	21-26590	1.50–3.00	21	2.3	—	—	4.2	—
MD21-06-73509	21-26589	7.00–9.00	23	3.2	—	—	5.3	—
MD21-06-73510	21-26589	17.00–19.00	30	3	—	—	4.6	9.4
MD21-06-73722	21-26485	43.00–45.00	24	5.4	—	—	—	—

Table 2.5-12 (continued)

Sample ID	Location ID	Depth (ft)	Carbon tetrachloride	Chloroethane	Chloroform	Chloromethane	Dichlorobenzene -[1,4-]	Dichlorodifluoromethane
MD21-06-70736	21-26480	48.00–49.00	—	—	12	—	—	5.1
MD21-06-70737	21-26480	36.00–38.50	1.8	—	11	—	—	7.5
MD21-06-70738	21-26480	25.00–27.00	2	—	12	—	—	9.2
MD21-06-70754	21-26481	45.00–46.00	—	3.4	29	—	—	41
MD21-06-70755	21-26481	25.00–27.00	—	—	11	—	—	21
MD21-06-70782	21-26482	30.00–32.00	—	—	8.8	—	—	—
MD21-06-70783	21-26482	19.00–22.00	—	—	7.4	—	—	—
MD21-06-70784	21-26482	13.20–15.00	—	—	—	—	—	—
MD21-06-70800	21-26482	40.00–41.00	—	—	10	—	—	—
MD21-06-70828	21-26484	48.00–49.00	—	—	—	—	—	—
MD21-06-70829	21-26484	35.00–37.00	—	—	—	—	—	—
MD21-06-70830	21-26484	25.00–27.00	—	—	—	—	—	—
MD21-06-70831	21-26484	13.00–15.00	—	—	—	—	—	1
MD21-06-70846	21-26485	48.00–49.00	—	—	23	—	—	10
MD21-06-70847	21-26485	32.00–34.00	2.7	—	16	—	—	16
MD21-06-70848	21-26485	30.00–32.00	2.7	—	20	—	—	25
MD21-06-70849	21-26485	28.00–30.00	2.9	—	22	—	—	25
MD21-06-70850	21-26485	24.00–26.00	—	—	14	—	—	16
MD21-06-71304	21-26588	359.00–360.00	8.9	—	3.1	—	—	7.7
MD21-06-71305	21-26588	300.00–302.00	12	—	9.2	0.97	—	25
MD21-06-71306	21-26588	200.00–202.50	12	—	12	—	—	18
MD21-06-71307	21-26588	110.00–112.50	5	—	14	—	—	20

Table 2.5-12 (continued)

Sample ID	Location ID	Depth (ft)	Carbon tetrachloride	Chloroethane	Chloroform	Chloromethane	Dichlorobenzene -[1,4-]	Dichlorodifluoromethane
MD21-06-71308	21-26588	62.50–65.00	5.8	—	62	—	—	160
MD21-06-71309	21-26588	25.00–27.50	—	—	59	—	—	440
MD21-06-71310	21-26588	15.00–17.50	—	—	38	—	—	320
MD21-06-71311	21-26588	5.50–7.00	5.5	—	8.5	—	—	82
MD21-06-71329	21-26589	139.00–140.00	0	—	22	—	—	9.4
MD21-06-71330	21-26589	92.00–94.00	0	—	13	—	—	0
MD21-06-71331	21-26589	78.00–80.00	0	—	12	—	—	0
MD21-06-71332	21-26589	47.00–52.00	—	—	—	—	—	5.8
MD21-06-71333	21-26590	139.00–140.00	31	—	21	0.92	—	9.1
MD21-06-71334	21-26590	100.00–102.00	0	—	11	—	—	11
MD21-06-71335	21-26590	75.00–77.00	0	—	9.9	—	—	12
MD21-06-71336	21-26590	45.00–50.00	0	—	4.6	—	—	0
MD21-06-71372	21-26591	34.00–35.00	1.3	—	20	—	—	64
MD21-06-71373	21-26591	27.00–30.00	—	—	13	—	—	65
MD21-06-71374	21-26591	15.00–17.00	2.5	—	27	—	—	150
MD21-06-71375	21-26591	1.50–2.50	1.5	—	22	—	—	120
MD21-06-71376	21-26592	34.00–35.00	—	—	3.3	—	—	4.9
MD21-06-71377	21-26592	23.00–25.00	—	—	7.3	—	—	9.3
MD21-06-71378	21-26592	15.00–17.00	—	—	6.5	—	—	9.4
MD21-06-71379	21-26592	1.50–4.00	—	—	4.2	—	2.2	6.6
MD21-06-71404	21-26593	34.00–35.00	1.3	—	13	—	—	14
MD21-06-71405	21-26593	20.00–22.00	2	—	21	—	—	28

Table 2.5-12 (continued)

Sample ID	Location ID	Depth (ft)	Carbon tetrachloride	Chloroethane	Chloroform	Chloromethane	Dichlorobenzene -[1,4-]	Dichlorodifluoromethane
MD21-06-71406	21-26593	15.00–17.00	1.7	—	18	—	—	26
MD21-06-71407	21-26593	3.00–4.00	—	—	4.3	—	—	10
MD21-06-71408	21-26594	34.00–35.00	1.8	—	6.3	1	—	6.1
MD21-06-71409	21-26594	25.00–27.00	2.7	—	13	—	—	12
MD21-06-71410	21-26594	17.00–20.00	2.7	—	12	—	—	10
MD21-06-71411	21-26594	1.50–3.00	1.6	—	4.4	—	—	5
MD21-06-71436	21-26595	34.00–35.00	—	—	1.4	1.5	—	4
MD21-06-71437	21-26595	23.00–25.00	3.5	—	11	—	2.8	9.2
MD21-06-71438	21-26595	15.00–17.00	1.6	—	6.1	—	1.9	7.1
MD21-06-71439	21-26595	2.00–4.00	—	—	—	1.5	—	3.9
MD21-06-71440	21-26596	34.00–35.00	—	—	—	—	—	3.2
MD21-06-71441	21-26596	27.00–30.00	—	—	1	—	—	3.4
MD21-06-71442	21-26596	17.00–20.00	—	—	—	0.82	—	3.5
MD21-06-71443	21-26596	5.00–7.00	—	—	—	1.1	—	—
MD21-06-71468	21-26597	84.00–85.00	8.1	—	8.1	—	—	23
MD21-06-71469	21-26597	23.00–25.00	0	—	3.9	—	—	100
MD21-06-71470	21-26597	12.00–15.00	0	—	5.1	—	—	92
MD21-06-71471	21-26597	1.50–3.00	0	—	1.3	—	—	42
MD21-06-71472	21-26598	84.00–85.00	10	—	7	—	—	12
MD21-06-71473	21-26598	50.00–51.00	9.5	—	5.1	—	—	17
MD21-06-71474	21-26598	25.00–30.00	1.6	—	1.5	—	—	11
MD21-06-71475	21-26598	1.50–3.00	—	—	—	—	—	5

Table 2.5-12 (continued)

Sample ID	Location ID	Depth (ft)	Carbon tetrachloride	Chloroethane	Chloroform	Chloromethane	Dichlorobenzene -[1,4-]	Dichlorodifluoromethane
MD21-06-73141	21-26480	42.00–44.00	—	—	—	—	—	11
MD21-06-73144	21-26481	40.50–42.00	—	—	—	—	—	60
MD21-06-73147	21-26482	49.00–50.00	—	—	—	—	—	—
MD21-06-73150	21-26484	43.00–45.00	—	—	—	—	—	—
MD21-06-73507	21-26590	27.00–30.00	0	—	4.1	—	—	8
MD21-06-73508	21-26590	1.50–3.00	—	—	—	—	—	3.3
MD21-06-73509	21-26589	7.00–9.00	—	—	—	—	—	3.1
MD21-06-73510	21-26589	17.00–19.00	2.3	—	2	—	—	4
MD21-06-73722	21-26485	43.00–45.00	—	—	18	—	—	53

Table 2.5-12 (continued)

Sample ID	Location ID	Depth (ft)	Dichloroethane[1,1-]	Dichloroethane[1,2-]	Dichloroethene[1,1-]	Dichloropropane[1,2-]	Ethanol	Ethylbenzene
MD21-06-70736	21-26480	48.00–49.00	—	—	—	—	—	—
MD21-06-70737	21-26480	36.00–38.50	1.7	1.8	—	0.94	—	1.6
MD21-06-70738	21-26480	25.00–27.00	1.8	2.2	—	1.5	—	1.9
MD21-06-70754	21-26481	45.00–46.00	7.7	5	—	—	—	—
MD21-06-70755	21-26481	25.00–27.00	—	—	14	—	—	—
MD21-06-70782	21-26482	30.00–32.00	—	6	—	—	—	—
MD21-06-70783	21-26482	19.00–22.00	—	7.1	28	12	—	—
MD21-06-70784	21-26482	13.20–15.00	—	—	6.8	—	—	—
MD21-06-70800	21-26482	40.00–41.00	2.8	7.6	3.1	—	—	—
MD21-06-70828	21-26484	48.00–49.00	4	10	—	—	41	7.1
MD21-06-70829	21-26484	35.00–37.00	—	—	—	—	—	—
MD21-06-70830	21-26484	25.00–27.00	—	—	—	—	—	—
MD21-06-70831	21-26484	13.00–15.00	—	0.88	—	—	—	—
MD21-06-70846	21-26485	48.00–49.00	—	—	—	—	—	—
MD21-06-70847	21-26485	32.00–34.00	1.5	1.3	—	—	—	—
MD21-06-70848	21-26485	30.00–32.00	1.9	1.5	—	—	—	1
MD21-06-70849	21-26485	28.00–30.00	2.4	2.9	—	1.3	—	2.3
MD21-06-70850	21-26485	24.00–26.00	—	—	—	—	—	—
MD21-06-71304	21-26588	359.00–360.00	—	—	—	—	—	—
MD21-06-71305	21-26588	300.00–302.00	1.4	—	—	—	—	—
MD21-06-71306	21-26588	200.00–202.50	1.8	—	—	—	—	1.4
MD21-06-71307	21-26588	110.00–112.50	2.1	—	—	—	—	—

Table 2.5-12 (continued)

Sample ID	Location ID	Depth (ft)	Dichloroethane[1,1-]	Dichloroethane[1,2-]	Dichloroethene[1,1-]	Dichloropropane[1,2-]	Ethanol	Ethylbenzene
MD21-06-71308	21-26588	62.50–65.00	11	—	—	—	—	—
MD21-06-71309	21-26588	25.00–27.50	13	—	—	—	—	—
MD21-06-71310	21-26588	15.00–17.50	7.4	—	—	—	—	—
MD21-06-71311	21-26588	5.50–7.00	1.4	—	—	—	—	—
MD21-06-71329	21-26589	139.00–140.00	—	—	—	—	—	—
MD21-06-71330	21-26589	92.00–94.00	—	—	—	—	—	—
MD21-06-71331	21-26589	78.00–80.00	—	—	—	—	—	1.3
MD21-06-71332	21-26589	47.00–52.00	—	—	—	—	—	—
MD21-06-71333	21-26590	139.00–140.00	—	—	—	—	—	1.6
MD21-06-71334	21-26590	100.00–102.00	—	—	—	—	—	—
MD21-06-71335	21-26590	75.00–77.00	—	—	—	—	—	—
MD21-06-71336	21-26590	45.00–50.00	—	—	—	—	—	—
MD21-06-71372	21-26591	34.00–35.00	3.4	—	—	—	—	—
MD21-06-71373	21-26591	27.00–30.00	—	—	—	—	—	—
MD21-06-71374	21-26591	15.00–17.00	4.6	—	—	—	—	1.6
MD21-06-71375	21-26591	1.50–2.50	3.5	—	—	—	—	—
MD21-06-71376	21-26592	34.00–35.00	—	—	—	—	—	0.96
MD21-06-71377	21-26592	23.00–25.00	0.86	—	—	—	—	0.87
MD21-06-71378	21-26592	15.00–17.00	—	—	—	—	—	—
MD21-06-71379	21-26592	1.50–4.00	—	—	—	—	—	1.8
MD21-06-71404	21-26593	34.00–35.00	1.8	—	—	—	—	4.3
MD21-06-71405	21-26593	20.00–22.00	2.8	—	—	—	—	3

Table 2.5-12 (continued)

Sample ID	Location ID	Depth (ft)	Dichloroethane[1,1-]	Dichloroethane[1,2-]	Dichloroethene[1,1-]	Dichloropropane[1,2-]	Ethanol	Ethylbenzene
MD21-06-71406	21-26593	15.00–17.00	2.4	—	—	—	—	1.4
MD21-06-71407	21-26593	3.00–4.00	—	—	—	—	—	2.1
MD21-06-71408	21-26594	34.00–35.00	—	—	—	—	—	—
MD21-06-71409	21-26594	25.00–27.00	1.5	—	—	—	—	—
MD21-06-71410	21-26594	17.00–20.00	1.3	—	—	—	—	—
MD21-06-71411	21-26594	1.50–3.00	—	—	—	4.2	—	1.3
MD21-06-71436	21-26595	34.00–35.00	—	—	—	—	—	—
MD21-06-71437	21-26595	23.00–25.00	2.4	1.7	—	39	—	11
MD21-06-71438	21-26595	15.00–17.00	—	—	—	—	—	3.7
MD21-06-71439	21-26595	2.00–4.00	—	—	—	—	—	—
MD21-06-71440	21-26596	34.00–35.00	—	—	—	—	—	—
MD21-06-71441	21-26596	27.00–30.00	—	—	—	—	—	1.1
MD21-06-71442	21-26596	17.00–20.00	—	—	—	—	—	—
MD21-06-71443	21-26596	5.00–7.00	—	—	—	—	—	1.4
MD21-06-71468	21-26597	84.00–85.00	—	3.8	—	—	—	—
MD21-06-71469	21-26597	23.00–25.00	—	—	—	—	—	0.99
MD21-06-71470	21-26597	12.00–15.00	—	—	—	—	—	—
MD21-06-71471	21-26597	1.50–3.00	—	—	—	—	—	—
MD21-06-71472	21-26598	84.00–85.00	—	—	—	—	—	—
MD21-06-71473	21-26598	50.00–51.00	—	—	—	—	—	—
MD21-06-71474	21-26598	25.00–30.00	—	—	—	—	—	—
MD21-06-71475	21-26598	1.50–3.00	—	—	—	—	—	—

Table 2.5-12 (continued)

Sample ID	Location ID	Depth (ft)	Dichloroethane[1,1-]	Dichloroethane[1,2-]	Dichloroethene[1,1-]	Dichloropropane[1,2-]	Ethanol	Ethylbenzene
MD21-06-73141	21-26480	42.00–44.00	—	—	—	—	—	—
MD21-06-73144	21-26481	40.50–42.00	—	—	—	—	—	—
MD21-06-73147	21-26482	49.00–50.00	—	—	—	—	—	—
MD21-06-73150	21-26484	43.00–45.00	—	—	—	—	—	—
MD21-06-73507	21-26590	27.00–30.00	—	—	—	—	—	0.97
MD21-06-73508	21-26590	1.50–3.00	—	—	—	—	—	—
MD21-06-73509	21-26589	7.00–9.00	—	—	—	—	—	—
MD21-06-73510	21-26589	17.00–19.00	—	—	—	—	—	—
MD21-06-73722	21-26485	43.00–45.00	—	—	—	—	—	—

Table 2.5-12 (continued)

Sample ID	Location ID	Depth (ft)	Dichloroethane[1,1-]	Dichloroethane[1,2-]	Dichloroethene[1,1-]	Dichloropropane[1,2-]	Ethanol	Ethylbenzene
MD21-06-70736	21-26480	48.00–49.00	—	—	—	—	—	—
MD21-06-70737	21-26480	36.00–38.50	1.7	1.8	—	0.94	—	1.6
MD21-06-70738	21-26480	25.00–27.00	1.8	2.2	—	1.5	—	1.9
MD21-06-70754	21-26481	45.00–46.00	7.7	5	—	—	—	—
MD21-06-70755	21-26481	25.00–27.00	—	—	14	—	—	—
MD21-06-70782	21-26482	30.00–32.00	—	6	—	—	—	—
MD21-06-70783	21-26482	19.00–22.00	—	7.1	28	12	—	—
MD21-06-70784	21-26482	13.20–15.00	—	—	6.8	—	—	—
MD21-06-70800	21-26482	40.00–41.00	2.8	7.6	3.1	—	—	—
MD21-06-70828	21-26484	48.00–49.00	4	10	—	—	41	7.1
MD21-06-70829	21-26484	35.00–37.00	—	—	—	—	—	—
MD21-06-70830	21-26484	25.00–27.00	—	—	—	—	—	—
MD21-06-70831	21-26484	13.00–15.00	—	0.88	—	—	—	—
MD21-06-70846	21-26485	48.00–49.00	—	—	—	—	—	—
MD21-06-70847	21-26485	32.00–34.00	1.5	1.3	—	—	—	—
MD21-06-70848	21-26485	30.00–32.00	1.9	1.5	—	—	—	1
MD21-06-70849	21-26485	28.00–30.00	2.4	2.9	—	1.3	—	2.3
MD21-06-70850	21-26485	24.00–26.00	—	—	—	—	—	—
MD21-06-71304	21-26588	359.00–360.00	—	—	—	—	—	—
MD21-06-71305	21-26588	300.00–302.00	1.4	—	—	—	—	—
MD21-06-71306	21-26588	200.00–202.50	1.8	—	—	—	—	1.4
MD21-06-71307	21-26588	110.00–112.50	2.1	—	—	—	—	—

Table 2.5-12 (continued)

Sample ID	Location ID	Depth (ft)	Dichloroethane[1,1-]	Dichloroethane[1,2-]	Dichloroethene[1,1-]	Dichloropropane[1,2-]	Ethanol	Ethylbenzene
MD21-06-71308	21-26588	62.50–65.00	11	—	—	—	—	—
MD21-06-71309	21-26588	25.00–27.50	13	—	—	—	—	—
MD21-06-71310	21-26588	15.00–17.50	7.4	—	—	—	—	—
MD21-06-71311	21-26588	5.50–7.00	1.4	—	—	—	—	—
MD21-06-71329	21-26589	139.00–140.00	—	—	—	—	—	—
MD21-06-71330	21-26589	92.00–94.00	—	—	—	—	—	—
MD21-06-71331	21-26589	78.00–80.00	—	—	—	—	—	1.3
MD21-06-71332	21-26589	47.00–52.00	—	—	—	—	—	—
MD21-06-71333	21-26590	139.00–140.00	—	—	—	—	—	1.6
MD21-06-71334	21-26590	100.00–102.00	—	—	—	—	—	—
MD21-06-71335	21-26590	75.00–77.00	—	—	—	—	—	—
MD21-06-71336	21-26590	45.00–50.00	—	—	—	—	—	—
MD21-06-71372	21-26591	34.00–35.00	3.4	—	—	—	—	—
MD21-06-71373	21-26591	27.00–30.00	—	—	—	—	—	—
MD21-06-71374	21-26591	15.00–17.00	4.6	—	—	—	—	1.6
MD21-06-71375	21-26591	1.50–2.50	3.5	—	—	—	—	—
MD21-06-71376	21-26592	34.00–35.00	—	—	—	—	—	0.96
MD21-06-71377	21-26592	23.00–25.00	0.86	—	—	—	—	0.87
MD21-06-71378	21-26592	15.00–17.00	—	—	—	—	—	—
MD21-06-71379	21-26592	1.50–4.00	—	—	—	—	—	1.8
MD21-06-71404	21-26593	34.00–35.00	1.8	—	—	—	—	4.3
MD21-06-71405	21-26593	20.00–22.00	2.8	—	—	—	—	3

Table 2.5-12 (continued)

Sample ID	Location ID	Depth (ft)	Dichloroethane[1,1-]	Dichloroethane[1,2-]	Dichloroethene[1,1-]	Dichloropropane[1,2-]	Ethanol	Ethylbenzene
MD21-06-71406	21-26593	15.00–17.00	2.4	—	—	—	—	1.4
MD21-06-71407	21-26593	3.00–4.00	—	—	—	—	—	2.1
MD21-06-71408	21-26594	34.00–35.00	—	—	—	—	—	—
MD21-06-71409	21-26594	25.00–27.00	1.5	—	—	—	—	—
MD21-06-71410	21-26594	17.00–20.00	1.3	—	—	—	—	—
MD21-06-71411	21-26594	1.50–3.00	—	—	—	4.2	—	1.3
MD21-06-71436	21-26595	34.00–35.00	—	—	—	—	—	—
MD21-06-71437	21-26595	23.00–25.00	2.4	1.7	—	39	—	11
MD21-06-71438	21-26595	15.00–17.00	—	—	—	—	—	3.7
MD21-06-71439	21-26595	2.00–4.00	—	—	—	—	—	—
MD21-06-71440	21-26596	34.00–35.00	—	—	—	—	—	—
MD21-06-71441	21-26596	27.00–30.00	—	—	—	—	—	1.1
MD21-06-71442	21-26596	17.00–20.00	—	—	—	—	—	—
MD21-06-71443	21-26596	5.00–7.00	—	—	—	—	—	1.4
MD21-06-71468	21-26597	84.00–85.00	—	3.8	—	—	—	—
MD21-06-71469	21-26597	23.00–25.00	—	—	—	—	—	0.99
MD21-06-71470	21-26597	12.00–15.00	—	—	—	—	—	—
MD21-06-71471	21-26597	1.50–3.00	—	—	—	—	—	—
MD21-06-71472	21-26598	84.00–85.00	—	—	—	—	—	—
MD21-06-71473	21-26598	50.00–51.00	—	—	—	—	—	—
MD21-06-71474	21-26598	25.00–30.00	—	—	—	—	—	—
MD21-06-71475	21-26598	1.50–3.00	—	—	—	—	—	—

Table 2.5-12 (continued)

Sample ID	Location ID	Depth (ft)	Dichloroethane[1,1-]	Dichloroethane[1,2-]	Dichloroethene[1,1-]	Dichloropropane[1,2-]	Ethanol	Ethylbenzene
MD21-06-73141	21-26480	42.00–44.00	—	—	—	—	—	—
MD21-06-73144	21-26481	40.50–42.00	—	—	—	—	—	—
MD21-06-73147	21-26482	49.00–50.00	—	—	—	—	—	—
MD21-06-73150	21-26484	43.00–45.00	—	—	—	—	—	—
MD21-06-73507	21-26590	27.00–30.00	—	—	—	—	—	0.97
MD21-06-73508	21-26590	1.50–3.00	—	—	—	—	—	—
MD21-06-73509	21-26589	7.00–9.00	—	—	—	—	—	—
MD21-06-73510	21-26589	17.00–19.00	—	—	—	—	—	—
MD21-06-73722	21-26485	43.00–45.00	—	—	—	—	—	—

Table 2.5-12 (continued)

Sample ID	Location ID	Depth (ft)	Ethyltoluene[4-]	Hexane	Hexanone[2-]	Methanol	Methyl-2-pentanone[4-]	Methylene chloride
MD21-06-70736	21-26480	48.00–49.00	—	11	—	—	—	—
MD21-06-70737	21-26480	36.00–38.50	—	—	1.8	—	0	—
MD21-06-70738	21-26480	25.00–27.00	2.2	—	—	—	2	—
MD21-06-70754	21-26481	45.00–46.00	—	—	—	—	—	3.4
MD21-06-70755	21-26481	25.00–27.00	—	—	—	—	—	—
MD21-06-70782	21-26482	30.00–32.00	—	—	—	—	—	—
MD21-06-70783	21-26482	19.00–22.00	—	—	—	—	—	—
MD21-06-70784	21-26482	13.20–15.00	—	—	—	—	—	—
MD21-06-70800	21-26482	40.00–41.00	—	—	—	—	—	6.2
MD21-06-70828	21-26484	48.00–49.00	5.4	34	—	0	—	—
MD21-06-70829	21-26484	35.00–37.00	—	—	—	—	—	—
MD21-06-70830	21-26484	25.00–27.00	—	—	—	—	—	—
MD21-06-70831	21-26484	13.00–15.00	—	—	—	—	—	—
MD21-06-70846	21-26485	48.00–49.00	—	9.1	—	—	—	—
MD21-06-70847	21-26485	32.00–34.00	—	—	—	—	—	—
MD21-06-70848	21-26485	30.00–32.00	—	—	—	—	—	—
MD21-06-70849	21-26485	28.00–30.00	3	—	—	—	0	1.1
MD21-06-70850	21-26485	24.00–26.00	—	—	—	—	—	—
MD21-06-71304	21-26588	359.00–360.00	—	—	—	—	—	—
MD21-06-71305	21-26588	300.00–302.00	2.6	—	—	—	0	—
MD21-06-71306	21-26588	200.00–202.50	—	—	—	—	—	—
MD21-06-71307	21-26588	110.00–112.50	—	—	—	—	—	—

Table 2.5-12 (continued)

Sample ID	Location ID	Depth (ft)	Ethyltoluene[4-]	Hexane	Hexanone[2-]	Methanol	Methyl-2-pentanone[4-]	Methylene chloride
MD21-06-71308	21-26588	62.50–65.00	—	—	—	—	—	—
MD21-06-71309	21-26588	25.00–27.50	—	—	—	—	—	—
MD21-06-71310	21-26588	15.00–17.50	—	—	—	—	—	—
MD21-06-71311	21-26588	5.50–7.00	—	—	—	—	—	—
MD21-06-71329	21-26589	139.00–140.00	—	—	—	—	—	—
MD21-06-71330	21-26589	92.00–94.00	—	—	—	—	—	—
MD21-06-71331	21-26589	78.00–80.00	—	—	—	—	0	—
MD21-06-71332	21-26589	47.00–52.00	—	—	—	—	—	—
MD21-06-71333	21-26590	139.00–140.00	—	—	—	—	—	0.86
MD21-06-71334	21-26590	100.00–102.00	—	—	2.5	—	0	—
MD21-06-71335	21-26590	75.00–77.00	—	—	—	—	0	—
MD21-06-71336	21-26590	45.00–50.00	—	—	—	—	—	—
MD21-06-71372	21-26591	34.00–35.00	—	—	—	—	—	—
MD21-06-71373	21-26591	27.00–30.00	—	—	—	—	—	—
MD21-06-71374	21-26591	15.00–17.00	3.2	—	—	—	0	—
MD21-06-71375	21-26591	1.50–2.50	2	—	—	—	0	—
MD21-06-71376	21-26592	34.00–35.00	—	—	—	—	—	—
MD21-06-71377	21-26592	23.00–25.00	—	—	1.9	—	2.8	—
MD21-06-71378	21-26592	15.00–17.00	—	—	—	—	0	—
MD21-06-71379	21-26592	1.50–4.00	8	—	—	—	—	—
MD21-06-71404	21-26593	34.00–35.00	11	—	—	—	0	—
MD21-06-71405	21-26593	20.00–22.00	3.3	—	—	—	0	—

Table 2.5-12 (continued)

Sample ID	Location ID	Depth (ft)	Ethyltoluene[4-]	Hexane	Hexanone[2-]	Methanol	Methyl-2-pentanone[4-]	Methylene chloride
MD21-06-71406	21-26593	15.00–17.00	—	—	—	—	—	—
MD21-06-71407	21-26593	3.00–4.00	4.1	—	—	—	—	—
MD21-06-71408	21-26594	34.00–35.00	8.4	—	—	—	—	—
MD21-06-71409	21-26594	25.00–27.00	2	—	—	—	—	—
MD21-06-71410	21-26594	17.00–20.00	—	—	—	—	—	—
MD21-06-71411	21-26594	1.50–3.00	4.3	—	—	—	—	—
MD21-06-71436	21-26595	34.00–35.00	—	—	—	—	—	—
MD21-06-71437	21-26595	23.00–25.00	20	—	—	—	0	—
MD21-06-71438	21-26595	15.00–17.00	8.6	—	—	—	0	—
MD21-06-71439	21-26595	2.00–4.00	—	—	—	—	0	—
MD21-06-71440	21-26596	34.00–35.00	—	—	—	—	—	—
MD21-06-71441	21-26596	27.00–30.00	2.8	—	—	—	0	—
MD21-06-71442	21-26596	17.00–20.00	—	—	—	—	—	—
MD21-06-71443	21-26596	5.00–7.00	3.6	—	—	—	—	—
MD21-06-71468	21-26597	84.00–85.00	—	—	—	—	—	—
MD21-06-71469	21-26597	23.00–25.00	—	—	—	—	—	—
MD21-06-71470	21-26597	12.00–15.00	—	—	—	—	—	—
MD21-06-71471	21-26597	1.50–3.00	2.6	—	—	—	—	—
MD21-06-71472	21-26598	84.00–85.00	—	—	—	—	—	—
MD21-06-71473	21-26598	50.00–51.00	—	—	—	—	—	—
MD21-06-71474	21-26598	25.00–30.00	—	—	—	—	—	—
MD21-06-71475	21-26598	1.50–3.00	2.2	—	—	—	—	—

Table 2.5-12 (continued)

Sample ID	Location ID	Depth (ft)	Ethyltoluene[4-]	Hexane	Hexanone[2-]	Methanol	Methyl-2-pentanone[4-]	Methylene chloride
MD21-06-73141	21-26480	42.00–44.00	—	—	—	—	—	—
MD21-06-73144	21-26481	40.50–42.00	—	—	—	—	—	—
MD21-06-73147	21-26482	49.00–50.00	—	—	—	—	—	—
MD21-06-73150	21-26484	43.00–45.00	—	—	—	—	—	—
MD21-06-73507	21-26590	27.00–30.00	—	—	—	—	—	—
MD21-06-73508	21-26590	1.50–3.00	—	—	—	—	—	—
MD21-06-73509	21-26589	7.00–9.00	—	—	—	—	—	—
MD21-06-73510	21-26589	17.00–19.00	—	—	—	—	—	—
MD21-06-73722	21-26485	43.00–45.00	—	—	—	—	—	—

Table 2.5-12 (continued)

Sample ID	Location ID	Depth (ft)	n-Heptane	Propanol[2-]	Propylene	Styrene	Tetrachloroethene	Toluene
MD21-06-70736	21-26480	48.00–49.00	15	—	42	—	24	16
MD21-06-70737	21-26480	36.00–38.50	—	—	—	36	24	25
MD21-06-70738	21-26480	25.00–27.00	—	—	—	54	32	22
MD21-06-70754	21-26481	45.00–46.00	—	—	—	—	43	28
MD21-06-70755	21-26481	25.00–27.00	—	—	—	28	14	27
MD21-06-70782	21-26482	30.00–32.00	—	—	—	49	20	29
MD21-06-70783	21-26482	19.00–22.00	—	—	—	39	37	30
MD21-06-70784	21-26482	13.20–15.00	—	—	—	36	7.1	31
MD21-06-70800	21-26482	40.00–41.00	—	—	—	—	32	4.7
MD21-06-70828	21-26484	48.00–49.00	20	14	—	0	45	70
MD21-06-70829	21-26484	35.00–37.00	—	—	—	35	12	25
MD21-06-70830	21-26484	25.00–27.00	—	—	—	46	—	30
MD21-06-70831	21-26484	13.00–15.00	—	—	—	9.6	4.1	3.8
MD21-06-70846	21-26485	48.00–49.00	6.3	—	—	—	39	20
MD21-06-70847	21-26485	32.00–34.00	—	—	—	24	28	7.1
MD21-06-70848	21-26485	30.00–32.00	—	—	—	27	40	10
MD21-06-70849	21-26485	28.00–30.00	—	—	—	65	50	31
MD21-06-70850	21-26485	24.00–26.00	—	—	—	24	38	10
MD21-06-71304	21-26588	359.00–360.00	—	—	—	—	2.4	1.2
MD21-06-71305	21-26588	300.00–302.00	—	—	—	38	7.4	3.5
MD21-06-71306	21-26588	200.00–202.50	—	—	—	26	9.4	2.9
MD21-06-71307	21-26588	110.00–112.50	—	—	—	9.3	10	2.4

Table 2.5-12 (continued)

Sample ID	Location ID	Depth (ft)	n-Heptane	Propanol[2-]	Propylene	Styrene	Tetrachloroethene	Toluene
MD21-06-71308	21-26588	62.50–65.00	—	—	—	24	80	6.4
MD21-06-71309	21-26588	25.00–27.50	—	—	—	11	110	—
MD21-06-71310	21-26588	15.00–17.50	—	—	—	17	110	—
MD21-06-71311	21-26588	5.50–7.00	—	—	—	23	47	3.7
MD21-06-71329	21-26589	139.00–140.00	—	—	—	—	78	1.6
MD21-06-71330	21-26589	92.00–94.00	—	—	—	12	30	3.1
MD21-06-71331	21-26589	78.00–80.00	—	—	—	11	29	3.4
MD21-06-71332	21-26589	47.00–52.00	—	—	—	6.3	14	—
MD21-06-71333	21-26590	139.00–140.00	—	—	—	4.4	53	3.6
MD21-06-71334	21-26590	100.00–102.00	—	—	—	9.6	25	3.5
MD21-06-71335	21-26590	75.00–77.00	—	—	—	12	24	3.8
MD21-06-71336	21-26590	45.00–50.00	—	—	—	12	10	4.9
MD21-06-71372	21-26591	34.00–35.00	—	—	—	—	26	4
MD21-06-71373	21-26591	27.00–30.00	—	—	—	10	18	20
MD21-06-71374	21-26591	15.00–17.00	—	—	—	58	72	38
MD21-06-71375	21-26591	1.50–2.50	—	—	—	35	47	4.5
MD21-06-71376	21-26592	34.00–35.00	—	—	—	—	5.9	3.3
MD21-06-71377	21-26592	23.00–25.00	—	—	—	46	14	4.8
MD21-06-71378	21-26592	15.00–17.00	—	—	—	26	14	3
MD21-06-71379	21-26592	1.50–4.00	—	—	—	93	9	6
MD21-06-71404	21-26593	34.00–35.00	—	—	—	—	18	13
MD21-06-71405	21-26593	20.00–22.00	—	—	—	—	30	14

Table 2.5-12 (continued)

Sample ID	Location ID	Depth (ft)	n-Heptane	Propanol[2-]	Propylene	Styrene	Tetrachloroethene	Toluene
MD21-06-71406	21-26593	15.00–17.00	—	—	—	—	34	6.7
MD21-06-71407	21-26593	3.00–4.00	—	—	—	22	12	8.4
MD21-06-71408	21-26594	34.00–35.00	—	—	—	—	6.8	—
MD21-06-71409	21-26594	25.00–27.00	—	—	—	33	15	2.2
MD21-06-71410	21-26594	17.00–20.00	—	—	—	12	14	1.5
MD21-06-71411	21-26594	1.50–3.00	—	—	—	63	4.9	6.2
MD21-06-71436	21-26595	34.00–35.00	—	—	—	—	4.3	4.4
MD21-06-71437	21-26595	23.00–25.00	—	—	—	150	25	75
MD21-06-71438	21-26595	15.00–17.00	—	—	—	180	8.6	62
MD21-06-71439	21-26595	2.00–4.00	—	—	—	1.3	5.2	6.9
MD21-06-71440	21-26596	34.00–35.00	—	—	—	—	2.3	2.3
MD21-06-71441	21-26596	27.00–30.00	—	—	—	32	2.8	8.5
MD21-06-71442	21-26596	17.00–20.00	—	—	—	25	—	5.1
MD21-06-71443	21-26596	5.00–7.00	—	—	—	48	—	12
MD21-06-71468	21-26597	84.00–85.00	—	—	—	—	16	1.3
MD21-06-71469	21-26597	23.00–25.00	—	—	—	25	22	4.6
MD21-06-71470	21-26597	12.00–15.00	—	—	—	21	24	3.7
MD21-06-71471	21-26597	1.50–3.00	—	—	—	39	7.2	6.5
MD21-06-71472	21-26598	84.00–85.00	—	—	—	—	21	4
MD21-06-71473	21-26598	50.00–51.00	—	—	—	—	22	310
MD21-06-71474	21-26598	25.00–30.00	—	—	—	8.1	12	3.2
MD21-06-71475	21-26598	1.50–3.00	—	—	—	26	3.4	9.5

Table 2.5-12 (continued)

Sample ID	Location ID	Depth (ft)	n-Heptane	Propanol[2-]	Propylene	Styrene	Tetrachloroethene	Toluene
MD21-06-73141	21-26480	42.00–44.00	—	—	—	—	16	—
MD21-06-73144	21-26481	40.50–42.00	—	—	—	—	—	9.8
MD21-06-73147	21-26482	49.00–50.00	—	—	—	—	—	—
MD21-06-73150	21-26484	43.00–45.00	—	—	—	—	—	45
MD21-06-73507	21-26590	27.00–30.00	—	—	—	12	13	4.6
MD21-06-73508	21-26590	1.50–3.00	—	—	—	16	2.6	6.5
MD21-06-73509	21-26589	7.00–9.00	—	—	—	18	2.4	6.1
MD21-06-73510	21-26589	17.00–19.00	—	—	—	13	5.2	6.3
MD21-06-73722	21-26485	43.00–45.00	—	—	—	13	27	9.4

Table 2.5-12 (continued)

Sample ID	Location ID	Depth (ft)	Trichloro-1,2,2-tri-fluoroethane-[1,1,2-]	Trichloroethane-[1,1,1-]	Trichloroethene	Trichlorofluoromethane	Trimethylbenzene-[1,2,4-]	Trimethylbenzene-[1,3,5-]
MD21-06-70736	21-26480	48.00–49.00	—	150	24	—	—	—
MD21-06-70737	21-26480	36.00–38.50	3.6	170	30	2.6	—	—
MD21-06-70738	21-26480	25.00–27.00	4	210	36	2.9	2.8	—
MD21-06-70754	21-26481	45.00–46.00	—	350	140	—	—	—
MD21-06-70755	21-26481	25.00–27.00	—	77	48	—	—	—
MD21-06-70782	21-26482	30.00–32.00	—	73	160	—	—	—
MD21-06-70783	21-26482	19.00–22.00	—	140	110	—	—	—
MD21-06-70784	21-26482	13.20–15.00	—	31	53	—	—	—
MD21-06-70800	21-26482	40.00–41.00	—	100	330	—	—	—
MD21-06-70828	21-26484	48.00–49.00	—	250	150	—	—	—
MD21-06-70829	21-26484	35.00–37.00	—	53	41	—	—	—
MD21-06-70830	21-26484	25.00–27.00	—	28	22	—	—	—
MD21-06-70831	21-26484	13.00–15.00	—	12	15	—	—	—
MD21-06-70846	21-26485	48.00–49.00	—	270	40	—	—	—
MD21-06-70847	21-26485	32.00–34.00	4.8	220	22	2.7	—	—
MD21-06-70848	21-26485	30.00–32.00	6.8	250	24	3.3	—	—
MD21-06-70849	21-26485	28.00–30.00	7.6	290	46	3.4	3.5	—
MD21-06-70850	21-26485	24.00–26.00	—	230	24	—	—	—
MD21-06-71304	21-26588	359.00–360.00	—	25	12	3.1	—	—
MD21-06-71305	21-26588	300.00–302.00	3.3	72	15	3.7	3.6	—
MD21-06-71306	21-26588	200.00–202.50	4.2	85	15	4	2.1	—
MD21-06-71307	21-26588	110.00–112.50	—	100	11	2.8	—	—

Table 2.5-12 (continued)

Sample ID	Location ID	Depth (ft)	Trichloro-1,2,2-trifluoroethane-[1,1,2-]	Trichloroethane-[1,1,1-]	Trichloroethene	Trichlorofluoromethane	Trimethylbenzene-[1,2,4-]	Trimethylbenzene-[1,3,5-]
MD21-06-71308	21-26588	62.50–65.00	6.6	520	19	6.1	2.7	—
MD21-06-71309	21-26588	25.00–27.50	—	780	15	—	—	—
MD21-06-71310	21-26588	15.00–17.50	—	620	13	—	—	—
MD21-06-71311	21-26588	5.50–7.00	3.7	180	7.7	3.7	2.4	—
MD21-06-71329	21-26589	139.00–140.00	—	58	51	2.2	—	—
MD21-06-71330	21-26589	92.00–94.00	3.4	0	17	—	—	—
MD21-06-71331	21-26589	78.00–80.00	—	0	15	2.3	—	—
MD21-06-71332	21-26589	47.00–52.00	—	40	—	—	—	—
MD21-06-71333	21-26590	139.00–140.00	—	59	37	2.6	—	—
MD21-06-71334	21-26590	100.00–102.00	—	71	15	—	—	—
MD21-06-71335	21-26590	75.00–77.00	—	78	15	—	—	—
MD21-06-71336	21-26590	45.00–50.00	—	0	5.4	—	—	—
MD21-06-71372	21-26591	34.00–35.00	—	210	4	3.1	—	—
MD21-06-71373	21-26591	27.00–30.00	—	150	—	—	—	—
MD21-06-71374	21-26591	15.00–17.00	5.3	320	6.9	4.8	3.9	—
MD21-06-71375	21-26591	1.50–2.50	4.1	340	4.2	3.8	2.7	—
MD21-06-71376	21-26592	34.00–35.00	—	47	1.5	—	—	—
MD21-06-71377	21-26592	23.00–25.00	—	120	2.9	2.7	2.3	—
MD21-06-71378	21-26592	15.00–17.00	—	110	2.4	2.7	—	—
MD21-06-71379	21-26592	1.50–4.00	—	61	2	—	8	4
MD21-06-71404	21-26593	34.00–35.00	—	140	17	3.8	21	5.1
MD21-06-71405	21-26593	20.00–22.00	4	260	27	6.8	4.5	—

Table 2.5-12 (continued)

Sample ID	Location ID	Depth (ft)	Trichloro-1,2,2-trifluoroethane-[1,1,2-]	Trichloroethane-[1,1,1-]	Trichloroethene	Trichlorofluoromethane	Trimethylbenzene-[1,2,4-]	Trimethylbenzene-[1,3,5-]
MD21-06-71406	21-26593	15.00–17.00	3.7	260	25	6.6	2.2	—
MD21-06-71407	21-26593	3.00–4.00	—	81	4.2	3.2	6.2	—
MD21-06-71408	21-26594	34.00–35.00	—	61	4.3	2.6	15	4.6
MD21-06-71409	21-26594	25.00–27.00	—	140	9.1	3.4	2.5	—
MD21-06-71410	21-26594	17.00–20.00	—	130	8.8	3.1	—	—
MD21-06-71411	21-26594	1.50–3.00	—	81	4.8	—	5.2	2.5
MD21-06-71436	21-26595	34.00–35.00	—	23	—	—	—	—
MD21-06-71437	21-26595	23.00–25.00	4.9	260	46	4.5	22	11
MD21-06-71438	21-26595	15.00–17.00	—	85	8.3	3.4	9.2	4.5
MD21-06-71439	21-26595	2.00–4.00	—	5.9	7.4	—	—	—
MD21-06-71440	21-26596	34.00–35.00	—	12	2.2	—	—	—
MD21-06-71441	21-26596	27.00–30.00	—	20	2	—	4.1	—
MD21-06-71442	21-26596	17.00–20.00	—	9.6	—	—	—	—
MD21-06-71443	21-26596	5.00–7.00	—	2.9	—	—	6.1	2.2
MD21-06-71468	21-26597	84.00–85.00	—	84	12	—	—	—
MD21-06-71469	21-26597	23.00–25.00	4.2	130	12	2.6	3.3	—
MD21-06-71470	21-26597	12.00–15.00	4.3	140	13	2.7	2.2	—
MD21-06-71471	21-26597	1.50–3.00	—	38	2.5	—	3.3	—
MD21-06-71472	21-26598	84.00–85.00	—	87	8.1	2.4	—	—
MD21-06-71473	21-26598	50.00–51.00	3.1	100	7.3	2.3	—	—
MD21-06-71474	21-26598	25.00–30.00	—	56	2.5	—	—	—
MD21-06-71475	21-26598	1.50–3.00	—	14	—	—	3.8	—

Table 2.5-12 (continued)

Sample ID	Location ID	Depth (ft)	Trichloro-1,2,2-tri-fluoroethane-[1,1,2-]	Trichloroethane-[1,1,1-]	Trichloroethene	Trichlorofluoromethane	Trimethylbenzene-[1,2,4-]	Trimethylbenzene-[1,3,5-]
MD21-06-73141	21-26480	42.00–44.00	—	100	—	—	—	—
MD21-06-73144	21-26481	40.50–42.00	—	110	21	—	—	—
MD21-06-73147	21-26482	49.00–50.00	—	17	33	—	—	—
MD21-06-73150	21-26484	43.00–45.00	—	15	—	—	—	—
MD21-06-73507	21-26590	27.00–30.00	—	54	5.1	—	—	—
MD21-06-73508	21-26590	1.50–3.00	—	9.8	—	—	2.2	—
MD21-06-73509	21-26589	7.00–9.00	—	6	—	—	2.6	—
MD21-06-73510	21-26589	17.00–19.00	—	18	1.4	—	2	—
MD21-06-73722	21-26485	43.00–45.00	—	230	3.4	—	—	—

Table 2.5-12 (continued)

Sample ID	Location ID	Depth (ft)	Xylene (Total)	Xylene[1,2-]	Xylene[1,3-] +Xylene [1,4-]	Tritium
MD21-06-70736	21-26480	48.00–49.00	—	—	—	590
MD21-06-70737	21-26480	36.00–38.50	9.5	2.7	—	670
MD21-06-70738	21-26480	25.00–27.00	11	3.1	—	570
MD21-06-70754	21-26481	45.00–46.00	—	—	—	610
MD21-06-70755	21-26481	25.00–27.00	—	—	5.3	2830
MD21-06-70782	21-26482	30.00–32.00	—	4.1	13	2740
MD21-06-70783	21-26482	19.00–22.00	—	—	9.2	850
MD21-06-70784	21-26482	13.20–15.00	—	—	7.6	860
MD21-06-70800	21-26482	40.00–41.00	—	—	—	1270
MD21-06-70828	21-26484	48.00–49.00	—	6	13	620
MD21-06-70829	21-26484	35.00–37.00	—	—	—	820
MD21-06-70830	21-26484	25.00–27.00	—	—	—	32900
MD21-06-70831	21-26484	13.00–15.00	—	—	—	480
MD21-06-70846	21-26485	48.00–49.00	—	—	—	1220
MD21-06-70847	21-26485	32.00–34.00	5.2	—	—	2990
MD21-06-70848	21-26485	30.00–32.00	5.8	—	—	670
MD21-06-70849	21-26485	28.00–30.00	14	—	—	4160
MD21-06-70850	21-26485	24.00–26.00	—	—	—	8060
MD21-06-71304	21-26588	359.00–360.00	—	—	—	1762.936
MD21-06-71305	21-26588	300.00–302.00	7.1	—	—	17200
MD21-06-71306	21-26588	200.00–202.50	7.3	—	—	—
MD21-06-71307	21-26588	110.00–112.50	—	—	—	—

Table 2.5-12 (continued)

Sample ID	Location ID	Depth (ft)	Xylene (Total)	Xylene[1,2-]	Xylene[1,3-] +Xylene [1,4-]	Tritium
MD21-06-71308	21-26588	62.50–65.00	5.7	—	—	730
MD21-06-71309	21-26588	25.00–27.50	—	—	—	4630
MD21-06-71310	21-26588	15.00–17.50	—	—	—	1250
MD21-06-71311	21-26588	5.50–7.00	3.7	—	—	6640
MD21-06-71329	21-26589	139.00–140.00	—	—	—	720
MD21-06-71330	21-26589	92.00–94.00	3.9	—	—	1460
MD21-06-71331	21-26589	78.00–80.00	6.3	—	—	5590
MD21-06-71332	21-26589	47.00–52.00	—	—	—	264.919
MD21-06-71333	21-26590	139.00–140.00	8.1	2.4	—	990
MD21-06-71334	21-26590	100.00–102.00	2.5	—	—	450
MD21-06-71335	21-26590	75.00–77.00	4	—	—	690
MD21-06-71336	21-26590	45.00–50.00	3.4	—	—	2090
MD21-06-71372	21-26591	34.00–35.00	—	—	—	862.172
MD21-06-71373	21-26591	27.00–30.00	—	—	—	980
MD21-06-71374	21-26591	15.00–17.00	12	—	—	2340
MD21-06-71375	21-26591	1.50–2.50	6	—	—	730
MD21-06-71376	21-26592	34.00–35.00	—	—	—	4399.701
MD21-06-71377	21-26592	23.00–25.00	8.2	—	—	1808.21
MD21-06-71378	21-26592	15.00–17.00	4.9	—	—	1025.954
MD21-06-71379	21-26592	1.50–4.00	18	—	—	420
MD21-06-71404	21-26593	34.00–35.00	22	7.7	—	1092486
MD21-06-71405	21-26593	20.00–22.00	15	3.5	—	0

Table 2.5-12 (continued)

Sample ID	Location ID	Depth (ft)	Xylene (Total)	Xylene[1,2-]	Xylene[1,3-] +Xylene [1,4-]	Tritium
MD21-06-71406	21-26593	15.00–17.00	6.9	1.7	—	0
MD21-06-71407	21-26593	3.00–4.00	14	4	—	1300.691
MD21-06-71408	21-26594	34.00–35.00	14	4.5	—	0
MD21-06-71409	21-26594	25.00–27.00	5.2	—	—	780
MD21-06-71410	21-26594	17.00–20.00	—	—	—	830
MD21-06-71411	21-26594	1.50–3.00	11	—	—	520
MD21-06-71436	21-26595	34.00–35.00	4.7	1.7	—	874.713
MD21-06-71437	21-26595	23.00–25.00	62	—	—	5304.121
MD21-06-71438	21-26595	15.00–17.00	26	—	—	721.207
MD21-06-71439	21-26595	2.00–4.00	—	—	—	1283.268
MD21-06-71440	21-26596	34.00–35.00	—	—	—	0
MD21-06-71441	21-26596	27.00–30.00	8.4	—	—	420
MD21-06-71442	21-26596	17.00–20.00	4.9	—	—	77100
MD21-06-71443	21-26596	5.00–7.00	11	—	—	930
MD21-06-71468	21-26597	84.00–85.00	—	—	—	1196.866
MD21-06-71469	21-26597	23.00–25.00	5.6	—	—	970
MD21-06-71470	21-26597	12.00–15.00	3.7	—	—	890
MD21-06-71471	21-26597	1.50–3.00	6.7	—	—	750
MD21-06-71472	21-26598	84.00–85.00	—	—	—	550
MD21-06-71473	21-26598	50.00–51.00	—	—	—	870
MD21-06-71474	21-26598	25.00–30.00	—	—	—	—
MD21-06-71475	21-26598	1.50–3.00	5.7	—	—	631.758

Table 2.5-12 (continued)

Sample ID	Location ID	Depth (ft)	Xylene (Total)	Xylene[1,2-]	Xylene[1,3-] +Xylene [1,4-]	Tritium
MD21-06-73141	21-26480	42.00–44.00	—	—	—	1352.503
MD21-06-73144	21-26481	40.50–42.00	—	—	—	6377.877
MD21-06-73147	21-26482	49.00–50.00	—	—	—	1000.681
MD21-06-73150	21-26484	43.00–45.00	—	—	—	776.792
MD21-06-73507	21-26590	27.00–30.00	4.6	—	—	1040
MD21-06-73508	21-26590	1.50–3.00	3.9	—	—	412.273
MD21-06-73509	21-26589	7.00–9.00	4.7	—	—	236.892
MD21-06-73510	21-26589	17.00–19.00	4.4	—	—	2593.565
MD21-06-73722	21-26485	43.00–45.00	—	—	—	1131.443

Note: VOC units are in µg/m^3. Tritium in pCi/L.

* — = The analyte was not detected.

Table 2.6-1
VOC Pore-Gas Screening Results

Chemical	Maximum Detected Concentration ($\mu g/m^3$)	H' (dimensionless)	Groundwater Screening Level (µg/L)	Screening Value
Acetone	180	0.0016	5500[a]	2.05E-02
Benzene	16	0.228	5[b]	1.40E-02
Butanol[1-]	74	0.000347	37,000[a]	5.76E-02
Butanone[2-]	190	0.0011	7,100[a]	2.43E-02
Carbon disulfide	140	1.2	1000[a]	1.17E-04
Chloroform	23	0.15	100[c]	1.53E-03
Cyclohexane	4.1	0.193	13,000[a]	1.63E-06
Dichlorodifluoromethane	140	4.1	390[a]	8.76E-05
Ethylbenzene	17	0.323	700[b]	7.52E-05
Ethyltoluene[4-]	18	0.00493	na[d]	na
Hexane	8.9	5	420[a]	4.24E-06
Methanol	240	0.000109	18,000[a]	1.22E-01
Heptane[n-]	190	2.06	na[d]	na
Propylene	23	0.0000854	na[d]	na
Tetrachloroethene	53	0.754	5[b]	1.41E-02
Tetrahydrofuran	9.9	0.00289	8.8[a]	3.89E-01
Toluene	3500	0.272	750[c]	1.72E-02
Trichloroethane[1,1,1-]	240	0.705	60[c]	5.67E-03
Tricloroethene	61	0.422	5[b]	2.89E-02
Trichlorofluoromethane	4.9	4	1300[a]	9.42E-07
Trimethylbenzene[1,2,4-]	28	0.23	13[a]	9.36-03
Trimethylbenzene[1,3,5-]	9.5	0.32	12[a]	2.47E-04
Xylene[1,2-]	25	0.213	620[c]	1.89E-04
Xylene[1,3-]+Xylene[1,4-]	48	0.3	620[c]	2.58E-04

[a] EPA Region 6 tap water screening level (EPA 2007, 099314).

[b] EPA MCL.

[c] NMWQCC groundwater standard.

[d] na = Not available.

Table 2.6-2
Summary of Pore-Gas Samples Collected and Analyses Requested at MDA A

Sample ID	Location ID	Depth (ft)	Borehole	Tritium (EPA Method 906)	VOCs (TO15)
MD21-07-6943	21-26481	25.00–27.00	5	X[a]	X
MD21-07-6942	21-26481	40.50–42.00	5	X	X
MD21-07-6941	21-26481	45.00–46.00	5	X	X
MD21-07-7014[b]	21-26481	45.00–46.00	5	X	X
MD21-07-6950	21-26484	13.00–15.00	15	X	X
MD21-07-6949	21-26484	25.00–27.00	15	X	X
MD21-07-6948	21-26484	35.00–37.00	15	X	X
MD21-07-6947	21-26484	43.00–45.00	15	X	X
MD21-07-6946	21-26484	48.00–49.00	15	X	X
MD21-07-6958	21-26485	24.00–26.00	3	X	X
MD21-07-6992[b]	21-26485	24.00–26.00	3	X	X
MD21-07-6957	21-26485	28.00–30.00	3	X	X
MD21-07-6956	21-26485	30.00–32.00	3	X	X
MD21-07-6955	21-26485	32.00–34.00	3	X	X
MD21-07-6954	21-26485	43.00–45.00	3	X	X
MD21-07-6953	21-26485	48.00–49.00	3	X	X
MD21-07-6961	21-26588	5.50–7.00	12	X	X
MD21-07-7013[b]	21-26588	5.50–7.00	12	X	X
MD21-07-6962	21-26588	15.00–17.50	12	X	X
MD21-07-6963	21-26588	25.00–27.50	12	X	X
MD21-07-6964	21-26588	62.50–65.00	12	X	X
MD21-07-6968	21-26588	110.00–112.50	12	X	X
MD21-07-6967	21-26588	200.00–202.50	12	X	X
MD21-07-6966	21-26588	300.00–302.00	12	X	X
MD21-07-6965	21-26588	359.00–360.00	12	X	X
MD21-07-6982	21-26593	14.0–15.0	8	X	X
MD21-07-6981	21-26593	34.00–35.00	8	X	X
MD21-07-6980	21-26593	54.00–55.00	8	X	X
MD21-07-6979	21-26593	74.00–75.00	8	X	X
MD21-07-6978	21-26593	94.00–95.00	8	X	X
MD21-07-6977	21-26593	114.00–115.00	8	X	X
MD21-07-6974	21-26596	5.00–7.00	11	X	X
MD21-07-6973	21-26596	17.00–20.00	11	X	X
MD21-07-6972	21-26596	27.00–30.00	11	X	X
MD21-07-6971	21-26596	34.00–35.00	11	X	X

[a] X = Sample collected and analysis requested.

[b] Samples are field duplicates.

Table 2.6-3
Summary of VOC Concentrations in Subsurface Vapor at MDA A

Sample ID	Location ID	Depth (ft)	Acetone	Benzene	Butanol[1-]	Butanone[2-]	Carbon Disulfide	Chloroform	Cyclohexane	Dichlorodifluoromethane
MD21-07-6943	21-26481	25.0–27.0	17	4.2	—*	57	—	15	—	77
MD21-07-6942	21-26481	40.5–42.0	47	—	—	190	—	—	—	39
MD21-07-6941	21-26481	45.0–46.0	69	9.1	—	41	3	16	—	88
MD21-07-6950	21-26484	13.0–15.0	17	—	—	9	—	—	—	8.5
MD21-07-6949	21-26484	25.0–27.0	28	—	—	18	—	—	—	5.1
MD21-07-6948	21-26484	35.0–37.0	7.7 (J)	—	—	—	—	—	—	—
MD21-07-6947	21-26484	43.0–45.0	10	6.2	—	—	—	—	—	—
MD21-07-6946	21-26484	48.0–49.0	12	—	—	—	—	—	—	—
MD21-07-6958	21-26485	24.0–26.0	100	3.3	38	20	—	6.8	—	68
MD21-07-6957	21-26485	28.0–30.0	17	—	—	3.8	—	6.3	—	58
MD21-07-6956	21-26485	30.0–32.0	32	—	—	5.8	2.7	12	—	99
MD21-07-6955	21-26485	32.0–34.0	38	—	—	8.5	—	15	3.4	140
MD21-07-6954	21-26485	43.0–45.0	22	—	—	5.6	—	17	4.1	130
MD21-07-6953	21-26485	48.0–49.0	26	—	—	22	—	15	—	110
MD21-07-6961	21-26588	5.5–7.0	100	—	—	42	—	—	—	28
MD21-07-6962	21-26588	15.0–17.5	50	—	—	25	—	14	—	80
MD21-07-6963	21-26588	25.0–27.5	43	—	—	17	—	20	—	91
MD21-07-6964	21-26588	62.0–65.0	27	—	—	44	—	15	—	56
MD21-07-6966	21-26588	300.0–302.0	140	—	—	16	—	4.8	—	9.6
MD21-07-6965	21-26588	359.0–360.0	20	—	—	3	—	—	—	4.2 (J)
MD21-07-6982	21-26593	15.0–16.0	15	—	—	26	13	13	—	62
MD21-07-6981	21-26593	34.0–35.0	15	—	—	15	—	22	3.7	88
MD21-07-6980	21-26593	54.0–55.0	16	—	—	24	—	23	—	80
MD21-07-6979	21-26593	74.0–75.0	12	—	—	17	—	20	—	57
MD21-07-6978	21-26593	94.0–95.0	47	—	74	23	—	13	—	32
MD21-07-6977	21-26593	114.0–115.0	92	3.8	—	20	140	12	—	29
MD21-07-6974	21-26596	5.0–7.0	10	—	—	6.3	—	—	—	—
MD21-07-6973	21-26596	17.0–20.0	96	8.3	—	12	—	—	—	—
MD21-07-6972	21-26596	27.0–30.0	130	7.2	—	27	3.4	—	—	—
MD21-07-6971	21-26596	34.0–35.0	180	16	—	34	3.1	—	—	—

Table 2.6-3 (continued)

Sample ID	Location ID	Depth (ft)	Ethylbenzene	Ethyltoluene[4-]	Hexane	Methanol	n-Heptane	Propylene	Tetrachloroethene	Tetrahydrofuran
MD21-07-6943	21-26481	25.0–27.0	6.9	18	—	—	22	—	23 (J+)	—
MD21-07-6942	21-26481	40.5–42.0	17	—	—	—	190	—	—	—
MD21-07-6941	21-26481	45.0–46.0	8.6	7.3	5.3	—	7.3	—	26 (J+)	7.6
MD21-07-6950	21-26484	13.0–15.0	—	—	—	—	—	—	—	3.1
MD21-07-6949	21-26484	25.0–27.0	—	—	—	—	—	—	—	9.9
MD21-07-6948	21-26484	35.0–37.0	—	—	—	—	—	—	—	—
MD21-07-6947	21-26484	43.0–45.0	—	—	—	—	—	—	—	—
MD21-07-6946	21-26484	48.0–49.0	—	—	—	—	—	—	—	—
MD21-07-6958	21-26485	24.0–26.0	—	—	—	—	5.9	—	20	—
MD21-07-6957	21-26485	28.0–30.0	—	—	—	—	—	—	20	—
MD21-07-6956	21-26485	30.0–32.0	—	—	—	—	—	—	31	—
MD21-07-6955	21-26485	32.0–34.0	—	—	—	—	—	—	33	—
MD21-07-6954	21-26485	43.0–45.0	—	—	—	—	—	—	32	—
MD21-07-6953	21-26485	48.0–49.0	—	—	—	—	5.7	—	27	—
MD21-07-6961	21-26588	5.5–7.0	—	—	3.7	—	—	—	20 (J+)	5
MD21-07-6962	21-26588	15.0–17.5	—	—	3.9	—	—	—	53 (J+)	2.6
MD21-07-6963	21-26588	25.0–27.5	—	—	3.9	—	—	—	48 (J+)	—
MD21-07-6964	21-26588	62.0–65.0	—	—	—	—	5.8	—	20 (J+)	—
MD21-07-6966	21-26588	300.0–302.0	—	—	—	—	—	23	—	—
MD21-07-6965	21-26588	359.0–360.0	—	—	—	—	—	—	—	—
MD21-07-6982	21-26593	15.0–16.0	—	—	—	—	—	—	22	—
MD21-07-6981	21-26593	34.0–35.0	—	—	—	240	—	—	27	—
MD21-07-6980	21-26593	54.0–55.0	—	—	—	—	—	—	22	—
MD21-07-6979	21-26593	74.0–75.0	—	—	—	—	—	—	15	—
MD21-07-6978	21-26593	94.0–95.0	—	—	—	—	4.1	—	12	—
MD21-07-6977	21-26593	114.0–115.0	—	—	—	—	—	—	14 (J+)	—
MD21-07-6974	21-26596	5.0–7.0	—	—	—	—	—	—	—	—
MD21-07-6973	21-26596	17.0–20.0	4.2	4.5	4.4	—	—	—	—	—
MD21-07-6972	21-26596	27.0–30.0	4.4	4.9	4.3	—	4.2	—	—	—
MD21-07-6971	21-26596	34.0–35.0	4.7	5.2	8.9	—	9	—	—	—

Table 2.6-3 (continued)

Sample ID	Location ID	Depth (ft)	Toluene	Trichloroethane[1,1,1-]	Trichloroethene	Trichlorofluoromethane	Trimethylbenzene[1,2,4-]	Trimethylbenzene[1,3,5-]	Xylene[1,2-]	Xylene[1,3-]+Xylene[1,4-]
MD21-07-6943	21-26481	25.0–27.0	990	160	61	—	28	9.5	12	23
MD21-07-6942	21-26481	40.5–42.0	3500	69	31	—	—	—	25	48
MD21-07-6941	21-26481	45.0–46.0	190	180	65	—	9.8	—	9.8	23
MD21-07-6950	21-26484	13.0–15.0	32	17	—	—	—	—	—	—
MD21-07-6949	21-26484	25.0–27.0	85	8.6	—	—	—	—	—	4.1
MD21-07-6948	21-26484	35.0–37.0	—	—	—	—	—	—	—	—
MD21-07-6947	21-26484	43.0–45.0	11	—	—	—	—	—	—	5.4
MD21-07-6946	21-26484	48.0–49.0	—	—	—	—	—	—	—	—
MD21-07-6958	21-26485	24.0–26.0	49	120	—	—	—	—	—	—
MD21-07-6957	21-26485	28.0–30.0	65	100	—	—	—	—	—	—
MD21-07-6956	21-26485	30.0–32.0	69	170	4.5 (J)	—	—	—	—	—
MD21-07-6955	21-26485	32.0–34.0	64	210	5.2	—	—	—	—	—
MD21-07-6954	21-26485	43.0–45.0	160	200	11	—	—	—	—	—
MD21-07-6953	21-26485	48.0–49.0	240	180	5.8	—	—	—	—	7
MD21-07-6961	21-26588	5.5–7.0	10	70	—	—	—	—	—	7.4
MD21-07-6962	21-26588	15.0–17.5	11	220	8.3	—	—	—	—	7.3
MD21-07-6963	21-26588	25.0–27.5	12	240	9.8	—	—	—	—	7.5
MD21-07-6964	21-26588	62.0–65.0	230	120	10	—	5.8	—	5.3	11
MD21-07-6966	21-26588	300.0–302.0	—	27	9.6	—	—	—	—	—
MD21-07-6965	21-26588	359.0–360.0	4.6	5.6	—	—	—	—	—	—
MD21-07-6982	21-26593	15.0–16.0	230	140	39	—	—	—	—	—
MD21-07-6981	21-26593	34.0–35.0	160	190	29	4.9 (J)	—	—	—	3.8
MD21-07-6980	21-26593	54.0–55.0	220	160	24	—	—	—	—	4.8
MD21-07-6979	21-26593	74.0–75.0	150	120	21	—	—	—	—	4.3
MD21-07-6978	21-26593	94.0–95.0	180	74	16	—	—	—	—	5.1
MD21-07-6977	21-26593	114.0–115.0	6.3	71	16	—	—	—	—	—
MD21-07-6974	21-26596	5.0–7.0	230	18	—	—	—	—	—	—
MD21-07-6973	21-26596	17.0–20.0	19	17	4.9	—	6.5	—	5.1	11
MD21-07-6972	21-26596	27.0–30.0	18	19	6.4	—	7.4	—	5.3	12
MD21-07-6971	21-26596	34.0–35.0	25	10	—	—	7.5	—	5.9	12

Note: VOC concentrations are in µg/m^3.

* — = The analyte was not detected.

Table 2.6-4
Summary of Tritium Activities in Subsurface Vapor at MDA A

Sample ID	Location ID	Depth Range (ft)	Tritium Activity
MD21-07-6943	21-26481	25.00–27.00	—*
MD21-07-6942	21-26481	40.50–42.00	—
MD21-07-6941	21-26481	45.00–46.00	329.656
MD21-07-6950	21-26484	13.00–15.00	—
MD21-07-6949	21-26484	25.00–27.00	—
MD21-07-6948	21-26484	35.00–37.00	—
MD21-07-6947	21-26484	43.00–45.00	—
MD21-07-6946	21-26484	48.00–49.00	—
MD21-07-6957	21-26485	28.00–30.00	—
MD21-07-6956	21-26485	30.00–32.00	—
MD21-07-6955	21-26485	32.00–34.00	252.997
MD21-07-6954	21-26485	43.00–45.00	391.019
MD21-07-6953	21-26485	48.00–49.00	490.804(J-)
MD21-07-6961	21-26588	5.50–7.00	921.662
MD21-07-6962	21-26588	15.00–17.50	800.545
MD21-07-6963	21-26588	25.00–27.50	917.729
MD21-07-6964	21-26588	62.50–65.00	594.588
MD21-07-6968	21-26588	110.00–112.50	911.306(J-)
MD21-07-6967	21-26588	200.00–202.50	569.78(J-)
MD21-07-6966	21-26588	300.00–302.00	283.644
MD21-07-6965	21-26588	359.00–360.00	—
MD21-07-6982	21-26593	15.00–16.00	359.048
MD21-07-6981	21-26593	34.00–35.00	323.456
MD21-07-6980	21-26593	54.00–55.00	—
MD21-07-6979	21-26593	34.00–35.00	277.793
MD21-07-6978	21-26593	94.00–95.00	—
MD21-07-6977	21-26593	114.00–115.00	—
MD21-07-6974	21-26596	5.00–7.00	—
MD21-07-6973	21-26596	15.00–20.00	375.046
MD21-07-6972	21-26596	27.00–30.00	382.272
MD21-07-6971	21-26596	34.00–35.00	1073.84

Note: Tritium activities are in pCi/L.

* — = The analyte was not detected.

Table 5.1-1
Summary of Screening and Clean-up Standards

Media	Screening and Cleanup Standards
Groundwater	New Mexico Water Quality Control Commission standards Safe Drinking Water Act Maximum Contaminant Levels EPA Region 6 Human Health Medium Specific Screening Levels
Soil	NMED "Technical Background Document for Development of Soil Screening Levels" EPA Region 6 Human Health Medium Specific Screening Levels

Table 6.0-1
Results of Technology Threshold Screening for the MDA A Corrective Measure

	Threshold Criteria			
Technology[a]	Protective of Human Health and the Environment	Attain Media Cleanup Standards	Control the Source—Reduce/Eliminate Future Release	Comply with Applicable Waste Management Standards
NFA[b] with no Institutional Controls (ICs)	No	Yes	No	Yes
NFA with ICs[c]	No	Yes	Yes	Yes
Long-Term Monitoring and Maintenance[c]	Yes	No	No	No
Long-Term Access Control	No	No	Yes	No
Vegetative Soil Cover[d]	Yes	Yes	Yes	Yes
Containment Cells[e]	Yes	Yes	Yes	Yes
Structural Barriers	Yes	No	Yes	Yes
RCRA Subtitle C Cover[f]	Yes	Yes	Yes	Yes
Biointrusion Barrier	No	No	Yes	Yes
In situ Vitrification[g]	Yes	Yes	Yes	Yes
In Situ Grouting or Chemical Fixing[h]	Yes	Yes	Yes	Yes
Partial Removal with Off-site Disposal[i]	Yes	Yes	Yes	Yes
Complete Removal with Off-Site Disposal	Yes	Yes	Yes	Yes
Ex Situ Treatment[j]	Yes	Yes	Yes	Yes

[a] Technologies shown in bold are used in the corrective measure alternatives.

[b] No further action is, in reality, a vegetative cap 2–6 ft thick.

[c] Long-term monitoring and ICs will be carried forward for all alternatives.

[d] Enhancing the existing cap to provide vegetative soil tooting media (vegetative cap) and incorporating a biointrusion barrier are combined to make one alternative for "Vegetative Soil Cover."

[e] Containment cell technology is dismissed because the geometry of the pits are such that full bottom containment is impracticable.

[f] RCRA Subtitle C Cover will be used as a "basis" for equivalency of the vegetative cover and is not carried forward as a separate alternative.

[g] In situ vitrification has been demonstrated practical for implementation of Laboratory treatment of subsurface soil and rock but is not practical for heterogeneous wastes in the pit and trenches or for the General's Tanks. Therefore, in situ vitrification is not carried forward as an alternative.

[h] In situ grouting is not practical at the Laboratory because implementation cannot be demonstrated, and the waste was placed in a manner that precludes a practical implementation. In situ grouting of the void space in the General's Tanks is carried forward as a subset of the remedies.

[i] Partial or full removal with off-site disposal are practical alternatives and combined to be carried forward as an alternative for evaluation.

[j] For the types of waste present, ex situ treatment will practicably consist of some form of grouting or vitrification process and will be a subset of the partial or full removal alternative. The treatment process will be driven by the waste form (liquid/solid) as determined by the WAC for the selected disposal facility. Ex situ treatment is considered necessary for the General's Tanks waste.

Table 6.0-2
Potential Remedies for MDA A

Corrective Measure	Corrective Measure Description and Technologies Employed	Comment
No Action	ICs Long-term monitoring 2–6 ft of existing soil cover Removal, treatment, and disposal of the General's tanks waste heel Grouting or opening and backfilling with soil for the steel tanks (General's Tanks) is required once the waste is removed	Carried forward as a basis for evaluation Does not offer adequate long-term protection from surface erosion Does not offer adequate biointrusion protection
ET Cap	ICs Long-term monitoring of performance Reuse portions of existing cover Provide vegetative cover layer Provide a biointrusion barrier Provide a partial perimeter shallow cutoff wall to deflect potential surface water infiltration away from waste Provide optimized soil zone for vegetation germination Provide optimized thickness for water balance and moisture holding capacity Removal, treatment, and disposal of the General's tanks waste heel Grouting or opening and backfilling with soil for the steel tanks (General's Tanks) is required once the waste is removed	Provides equivalency when compared with Subtitle C RCRA cap as demonstrated for arid environments—see Sandia Landfill demonstration caps Will have engineered performance requirements specified in the design and based on appropriate geotechnical materials properties
Source (Waste) Removal	Investigations resulted in no media contamination above industrial SALs/SSLs outside the waste disposal units Removal is limited to the waste disposal units Backfill of the pits is required Removal, treatment, and disposal of the General's tanks waste heel and steel tanks Backfill of excavations Long-term monitoring of waste left in natural media	Most of the radiological inventory is contained in the General's Tanks making partial removal of the waste inventory attractive. Small chemical inventory is present compared to the radiological inventory, based on results of Consent Order investigations. Treatment of exhumed wastes will only be considered as needed to meet waste management criteria of the exhumed waste streams.

Table 6.2-1
Corrective Measure Alternatives

Alternative	Description	Monitoring and Maintenance Period (yr)*	DOE Active Institutional Control Period (yr)	DOE Long-Term Performance Period (yr)
1	No Action (Existing Cover), Monitoring and Maintenance	30	100	1000
2	Engineered ET Cover, Monitoring and Maintenance	30	100	1000
3	Complete Waste Source Excavation, On-site or Off-site Disposal	30	100	1000

* Based on the RCRA postclosure-care period.

Table 7.1-1
Comparative Analysis of Corrective Measures Alternatives

Criteria	Alternative1: Existing Cover, Monitoring and Maintenance (Rank 1 to 3)*	Alternative 2: Engineered ET Cover, Monitoring and Maintenance (Rank 1 to 3)*	Alternative 3: Complete Waste Source Excavation and Disposal (Rank 1 to 3)*
1. Applicability (Consent Order Ref: XI.F.10a)	Monitoring to date has shown containment of waste and is protective of groundwater. However, biotic intrusion and dispersal exceeds target goal, cover performance is equivalent to RCRA Subtitle C prescribed cover. (Rank = 2)	Monitoring to date has shown containment of waste and is protective of groundwater. Cover is protective of biotic intrusion and dispersal providing maintenance is achieved, cover performance is equivalent to RCRA Subtitle C prescribed cover. (Rank = 3)	Excavation has applicability based on demonstrated concept at MDA B (Rank =3)
2. Technical Practicability (Consent Order Ref: XI.F.10b)	Existing cover maintenance and has been shown to be technically feasible. (Rank = 3)	Engineered ET cover has been shown to be technically feasible (Rank = 3)	Excavation has been shown to be technically feasible (Rank = 3)
3. Effectiveness: short and long term (Consent Order Ref: XI.F.10c)	Short term : not effective ants are potentially intruding into the waste pits Long term : not effective due to poor biointrusion resistance. (Rank = 1)	Short term: effective Long term: less effective (Rank = 2)	Short term: less effective Long term: most effective, Eliminates the operation and monitoring period. (Rank =3)
4. Implementability (Consent Order Ref: XI.10d)	Designed and constructed in less than 6 months with normal construction equipment. (Rank = 3)	Designed and constructed in less than 12 months with normal construction equipment. (Rank = 3)	Designed and constructed in approximately 24 months. Requires new authorization Basis Documentation. Requires a characterization, sorting and packaging facility. Requires engineered barriers. (Rank = 2)

Table 7.1-1 (continued)

Criteria	Alternative1: Existing Cover, Monitoring and Maintenance (Rank 1 to 3)*	Alternative 2: Engineered ET Cover, Monitoring and Maintenance (Rank 1 to 3)*	Alternative 3: Complete Waste Source Excavation and Disposal (Rank 1 to 3)*
5. Human Health and Ecological Protectiveness (Consent Order Ref: XI.F.10e)	Little short term potential risk. Long term potential effect on human health and biological resources. No effect on cultural resources. Potential long term ecological risk. (Rank = 1)	Little short term potential risk. Lower effect on human health and biological resources. No effect on cultural resources. Potential long term ecological risk. Bio-barrier prevents intrusion. (Rank = 2)	Higher potential short term effect on human health and biological resources during excavation. No effect on cultural resources. No long term ecological risk. (Rank = 2)
6. Cost (Consent Order Ref: XI.F.10f)	Lowest total cost. (Rank = 3)	Higher capital cost (Rank = 2)	Highest total cost. (Rank = 1)
6.1 Capital Cost	$9,727,127	$12,878,967	$81,102,171
6.2 Annual Costs	$3,602,371 over 100 years $3,706,468 over 30 years	$3,602,371 over 100 years $3,706,468 over 30 years	$0
6.3 Cost Estimate, Present Value @ 7% 100-yr	$2,047,155	$2,047,155	Not applicable
7. Achieve Cleanup Objectives in a Timely Manner (Consent Order Ref: XI.F.11-1)	Installation of monitoring devices is limited to one construction season (Rank = 3)	Installation of cover and monitoring devices is limited to one construction season. (Rank = 3)	Considerately more difficult to implement under DOE Safety Basis Program Removal and disposal or waste is limited to on construction season. (Rank = 2)

Table 7.1-1 (continued)

Criteria	Alternative1: Existing Cover, Monitoring and Maintenance (Rank 1 to 3)*	Alternative 2: Engineered ET Cover, Monitoring and Maintenance (Rank 1 to 3)*	Alternative 3: Complete Waste Source Excavation and Disposal (Rank 1 to 3)*
8. Protect Human and Ecological Receptors (Consent Order Ref: XI.F.11-2)	HI and dose are unlikely to exceed CAOs because maintenance will correct problems. (Rank = 2)	HI and dose are unlikely to exceed the CAOs because maintenance will correct problems. Bio-intrusion and lateral moisture barrier features offer enhanced protection. (Rank = 3)	HI and dose may be exceeded during the construction period if a high intensity storm occurs. This alternative is most protective for long term risks on site, but transfers risks to another site. (Rank = 3)
9. Control or Eliminate the Sources of Contamination (Consent Order Ref: XI.F.11-3)	The existing cover would not eliminate or control sources of contamination due to biotic uptake and dispersal. Indefinite maintenance is required to control vegetation. Additional release of small amounts of potential TRU level contamination due to the degradation of the General's Tanks is possible (Rank = 1)	The cover would not eliminate or control sources of contamination, but would contain sources for an extended time. The cover is optimized to prevent run-on/infiltration of stormwater and minimize erosion potential, limit lateral infiltration, and minimize biotic intrusion. Biotic intrusion of tree roots cannot be prevented. Additional release of small amounts of potential TRU level contamination due to the degradation of the General's tanks is possible. (Rank = 2)	The excavation with disposal in approved disposal facilities would not eliminate sources of contamination, but would control contamination in the other facilities. (Rank = 3)
10. Control Migration of Released Contaminants (Consent Order Ref: XI.F.11-4)	Existing contaminants are "locked" within the vadose zone at current day levels. (Rank = 3)	Existing Contaminants are "locked" within the vadose zone at the current day levels. (Rank = 3)	Existing contaminants are "locked" within the vadose zone at current day levels (Rank = 3)

Table 7.1-1 (continued)

Criteria	Alternative1: Existing Cover, Monitoring and Maintenance (Rank 1 to 3)*	Alternative 2: Engineered ET Cover, Monitoring and Maintenance (Rank 1 to 3)*	Alternative 3: Complete Waste Source Excavation and Disposal (Rank 1 to 3)*
11. Manage Remediation Waste in Accordance with State and Federal Regulations (Consent Order Ref: XI.F.11-5)	Little to no wastes would be generated during installation of the neutron access holes. (Rank = 3)	Little to no wastes would be generated during installation of the neutron access holes. Some waste may be generated during excavation for the lateral moisture infiltration barrier. (Rank = 2)	Quantities of wastes would be generated and require segregation to disposal facility WACs. (Rank = 1)
TOTAL (Average) SCORE	25	28	26

* Ranks from 1 being the least beneficial to 3 being the most beneficial.

Table 10.0-1
Consent Order Milestones

Activity	Start	Completion
Verification of hydrologic modeling	—*	6/2/2009
Long-term climax vegetation study	—	6/2/2009
Waste trench cover thickness verification	—	6/2/2009
Existing surface contamination from biota study	—	6/2/2009
Determine TA-21 potential biotic intruders	—	6/2/2009
Existing cover geotechnical and hydrological properties	—	6/2/2009
Install permanent vapor well in BH-08	—	6/2/2009
General’s Tanks contents	10/1/2008	9/30/2009
Safety basis	No earlier than June 2, 2009	6/2/2010
Identify, test, and approve rock source	No earlier than June 2, 2009	9/30/2009
Corrective measures implementation plan	No earlier than June 2, 2009	90 days following NMED's remedy selection or 9/2/2009
General’s Tanks waste removal and remedy implementation	6/3/2010	6/3/2011
Remedy completion report	—	8/3/2011

*— = Not applicable.

Appendix A

Acronyms and Abbreviations, Metric Conversion Table, and Data Qualifier Definitions

A-1.0 ACRONYMS AND ABBREVIATIONS

AOC	area of concern
asl	above sea level
ASTM	American Society for Testing and Materials
bgs	below ground surface
BH	borehole
BMP	best management practice
BV	background value
CAO	corrective action objective
CME	corrective measures evaluation
CMI	corrective measure implementation
Consent Order	Compliance Order on Consent
COPC	chemical of potential concern
COPEC	chemical of potential ecological concern
CSM	conceptual site model
CY	calendar year
D&D	decontamination and decommissioning
DOE	Department of Energy (U.S.)
DP	Delta Prime
EPA	Environmental Protection Agency (U.S.)
ESL	ecological screening level
ET	evapotranspiration
FV	fallout value
FY	fiscal year
HHMSSL	Human Health Medium Specific Screening Level (EPA)
HI	hazard index
HIR	historical investigation report
INL	Idaho National Laboratory
IC	institutional control
INL	Idaho National Laboratory
IR	investigation report
ITP	Integrated Test Plot
K_d	distribution coefficient
K_{sat}	saturated hydraulic conductivity

LANL	Los Alamos National Laboratory
LCF	latent cancer fatality
LLRW	low-level radioactive waste
MCL	maximum contaminant level
MDA	material disposal area
NES	nuclear environmental site
NFA	no further action
NMAC	New Mexico Administrative Code
NMED	New Mexico Environmental Department
NMWQCC	New Mexico Water Quality Control Commission
OMB	Office of Management and Budget
OSHA	Occupational Safety and Health Administration
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PE	potential evaporation
PET	potential evapotranspiration
PT	potential transpiration
PMP	probable maximum precipitation
QA	quality assurance
QC	quality control
RCRA	Resource Conservation and Recovery Act
RCT	radiation control technician
RFI	RCRA facility investigation
SAL	screening action level
SF	seepage face
SL	screening level
SOP	standard operating procedure
SSL	soil screening level
SV	screening value
SVOC	semivolatile organic compound
SVE	soil vapor extraction
SWEIS	site-wide environmental impact statement
SWMU	solid waste management unit
SWPPP	stormwater pollution prevention plan

TA	technical area
TCA	1,1,1-trichloroethane
TD	total depth
TRU	transuranic
TSTA	Tritium Systems Test Assembly
VOC	volatile organic compound
vwc	volumetric water content
WAC	waste acceptance criteria
WIPP	Waste Isolation Pilot Plant
wt%	weight percent

A-2.0 METRIC CONVERSION TABLE

Multiply SI (Metric) Unit	by	To Obtain US Customary Unit
kilometers (km)	0.622	miles (mi)
kilometers (km)	3281	feet (ft)
meters (m)	3.281	feet (ft)
meters (m)	39.37	inches (in.)
centimeters (cm)	0.03281	feet (ft)
centimeters (cm)	0.394	inches (in.)
millimeters (mm)	0.0394	inches (in.)
micrometers or microns (µm)	0.0000394	inches (in.)
square kilometers (km^2)	0.3861	square miles (mi^2)
hectares (ha)	2.5	acres
square meters (m^2)	10.764	square feet (ft^2)
cubic meters (m^3)	35.31	cubic feet (ft^3)
kilograms (kg)	2.2046	pounds (lb)
grams (g)	0.0353	ounces (oz)
grams per cubic centimeter (g/cm^3)	62.422	pounds per cubic foot (lb/ft^3)
milligrams per kilogram (mg/kg)	1	parts per million (ppm)
micrograms per gram (µg/g)	1	parts per million (ppm)
liters (L)	0.26	gallons (gal.)
milligrams per liter (mg/L)	1	parts per million (ppm)
degrees Celsius (°C)	9/5 + 32	degrees Fahrenheit (°F)

A.3-0 DATA QUALIFIER DEFINITIONS

Data Qualifier	Definition
U	The analyte was analyzed for but not detected.
J	The analyte was positively identified, and the associated numerical value is estimated to be more uncertain than would normally be expected for that analysis.
J+	The analyte was positively identified, and the result is likely to be biased high.
J-	The analyte was positively identified, and the result is likely to be biased low.
UJ	The analyte was not positively identified in the sample, and the associated value is an estimate of the sample-specific detection or quantitation limit.
R	The data are rejected as a result of major problems with quality assurance/quality control (QA/QC) parameters.

Appendix B

Public Involvement Plan for Material Disposal Area A

Material Disposal Area

PUBLIC INVOLVEMENT PLAN

Table of Contents

Purpose of This Plan

Plan and execute a series of public involvement opportunities, including events, to keep the public informed about investigation outcomes and remedy options for Material Disposal Area (MDA) A.. This is a living document that will be updated as the project progresses.

Primary Contacts

Name	Organization	Phone	Email	Role
LANL				
Allan Chaloupka	TA-21 Closure Project	231-1343	allanc@lanl.gov	Program Director
Bill Criswell	TA-21 Closure Project	699-2979	bcriswell@lanl.gov	Deputy Program Director
Bruce Wedgeworth	TA-21 Closure Project	231-0108	brucew@lanl.gov	Project Leader
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Deb Hall	ADEP	667-4371	dhall@lanl.gov	Outreach coordinator
DOE				
George Henckel	LASO	845-5746	GHenckel@doeal.gov	
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George Rael	LASO	606-0397	grael@doeal.gov	
Public				
Accord Pueblos			LA County Utilities	
Delta Prime Road Stakeholders				
LA County Council Members				

Goals for Overall Outreach

1. Meet regularly with stakeholders and opinion leaders to report on status and explain issues related to key sites and to listen carefully to community concerns
2. Collect comments and concerns from citizens on investigation and remedy selection
3. Ensure that a broad range of citizens are included in meetings
4. Use a range of locales for public involvement sessions
5. Involve media to ensure that the Laboratory's activities are broadly understood
6. Address comments and concerns on web site and in future meetings
7. Make a targeted effort to inform accord pueblos
8. Obtain public input for closure alternatives

Drivers for This Public Involvement

U.S. Department of Energy/New Mexico Environment Department (DOE/NMED) Compliance Order on Consent (Consent Order)

Los Alamos National Laboratory (the Laboratory) Hazardous Waste Permit

Informed consent of the public

Target Audience

Target Audience	Expected Level of Involvement [1]	Outreach Methods
Internal Audience		
Residents who are employees	Consult	Mailing list, News bulletin, news releases, public meetings
External Audience		
Northern New Mexico Citizen Advisory Board (NNMCAB)	Collaborate	Mailing list, presentations in NNMCAB meetings, news releases, public meetings, web site
Delta Prime Road residents and land owners	Consult	Mailing list, presentations in resident and land owner meetings, news releases, public meetings, web site
Santa Clara and San Ildefonso Pueblos	Consult	Mailing list, appointments with governors and environmental departments, news releases, web site
Los Alamos County	Collaborate	Mailing list, periodic solid waste management unit meetings, news releases, web site

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[1] "Inform" means information dissemination only. "Consult" means to collect and respond to comments and concerns. "Involve" means use stakeholder input in decisions. "Collaborate" means to ask for direct advice on solutions and to incorporate such. "Empower" means that stakeholders make the decisions.

Key Messages

Environmental Programs	• Ensure the Laboratory is a good environmental steward o Cleaning up contaminated sites is our mission. o The NMED Consent Order is our guide to clean up. o Our core value is minimizing impacts on natural resources.

Project Specific Key Messages

Technical Area 21 (TA-21) Project	• We collect public input on remedy alternatives. • The Laboratory performs the investigation and the work on the remedy, determining remedy options. • NMED chooses the final remedy. • All applicable standards are being and will be met.
MDA A	• Part of the site will remain in operation for hazardous waste characterization and staging. • The MDA will be ready for remedy and closure by 2015.

Types of Outreach to Use

Opportunity	Frequency
Public Meetings	1. Provide annual or more frequent TA-21 project update(s). 2. Attend NMED meeting for remedy selection. 3. After remedy selection, inform public of transportation plans, and construction implementation of cover.
Web Information	Update at least monthly with project information. Film and post pod cast as an overview of TA-21 Project
Media Updates	Provide press releases and tour opportunities to reporters
Mailer to NMED facility list	2 weeks before each public meeting
Public Information Availability	Post investigation report and corrective measures evaluation on web when complete. Place hard copy in the Public Reading Room.
Presentations to the NNMCAB	Update NNMCAB annually on TA-21 progress

Appendix C

Descriptions of Potential Technologies

C-1.0 INTRODUCTION

This appendix contains a brief description of technologies considered appropriate for creating alternatives to be evaluated for the Material Disposal Area (MDA) A corrective measures evaluation (CME). Only technologies considered potentially suitable for use at MDA A are considered.

C-2.0 NO FURTHER ACTION

No further action (NFA) is a general corrective measure used to provide a baseline for comparison against remedial action technologies. Under the NFA response, institutional controls are optimal. NFA may include long-term monitoring, long-term surveillance and maintenance, and long-term access controls. The NFA response without institutional controls is not appropriate for MDA A. The NFA response with institutional controls, however, is appropriate for MDA A and is retained for baseline comparison analysis. The NFA response with institutional controls is readily implementable and the least expensive response action possible.

C-3.0 INSTITUTIONAL CONTROLS

Institutional controls are passive measures that are used to prevent unacceptable exposure to contaminants that could pose risks to human health and the environment. They are typically used in conjunction with structural engineering controls as part of a final remedy. Effective institutional controls must be low-cost, highly effective, easily implementable, and adaptable over relatively long periods of time. Often, they must outlive the institutions that create them. Thus, they need to be easily transferred to subsequent authorities having control of the land under consideration.

Institutional controls require clear human responsibilities and the active performance of measures to achieve these responsibilities. Examples are controlling access to a closed site by means of security guards; performing frequent, site surveillance and maintenance; controlling or cleaning up releases; or monitoring environmental parameters related to remedial measure(s) performance. Institutional controls depend on the design of controls and engineering structures. Examples are permanent markers or monuments placed at a closed site; public records and archives; government ownership and regulations regarding land or resource use; and other methods of preserving knowledge about a specific location, design, and contents of a closed site. Structural controls include physical barriers such as gates, fences, and natural barriers to keep mammals and trespassers away from a site; signs to warn people of dangers; and engineered barriers that contain or restrict actual or potential contaminant migration.

C-3.1 Long-Term Monitoring

Long-term environmental monitoring is used to measure the physical and/or chemical properties of an environmental medium, such as soil, air, biota, surface water, or groundwater. For remedial action applications, monitoring may be used to detect surface and/or subsurface releases from waste management or disposal facilities, to characterize temporal variations, or to document the progress and performance of remedial action.

Monitoring soil or stream sediment is used to define the nature and extent of contaminants, the physical characteristics of the contaminated materials, or the effectiveness of remediation. Physical characteristics, such as subsidence, may also be monitored. Soil vapor monitoring is commonly used to verify the effectiveness of vapor extraction systems or other treatment systems. Surface-water monitoring uses various methods to characterize water quality in streams, wetlands, or other impoundments. Monitoring may also require the use of devices to measure volumetric flow rates in streams or pipes. Groundwater monitoring typically involves the use of monitoring wells and/or piezometers. Monitoring wells are designed to measure groundwater elevation, perform aquifer pumping tests, or collect groundwater samples for analysis. Piezometers are designed primarily to measure groundwater elevations only.

Long-term monitoring provides a degree of protection of human health and the environment and is relatively simple to implement. It is an implicit part of all corrective measures alternatives for MDA A. Long-term environmental monitoring alone is not responsive to corrective action objectives, but when used in conjunction with other technologies, it may increase the overall effectiveness of corrective measures.

C-3.2 Long-Term Site Surveillance and Maintenance

Long-term site surveillance and maintenance includes on-site activities designed to help recognize and control waste sites and promote the longevity of other remedial responses. Typical activities include controlling vegetation (mulching/seeding), limited grading to fill areas of subsidence and erosion, and maintenance of site drainage features to minimize the formation of the rills and gullies. Site maintenance may also include maintaining perimeter security fences, warning signs, and monuments.

Long-term site surveillance and maintenance controls provide a degree of protection of human health and the environment and are relatively easy to implement. It is an implicit part of all corrective measures alternatives for MDA A. Long-term site surveillance and maintenance alone are not responsive to corrective action objectives, but when used in conjunction with other technologies, they may increase the overall effectiveness of corrective measures.

C-3.3 Long-Term Access Controls

Long-term access controls include measures involving temporary or permanent physical restrictions to prevent or reduce animal and human exposure to contaminants. Controls can also be used to prevent vandalism of on-site remedial equipment or disturbance of contaminant and monitoring systems. Regular monitoring and maintenance of access controls is required for the measures to effectively deter site trespass. Access controls generally include site security measures, such as fences and signs. Fences are used to completely surround the restricted area. Fences must be in good repair. Signs are posted around the facility with a legend warning of the hazard at the site. They are posted at each entrance to the restricted unit and at other appropriate locations in sufficient numbers to be seen from any approach.

In addition to access controls, administrative controls, such as land use restrictions, may also be used to prevent or reduce future human or environmental exposure to contaminants remaining at the site. Excavation permit restrictions may be used to permanently prohibit excavation or subsurface construction. Land use restrictions may also be a temporary measure used while other remedial actions are taking place.

In the long-term, if the property were ever to be transferred to nonfederal ownership, the U.S. government would create a deed for the new property owner. The deed would include notification disclosing the former waste management and disposal activities, as well as remedial actions taken at the site, and any continuing monitoring commitments. The deed notification would, in perpetuity, notify any potential purchaser that the property had been used for the management and disposal of hazardous waste. The deed would also include deed restrictions precluding residential use of the property. However, the need for these deed restrictions may be reevaluated at the time of transfer in the event that contamination no longer poses an unacceptable risk under industrial use. In addition, if the site were ever to be transferred to nonfederal ownership, a survey plat of the area would be prepared, certified by a professional land surveyor, and recorded with the appropriate county recording agency.

Access and administrative controls provide a degree of protection of human health and the environment and are relatively simple to implement. It is an implicit part of all corrective measures alternatives for MDA A. Long-term access controls alone are not responsive to corrective action objectives, but when used in conjunction with other technologies, they may increase the overall effectiveness of corrective measures.

C-4.0 CONTAMINANT TECHNOLOGIES

Contaminant technologies involve the construction of a barrier to isolate contaminated media. When properly constructed and maintained, contaminant technologies can provide a reliable and effective method for controlling direct exposure to waste and minimizing contaminant transport through leaching, erosion, and/or biouptake.

C-4.1 Vegetative Soil Cover

This technology involves the deployment of a monolithic soil cover to limit water infiltration and direct surface water away from a disposal site. A diverse community of native plants would be established on the cover to extract water and mitigate wind and water erosion. A cover constructed of natural materials will function with minimal maintenance over the long-term as a natural ecosystem.

The goals of the U.S. Environmental Protection Agency-recommended design of landfill caps are to minimize the formation of leachate by minimizing the contact of water with waste, to minimize further maintenance, and to protect human health and the environment considering future use of the site. The New Mexico Environment Department accepts alternative designs that consider site-specific conditions, such as climate and the nature of the waste, that meet the intent of the regulations. A fundamental concern of cap designs is that all components are stable and that the cap performs as intended without posing a significant risk to human health and the environment.

Vegetative soil covers are composed of multiple lifts of compacted, native soil. The cover is built by adding successive lifts of native soil over an existing landfill surface to form a soil monolith of sufficient thickness to store precipitation and support a healthy vegetative community. A topsoil layer is added that is seeded with native vegetation to mitigate surface erosion and promote evapotranspiration. During the institutional control period, native soil can be added to the cover as needed to correct subsidence resulting from degradation of buried waste containers and rills that may result from surface erosion. At the end of institutional control, additional native soil can be added to accommodate any future subsidence and erosion. Because the cover is constructed without rigid layers, it can accommodate differential subsidence without undue impairment of its performance.

Vegetative covers are intended to meet Resource Conservation and Recovery Act (RCRA) requirements of Title 40 Code of Federal Requirements 264.310. Vegetative soil covers minimize water migration into contaminated media. Cover maintenance is minimized by using a monolithic soil layer. Individual layers, such as those used in traditional RCRA Subtitle C caps, are rigid and would require extensive maintenance and repair due to admixtures within the topsoil layer. Covers are centrally crowned and sloped at 2% to 5%. Subsidence is accommodated by using a “soft” self-healing design. The permeability of cover soils is less than or equal to the permeability surrounding subsoils eliminating the “bathtub” effect.

Performance of alternative covers cannot be isolated from the performance of the prospective site. Natural site conditions, integrated with the cover, produce a “system performance” that will ensure that the alternative design adequately meets regulatory requirements and functions as a natural ecosystem. Institutional controls, such as environmental monitoring, site surveillance and maintenance, and access controls, are also components of this response action.

C-4.2 Structural Barriers

This technology involves the deployment of a single-layer concrete slab on grade or asphalt barrier on grade to minimize water infiltration. This technology would also mitigate biological and inadvertent human intrusion. This technology is usually reserved for temporary or short-term use in controlling the vertical migration of contaminants by reducing or eliminating surface-water percolation through the soil column. Support for a robust concrete structure may require dynamic compaction of soils or replacement of pilings.

Various structural cap designs and capping materials are available. Common structural caps include concrete slabs placed on grade or thin-shelled concrete or steel domes. The design must include sloping and drainage control. These materials are readily available, and construction costs for structural barriers are low in comparison to more complicated composite cap designs.

Structural caps are generally supported either by pilings or by the disposal site surface. Pile-supported caps are less sensitive to settlement of the subbase but may require extensive intrusive activities to place the pilings. Barriers that are supported by the disposal area surface do not require extensive intrusive activities but generally require compaction of the surface before barrier construction. The selection of the design and materials depends on the nature of the site to be covered, the function and design life of the barrier, the local climate and hydrogeology, the geotechnical considerations that affect settling potential, the availability of materials, and the intended future use of the site.

The integrity of a structural barrier is susceptible to weather effects, such as rusting and corrosion, differential settlement of underlying material, and loading. Deterioration of barriers leads to cracking and breaching, enabling water to reach the waste. Consequently, barrier integrity must be maintained as long as the contaminants continue to pose a potential threat to human health or the environment. Maintenance includes inspections, vegetation control, monitoring for evidence of subsidence, routine repair, and eventual replacement.

Structural barriers employ well-established materials and are designed for short-term durability. However, their maintenance costs are high, and the effectiveness of barriers is limited because of their susceptibility to weathering, cracking, subsidence, and loading.

C-4.3 RCRA Subtitle C Caps

This technology involves the construction of an engineered cap using natural and synthetic materials. A RCRA Subtitle C cap is composed of a minimum of three layers: (1) an uppermost vegetation/soil layer, underlain by a minimum of 24 in. of compacted soil sloped between 3% and 5%; (2) a drainage layer, a minimum of 12 in. of sand, underlain by a flexible membrane liner to convey water out of the cap; and (3) a lowermost moisture barrier, a minimum of 24 in. of compacted clay, to prevent infiltration. The primary function of a RCRA cap is to limit water infiltration into waste disposal cells in order to minimize creation of leachate that could migrate to groundwater.

Natural clay or soil amended with bentonite is commonly used for the lowermost moisture barrier. The permeability of this compacted clay layer is required to be no more than 1.0×10^{-7} cm/s. The overlying drainage layer allows lateral drainage off of and away from the moisture barrier. It is generally composed of a sand or gravel layer that is placed on a flexible membrane liner that overlies the moisture barrier. Under normal, unsaturated conditions, the drainage layer acts as capillary barrier, that is, the large pores of the sand or gravel inhibit capillary flow from the overlying soil layer. Under saturated conditions such as might occur after heavy rainfall, the drainage layer serves as a high permeability conduit to drain water laterally off the compacted clay layer to the perimeter of the cap. The upper soil layer would consist of compacted soil of sufficient thickness to store precipitation and support a healthy vegetative community.

C-4.4 Biointrusion Barriers

This technology involves the use of gravel and cobbles (rip rap), woven wire mesh, or other materials to limit intrusion by deep-rooted plants and burrowing mammals. The purpose of a biointrusion barrier is to minimize intrusion into waste disposal cells and to extend the life of a cap of cover by minimizing degradation from biotic intrusion. If a biointrusion barrier were constructed from a resistant material such as granite or quartzite, the layer may also serve as an effective human intrusion barrier. A biointrusion barrier can extend the lifetime of a cover by preventing intrusion by deep-rooted plants and burrowing animals. Even if a biointrusion barrier consisting of gravel and cobbles or woven wire mesh were deployed, it would not be effective against ants, the largest potential biomass that may penetrate a cap or cover. Biointrusion barriers are designed for long-term durability and minimal maintenance requirements; however, the long-term performance for biointrusion barriers has not been demonstrated. The short-term performance of biointrusion barriers within caps and covers has been studied recently in Idaho. The results of field and pilot tests indicate that long-term performance is promising.

C-4.5 Containment Cells

This technology involves the use of subsurface horizontal and vertical barriers to isolate buried waste from the environment and to prevent the release and migration of contaminants. Grout curtains and slurry walls are often preferred over geomembranes and sheet pile walls due to ease of installation. When properly constructed and maintained, containment cells can provide a reliable and effective method for controlling contaminant transport.

Grout curtains are low permeability barriers constructed using injection of fluids under pressure. Grouting fluids are typically composed of cement, bentonite, or specialty fluids such as silicate or lignochrome grout. The material that is selected must be compatible with the site geology, soil characteristics, and the waste itself. The grout must have the proper hardening time considering the method of injection. This will ensure that the grout does not harden so quickly that it does not reach the areas where it is needed and that it does not harden so slowly that it spreads too thinly. Furthermore, the grout must be able to harden and remain competent in the presence of the waste itself. The method of grout emplacement must also be selected. Permeation grouting injects a low-viscosity grout into the soil at low pressure, filling the voids without significantly changing the structure or volume of the soil. Jet grouting, in contrast, injects grout at high pressure and velocity, which destroys the structure of the soil and mixes the grout and soil to form a relatively homogeneous mass.

There are four frequently used grout methodologies available: stage-down, stage-up, grout port, and vibrating beam. In the stage-down method, a borehole is drilled to the full depth of the wall and grout is injected as the drill is withdrawn. In the stage-up method, the grout is injected starting at the top of the borehole and continuing to the desired depth. The grout port method uses a slotted injection pipe and a double packer to inject the grout at specific intervals. In the vibrating bean method, an I-beam is vibrated into the soil to the desired depth then grout is injected as the beam is withdrawn. Horizontal grout curtains are constructed to form horizontal barriers using methods similar to vertical barriers, except that the adjacent grout injection zones would completely overlap to cover a broad horizontal area. Alternatively, grout holes can be installed using horizontal drilling methods.

Slurry walls are vertical subsurface barriers constructed to limit horizontal migration of contaminants. This technology requires that an open trench be excavated and filled with slurry. The slurry wall (and trench) are generally 3 ft wide and may be up to 20 ft deep. The slurry usually consists of cement of a soil-bentonite mixture. A soil “saw” is a common implement to create a slurry wall. It uses soil-cutting blades or a steel cable combined with high-pressure grouting jets to mix soil and grouting fluids to produce a homogeneous grout wall of uniform thickness.

Geomembranes are synthetic sheets that are placed by hand in trenches around the contaminated media. Geomembranes, although relatively new, have a proven record for containment and are fundamental to the proper functioning of the RCRA Subtitle C prescriptive liners and covers used throughout the United States. In spite of this, there are concerns about the long-term efficiency and compatibility of the synthetic fibers with organic solvents.

Sheet pile walls are constructed by driving steel sheets into the ground to the desired depth. Sheet piling can be constructed of various materials. Steel with interlocking joints is frequently used. Grouting can also be used to seal the joints. Sheet pile walls are often used where both an impermeable barrier and excavation adjacent to the barrier are desired.

Containment cells are capable of confining leaking waste sites without disturbing the waste itself. A common benefit of a subsurface barrier system is that the waste remains fixed, allowing additional time to develop final remediation alternatives. Barriers are limited by the directional control of the drilling technology and by the inability of nonintrusive techniques to verify barrier continuity. Consistency, dimensions, and continuity of the grout barriers cannot be directly observed, and preferential flow of grout in higher permeability zones within heterogeneous soils can create discontinuities in the barrier.

C-5.0 IN SITU TREATMENT

In situ treatment technologies treat contaminated media in place. For soil containing organic constituents, in situ treatment technologies generally involve physical, chemical, and/or biological treatment processes that immobilize the contaminants or that reduce the contaminant concentrations in soil. Relative to comparable ex situ treatment technologies, in situ remedial technologies have the advantages of minimal handling of contaminated media and lower capital cost.

C-5-1 In Situ Vitrification

This technology involves an electric current to convert soil and waste at extremely high temperatures to a crystalline mass. The crystalline mass is a chemically stable, leach resistant, vitreous material similar to obsidian or basalt rock. The process destroys and/or removes organic material while immobilizing heavy metals and radionuclides. In situ vitrification greatly reduces contaminant mobility via leaching and biotic uptake. Because of the high temperature induced during vitrification, the process also destroys or removes organic contaminants in the waste medium. Furthermore, in situ vitrification provides long-term stability to the site and reduces the long-term possibility of human intrusion.

In situ vitrification is accomplished by inserting electrodes into the ground at the desired treatment depth or in surface soils and advancing them to depth during the melting process. A conductive mixture of flaked graphite and glass frit is placed among the electrodes to act as a starter path. The starter path is necessary because dry soil is not conductive after the conduction path in soil pore water is boiled away. Electrical power is charged to the electrodes, which establishes a current through the soil along the starter path. The resulting heat in the starter path reaches between 1400°C and 2000°C and begins to melt the surrounding soil. The starter is consumed by oxidation, and the current is transferred to the soil, which is electrically conductive in the molten state. The molten mass grows outward at a rate of approximately 4 to 6 tons/h, or 1 to 2 in./h. Under favorable site conditions, vitrification of an area 30 ft long × 30 ft wide × 30 ft deep can be achieved. The process is repeated in adjacent areas until the desired area and volume of soil has been vitrified. The molten mass is then allowed to cool into a stable, microcrystalline solid. Cooling may take several years. Emissions from the soil are captured using a vacuum pressurized hood and treated in an off-gas treatment system. The size and type of the treatment system are dependent on the amount of organic contaminant in the soil to be treated.

The in situ vitrification product is chemically stable, leach resistant, glass and crystalline material similar to obsidian or basalt. Radionuclides (including transuranic isotopes and fission products) and inorganics are trapped in the solid product.

Factors that limit the applicability and effectiveness of the technology include rubble exceeding 20% by weight, combustible organics exceeding 5% to 10 weight percent (wt%), and inorganics exceeding 15wt%. Inclusions such as highly concentrated contaminant layers, void columns, containers, metal scrap, general refuse, demolition debris, rock, or other heterogeneous materials also limit effectiveness. Significant disadvantages of the technology include the possibility that heating the soil will cause subsurface migration of contaminants into clean areas. In situ vitrification limits future remedial alternatives and waste may remain at the site indefinitely.

C-5.2 Stabilization (In Situ Grouting and Chemical Fixation)

This technology would involve either physical stabilization (grouting) or chemical stabilization (fixation) by injection of a fluid under pressure directly into waste disposal cells and contaminated media. The technology may be applied to pits, trenches, soils, or containers such as underground storage tanks. The grout envelops contaminated media and occupies soil void spaces, hardens, and immobilizes contamination in a cementlike matrix. In addition to immobilization, the technology also increases strength, decreases permeability, and provides many other geotechnical improvements without requiring excavation. This technology is typically used for wastes that leach heavy metals or other inorganic contaminants to immobilize the hazardous constituents. The process is not generally applicable to soils that are contaminated by volatile organic compounds, polychlorinated biphenyls, or pesticides because of potential adverse impact on the setting properties of the grout. The difference between in situ grouting technology and the containment cell technology is that in situ grouting involves grouting the waste itself, whereas grouting associated with containment is performed adjacent to the waste.

When applied to soils, the grout is emplaced using pressure injection. Grouting fluids are typically comprised of cement or bentonite. Less frequently used reagents include silicate or lignochrome grout, pozzolanic-based materials, thermoplastic materials, and organic polymers. An innovative mix of ferrous sulfate hydrates combined with calcium hydroxide is currently under development as an in situ solidification slurry. The material that is selected must be compatible with the site geology, soil characteristics, and the waste itself. The grout must have the proper hardening time considering the method of injection. This will ensure that the grout does not harden so quickly that it does not reach the areas where it is needed and that it does not harden so slowly that it spreads too thinly. Furthermore, the grout must be able to harden and remain competent in the presence of the waste itself. The method of grout emplacement must also be selected. Permeation grouting injects a low-viscosity grout into soil at low pressure, filling the voids without significantly changing the structure or volume of the soil. Jet grouting, in contrast, injects grout at high pressure and velocity that destroys the structure of the soil and mixes the grout and soil to form a relatively homogenous mass.

In situ chemical fixation includes a class of technologies where contaminants are chemically immobilized or isolated from migration or exposure. This is an emerging technology whereby contaminated soils are treated to convert inorganics into relatively immobile forms. An example of chemical fixation is stabilization of elemental mercury using calcium sulfides. Chemical fixation of soil is generally limited to surface soil, where the reagent is applied directly to the soil in a powdered, granular, or liquid form. Chemical fixation of groundwater is generally limited to permeable reactive walls.

In situ grouting or chemical fixation may limit future remedial alternatives and wastes may remain at the site indefinitely.

C-6.0 EXCAVATION, TREATMENT, DISPOSAL STORAGE

Excavation technologies include removal, shielding, handling, storage, repackaging, transportation, and disposal of contaminated media. These technologies represent the most aggressive response to the contamination problems at a given site. Relative to in situ treatment technologies, ex situ treatment has the advantage of greater certainty in verification of the effectiveness of treatment and greater certainty that all contaminated media has been treated effectively.

Digging, scraping, ramping, scooping, and vacuuming may accomplish excavation of contaminated materials from hazardous waste sites. Removal is effective because contaminated materials are physically removed from the site. Excavations can range from narrow trenchlike excavation to large pitlike excavations. Excavation above the water table can be done with very little secondary migration.

The equipment and sequence of operations used depend on physical characteristics of the site, the contaminated materials, dimension and depth of the excavation, size of the projects, desired rate of excavation, degree of excavation accuracy required, available work space, and haul distances. Typical types of excavation equipment include long-reach backhoes, front-end loaders, cranes and attachments, scrapers, bulldozers, clamshells, draglines, hydraulic dredges, and vacuum trucks. After the buried wastes are exhumed, the area is normally backfilled with suitable materials and compacted to grade.

Although excavation can be effective, it requires shielding, handling, transporting, and treating or disposing of contaminated materials, resulting in greater potential of short-term exposure to site workers and the environment. Adequate controls against soil dispersion must be included to minimize the effects of spillage or the passage of contaminated equipment. Control of fugitive dust and vapor transport may be of particular concern. Extensive precautions to protect excavation side slopes and safety of remediation workers are required. Removing noncontainerized wastes makes exhumation relatively dangerous compared to original disposal of the wastes. Safety and environmental concerns must be balanced against the benefits of removal. Excavation of contaminated soil is limited to the practical depth of excavation. The excavation of deep contaminated soils is often prohibitively expensive.

Bulk material storage is used to store solids, liquids, and sometimes gases on-site, either as waste or as a material for treating waste, such as stabilization agents or dewatering additives. Common storage methods include waste piles, containers, and tanks.

Waste piles store solid waste above or on the ground. In the past, waste stored on soil or permeable surfaces permitted leaching of contaminants into shallow soils and groundwater. Currently, regulations require impermeable surfaces and lead detection with monitoring under waste piles.

Leak-tight containers are used to store or stage solids and semisolids. Fifty-five gallon drums are common. Roll-off dumpster containers are sometimes used for larger volumes because of their low height, thereby allowing access with a backhoe and ease of transportation and loading onto tilt-bed trucks. To provide leak-tight characteristics, containers with gasketted hatches are available and lining.

Portable tanks are often used for storing pumpable sludges, wastewater, or other liquids. Bulk storage and interim treatment vessels include portable steel tanks, which range in capacity from 50 to 20,000 gal. and portable high-density polyethylene tanks up to 15,000 gal.

Depending on the climate, storage of stabilization/solidification agent, such as cement, fly ash, or lime, may be in surface impoundments.

Aboveground storage of waste requires secondary containment, such as a lined dike or a larger tank placed around a storage vessel or a vault. Regulations require secondary containment to be large enough to contain 100% of the capacity of the largest tank or 10% of all tanks within its boundary. Containment must also be sized to hold a 24-h rain event in addition to tank volumes.

Incineration is the thermal destruction of hazardous wastes in the presence of adequate oxygen for combustion. Incineration destroys halogenated and nonhalogenated organic wastes, including volatile organic compounds, polychlorinated biphenyls, and pesticides, through combustion under net oxidizing conditions. Toxic organic contaminants are permanently destroyed by high-temperature oxidation; however, a residual ash is created that may contain heavy metals and toxic products of incomplete combustion. Air pollution control systems (such as quench chambers, baghouse filters, gas absorbers, and mist eliminators) frequently must be incorporated into incinerator design to capture particulates, aerosols, hydrogen chloride, sulfur oxides, and other emissions.

Wastes generated at MDA A may be shipped off-site to a licensed, waste disposal facility, if containing only low level radioactive waste, or shipped to Technical Area 54 (TA-54). Disposal includes placement of waste materials in a permanent repository that is subsequently managed to ensure that contaminants are not reintroduced to the environment.

Transportation methods discussed here apply to TA 54 or off-site movement of hazardous wastes. On-site waste movement will be considered “material handling” because there is no use of public rights-of-way. Off-site transport is subject to the restrictions imposed by RCRA and the U.S. Department of Transportation. Material characteristics and economics are the primary methods of waste transportation for containerized or bulk material: truck-highway, barge/ship-waterway, and railroad. For MDA A, only truck-highway is an acceptable process option. The outer surfaces of transport vehicles must be thoroughly decontaminated before leaving a hazardous waste site, and again, after discharging their load at the receiving facility. Transportation is retained as an ancillary process in conjunction with disposal of material off-site.

Appendix D

Final Cover Design Specifications

Appendix E

Erosion and Modeling Evaluations

E-1.0 INTRODUCTION

This section summarizes vadose zone modeling conducted to support the corrective measures evaluation (CME) for Material Disposal Area (MDA) A at Los Alamos National Laboratory (the Laboratory). Three sets of simulations are described. The first set was conducted with HYDRUS-1D to estimate drainage through the current crushed tuff evapotranspiration (ET) waste cover that represents CME Alternative 1, and through an enhanced ET cover design that represents CME Alternative 2 (Attachment E-1 contains the supporting calculations). The second set of simulations was conducted with VS2DTI to bound the maximum extent of 1000 yr of flow beneath MDA A (and therefore, the maximum extent of contaminant transport) resulting from elevated saturations due to 10 yr of potential enhanced infiltration in open pits at MDA A. The third set of simulations was conducted with VS2DTI to bound the maximum extent of 1000 yr of contaminant transport from a hypothetical instantaneous release of the remaining 650 gal. of sludge from each of the two General's Tanks.

For the ET cover modeling, this section includes a variety of simulations that investigate the effects of cover thickness, cover design, alternative hydraulic properties, various vegetation cover densities, as well as elevated precipitation, on drainage through the cover. The ET cover modeling focuses on estimating the downward flux of water though a waste cover and into the waste zone. Downward flux from the bottom boundary of the waste cover is referred to as drainage and is synonymous with seepage. In this section, this set of simulations is referred to as ET cover modeling.

For the bounding calculations of flow and transport beneath MDA A, this section includes a variety of simulations that are intended to be conservative. This deep vadose zone modeling focuses on estimating the maximum possible extent of 1000 yr of redistribution of elevated saturations from the MDA A pits, as well as the maximum possible extent of 1000 yr of plutonium transport from the General's Tanks by simulating an instantaneous release of the remaining plutonium inventory in these tanks (Attachment E-2). For the deep vadose zone modeling, this section includes the rationale for the stratigraphic model, boundary conditions, initial conditions and assumptions used in this modeling. These two sets of simulations are referred to as deep vadose zone modeling in this section.

E-2.0 ET COVER MODELING USING HYDRUS-1D

The modeling work undertaken to evaluate ET cover performance at MDA A was conducted with HYDRUS-1D, version 3.0. The HYDRUS model is based on Richards' equation (the theoretical equation for vertical unsaturated flow) and allows for the analysis of water flow and solute transport in variably saturated porous media. HYDRUS-1D uses a finite-element approach for simulating the one-dimensional (1-D) movement of water, heat, and multiple solutes in variably saturated media. Consequently, it is used extensively to address a wide variety of waste disposal and other hydrologic applications that require consideration of variably saturated porous media. HYDRUS numerically solves the Richards' equation for saturated-unsaturated water flow and Fickian based advection-dispersion equations for heat and solute transport. The water flow part of the model, which was the feature of HYDRUS used specifically for this study, can address constant or time-varying prescribed head or flux boundaries, boundaries controlled by atmospheric conditions, and free-drainage boundary conditions. Unsaturated soil hydraulic properties can be described using a variety of analytical functions (e.g., van Genuchten-type parameters) and both evaporation and root water uptake (transpiration) can be modeled. The HYDRUS package has been extensively tested, used for regulatory-based assessments, and used for research. Additional information on the HYDRUS modeling package can be found in the HYDRUS-1D manual.

E-2.1 Atmospheric Input Data

Potential ET (PET), the driving force for ET that represents the climatic demand for water, was calculated using the method of Doorenbos and Pruitt (1977) described in Jensen et al. (1990, 071430). This PET calculation method is a solar radiation method and was selected to complement the meteorological data available from Technical Area 53 (TA-53), the nearest recording weather station to TA-21. Data inputs required for this method include daily maximum and minimum air temperature, average relative humidity, average wind speed, average barometric pressure, and daily incoming solar radiation. A near-complete data record of these parameters (except barometric pressure) for the 16.5-yr period from February 8, 1992, to July 24, 2008 (date of data download) is available for the weather station at TA-53. Barometric pressure data were acquired from the weather station at TA-54. Sporadic missing data were replaced with the previous day's value or with zero for precipitation. In the case of precipitation, missing data occurred on only 35 out of 6012 days of data.

The average PET for the 16-yr period of February 8, 1992, to February 7, 2007, was calculated to be 1790 mm/yr using the Doorenbos and Pruitt (1977) method. Considering that different PET calculation methods will yield somewhat different PET estimates, this value compares reasonably well with the average value of 1996 mm/yr calculated using the TA-54 data for 1992 to 2001 (LANL 2003, 076039, Section 2.1.3.1). Calculated PET and measured precipitation from the TA-53 weather station are shown in Figure E-2.1-1 for the 16.5-yr period of record. Average annual precipitation for the 16-yr period is 361.6 mm/yr.

HYDRUS-1D requires the separation of daily PET into inputs of potential evaporation (PE) and potential transpiration (PT). In the case of an unvegetated cover, PT is zero for all days, and PE is equal to some fraction of PET. In the case of a fully vegetated cover, PE is generally set to zero, and PT is equal to PET or some fraction of PET. The fraction of PET used depends on many factors, and this fraction (f) can be used as a model calibration variable. For this ET cover modeling study, PE (PE = PET × f) was estimated as part of the model calibration effort described in section E.2.2.3, using data collected for unvegetated covers at TA-54, and using data collected for vegetated covers at MDA B within TA-21. Potential transpiration was subsequently bounded to address the effects of vegetation on water balance; a range of values (0.1 to 0.5) of f was used to estimate PT (PT = PET × f) because the Area A vegetation is not expected to be a full cover, even under climax conditions.

E-2.2 Model Calibration

Model calibration primarily consisted of adjusting the PE multiplier f (PE = PET x f) until modeled water storage had the best match to field data for an unvegetated cover at TA-54. As a secondary calibration, the PE and PT multipliers were adjusted until modeled water storage had the best match to field data for a vegetated cover at MDA B at TA-21.

E-2.2.1 Calibration Using TA-54 Integrated Test Plot Field Data

A research site at TA-54 known as the Integrated Test Plot (ITP) experiment has collected long-term water balance datasets for a variety of landfill cover designs. Nyhan et al. (1990, 011760) describe the performance of two landfill cover designs at the ITP site: a conventional topsoil and crushed tuff design, and a capillary barrier design. Nyhan et al. (1996, 063111) describe the performance of four landfill cover designs with varied slopes. The four designs represent a conventional cover, an EPA recommended cover, and two capillary barrier designs. Nyhan (2005, 102729) describes the performance of an unvegetated landfill cover design (a conventional design of topsoil and crushed tuff) with slopes of 5%, 10%, 15%, and 20%. Figure E-2.2-1 shows the cover design from Nyhan (2005, 102729).

Water balance monitoring data are available for December 1, 1991, through December 31, 1997, from the Nyhan (2005, 102729) experiment. These data include precipitation, drainage, runoff, and interflow as well as the change in soil water content at three depths within each unvegetated cover. Nyhan et al. (1996, 063111) provide the hydraulic properties for the cover materials described in Nyhan (2005, 102729). Together, the data from Nyhan (2005, 102729) and Nyhan et al. (1996, 063111) provide water balance data and hydraulic properties that can be used for model calibration.

A HYDRUS simulation was set up to match the cover design shown in Figure E-2.2-1 (from ground surface to the geotextile layer) and described in Nyhan (2005, 102729). The 5% slope cover was selected for model calibration since it most closely matches the slope range of the MDA A existing cover. Drainage from the cover was set as a boundary condition in the modeling; the interflow measured by Nyhan et al. (2005, 102729) was added to the measured drainage because interflow occurred at the geotextile layer and HYDRUS-1D does not account for lateral flow. Runoff measured for the cover design was subtracted from the total precipitation input to HYDRUS because HYDRUS-1D did not calculate any runoff for the model calibration simulations. The lack of projected runoff resulted from the use of daily time steps; higher resolution data are generally needed to obtain projections of overland flow.

The Nyhan datasets do not include the data necessary to calculate PET, so weather data from the TA-54 weather station were used to calculate PET, using the approach described above. Because the TA-54 weather station dataset begins on January 29, 1992, the model calibration runs used atmospheric data inputs from January 29, 1992, to December 31, 1997 (5.9 yr). Precipitation data measured at the ITP site were used rather than the precipitation record from the TA-54 weather station.

Total drainage, runoff, and interflow measured for the 5% slope cover were 28 mm, 36 mm, and 99 mm (1.1 in., 1.4 in., and 3.9 in.), respectively, for the 5.9 yr (Nyhan 2005, 102729). Simulations were conducted to try to reproduce the measured water contents by adjusting the PE multiplier. The best match was found by setting the PE multiplier to 0.25 (PE = PET × 0.25). No other model input parameters were varied. Figure E-2.2-2 compares measured and simulated water contents at three depths within the cover profile. As shown in Figure E-2.2-2, the modeled results tend to overestimate the water contents in the topsoil and underestimate water contents in the lowest portion of the profile (75 to 91 cm). The lack of a better fit for all three time series is not surprising given (1) the uncertainty and heterogeneity in hydraulic properties; the bottom boundary condition, which was simulated as a seepage face but is more like a combination seepage face - free drainage boundary condition (because of gravel and drainage pans); and (2) possible measurement error as evidenced by water contents that reach 0.46 m^3/m^3 while the published saturated water content for this layer is only 0.41 m^3/m^3 (Nyhan et al. 1996, 063111, Table 1). Nevertheless, HYDRUS captures the overall trends in water content observed by Nyhan (2005, 102729). As a result of this calibration effort, the PE multiplier was estimated as PE = PET × 0.25 for all HYDRUS simulations of the MDA A ET cover modeling.

E-2.2.2 Calibration Using MDA B Field Data

Nyhan et al. (1998, 071345) describe a landfill cover demonstration experiment at MDA B, located approximately 600 m west of MDA A on DP Mesa. This experiment consisted of 12 plots varying in cover design, vegetation, mulching, and slope. Water balance data, including precipitation, ET, water storage (calculated from neutron logging data), runoff, and seepage (calculated), are available for the period of March 19, 1987, to June 30, 1995. Unfortunately, hydraulic properties are not available for the various cover materials, and no site-specific meteorology data from the area are available to use for calculating PET until February 1992 (from TA-53). Despite the lack of data required for model calibration using HYDRUS, some assumptions were made regarding hydraulic properties and PET to conduct a secondary model calibration.

Data from plot 4 were selected to be used for model calibration because this plot had the fewest number of layers; it consisted of grass cover rather than shrubs (considered to be more appropriate for the MDA A cover); and it had no gravel mulching (consistent with the existing MDA A ET cover). Figure E-2.2-3 shows the plot 4 cover design from Nyhan (2005, 102729).

Hydraulic properties for the three layers shown in Figure E-2.2-3 were acquired as follows. Properties for the old waste cover consisting of crushed tuff were taken from Table E-2.2-1, line 1. Properties for the sandy clay loam were taken from the HYDRUS pulldown menu for sandy clay loam. Because the middle layer is a mixture of soil textures, sandy loam was selected from the pulldown menu, and alpha was reduced from 7.5 to 7.0 (1/m) and K_{sat} was reduced from 1.06 to 0.7 m/d to estimate the mix of textures. There is considerable uncertainty in this approach for estimating hydraulic properties of all three layers.

Although daily precipitation data exist for the experiment, daily PET data do not. Therefore, PET was estimated by fitting a sine curve through the 16 yr of PET data calculated from TA-53 and shown in Figure E-2.1-1. Daily PET was reduced by a factor of 2 during days with measurable rainfall.

The model domain was set to 1-m deep because the water storage was calculated from 1-m deep neutron logging boreholes. Drainage (which was calculated and not measured) from the cover was set as the lower boundary condition in the model setup, and measured runoff was subtracted from the total precipitation input to HYDRUS because HYDRUS-1D did not calculate any runoff for these model calibration simulations. However, there is considerable uncertainty in these boundary conditions because the drainage, runoff, and soil water storage data were calculated on 5- to 62-d intervals (average interval of 20 d).

Model calibration consisted of adjusting both the PE and PT multipliers until the best match was found between the water storage calculated from the Nyhan et al. (1998, 071345) dataset, and HYDRUS. The best match was found using PE and PT multipliers of 0.25. A PT multiplier roughly translates into a vegetation density of 25%, which compares well with the estimated vegetation density for plot 4 of 29.7% (Nyhan et al. 1998, 071345, Table 6). A comparison of measured versus modeled water storage for plot 4 from Nyhan et al. (1998, 071345) is shown in Figure E-2.2-4. Considering the large uncertainty in hydraulic properties and daily PET, as well as the frequency of the drainage, runoff, and soil water storage data, the model calibration comparison is reasonable and adds confidence to the use of PE and PT multipliers in the ET cover modeling simulations described below.

E-2.3 Hydraulic Properties

The existing MDA A ET cover is comprised of crushed tuff. Hydraulic properties of crushed tuff were compiled from Rogers and Gallaher (1995, 097569, Table B1). The source of this crushed tuff is the quarry at the entrance to TA-53, which is in Tshirege unit 3 (Qbt 3) (Rogers and Gallaher 1995, 097569, p. 17). Properties of crushed tuff are also provided by Nyhan et al. (1996, 063111, Table 1), although they do not report the source location or Tshirege unit type of crushed tuff. These hydraulic properties of crushed tuff are summarized in Table E-2.2-1.

As previously discussed, if CME Alternative 2 is implemented, then some material from the existing cover would be removed, a 0.61-m thick biobarrier (abbreviated as “bb”) consisting of 10- to 30-cm cobble diameter would be installed, followed by an ET cover consisting of a 0.84-m (33-in.) thick moisture retention layer and a 0.31-m- (12-in.-) thick rooting media. The materials used for the ET cover (above the biobarrier) will consist of excavated crushed tuff from the existing cover, and crushed tuff from the TA-61 borrow site. Hydraulic properties from the TA-61 borrow site are described in a report prepared by Shaw Environmental, Inc.(2006, 091368). Average values of TA-61 hydraulic properties (log-mean for saturated hydraulic conductivity [K_{sat}] and van Genuchten alpha) are included in Table E-2.2-1. Hydraulic properties of the biobarrier layer were estimated using professional judgment. This layer is represented with a very high K_{sat}, and very high van Genuchten alpha and n parameters (that provide almost zero water-holding capacity). Hydraulic properties for the moisture retention layer and the rooting media were assumed to be the same. The water retention curves (water content-tension) for all hydraulic property sets used in the ET cover modeling are shown in Figure E-2.3-1.

E-2.4 Model Settings

A series of 34 HYDRUS model simulations was conducted to characterize the performance of the MDA A CME Alternatives 1 and 2 ET cover designs. The model settings used to conduct these simulations are described below.

Model layers: The ET cover designs and layer thicknesses representing Alternatives 1 and 2 that were simulated using HYDRUS are shown in Figure E-2.4-1. Alternative 1 had one layer of crushed tuff and a total depth of 1 m. Alternative 2 had four layers and a total depth of 2.36 m.

Hydraulic properties: All HYDRUS simulations used the van Genuchten–Mualem hydraulic property model, with no hysteresis. Simulations of CME Alternative 1 design evaluated a variety of hydraulic properties from Table E-2.2-1 while simulations of CME Alternative 2 design used the mean properties from TA-61 for the top two layers, and Stephens data (material 2) for the bottom layer (abbreviated as “TA61,bb,St” in Table E-2.4-1).

Vegetation properties: For all simulations that included vegetation, the Feddes root uptake model was used and “Grass” was selected from the root update model HYDRUS pulldown menu. Rooting depths were set to 1.0 and 1.1 m for CME Alternative 1 and 2 designs, respectively. All root mass distribution functions were simulated using a curvilinear beta distribution with beta = 5 and alpha = 1. Root growth with growing season was not simulated, but rather, established vegetation scenarios were simulated using root uptake options.

Heat flow: All HYDRUS simulations were run with heat flow set to simulate snow hydrology. Air temperature data were obtained from the TA-53 weather station dataset. Thermal properties were taken from HYDRUS pulldown menus, with sand properties used for all layers.

Snow: All HYDRUS simulations were run with snow hydrology simulated. One HYDRUS input for snow is the snowmelt constant, which was set to 2 mm/d snowmelt per °C increase above 2°C. This value is consistent with the range of snowmelt coefficients in Maidment (1993, p. 7.24). HYDRUS results are not sensitive to this parameter.

HcritA: This is the minimum allowed pressure head at the soil surface, which was set to –150 m tension (–15 bars) for all simulations. HYDRUS results are not sensitive to this parameter.

Gridding: For simulations representing Alternative 1 (1-m thick), 201 nodes were used. For simulations representing Alternative 2 (2.36-m thick), 301 nodes were used. The lower grid density was set to 0.5, which generated nonuniform grid spacings of less than 1 cm at the ground surface to slightly more than 1 cm at the lower boundary.

Boundary Conditions: The top boundary condition for all simulations was set to an atmospheric boundary condition with surface water runoff calculation enabled. The bottom boundary condition for most of the simulations was set to free drainage. Several simulations were conducted in which only the top two layers of Alternative 2 cover design were used, and a seepage face (SF) lower boundary conditions was used.

Initial Conditions: Initial conditions varied from simulation to simulation. The initial pressure head conditions for every simulation were varied until equilibrium pressure head and water content conditions were established. For example, if initial conditions were too wet, then water contents over 16.5 yr showed a decreasing trend and drainage was overestimated. If initial conditions were too dry, then water contents showed an increasing trend and drainage was underestimated. In some cases, the initial conditions were adequately approximated using a single value of pressure head for a layer, but in most cases a pressure-head gradient was used for the initial conditions (i.e., for most of the vegetated simulations). This approach ensures that the simulated profiles are stable and not in a long-term wetting or draining status.

E-2.5 Simulations Using Variable Conditions

Simulations were varied to explore the effects of changes in hydraulic properties, cover thickness, and vegetation density. In addition, several simulations were run with elevated precipitation. Table E-2.4-1 describes general aspects of the 34 model simulations that were run. All 34 simulations were run using the 16.5-yr daily atmospheric boundary data measured at the TA-53 weather station, and nearly all simulations used PE = PET × 0.25. Of the 34 simulations, 22 used ambient precipitation record, while 12 simulations used an elevated precipitation record in which daily precipitation was multiplied by a factor of 2.

Hydraulic properties: The effects of using different hydraulic property sets from Table E-2.2-1 on drainage were investigated in the first set of simulations (simulations 1 thought 10) shown in Table E-2.4-1. The Alternative 1 (Alt. 1) cover design was used for this evaluation. Simulations were run with and without vegetation.

Cover thickness: The effects of varying cover thickness (of Alt. 1 cover design only) on drainage were investigated in the second set of simulations (simulations 11 through 15) for vegetated and unvegetated covers. Cover thicknesses of 0.61 m, 1.0 m, and 1.83 m (corresponding to the range of 2 to 6 ft of thicknesses believed to occur for the existing cover) were simulated.

Vegetation density: Eight simulations (simulations 16 through 22) were run to investigate the effects of vegetation density on drainage using ambient precipitation. An additional set of nine simulations (simulations 24, 25, 26, 27, 28, 29, 32, 33, 34) were run using elevated precipitation. As discussed in section E.2.2.2, all simulations used PE = PET × 0.25. However, PT was estimated using a range of multipliers from 0.1 to 0.5. A value of PE = PET × 0.25 and PT = PET × 0.5 indicates that actual ET is approximately equal to PET × 0.75 (i.e., under saturated or near-saturated conditions).

Elevated precipitation: Finally, a variety of simulations were run with daily precipitation multiplied by two to evaluate the effects of elevated precipitation on drainage. These simulations were included to simulate extraordinarily wet periods, potential future glacial-transition, or full-glacial climates.

E-2.6 ET Cover Modeling Results

The results of the HYDRUS model simulations (average annual drainage) are summarized in the last column of Table E-2.6-1.

Hydraulic properties: Results of the evaluation of hydraulic properties indicate that under unvegetated conditions, use of the Abeele1 crushed tuff properties (material 3 in Table E-2.2-1) generated the highest drainage (103 mm/yr). However, under vegetated conditions, use of the Stephens properties (material 2 in Table E-2.2-1) generated the highest drainage (3.24 mm/yr), excluding TA-61 properties (not applicable to the Alternative 1 design). Because the ET covers are expected to always be vegetated, the

Stephens properties were used for the remainder of the simulations. Drainage results from this set of simulations are shown in Figure E-2.6-1.

Cover thickness: Results of the evaluation of cover thickness indicate that cover thickness has a large influence on drainage for vegetated covers but relatively little influence on drainage for unvegetated covers. Results of this set of simulations indicate that 30% vegetation cover significantly reduces drainage compared to an unvegetated cover. Drainage results from this set of simulations are shown in Figure E-2.6-2.

Vegetation density: Results of the evaluation of vegetation density indicate that vegetation density has a substantial effect on drainage. For the Alternative 1 cover design, drainage ranged from 68.3 mm/yr for an unvegetated cover to less than 1 mm/yr for a 50% vegetation cover density. For the Alternative 2 cover design, zero drainage occurred though the biobarrier. A very small amount of drainage (1E-3 mm/yr) was calculated from these simulations as a result of drainage from the lower-most crushed tuff layer. Drainage results from this set of simulations are shown in Figure E-2.6-3. The RCRA regulatory limit of 31.6 mm/yr (equivalent to a flux of 1E-7 cm/s) for landfill cover hydraulic conductivities is also shown in this figure. As shown in the figure, vegetation densities of 10% or greater result in drainage amounts that are less than the Resource Conservation and Recovery Act (RCRA) limit.

Elevated precipitation: Results of the evaluation of elevated precipitation on drainage indicate that drainage from the Alternative 1 cover increased significantly in response to the increased precipitation. Drainage amounts were 48%, 17%, 9%, and 4% of precipitation for vegetation densities of 0%, 30%, 50%, and 100%, respectively. This is compared to drainage amounts of 19%, 7%, 0.9%, and 0.2% of precipitation for vegetation densities of 0%, 10%, 30%, and 50%, respectively, under ambient precipitation conditions.

However, it is noteworthy that there was no drainage through the biobarrier of the Alternative 2 cover under elevated precipitation conditions. This is because the biobarrier acts as a severe capillary barrier due to the large differences in hydraulic properties between this layer and the overlying crushed tuff layer. Since the actual hydraulic properties of the biobarrier layer are not known, to evaluate how much drainage could move through the biobarrier layer under elevated precipitation conditions, an alternative model was setup in which the top two crushed tuff layers are included in the HYDRUS model, but a seepage face boundary condition was set at the depth corresponding to the top of the biobarrier. A seepage face allows water to drain once saturated conditions develop at the bottom of the overlying crushed tuff layer. Results of the simulations using a seepage face indicate that drainage ranged from 271 mm/yr to near zero. These drainage amounts are 38%, 0.3%, 0%, and 0% of precipitation for vegetation densities of 0%, 30%, 50%, and 100%, respectively, under elevated precipitation conditions. The results described here indicate that the Alternative 2 cover design will perform significantly better than the Alternative 1 design under ambient and elevated precipitation conditions. Results from the simulations of drainage under elevated precipitation conditions, including those using a seepage face boundary condition are shown in Figure E-2.6-4.

A cumulative distribution function plot of all HYDRUS simulation results under ambient precipitation conditions is shown in Figure E-2.6-5, which includes labels that identify the individual simulations. The highest drainage amounts are attributable to unvegetated conditions, which are certainly not expected to occur. The remainder of these simulation results range from less than 0.001 mm/yr to 25.6 mm/yr for the low vegetation density simulation using Alternative 1 design. This high value of 25.6 mm/yr is less than the RCRA limit of 31.6 mm/yr discussed previously.

E-3.0 DEEP VADOSE ZONE MODELING USING VS2DT

Bounding calculations of flow and transport from MDA A were made using VS2DTI. VS2DTI was selected for these calculations due to its simplicity and availability (http://wwwbrr.cr.usgs.gov/projects/GW_Unsat/vs2di1.2/). These modeling results are presented as bounding calculations to provide confidence to the position that there is no groundwater pathway between MDA A and the regional aquifer for contaminant transport for at least the next 1000 yr. If realistic simulations of contaminant transport from MDA A are required in the future, then implementation of fully 3-D vadose zone flow and transport model such as FEHM (Finite Element Heat and Mass) (Zyvoloski et al. 1994, 054420; Zyvoloski et al. 1996, 054421)is necessary. Because they are bounding 2-dimensional (2D) calculations, conservative assumptions have been made, and model calibration is unnecessary.

Two sets of simulations were conducted for this modeling. The first set was conducted to simulate redistribution of elevated saturations from the MDA A central pit as a result of being open for nearly 10 yr. The second set was conducted to simulate flow and transport of plutonium from the General's Tanks by simulating an instantaneous release of the remaining plutonium inventory in these tanks. Both sets of simulations were conducted in order to determine the maximum possible extent of 1000 yr of contaminant transport in the vadose zone beneath MDA A, and to support the position that there is no groundwater pathway between MDA A and the regional aquifer for at least the next 1000 yr.

E-3.1 Model Setup

This section describes the VS2DTI model setup, including model domain, stratigraphy, boundary conditions, hydraulic properties, and model assumptions.

E-3.1.1 Model Domain

A 2-D model domain was configured with a width of 150 m, which is approximately 3 times the width (N-S direction) of MDA A. The depth of the domain is 400 m, which is approximately 20 m beneath the regional aquifer water table (at a depth of 380 m bgs based on the regional aquifer depth at well R-7). This domain was used for all VS2DTI simulations. For the MDA A central pit simulations, the pit floor was set to a depth of 6.7 m below ground surface (bgs).

E-3.1.2 Stratigraphy

The stratigraphy used in the model is provided by (1) contacts in borehole 21-26588 (also known as BH-12); and (2) contacts in characterization well R-7. Specifically, depths to various layer contacts were taken from Figure 4.4-2 in the MDA A investigation report (2006, 095046) for the interval of ground surface to 360 ft (110 m) bgs; and from Figure 10.0-1 in Stone et al. (2002, 072717) for the interval of 360 ft bgs (110 m bgs) to the water table. Table E-3.1-1 includes the contact depths of various geologic layers beneath MDA A compiled from these two sources. Using this approach, the regional aquifer water table is modeled at a depth of 1248 ft (380 m), which is probably higher in elevation than reality. Note that the Puye unit includes both pumice-poor Puye and pumiceous Puye units.

Figure E-3.1-1 shows the stratigraphy from borehole 21-26588 and the corresponding VS2DTI model layers to a depth of 220 m bgs.

The Cerros del Rio basalt layer is not included in the VS2DTI model for MDA A. This is consistent with data from the Weston 2008 geologic framework model (GFM). Figure E-3.1-2 shows the extent of this basalt layer in the GFM.

E-3.1.3 Perched Intermediate Groundwater

No perched groundwater was found in the boreholes described in the MDA A investigation report (LANL 2006, 095046, p. 11). No perched groundwater was assumed to occur beneath MDA A in this study. This assumption is supported by the lack of perched groundwater found in wells LADP-4 and LADP-5 (Broxton et al. 1995, 050119), despite the locations of these wells in a canyon bottom where perched groundwater can be expected to be encountered.

E-3.1.4 Boundary Conditions

The top boundary conditions consist of a constant flux boundary set to 2 mm/yr. For the 10-yr period when the MDA A central pit is open, a constant flux boundary was set to 200 mm/yr over a width of 50 m. This value represents more than 50% of average annual precipitation (362 mm/yr measured at TA-53 weather station). The side boundaries and bottom boundary are no flow boundaries. Since the water table is at a depth of about 380 m, and the model lower boundary is at 400 m, there is a 20-m deep porous media to act as a bucket. If lateral flow occurs along stratigraphy unit boundaries, the no flow boundaries on the sides of the model will stop lateral flow and thereby force downward flow which is conservative.

E-3.1.5 Hydraulic Properties

Hydraulic properties for the Bandelier tuff units were taken from Stauffer et al. (2005, 097432, Attachment III), except for unit Qbt 3 which is not included in Stauffer et al. (2005, 097432). Properties for Qbt 3 were taken from Springer et al. (2001, 070114, Table 7). Properties for the Puye were taken from Birdsell et al. (1999, 069792, Table 2.1-1). All hydraulic properties and their sources are shown in Table E-3.1-2. Although some hydraulic properties for the Cerro Toledo interval are reported in MDA A investigation report (LANL 2006, 095046, section 4.4.3.3), these properties were not used in the VS2DTI models because they do not include van Genuchten hydraulic properties, and they were considered to be less conservative than the properties in Stauffer et al. (2005, 097432).

E-3.1.6 Modeling Assumptions

A number of assumptions were made in order to accomplish this modeling study. These assumptions include the following:

1. Hydraulic properties for the Cerro Toledo unit were also used for the Tsankawi unit.
2. The Puye unit may consist of pumiceous and pumice-poor zones, as was found in well R-7. The same hydraulic properties were used for all Puye. This assumption is not important since simulated wetting fronts did not reach the Puye.
3. After the MDA A central pit is filled, hydraulic properties of the Qbt 3 tuff unit were used for the waste zone.
4. The water table elevation was assumed to be at the same elevation as measured at R-7. Since the water table at R-7 is upgradient of the water table beneath MDA A, this is a conservative assumption (the water table elevation is assumed to be higher than reality).
5. Hydraulic properties are isotropic and homogeneous. No vertical anisotropy was assigned to hydraulic conductivity. This is conservative.
6. All units were modeled as porous media, without fractures. This is a safe assumption based on Robinson et al. (2005, 092040) who modeled a water injection test at the Laboratory and found that the bulb of elevated saturation moved as matrix flow.

E-3.2 Simulation of Flow from MDA A Central Pit

First, VS2DTI was run for undisturbed (pre-MDA) conditions to calculate the steady-state saturations in the vadose zone beneath MDA A. VS2DTI was used to simulate 2000 yr of redistribution using a steady-state infiltration rate of 2 mm/yr. This infiltration rate is the upper value of the 0 to 2 mm/yr range that appears to represent the typical undisturbed infiltration rate range for MDA A from the Laboratory infiltration map in Kwicklis et al. (2005, 090069, Figure 11). In addition, 2 mm/yr is between the values of 3.24 and 0.75 mm/yr calculated with HYDRUS-1D (see Table E-2.6-1), for cover vegetation densities of 30% and 50%, respectively. Figure E-3.2-1 shows a time series of water contents at various depths for the 2,000-yr period. As shown, water contents appear to reach steady-state after 500 yr.

Next, a steady-state infiltration rate of 200 mm/yr was set for 10 yr over the MDA A footprint. This value represents more than 50 percent of average annual precipitation (362 mm/yr measured at TA-53 weather station). This atmospheric boundary condition is intended to represent conditions in which the central pit of MDA A was open for nearly 10 yr. Since the open pit probably had little to no vegetation or soil, about half the incoming precipitation was assumed to be evaporated from the top few centimeters of tuff, and about half was assumed to become recharge.

After 10 yr, the steady-state infiltration rate of 2 mm/yr was reassigned, and redistribution was simulated for another 1000 yr. Although the Alternative 1 or 2 ET covers will likely result in a long-term average drainage rate of less than 2 mm/yr (particularly for Alternative 2 design), 2 mm/yr was assigned to be conservative.

Results of the VS2DTI simulation described above are shown in the following three figures. Figure E-3.2-2 shows volumetric water content (vwc) on the left, and saturation on the right for the vadose zone profile after the initial 2000-yr period, which corresponds to the year 1969. Figure E-3.2-3 shows vwc 10 (year 1979) and 110 yr (year 2079) following the start of the 10-yr period of elevated infiltration on the left and right, respectively. Note the scale change in this figure going from left to right. Ten and 110 yr after the start of the period of elevated infiltration, the wetting front caused by elevated saturations reached depths of 40 and 121 m, respectively. Figure E-3.2-4 shows vwc 1000 yr after the end of the 10-yr period of elevated infiltration. Elevated water contents are not evident in the left side of Figure E-3.2-4. The scale must be changed to an extreme degree to see any remnants of the elevated saturations, as is shown on the right side of this figure where the remaining elevated water contents reach the top of the Guaje pumice at a depth of 192 m bgs.

E-3.3 Simulation of Flow and Transport from General's Tanks

The VS2DTI model setup for the simulations of flow and transport from the General's Tanks was nearly identical to the previous set of simulations. For this set of simulations, the top of the model geometry was flat (no central pit), and two source points were set at a depth of 6 m bgs, and 9.7 m apart. A total of 650 gal. (2.46 m^3) was released from each tank over a period of 10 d (0.246 m/d) so that the release rate would not exceed the saturated hydraulic conductivity of the tuff unit (0.41 m/d). The top boundary condition was set to a constant flux value of 2 mm/yr.

The source term in the General's Tanks was taken from Table 1-10 of the Laboratory's documented safety analysis for nuclear environmental sites (LANL 2007, 098554). Based on this table, the source term of plutonium was set to 43 and 11 Curies (Ci) of Pu-239 for the west and east tanks, respectively, and to 63 and 16 Ci of Pu-241 for the west and east tanks, respectively. Two simulations were run for the General's Tanks based on this inventory. The first model simulated transport of Pu-241 with decay (half-life of only 14.35 yr). The second model simulated transport of Pu-239 separately because it has a long half-life of 24,000 yr. The remaining inventory of Pu-238 is relatively small compared to Pu-241 and

Pu-239 and was not simulated. For both simulations, a conservatively low value of K_d for plutonium was used. All transport parameters and their sources are shown in Table E-3.3-1.

Longitudinal and transverse dispersivities were estimated by conducting a VS2DTI simulation with these dispersivities set to zero. The center of the mass of plutonium reached a depth of 50 m bgs after 1000 yr. Longitudinal dispersivity was then set to a value of 10% of the 50-m path length (5 m), and transverse dispersivity was set to 10% of the longitudinal dispersivity (0.5 m).

Results of the VS2DTI simulation described above are shown in the following figures. Figure E-3.3-1 shows Pu-241 concentration profiles 10 yr after the release from the General's Tanks. The left profile has a scale of zero to 5 Ci/m^3 while the right profile has a scale of 1E-19 to 1E-18 Ci/m^3, which corresponds to the boundary of a plume at a concentration of 1 pCi/g or higher. Figure E-3.3-2 shows Pu-241 concentration profiles 100 and 1000 yr after release from the tanks. This figure only shows the pCi/g boundary because the concentrations have substantially decreased due to radioactive decay. After 100 yr, the pCi/g plume shown in Figure E-3.3-2 (left) reaches a maximum depth of about 72 m. After 1000 yr, the plume is barely visible in Figure E-3.3-2 (right) at concentrations less than 1 pCi/g.

Figures E-3.3-3, E-3.3-4, and E-3.3-5 show Pu-239 concentration profiles 10, 100, and 1000 yr after the release from the General's Tanks. In all three of these figures, the left profile has a scale of zero to 1 or 5 Ci/m^3 while the right profile has a scale of 1E-19 to 1E-18 Ci/m^3 which corresponds to the boundary of a plume at a concentration of 1 pCi/g or higher. These results indicate that 1000 yr following a hypothetical release from the General's Tanks at MDA A, the Pu-241 plume boundary (at 1 pCi/g) virtually disappears due to decay while the Pu-239 plume boundary (at 1 pCi/g) reaches slightly into the Guaje Pumice layer at a depth of 196 m, or 184 m above the regional aquifer. For the Pu-239 simulations, the initial recharge period was reduced from 1000 to 2000 yr to decrease runtime.

It is important to note, however, that the 1 pCi/g plume is probably not highly accurate and very conservative as a result of the introduction of artificial numerical dispersion. It is also important to note that all the deep vadose zone simulations using VS2DTI presented here represent bounding calculations to support decision making processes, and the true extent of the plumes presented are likely to be considerable less extensive than those shown.

E-4.0 SUMMARY AND CONCLUSIONS

Two types of vadose zone modeling were analyzed in this section: ET cover modeling using HYDRUS-1D and deep vadose zone modeling using VS2DTI. The ET cover modeling was intended to be realistic but slightly conservative while the deep vadose zone modeling was intended to be highly conservative and bounding.

The results of the HYDRUS modeling indicate that the existing crushed tuff ET cover at MDA A (corresponding to Alternative 1) has an average annual drainage rate ranging from less than 0.001 to 25.6 mm/yr under vegetated conditions, depending on cover thickness, hydraulic properties, and vegetation density. Modeled drainage through an ET cover with a biobarrier (corresponding to Alternative 2) is predicted to have zero drainage, even under conditions of elevated precipitation. A seepage face boundary condition was introduced to estimate the amount of drainage that would enter the biobarrier in the Alternative 2 cover design. Results of the simulations with a seepage face ranged from zero to 2.45 mm/yr under vegetated conditions, and elevated precipitation conditions. These results clearly indicate that although the existing crushed tuff ET cover (Alternative 1) performs adequately and meets RCRA requirements for equivalent saturated hydraulic conductivity limits of covers, the Alternative 2 ET cover will perform better than the existing crushed tuff cover.

Results of the VS2DTI flow modeling indicate that the wetting front of a pulse of elevated moisture caused by elevated infiltration from the MDA A central pit may reach the top of the Guaje unit at a depth of 192 m after 1000 yr. Results of the VS2DTI transport modeling of a hypothetical release from the General's Tanks indicates that the 1 pCi/g contaminant boundary of Pu-241 may reach a depth of 72 m after 100 yr but will virtually disappear after 1000 yr. The 1 pCi/g contaminant boundary of Pu-239 may reach a depth of 77 and 196 m after 100 and 1000 yr, respectively, although these results may not be highly accurate due to artificial numerical dispersion.

The deep vadose zone modeling results presented in this Section are important for demonstrating that contaminant transport from MDA A to the regional aquifer is highly unlikely for at least the next 1000 yr.

E-5.0 REFERENCES

The following list includes all documents cited in this appendix. Parenthetical information following each reference provides the author(s), publication date, and ER ID number. This information is also included in text citations. ER ID numbers are assigned by the Environmental Programs Directorate's Records Processing Facility (RPF) and are used to locate the document at the RPF and, where applicable, in the master reference set.

Copies of the master reference set are maintained at the NMED Hazardous Waste Bureau; the U.S. Department of Energy–Los Alamos Site Office; the U.S. Environmental Protection Agency, Region 6; and the Directorate. The set was developed to ensure that the administrative authority has all material needed to review this document, and it is updated with every document submitted to the administrative authority. Documents previously submitted to the administrative authority are not included.

Birdsell, K.H., K.M. Bower, A.V. Wolfsberg, W.E. Soll, T.A. Cherry, and T.W. Orr, July 1999. "Simulations of Groundwater Flow and Radionuclide Transport in the Vadose and Saturated Zones Beneath Area G, Los Alamos National Laboratory," Los Alamos National Laboratory report LA-13299-MS, Los Alamos, New Mexico. (Birdsell et al. 1999, 069792)

Broxton, D.E., P.A. Longmire, P.G. Eller, and D. Flores, June 1995. "Preliminary Drilling Results for Boreholes LADP-3 and LADP-4," in *Earth Science Investigation for Environmental Restoration—Los Alamos National Laboratory, Technical Area 21*, Los Alamos National Laboratory report LA-12934-MS, Los Alamos, New Mexico, pp. 93-109. (Broxton et al. 1995, 050119)

Dawson, L.A., and P.I. Pohl, November 1997. "Modeling and Risk Assessment of a 30-year-old Subsurface Radioactive-Liquid Drain Field," *Journal of Geophysical Research,* Vol. 33, No. 11, pp. 2535-2545. (Dawson and Pohl 1997, 102730)

Jensen, M.E., R.D. Burmen, and R.G. Allen (Eds.), 1990. *Evapotranspiration and Irrigation Water Requirements*, manual prepared by the Committee on Irrigation Water Requirements on the Irrigation and Drainage Division of the American Society of Civil Engineers, New York, New York. (Jensen et al. 1990, 071430)

Kwicklis, E., M. Witkowski, K. Birdsell, B. Newman, and D. Walther, August 2005. "Development of an Infiltration Map for the Los Alamos Area, New Mexico," *Vadose Zone Journal,* Vol. 4, pp. 672-693. (Kwicklis et al. 2005, 090069)

LANL (Los Alamos National Laboratory), May 2003. “Corrective Measures Study Report for Material Disposal Area H, Solid Waste Management Unit 54-004, at Technical Area 54,” Los Alamos National Laboratory document LA-UR-03-3354, Los Alamos, New Mexico. (LANL 2003, 076039)

LANL (Los Alamos National Laboratory), November 2006. “Investigation Report for Material Disposal Area A, Solid Waste Management Unit 21-014, at Technical Area 21,” Los Alamos National Laboratory document LA-UR-06-7902, Los Alamos, New Mexico. (LANL 2006, 095046)

LANL (Los Alamos National Laboratory), June 2007. “Documented Safety Analysis for Surveillance and Maintenance of Nuclear Environmental Sites at Los Alamos National Laboratory, Revision 1,” Los Alamos National Laboratory document NES-ABD-0101, Los Alamos, New Mexico. (LANL 2007, 098554)

Longmire, P., C.R. Cotter, I.R. Triay, J.J. Kitten, C. Hall, J. Bentley, D.J. Hollis, and A.I. Adams, December 1996. “Batch Sorption Results for Americium, Neptunium, Plutonium, Technetium, and Uranium Transport through the Bandelier Tuff, Los Alamos, New Mexico,” Los Alamos National Laboratory document LA-UR-96-4716, Los Alamos, New Mexico. (Longmire et al. 1996, 056030)

Nyhan, J.W., 2005. “A Seven-Year Water Balance Study of an Evapotranspiration Landfill Cover Varying in Slope for Semiarid Regions,” *Vadose Zone Journal,* Vol. 4, pp. 466-480. (Nyhan 2005, 102729)

Nyhan, J.W., T.E. Hakonson, and B.J. Drennon, April-June 1990. “A Water Balance Study of Two Landfill Cover Designs for Semiarid Regions,” *Journal of Environmental Quality,* Vol. 19, No. 2, pp. 281-288. (Nyhan et al. 1990, 011760)

Nyhan, J.W., J.A. Salazar, D.D. Breshears, and F.J. Barnes, June 1998. “A Water Balance Study of Four Landfill Cover Designs at Material Disposal Area B in Los Alamos, New Mexico,” Los Alamos National Laboratory report LA-13457-MS, Los Alamos, New Mexico. (Nyhan et al. 1998, 071345)

Nyhan, J.W., T.G. Schofield, and R.H. Starmer, 1996. “A Water Balance Study of Four Landfill Cover Designs Varying in Slope for Semiarid Regions,” Los Alamos National Laboratory document LA-UR-96-4093, Los Alamos, New Mexico. (Nyhan et al. 1996, 063111)

Robinson, B.A., S.G. McLin, and H.S. Viswanathan, 2005. “Hydrologic Behavior of Unsaturated, Fractured Tuff: Interpretation and Modeling of a Wellbore Injection Test,” *Vadose Zone Journal,* Vol. 4, pp. 694-707. (Robinson et al. 2005, 092040)

Rogers, D.B., and B.M. Gallaher, September 1995. “The Unsaturated Hydraulic Characteristics of the Bandelier Tuff,” Los Alamos National Laboratory report LA-12968-MS, Los Alamos, New Mexico. (Rogers and Gallaher 1995, 097569)

Shaw Environmental Inc., February 2006. “Geotechnical and Hydraulic Characterization at the Technical Area 61 Borrow Area,” report prepared for Los Alamos National Laboratory, Albuquerque, New Mexico. (Shaw Environmental, Inc. 2006, 091368)

Springer, E.P., G.J. Langhorst, and E.S. Hamilton, 2001. “Hydrogeologic Properties of the Bandelier Tuff and Groundwater Occurrence at DP Mesa, TA-21, Los Alamos National Laboratory, Los Alamos, New Mexico,” Los Alamos National Laboratory document LA-UR-01-4242, Los Alamos, New Mexico. (Springer et al. 2001, 070114)

Stauffer, P.H., H.S. Viswanathan, B.A. Robinson, C.W. Gable, G.L. Cole, D.E. Broxton, E.P. Springer, and T.G. Schofield, 2005. “Groundwater Pathway Model for the Los Alamos National Laboratory Technical Area 54, Material Disposal Area G,” Los Alamos National Laboratory document LA-UR-05-7393, Los Alamos, New Mexico. (Stauffer et al. 2005, 097432)

Stone, W., D. Vaniman, P. Longmire, D. Broxton, M. Everett, R. Lawrence, and D. Larssen, April 2002. “Characterization Well R-7 Completion Report,” Los Alamos National Laboratory report LA-13932-MS, Los Alamos, New Mexico. (Stone et al. 2002, 072717)

Zyvoloski, G.A., B.A. Robinson, Z.V. Dash, and L.L. Trease, March 30, 1995. “Models and Methods Summary for the FEHMN Application,” Los Alamos National Laboratory document LA-UR-94-3787, Los Alamos, New Mexico. (Zyvoloski et al. 1994, 054420)

Zyvoloski, G.A., B.A. Robinson, Z.V. Dash, and L.L. Trease, May 20, 1996. “Users Manual for the FEHMN Application,” Rev. 1, Los Alamos National Laboratory document LA-UR-94-3788, Los Alamos, New Mexico. (Zyvoloski et al. 1996, 054421)

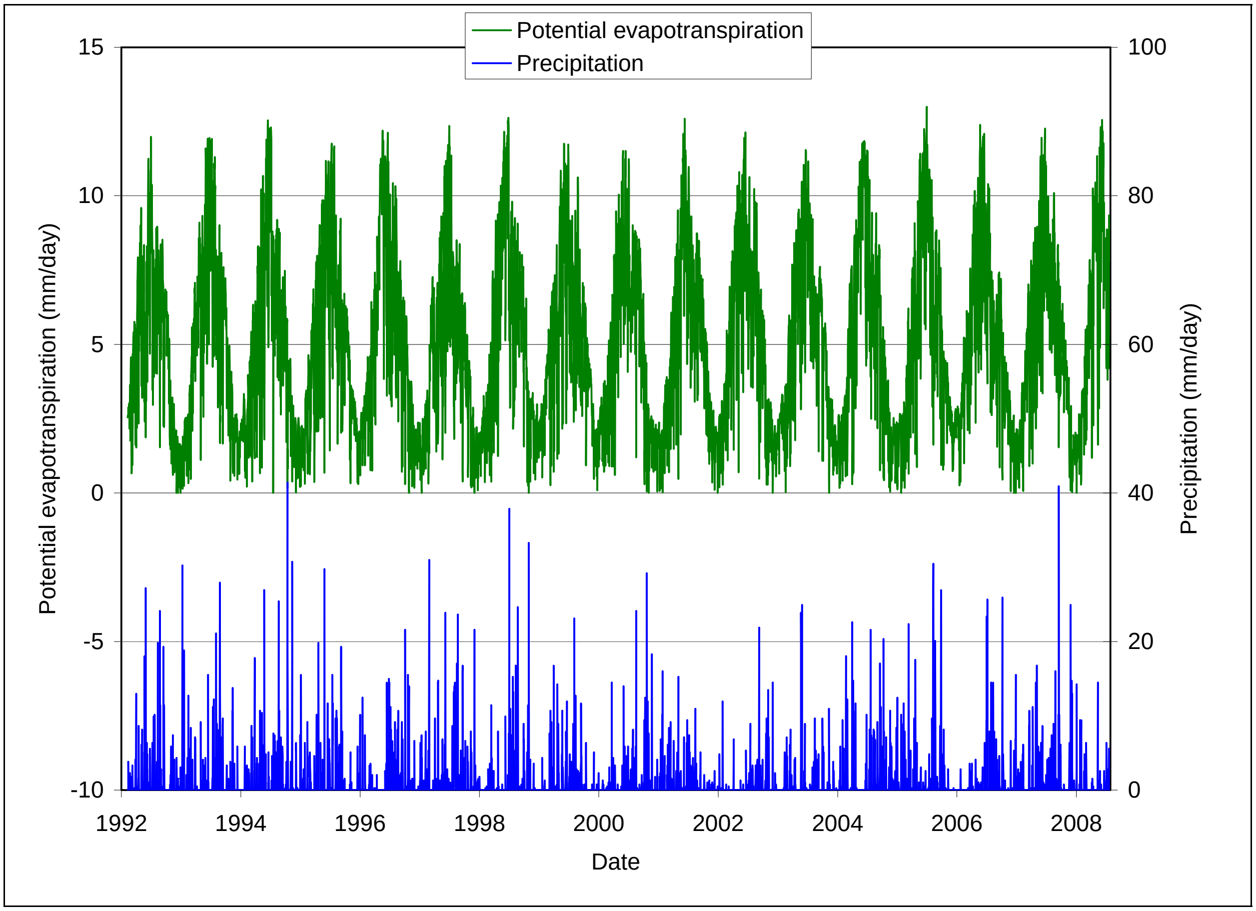
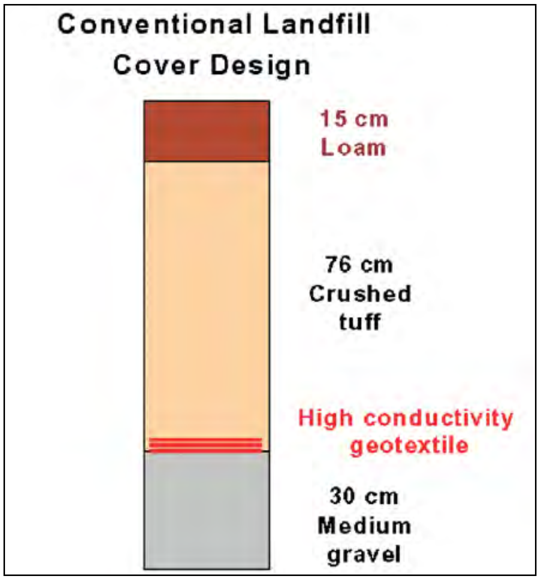


Figure E-2.1-1 **Calculated potential ET and measured precipitation based on data collected at the TA-53 weather station**



Source: Nyhan (2005, 102729), Figure 2.

Figure E-2.2-1 **Cover design from ITP experiment used for model calibration**

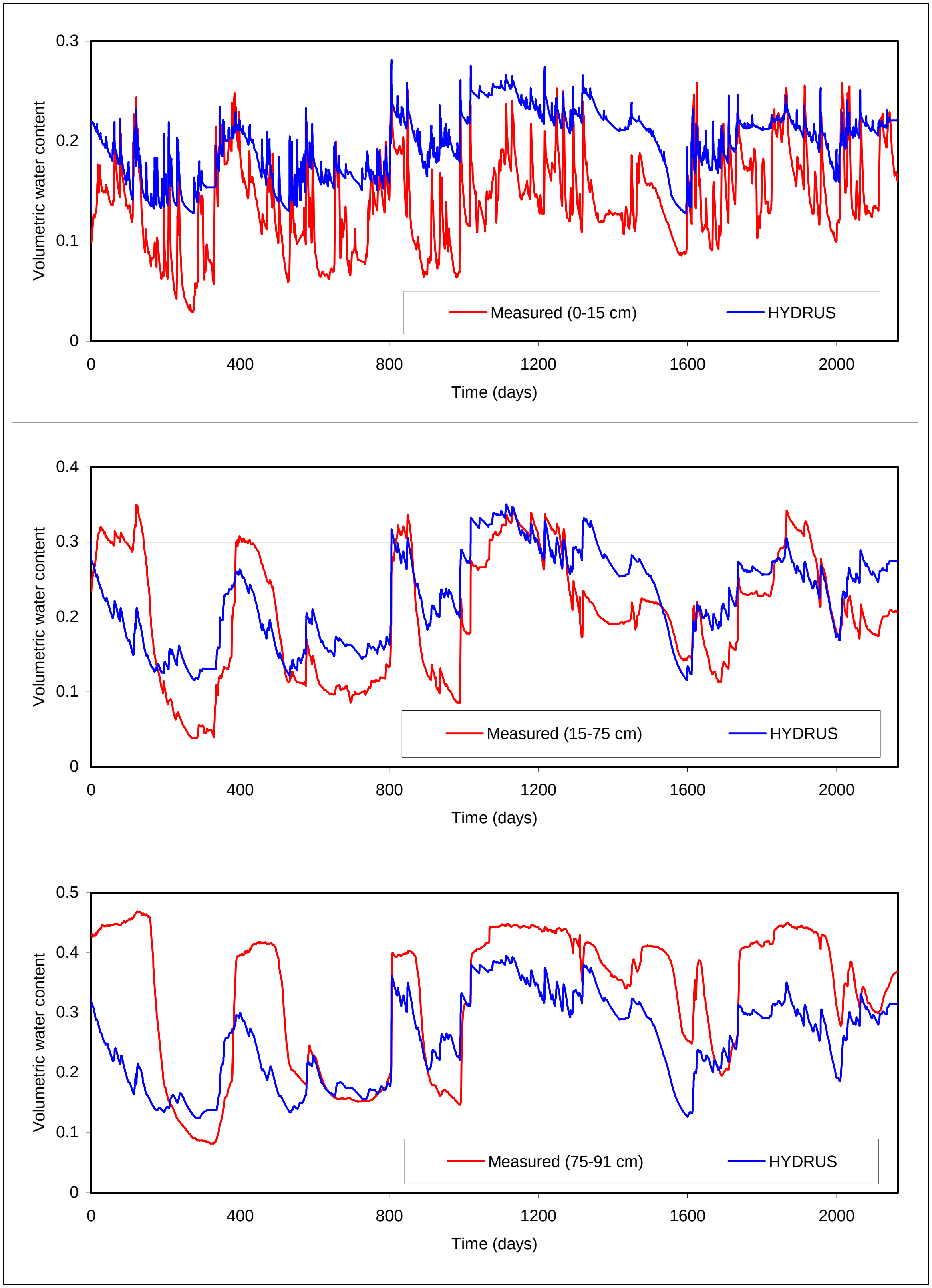
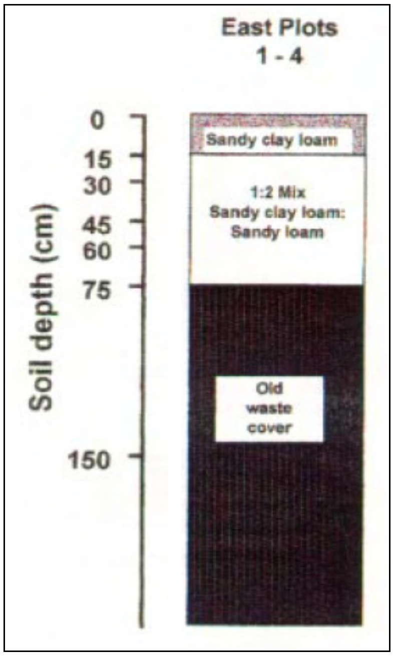


Figure E-2.2-2 HYDRUS simulations of water content from ITP experiment, 5% slope cover using PE multiplier = 0.25



Source: Modified from Nyhan et al. 1998, 071345, Figure 2b.

Figure E-2.2-3 Plot 4 cover design from MDA B cover experiment used for model calibration

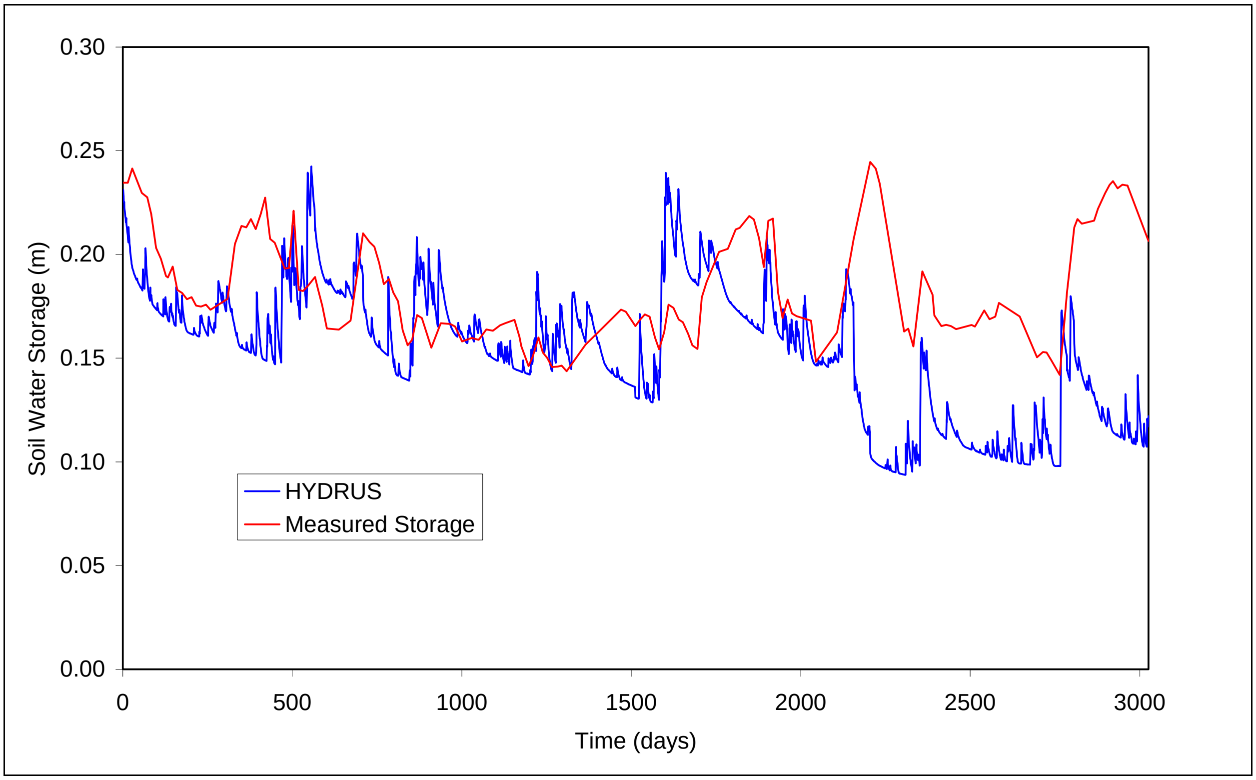


Figure E-2.2-4 HYDRUS simulations of water storage from Plot 4 of the MDA B cover experiment

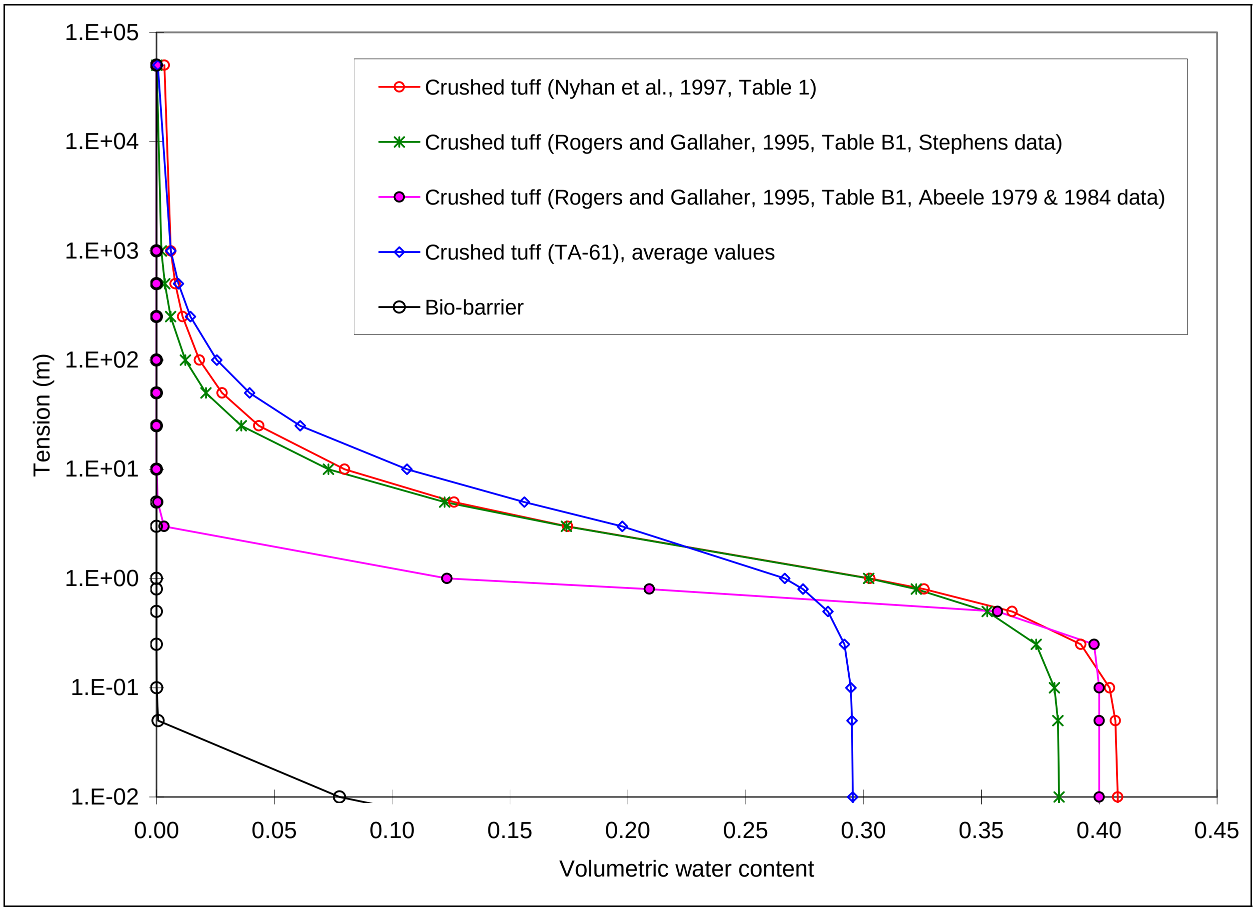


Figure E-2.3-1 Water retention curves for hydraulic property sets used in the ET cover modeling

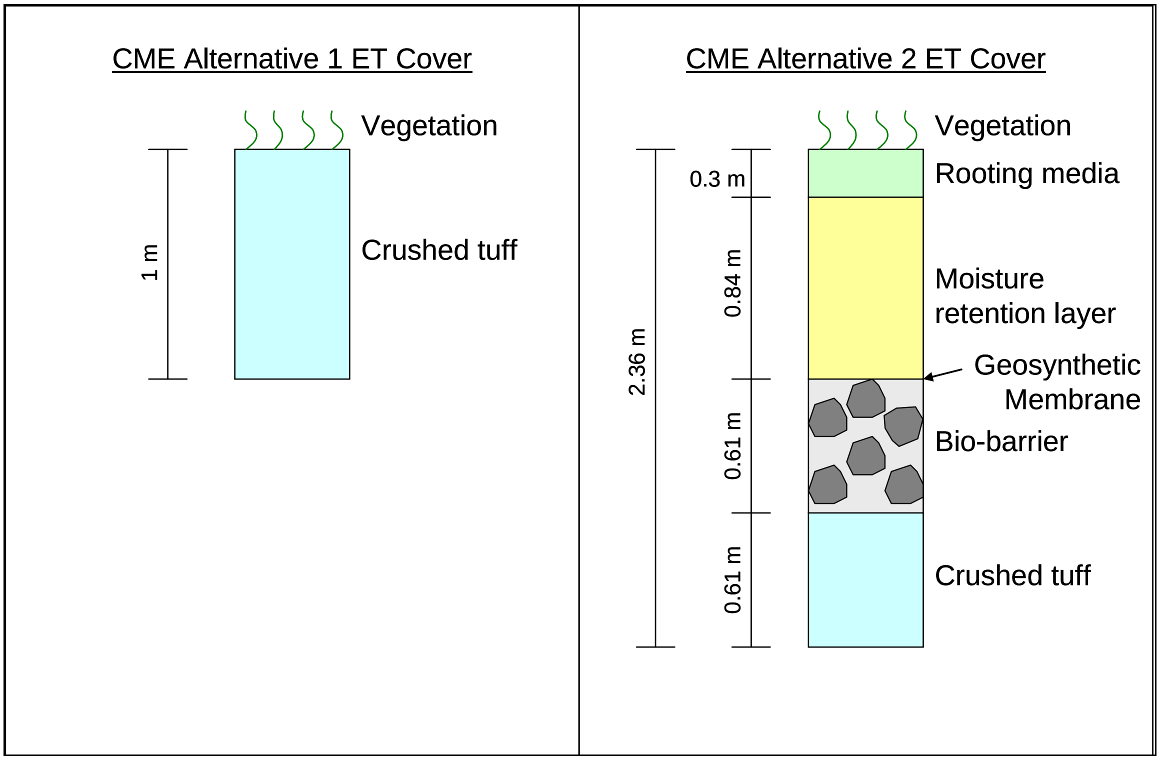


Figure E-2.4-1 ET cover designs for Alternatives 1 and 2

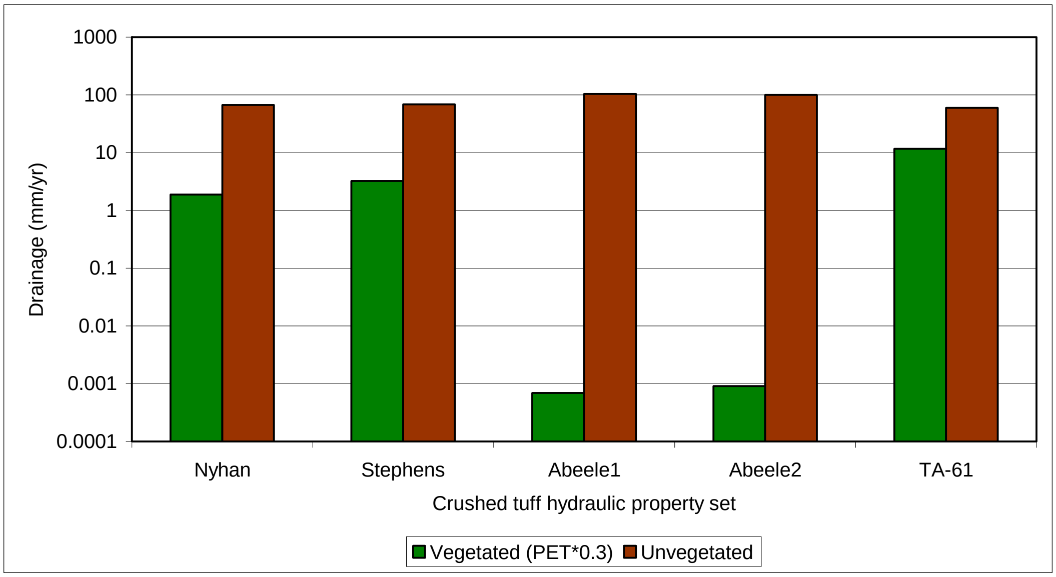


Figure E-2.6-1 HYDRUS drainage results for various hydraulic property sets

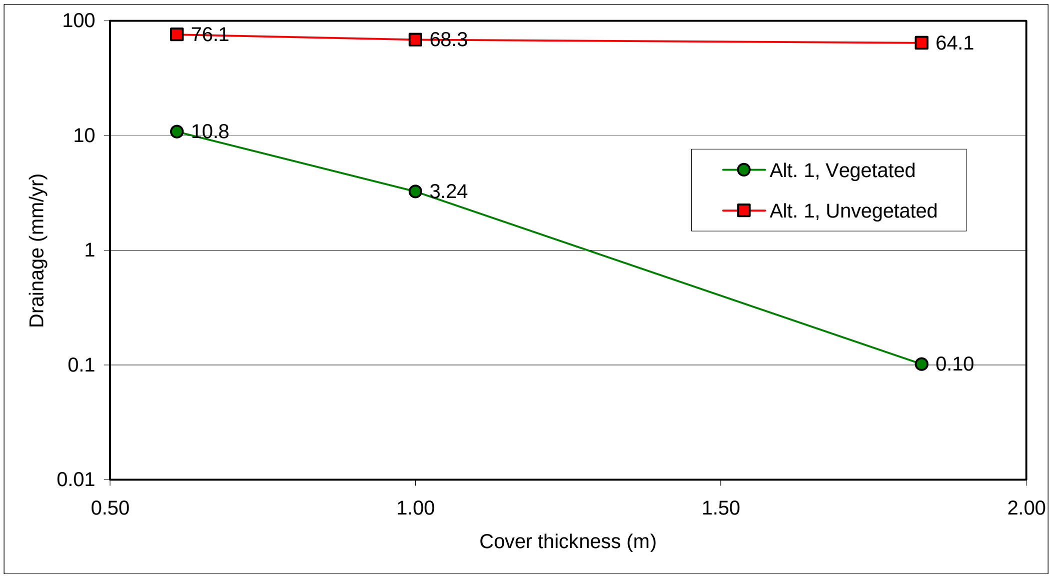


Figure E-2.6-2 HYDRUS drainage results for various cover thicknesses

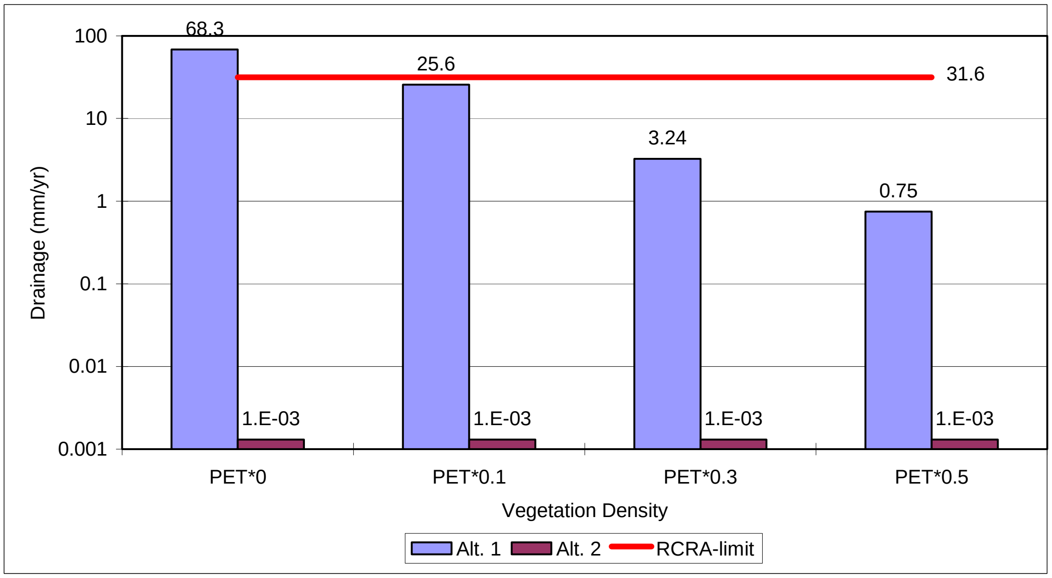


Figure E-2.6-3 HYDRUS drainage results for various vegetation densities

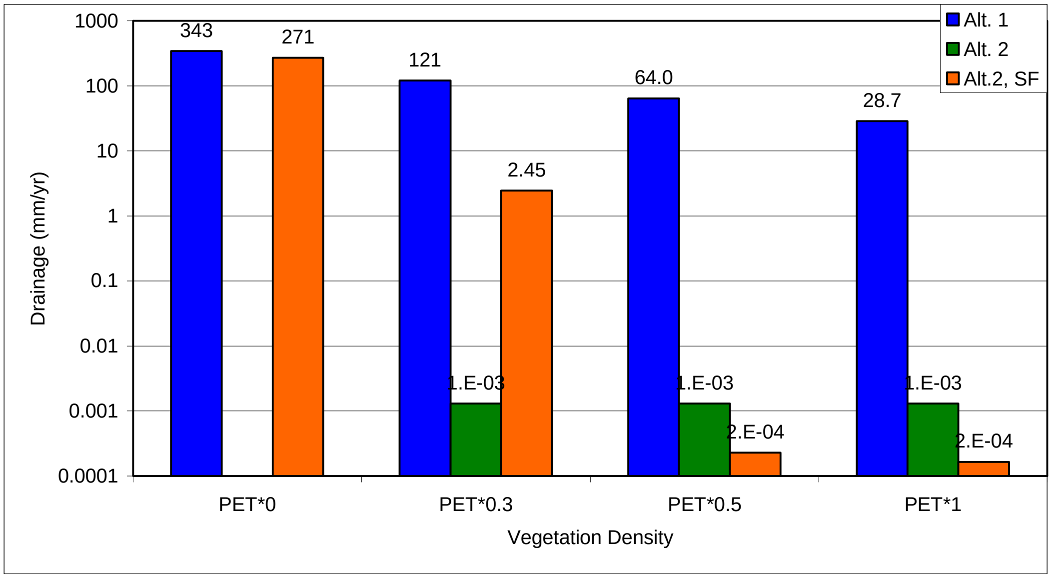


Figure E-2.6-4 HYDRUS drainage results for various cover designs under elevated precipitation conditions

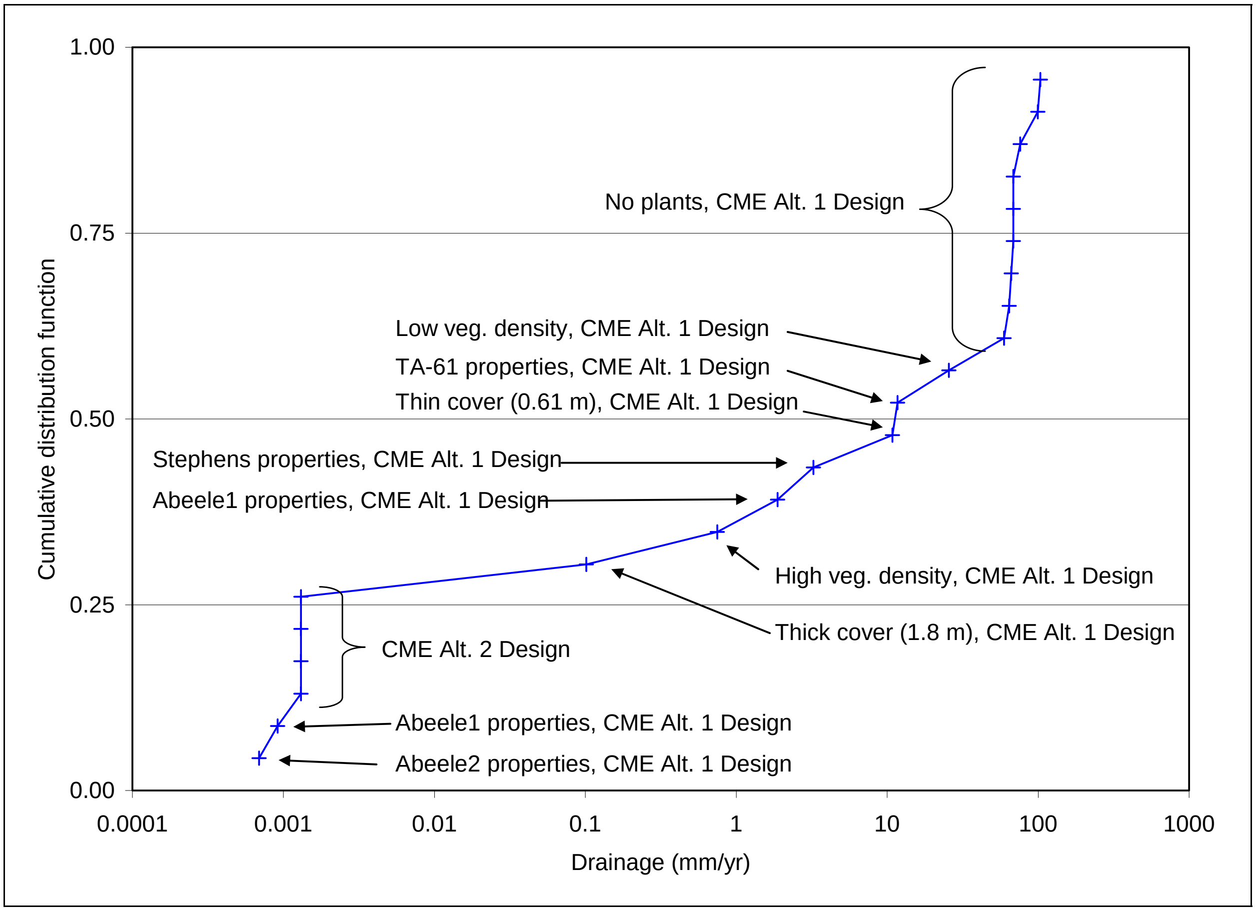


Figure E-2.6-5 Cumulative distribution function plot of drainage for all HYDRUS simulations under ambient precipitation

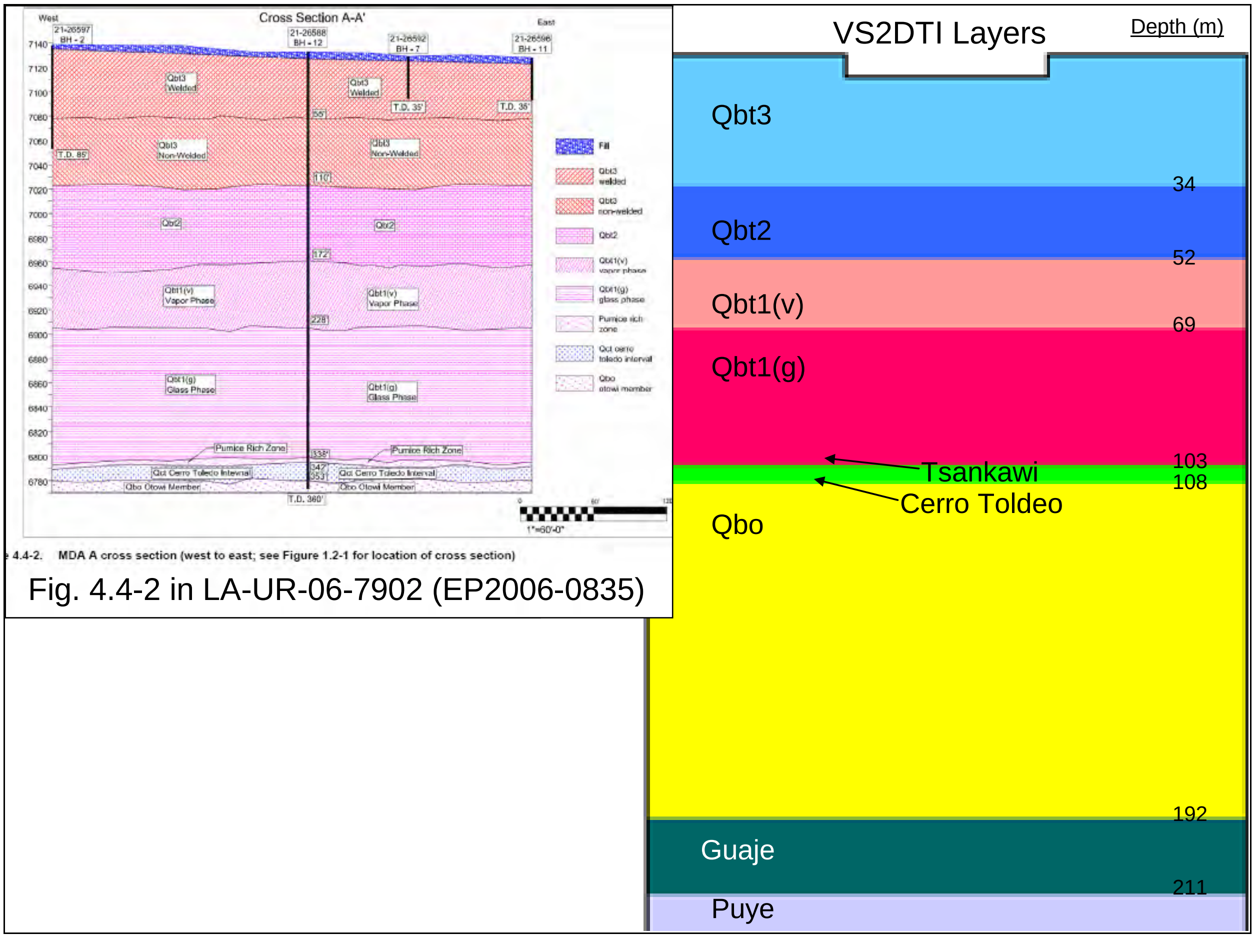


Figure E-3.1-1 MDA A stratigraphy from investigation report (LANL 2006, 095046), and corresponding layers in VS2DTI model

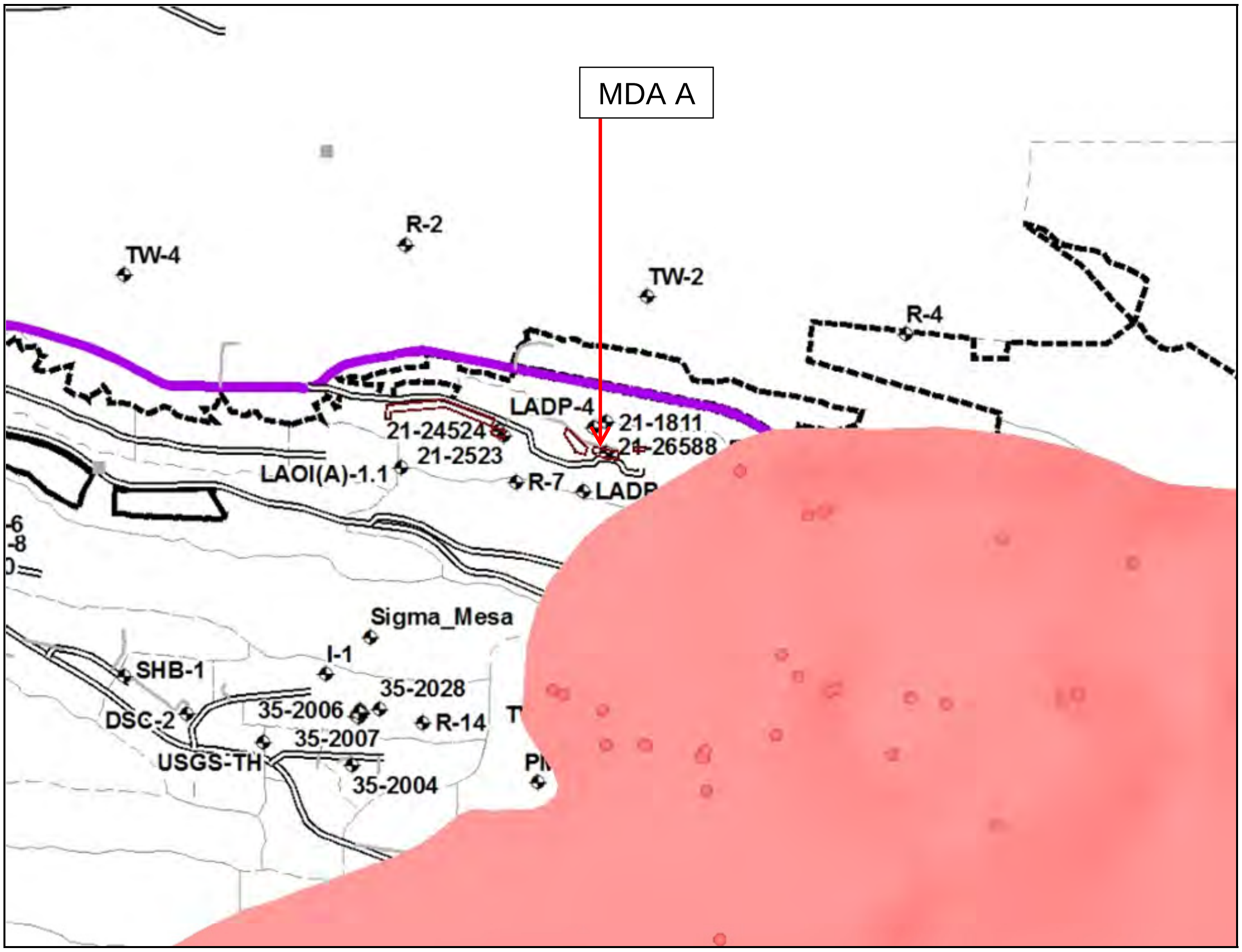


Figure E-3.1-2 Extent of Cerros del Rio basalt (from Weston 2008 EarthVision GFM)

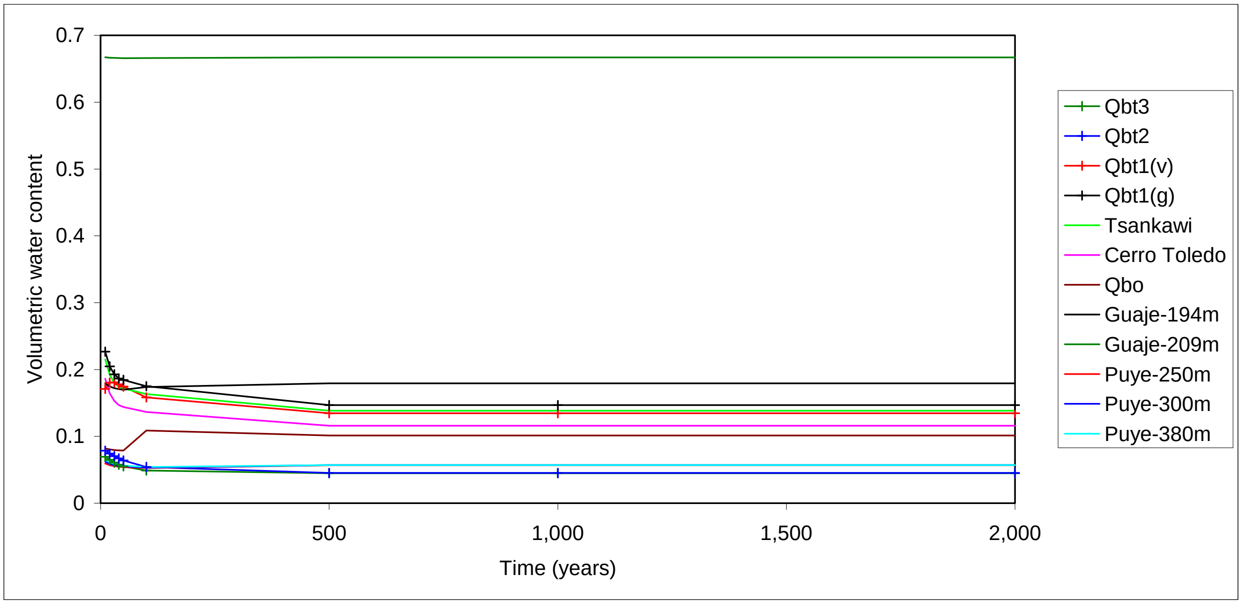


Figure E-3.2-1 Time series of volumetric water content for initial 2000 yr of simulation

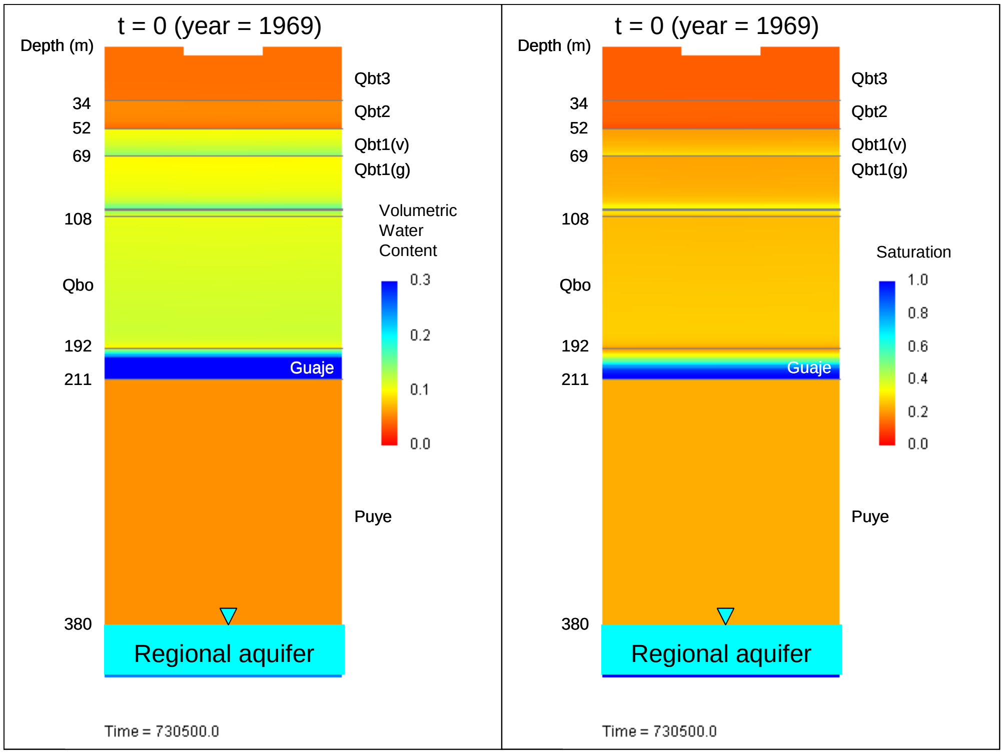


Figure E-3.2-2 Steady-state profiles of water content (left) and saturation (right) at year 1969

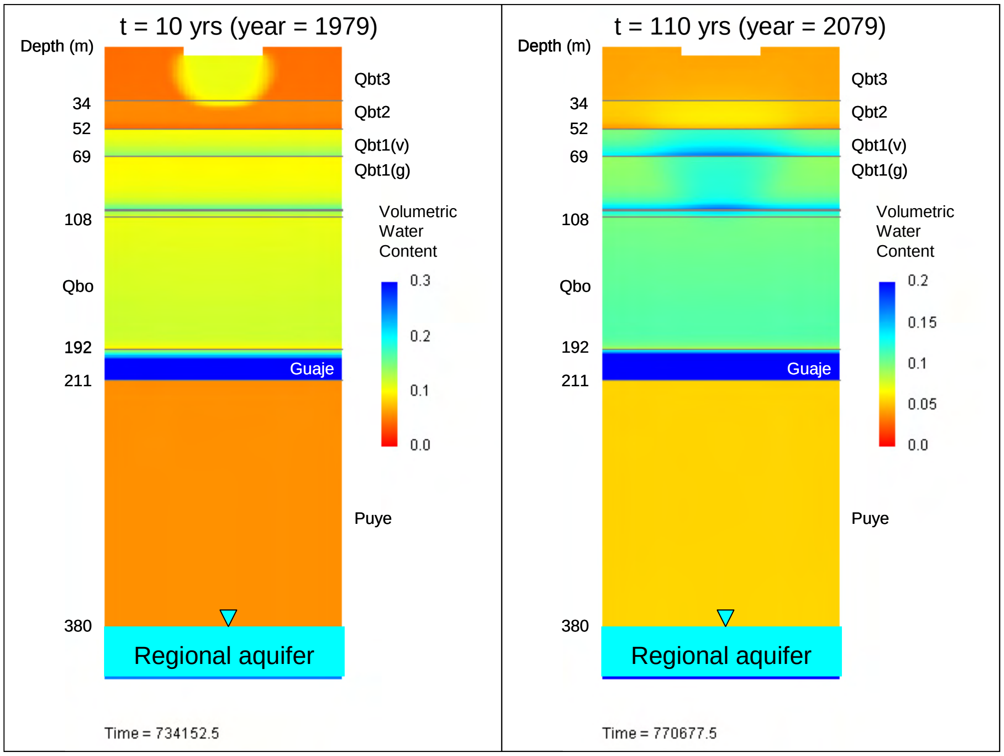


Figure E-3.2-3 Water content profiles 10 yr (left) and 110 yr (right) after start of period of elevated infiltration

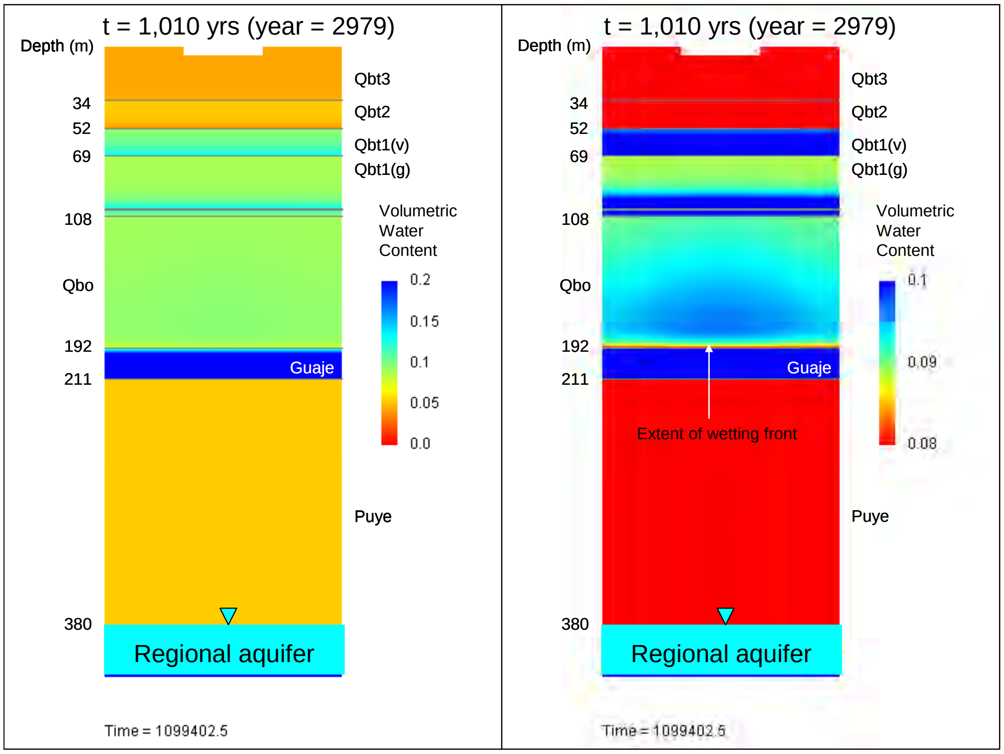


Figure E-3.2-4 Water content profiles 1000 yr after end of period of elevated infiltration

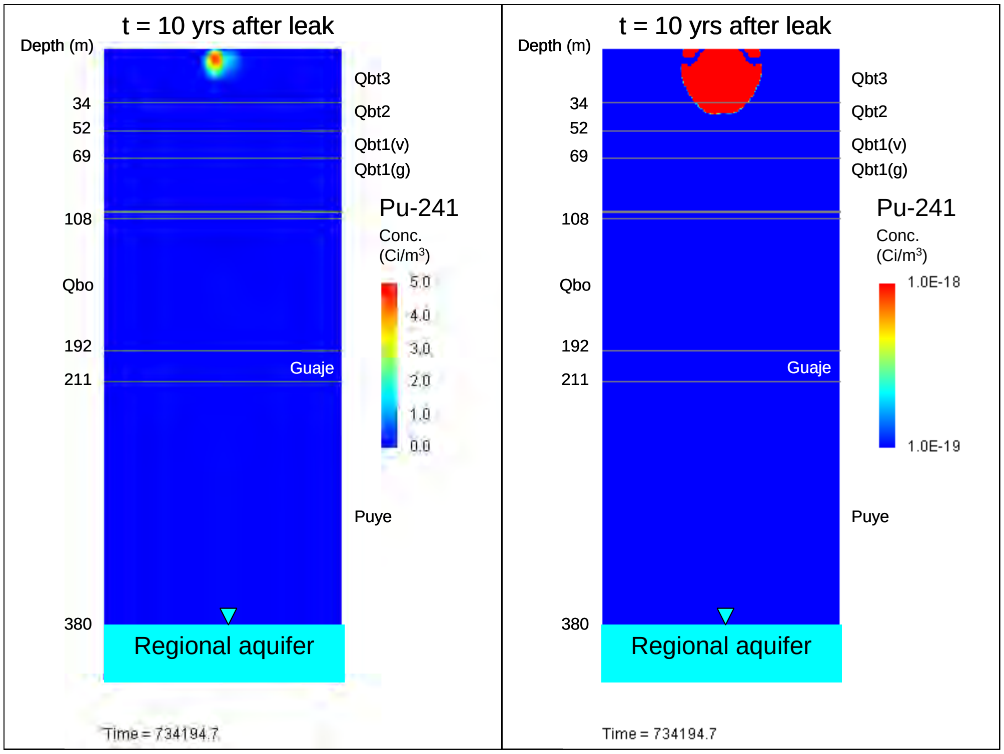


Figure E-3.3-1 Pu-241 concentration profiles10 yr after release from General's Tanks

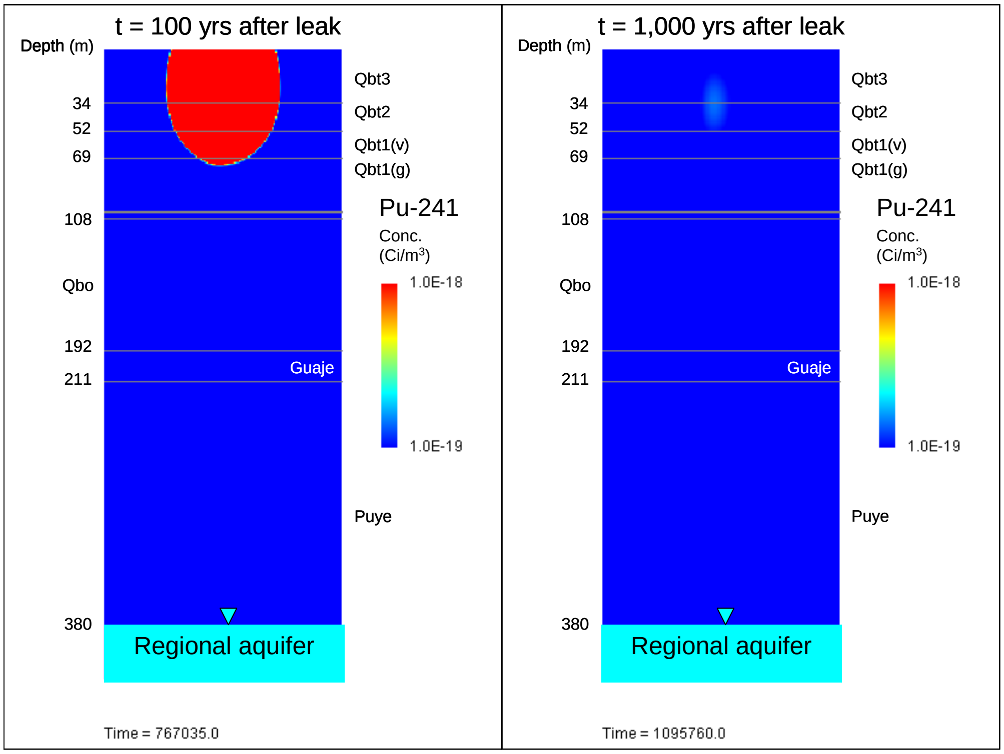


Figure E-3.3-2 Pu-241 concentration profile 100 and 1000 yr after release from General's Tanks

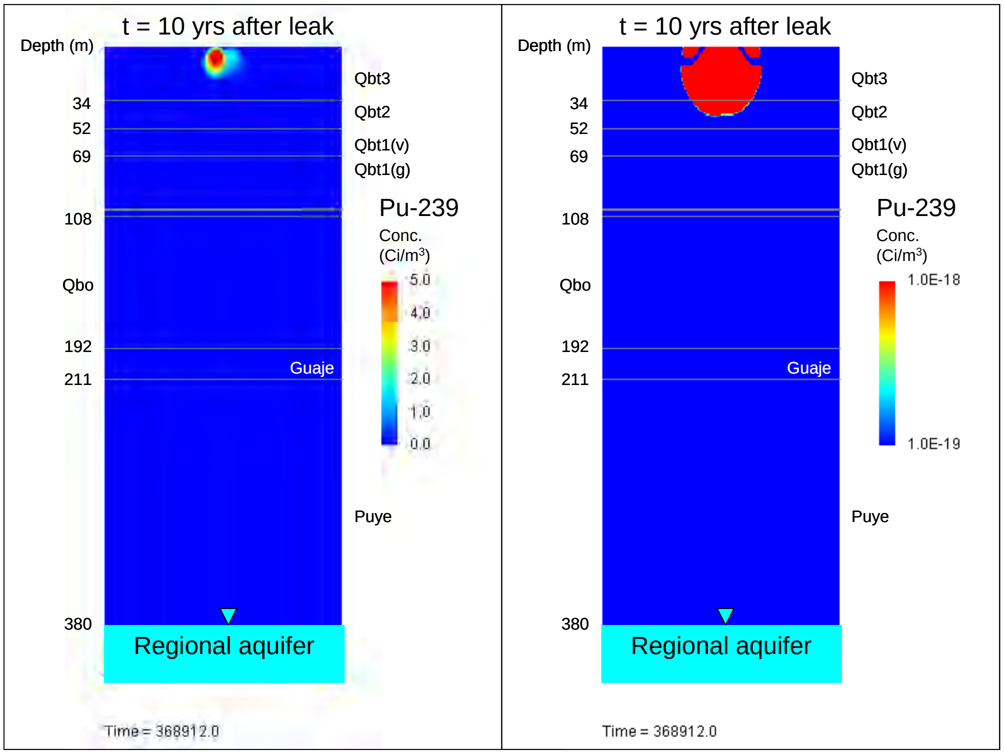


Figure E-3.3-3 Pu-239 concentration profiles10 yr after release from General's Tanks

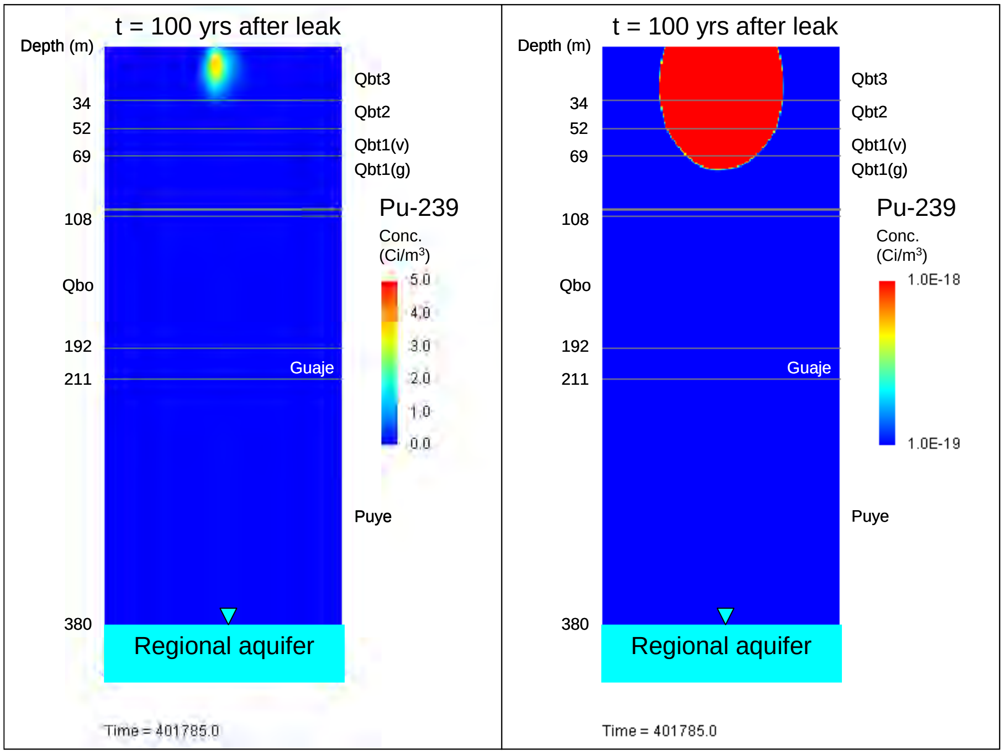


Figure E-3.3-4 Pu-239 concentration profiles 100 yr after release from General's Tanks

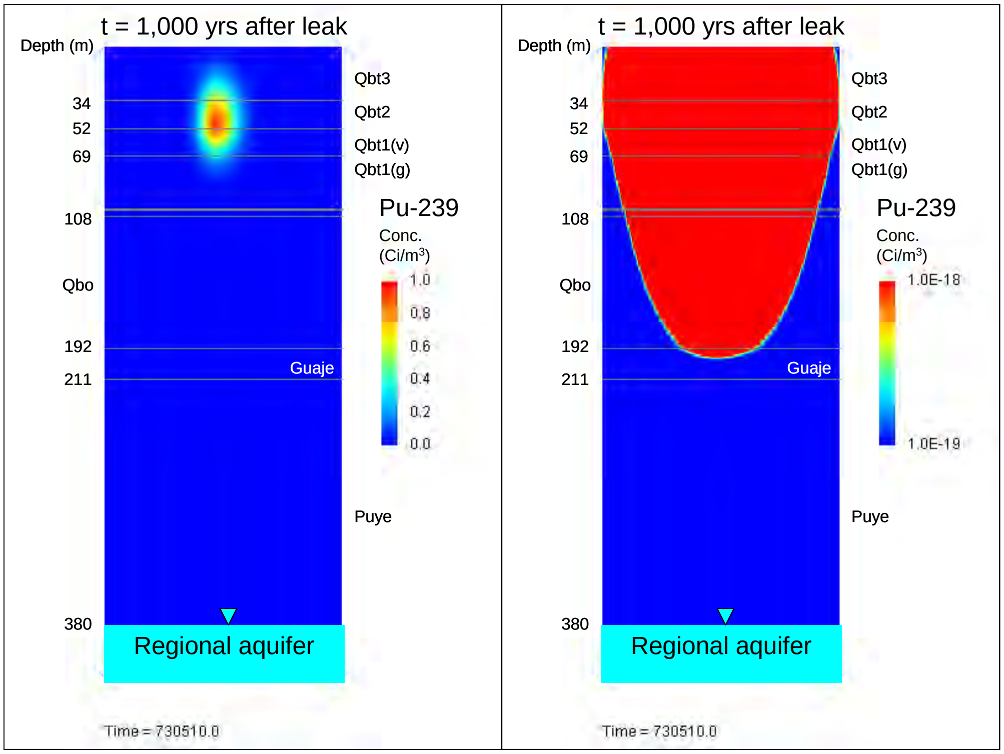


Figure E-3.3-5 Pu-239 concentration profiles 1000 yr after release from General's Tanks

Table E-2.2-1
Summary of Hydraulic Properties Compiled for ET Cover Modeling

Material		Residual Water Content	Saturated Water Content	van Genuchten Parameters		Saturated Hydraulic Conductivity (m/d)	Saturated Hydraulic Conductivity (cm/s)	Source
				α (1/m)	*n*			
1	Crushed Tuff (Qbt 3 from TA-53)	0.0031	0.4079	1.04	1.707	7.08E-01	8.20E-04	Nyhan et al. 1996, 063111, Table 1
2	Crushed Tuff (Qbt 3 from TA-53) (referred to as Stephens or “St”)	0.0	0.383	0.83	1.779	7.08E-01	8.20E-04	Rogers and Gallaher 1995, 097569, Table B1, Stephens data
3	Crushed Tuff (Qbt 3 from TA-53) (referred to as Abeele1)	0.0	0.4	4.49	1.326	7.95E-02	9.20E-05	Rogers and Gallaher 1995, 097569, Table B1, Abeele 1979 data (Abeele1)
4	Crushed Tuff (Qbt3 from TA-53) (referred to as Abeele2)		0.4			1.21E-01	1.40E-04	Rogers and Gallaher 1995, 097569, Table B1, Abeele 1984 data (Abeele2)
5	Crushed Tuff (Qbt 3 from TA-61), Average values (referred to as TA-61)	0.0001	0.2954	0.4815	1.6323	1.59E+00	0.0018	(Shaw Environmental Inc. 2006, 091368) (TA-61)
6	Biobarrier Cobble Layer (referred to as “bb”)	0.0	0.3	250	4	1000		Professional judgment

Table E-2.4-1
Summary of the 34 HYDRUS-1D Simulations.

Investigate	Sim. No.	Cover Design	Initial Head (m)	Cover Thickness (m)	Hydraulic Prop. set	Plants	PE mult.	PT mult.	Precip. Mult.
Hydraulic properties	1	Alt. 1	-15	1.0	Nyhan	Yes	0.25	0.3	1
	2	Alt. 1	-15	1.0	Stephens	Yes	0.25	0.3	1
	3	Alt. 1	-40	1.0	Abeele1	Yes	0.25	0.3	1
	4	Alt. 1	-40	1.0	Abeele2	Yes	0.25	0.3	1
	5	Alt. 1	-10	1.0	TA-61	Yes	0.25	0.3	1
	6	Alt. 1	-4	1.0	Nyhan	No	0.25	0	1
	7	Alt. 1	-4	1.0	Stephens	No	0.25	0	1
	8	Alt. 1	-1	1.0	Abeele1	No	0.25	0	1
	9	Alt. 1	-1	1.0	Abeele2	No	0.25	0	1
	10	Alt. 1	-4	1.0	TA-61	No	0.25	0	1
Cover thickness	11	Alt. 1	-15	0.61	Stephens	Yes	0.25	0.3	1
	2	Alt. 1	-15	1.0	Stephens	Yes	0.25	0.3	1
	12	Alt. 1	-40	1.83	Stephens	Yes	0.25	0.3	1
	13	Alt. 1	-4	0.61	Stephens	No	0.25	0	1
	14	Alt. 1	-4	1.0	Stephens	No	0.25	0	1
	15	Alt. 1	-4	1.83	Stephens	No	0.25	0	1
Vegetation density	16	Alt. 1	-4	1.0	Stephens	No	0.25	0	1
	17	Alt. 1	-10	1.0	Stephens	Yes	0.25	0.1	1
	2	Alt. 1	-15	1.0	Stephens	Yes	0.25	0.3	1
	18	Alt. 1	-20	1.0	Stephens	Yes	0.25	0.5	1
	19	Alt. 2	-20, -100	1.0	TA61,bb,St	No	0.25	0	1
	20	Alt. 2	-20, -100	1.0	TA61,bb,St	Yes	0.25	0.1	1
	21	Alt. 2	-20, -100	1.0	TA61,bb,St	Yes	0.25	0.3	1
	22	Alt. 2	-20, -100	1.0	TA61,bb,St	Yes	0.25	0.5	1
Elevated precipitation	23	Alt. 1	-15	1.0	Stephens	No	0.25	0	2
	24	Alt. 1	-15	1.0	Stephens	Yes	0.25	0.3	2
	25	Alt. 1	-15	1.0	Stephens	Yes	0.25	0.5	2
	26	Alt. 1	-15	1.0	Stephens	Yes	0	1.0	2
	27	Alt. 2	-20, -100	1.0	TA61,bb,St	Yes	0.25	0.3	2
	28	Alt. 2	-20, -100	1.0	TA61,bb,St	Yes	0.25	0.5	2
	29	Alt. 2	-20, -100	1.0	TA61,bb,St	Yes	0	1.0	2
	30	Alt.2, SF	-10	1.14	Stephens	No	0.25	0	1
	31	Alt.2, SF	-1	1.14	Stephens	No	0.25	0	2
	32	Alt.2, SF	-15	1.14	Stephens	Yes	0.25	0.3	2
	33	Alt.2, SF	-15	1.14	Stephens	Yes	0.25	0.5	2
	34	Alt.2, SF	-15	1.14	Stephens	Yes	0	1.0	2

Table E-2.6-1
Summary of the 34 HYDRUS-1D Simulations with Drainage Results

Investigate	Sim. No.	Cover Design	Cover Thickness (m)	Hydraulic Prop. set	Plants	PE mult.	PT mult.	Precip. Mult.	Drainage (mm/yr)
Hydraulic properties	1	Alt. 1	1.0	Nyhan	Yes	0.25	0.3	1	1.88
	2	Alt. 1	1.0	Stephens	Yes	0.25	0.3	1	3.24
	3	Alt. 1	1.0	Abeele1	Yes	0.25	0.3	1	6.89E-04
	4	Alt. 1	1.0	Abeele2	Yes	0.25	0.3	1	9.14E-04
	5	Alt. 1	1.0	TA-61	Yes	0.25	0.3	1	11.7
	6	Alt. 1	1.0	Nyhan	No	0.25	0	1	66.3
	7	Alt. 1	1.0	Stephens	No	0.25	0	1	68.3
	8	Alt. 1	1.0	Abeele1	No	0.25	0	1	103
	9	Alt. 1	1.0	Abeele2	No	0.25	0	1	99.4
	10	Alt. 1	1.0	TA-61	No	0.25	0	1	59.5
Cover thickness	11	Alt. 1	0.61	Stephens	Yes	0.25	0.3	1	10.82
	2	Alt. 1	1.0	Stephens	Yes	0.25	0.3	1	3.24
	12	Alt. 1	1.83	Stephens	Yes	0.25	0.3	1	0.10
	13	Alt. 1	0.61	Stephens	No	0.25	0	1	76.1
	14	Alt. 1	1.0	Stephens	No	0.25	0	1	68.3
	15	Alt. 1	1.83	Stephens	No	0.25	0	1	64.1
Vegetation density	16	Alt. 1	1.0	Stephens	No	0.25	0	1	68.3
	17	Alt. 1	1.0	Stephens	Yes	0.25	0.1	1	25.6
	2	Alt. 1	1.0	Stephens	Yes	0.25	0.3	1	3.24
	18	Alt. 1	1.0	Stephens	Yes	0.25	0.5	1	0.75
	19	Alt. 2	1.0	TA61,bb,St	No	0.25	0	1	1.31E-03
	20	Alt. 2	1.0	TA61,bb,St	Yes	0.25	0.1	1	1.31E-03
	21	Alt. 2	1.0	TA61,bb,St	Yes	0.25	0.3	1	1.31E-03
	22	Alt. 2	1.0	TA61,bb,St	Yes	0.25	0.5	1	1.31E-03
Elevated precipitation	23	Alt. 1	1.0	Stephens	No	0.25	0	2	343
	24	Alt. 1	1.0	Stephens	Yes	0.25	0.3	2	121
	25	Alt. 1	1.0	Stephens	Yes	0.25	0.5	2	64.0
	26	Alt. 1	1.0	Stephens	Yes	0	1.0	2	28.7
	27	Alt. 2	1.0	TA61,bb,St	Yes	0.25	0.3	2	1.31E-03
	28	Alt. 2	1.0	TA61,bb,St	Yes	0.25	0.5	2	1.31E-03
	29	Alt. 2	1.0	TA61,bb,St	Yes	0	1.0	2	1.31E-03
	30	Alt.2, SF	1.14	Stephens	No	0.25	0	1	5.45E-04
	31	Alt.2, SF	1.14	Stephens	No	0.25	0	2	271
	32	Alt.2, SF	1.14	Stephens	Yes	0.25	0.3	2	2.45
	33	Alt.2, SF	1.14	Stephens	Yes	0.25	0.5	2	2.30E-04
	34	Alt.2, SF	1.14	Stephens	Yes	0	1.0	2	1.64E-04

Table E-3.1-1
Depths of Geologic Layers Based on Stratigraphy from 21-26588 and Well R-7

Rock Unit	BH-12 Depth of Lower contact (ft)	BH-12 Elevation (ft)	R-7 borehole Depth of Lower contact (ft)	R-7 borehole Elevation (ft)	B-12 & R-7 Combined Elevation (ft)	B-12 & R-7 Combined Elevation (m)	Depth (m)
Surface		7125		6780	7125	2172	0
Qbt3-w	55	7070			7070	2155	17
Qbt3-nw	110	7015			7015	2138	34
Qbt2	172	6953			6953	2119	52
Qbt1(v)	228	6897			6897	2102	69
Qbt1(g)	338	6787			6787	2069	103
Tsankawi	342	6783			6783	2067	104
Cerro Toledo	353	6772			6772	2064	108
Qbo			285	6495	6495	1980	192
Guaje			347	6433	6433	1961	211
Water table			903	5877	5877	1791	380
Puye			1087	5693	5693	1735	436

Table E-3.1-2
Hydraulic Properties Used in for VS2DTI Modeling

Rock Unit	Theta Sat	Ksat (cm/s)	Ksat (m^2)	Ksat (m/d)	Theta Res	Alpha (1/cm)	Alpha (1/m)	n	Source
Qbt3	0.36	4.70E-04		0.41	0.011	0.0059	0.591	2.16	Springer et al., 2000, Table 7
Qbt2	0.41	3.40E-04		0.29	0.010	0.0060	0.600	2.10	Stauffer et al., 2005, Att. III, Table III-2
Qbt1(v)	0.49	2.35E-04		0.20	0.003	0.0040	0.400	1.74	Stauffer et al., 2005, Att. III, Table III-3
Qbt1(g)	0.46	2.00E-04		0.17	0.010	0.0060	0.600	1.80	Stauffer et al., 2005, Att. III, Table III-5
Tsankawi	0.45	3.40E-04		0.29	0.003	0.0200	2.000	1.50	Stauffer et al., 2005, Att. III, Table III-6
Cerro Toledo	0.45	3.40E-04		0.29	0.003	0.0200	2.000	1.50	Stauffer et al., 2005, Att. III, Table III-6
Qbo	0.44	2.50E-04		0.22	0.019	0.0060	0.600	1.80	Stauffer et al., 2005, Att. III, Table III-7
Guaje	0.67	1.47E-04	1.5E-13	0.13	0.000		0.081	4.00	Stauffer et al., 2005, Table 4
Puye	0.25	4.60E-03		3.97	0.045	0.1450	14.50	2.68	Birdsell et al., 1999, Table 2.1-1

Table E-3.3-1
VS2DTI Transport Properties Used for General's Tanks Simulations

Transport parameter	Units	Value	Source
Longitudinal dispersivity	m	5.0	Estimated from simulation with dispersivity = 0
Transverse dispersivity	m	0.5	Estimated from simulation with dispersivity = 0
Diffusion coefficient	m^2/day	1.58E-06	(Dawson and Pohl 1997, 102730, Table 2)
Equilibrium distribution coefficient (K_d)	m^3/kg	0.0012	(Longmire et al. 1996, 056030)

Attachment E-1

Erosion Evaluation

Washington

Sheet 1 of 1

Project MDA A REMEDIATION Contract No. — File No. E-1.1

Feature COVER DESIGN Designed R RAGAN Date 7/9/08

Item SOIL LOSS RUSLE Checked V. Rhodes Date 8/19/08

APPROACH: USE SOIL LOSS CALCULATED FROM LANDFILL DESIGN .COM (USLE).

PARTICLE SIZE = 0.3 mm d_{50} BASED ON TA 63 GRADATION TESTS OF TUFF (SHAW ENV)

BARE SOIL 2.72 TONS/ACRE/YEAR

KNOWNS:

AREA OF COVER 1.3 ACRES

ASSUMPTIONS:

SOIL DENSITY = 85 pcf

= WEIGHT (TONS) SOIL / ACRE / IN-THICKNESS = 150.7

W_T = 85 · 43,560 $^{ft^2}/_{acre}$ / 12 "/' · 2000 #/T = 154.3 T/ACRE

ASSUME 1000 YR W/ POOR VEGETATION:

FOR 1000 YRS

= .01 × 1000 = 10 TONS/ACRE

10/154.3 = <u>0.07 " SOIL LOSS</u>

ASSUME 1000 YEARS W/ BARE SOIL

= 1.34 (1000) = 1,340 TONS/ACRE

1340/154.3 = 8.7 " SOIL LOSS

USE 9" SOIL LOSS (23 cm)

IN 1000 YEARS FOR BARE SOIL

ATTACHMENT A - SOIL LOSS (RUSLE) CALCULATION

MDA A REMEDIATIC
COVER DESIGN
SOIL LOSS
ATTACHMENT A

go to problem statement input values solution contact help references

landfilldesign.com

Landfill Slope Erosion Control, RUSLE - Design Calculator

Problem Statement

Erosion control is a critical component for designing landfill final covers. This is due to the fact that landfill covers are typically expensive to construct and very expensive to repair when they fail. This calculator predicts the soil loss from a slope based on the Revised Universal Soil Loss Equation (RUSLE). Selection of a Geosynthetic Erosion Control Blanket (GECB) to limit erosion is achieved by submitting a proper cover factor into the calculation.

For more information on RUSLE, visit the USDA National Sedimentation Laboratory website at http://www.sedlab.olemiss.edu/rusle/current.html

Solutions

Annual Soil Loss in tons/acre/year is calculated as follows, each factor will be explained in more detail below.

$$A = R * K * L * S * C * P$$

A Average Annual Soil Loss (ton/acre/year)

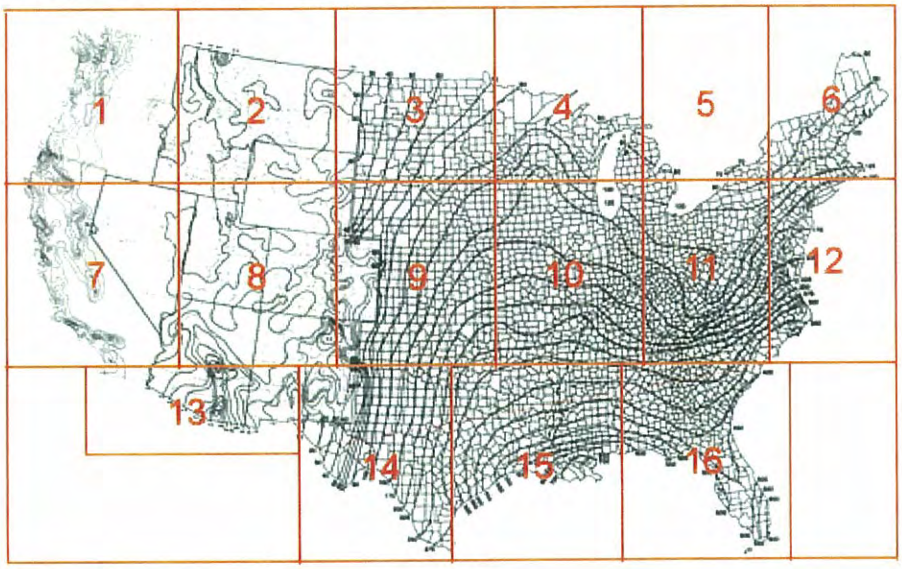
MDA A Remediation
Cover Design
Soil Loss
Attachment A

R	Regional Rainfall and Erosivity Index
K	Soil Erodibility Factor (tons/acre)
L	Slope Length Factor (ft)
S	Slope Angle Factor
C	Cover Management Factor
P	Crop Support Practice Factor

where:

R = Regional Rainfall and Erosivity index
The rainfall erosion index plus a factor for any significant runoff from snowmelt.

(use map below to determine your location, then follow the link to determine what your index would be)



K = Soil Erodibility factor
The soil-loss rate per erosion index unit for a specified soil as measured on a standard plot, which is defined as a 72.6 ft (22.1 m) length of uniform 9% slope in continuous clean-tilled fallow.

$$K = 7.594 * \left\{ 0.0034 + 0.0405 \exp\left[-\frac{1}{2}\left(\frac{\log(D_g) + 1.659}{0.7101} \right)^2 \right] \right\}$$

where D_g = geometric mean particle diameter

L= Slope Length Factor
The ratio of soil loss from the field slope length to soil loss from a 72.6-ft length under identical conditions.

MDA A REMEDIAT
COVER DESIGN
SOIL LOSS
ATTACHMENT A

$$L = \left(\frac{l_h}{72.6}\right)^m \quad \text{with} \quad m = \frac{\dfrac{\sin(s)}{0.0896} * \dfrac{1}{3*(\sin(s))^{0.8} + 0.56}}{1 + \dfrac{\sin(s)}{0.0896} * \dfrac{1}{3*(\sin(s))^{0.8} + 0.56}}$$

where l_h is the horizontal length and ***s*** is slope

S= Slope Steepness Factor
The ratio of soil loss from the field slope gradient to soil loss from a 9% slope under otherwise identical conditions.

If gradient < 0.09 then $S = 10.8 * \sin(s) + 0.03$,
If $l_h <= 3$ then $S = 3(\sin(s))^{0.8} + 0.56$,
If $l_h < 15$ then $S = 16.8 * \sin(s) - 0.50$

C= Cover Management Factor
The ratio of soil loss from an area with specified cover and management to soil loss from an identical area in tilled continuous fallow.

P= Support Practice Factor
The ratio of soil loss with a support practice like contouring, stripcropping, or terracing to soil loss with straight-row farming up and down the slope.

Input Values

Annual Soil Loss in Tons/acre/year- Input

R from map	30	hunderds ft.tonf.in/(acre.h.yr)
Avg soil particle diameter	0.3	mm
slope	1.5343	degrees (°)
length	160	ft
C_{veg}	.01	<Help!
C_{ecb}	.01	<Help!
P	1	

Calculate Annual Soil Loss

Solution

Annual Soil Loss in tons/acre/year - Output

Annual Soil Loss - Bare Soil	**1.34**	tons/acre/year
Annual Soil Loss - Vegetated	**0.01**	tons/acre/year
Annual Soil Loss - ECB	**0.01**	tons/acre/year

Additional Assistance

ATTACHMENT A

MDA A REMEDIATION
COVER DESIGN
SOIL LOSS

If you would like to have Advanced Geotech Systems provide material specifications that meet your performance criteria, please fill in the following fields and click the submit button. All information is kept strictly confidential.

Name *

Company

Email Address *

Phone

Project Reference

Comments

*required fields

Submit Design Results

References

K.G. Renard, G.R. Foster, G.A. Weesies, D.K. McCool, and D.C. Yoder. (1997), "Predicting Soil Erosion by Water: A Guide to Conservation Planning with the Revised Universal Soil Loss Equation (RUSLE)", U.S. Government Printing Office, ISBN 0-16-048938-5.

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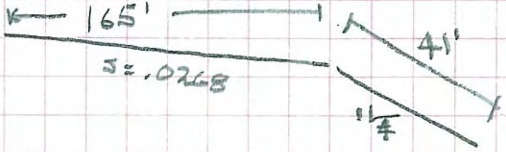
Washington

Sheet 1 OF 12
Project MDA A COVER DESIGN Contract No. —
File No. E-1.3
Feature EROSION PROTECTION Designed RER Date 7/11/08
Item SIDE SLOPE ROCK SIZING Checked Date



THE CONCEPTUAL CELL HAS A 165' MAXIMUM TOP SLOPE W/ $S = 2.68\%$ AND A 40' (41' ALONG SLOPE OF 4:1)

KIRPICH EQ. FOR TC

$$T_c = .0078 \frac{L^{0.77}}{S^{0.385}} =$$

$$T_{c_{165}} = .0078 \frac{165^{0.77}}{.0268^{0.385}} = .0078 \frac{50.9874}{.2482} = 1.60 \text{ min}$$

BRAUN & ORLIMAN – UDKA APPROACH

$$T_c = C\left(\frac{L}{S\,i^2}\right)^{1/3} =$$

$C = 1.0$ (BARE EARTH)

$i = 40.4$ 1 HR TS PMP
L (SEE PMP CALCULATION, SHEET 1)

$$T_{c_{165}} = 1.0 \left[\frac{165}{.0268\,(40.4)^2}\right]^{1/3} = 1.56 \text{ min}$$

SCS METHOD

$$T_c = \left[\frac{11.9\,(L)^3}{H}\right]^{.385} = \left[\frac{11.9\,(.0313)^3}{6}\right]^{.385} = \frac{.0238}{60} = 10004 \text{ min}$$

H = SLOPE HEIGHT = 6'
L = SLOPE LENGTH IN MILES

FOR 41' SLOPE @ 4:1

KILPICH

$$T_{c_{41}} = .0078 \frac{41^{.77}}{.25^{0.385}} = 0.232 \text{ min}$$

B&O

$$T_{c_{41}} = 1.0 \left[\frac{41}{0.25\,(40.4)^2}\right]^{1/3} = 0.46 \text{ min}$$

SCS

B4 WSP TOO LOW

Sheet 2 of 12

Project M.DA A Contract No. ______ File No. E-1.3

Feature Erosion Protection Designed ______ Date 7/14/08

Item Sideslope Rock Sizing Checked ______ Date ______

SUMMARY OF T_C:

	165' (TS)			41' SIDESLOPE			TS+SS		
	KIL	B&O	SCS	KIL	B&O	SCS	KIL	B&O	SCS
PMP	1.60	1.56	.0238	.253	0.46	~0	1.85	2.02	~.0238

FROM PLOT OF HMR55a 1hr 10²mi DATA FOR LOS ALAMOS (SHEET 3) AND APPLYING A REGRESSION ANALYSIS OF INTENSITY VALUES (SHEET 7) YIELDS A CALCULATED DEPTH OF 2.36" FOR t_c = 2.5m

USE t_c = 2.5 MIN MINIMUM VALUE

$i = 2.36 \times 60/2.5 = 56.6''/hr$

CHECK 1hr-1mi² TS. PMP FROM HMR55a, SHEET 10 = 10.2"

APPLY TABLE 4.1 OF TAD, p65

$PMP_{tc} = .275 \times 10.2 = 2.80''$

$i = 2.80 \times 60/2.5 = 67.3''/hr$ ⇐ USE

CALCULATE FLOW:

$Q_T = CiA$

$C = 1.0$ (ASSUMED)

$i = 67.3''/hr$

$A = AREA = L \times W$

(NOTE: DIVIDE BY 1/43,200 TO CONVERT iph TO FPS.)

$W = 1.0'$

$Q_T = 1.0\,(67.3)\frac{1}{43200} \cdot L = .0016L$

$L = L_{TS} + L_{SS} = 165 + 41 = 206'$

$Q_T = .0016(206) \cong .321$ CFS/F

IGNORE INTERSTITIAL FLOW (ASSUME MORE THAN 30% OF ROCK IS ≤ 1.0")

CALCULATE THE DEPTH OF FLOW:

$$Y = \left[\frac{n \times Q}{1.486 \times S^{0.5}}\right]^{3/5}$$

$$n = \frac{R^{1/6}}{23.85 + 21.95 \log_{10}(R/K)}$$

K = MEAN ROCK Ø IN ' = .1667' (ASSUME 2" d_{50})

R ASSUME = .5'

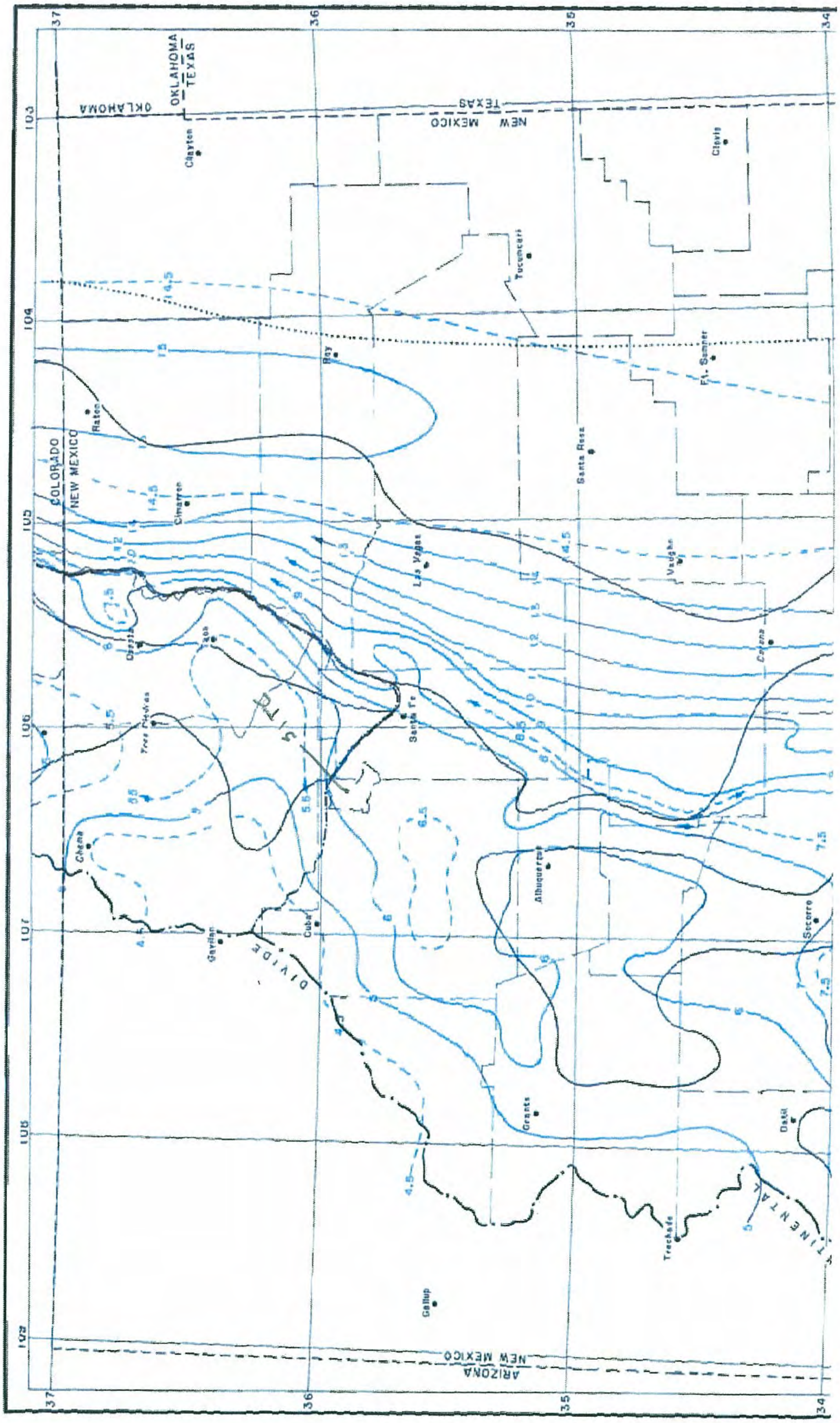
$$\frac{.8909}{34.3274} \quad n = \frac{.5^{1/6}}{23.85 + 21.95 \log_{10}(.5/.1667)}$$

MDA A
CAP DESIGN
PMP CALCULATIONS
ROCKSPRING

REK
JAR

SHEET 3 OF 12
E-1.3
7/23/08
8/18/08

REF: HMR 55a

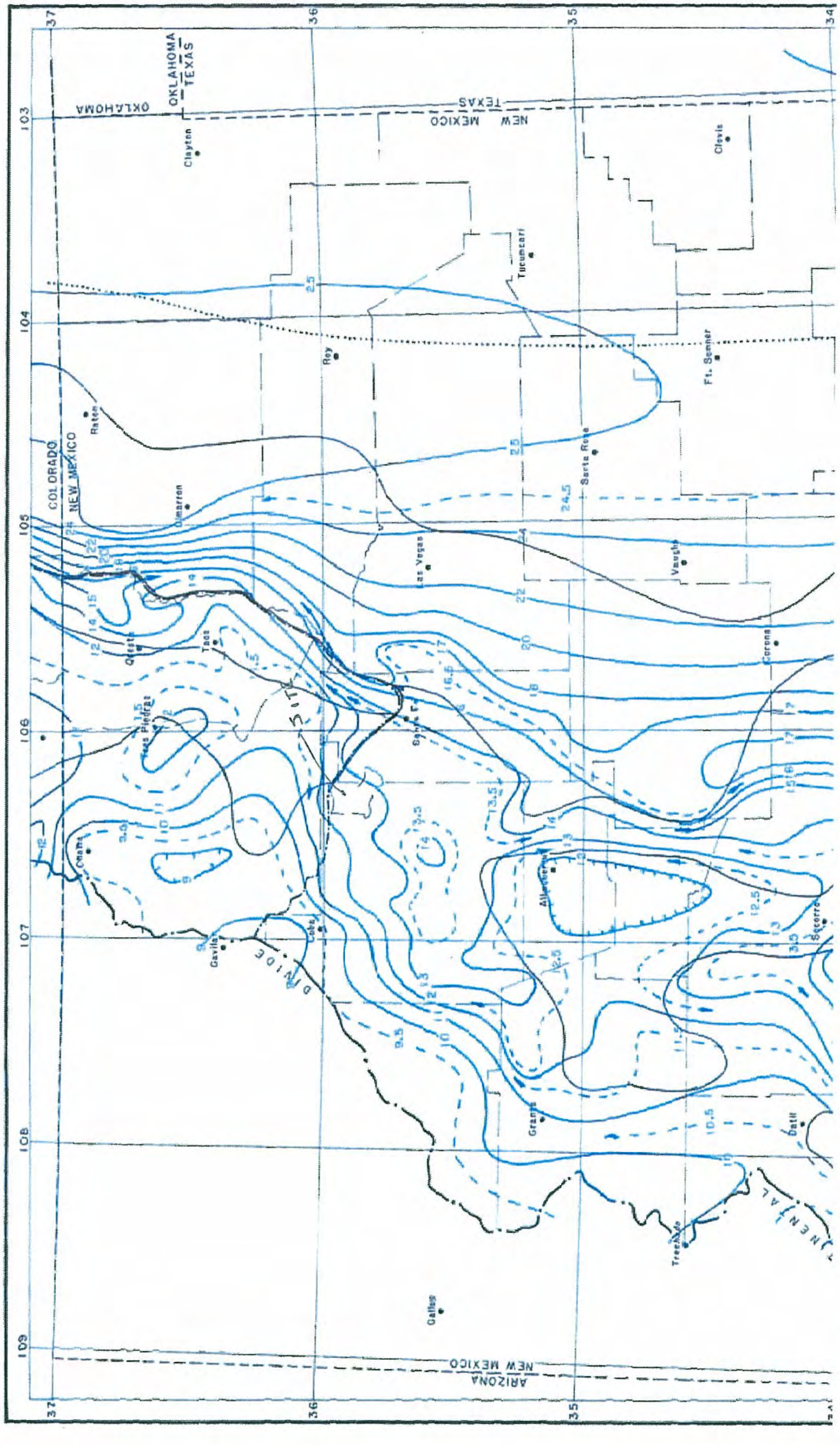


1 HR 10 mi² PMP 6.2"

MDA A
CAP DESIGN
PMP CALCULATIONS
ROCKSIZING

SHEET 4 of 12
E-1.3
RER 7/23/08
VAR 8/18/08

REF: HMR 55a



6 HR 10mi² PMP = 12.5"

MDA A

CAP DESIGN

PMP CALCULATIONS

ROCK SIZING

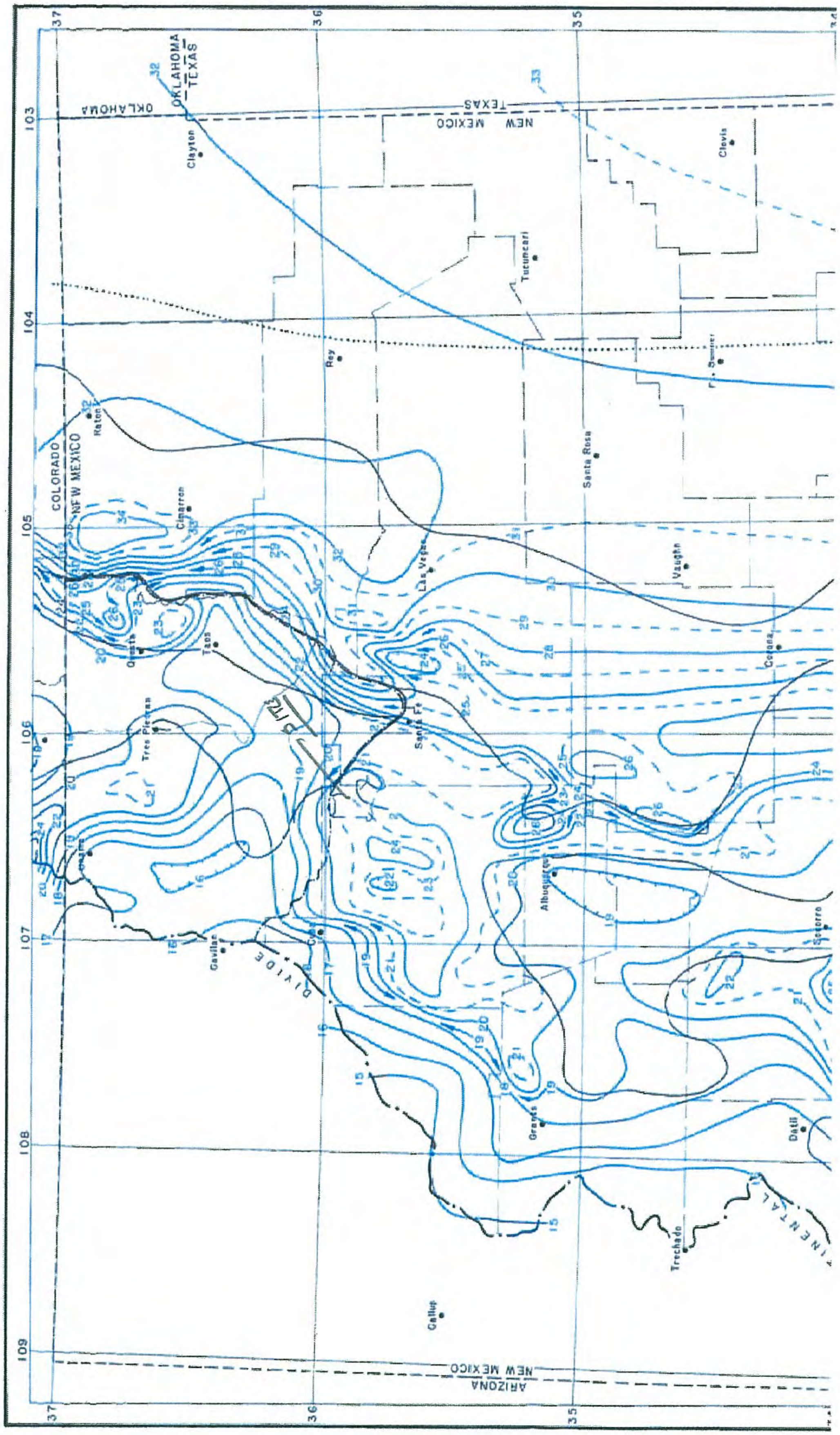
SHEET 5 OF 1

E-1.3

RER 7/23/0

VAR 8/18/0

REF HMR 55a



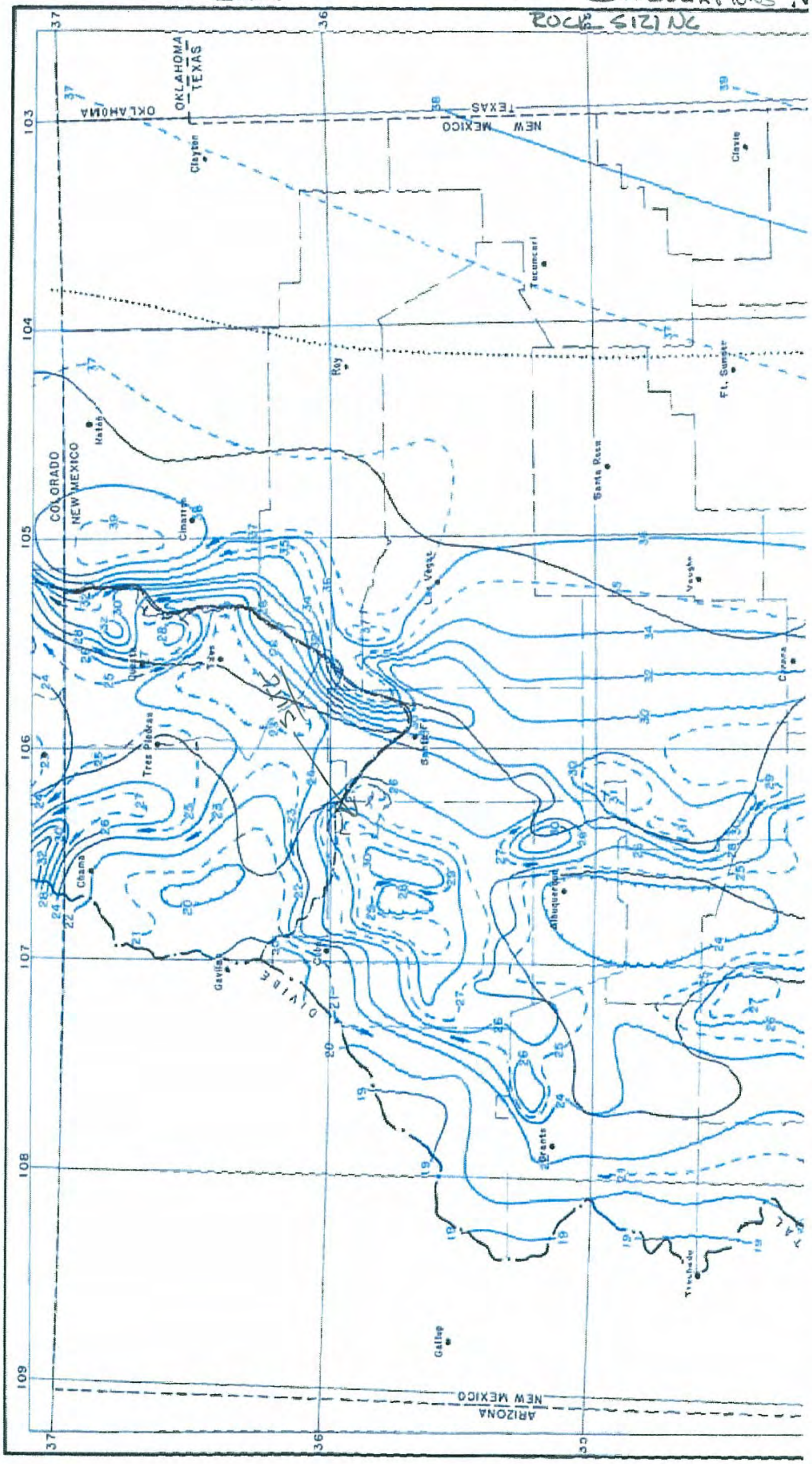
24 hr 10 mi² PMP 23"

MDA A
Cap Design
PMP Calculations: VAR 8/18/08

Sheet 6 of 12
REF E-1.3 7/23/08

Ref HMR 55a

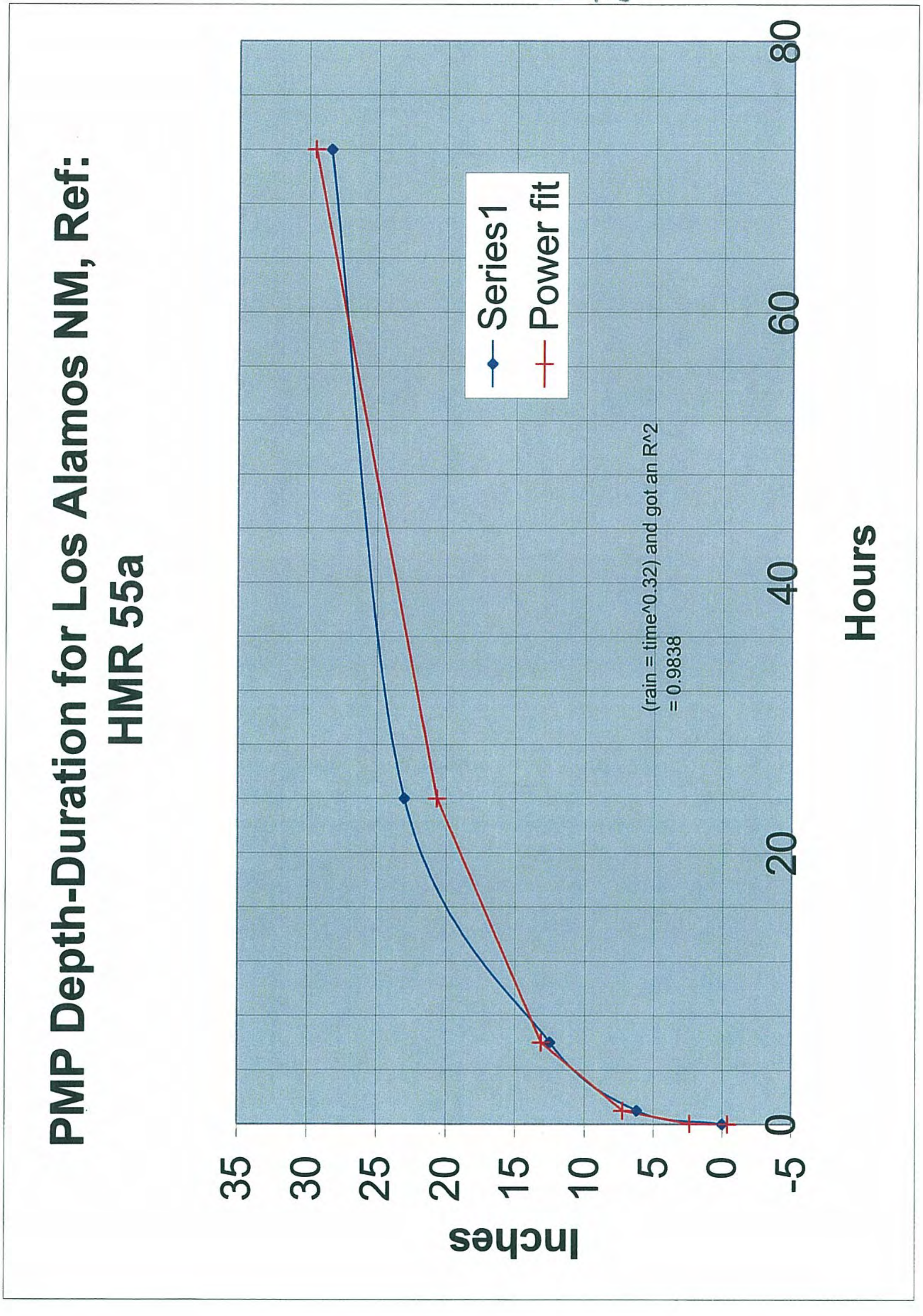
ROCK SIZING



72 hour 10 sq mi PMP 28.4"

MDA A
CAP DESIGN
PMP CALCULATIONS
ROCK SIZING
E-1.3

SHEET 7 OF 1
RER 7/23/0



MDA A

CAP DESIGN RER

PMP CALCULATIONS VAR

Sheet 8 of 12

E-1.3

7/23/08

8/18/08

REF: HMR 55a

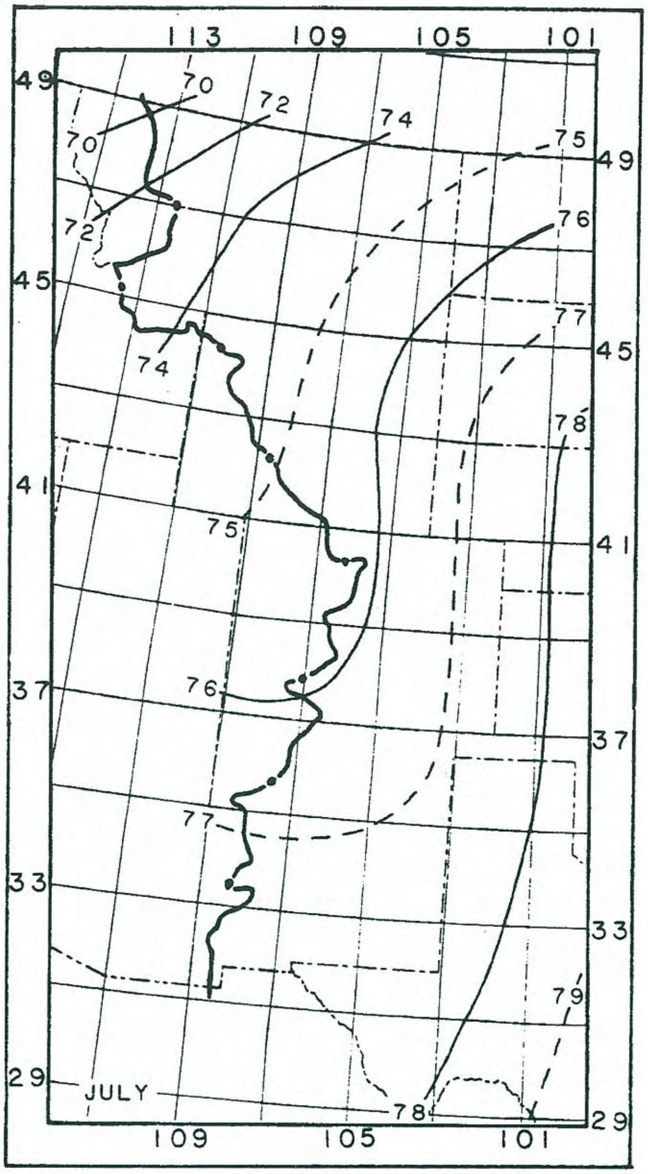


Figure 4.11.--Maximum persisting 12-hr 1000-mb dew points (°F) for July.

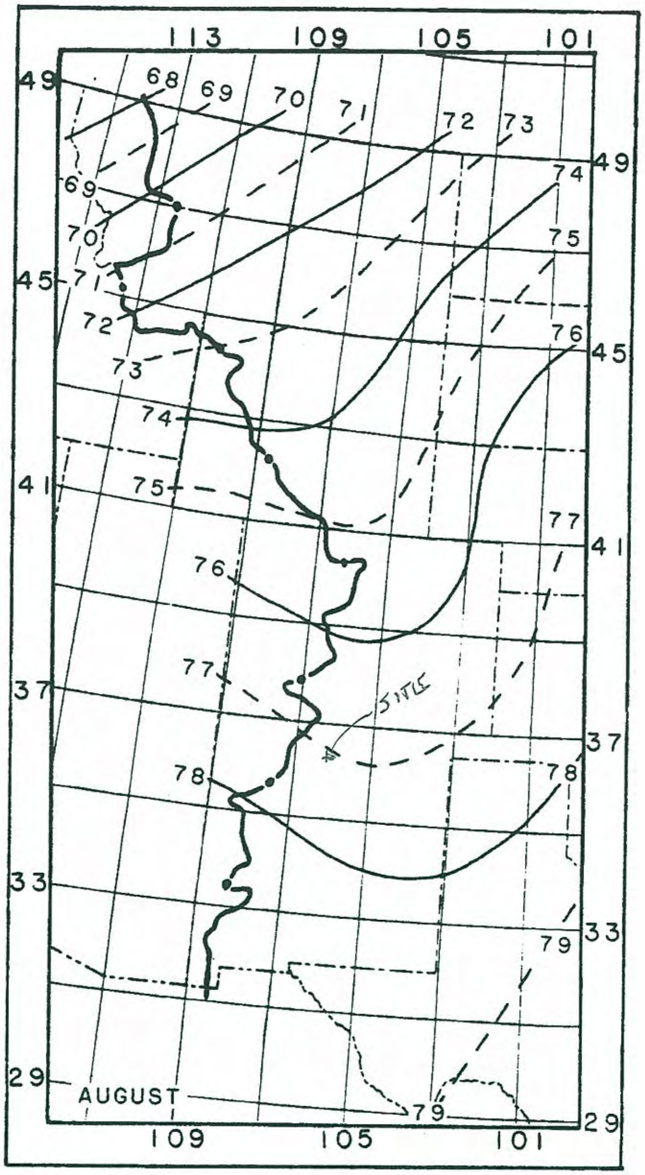
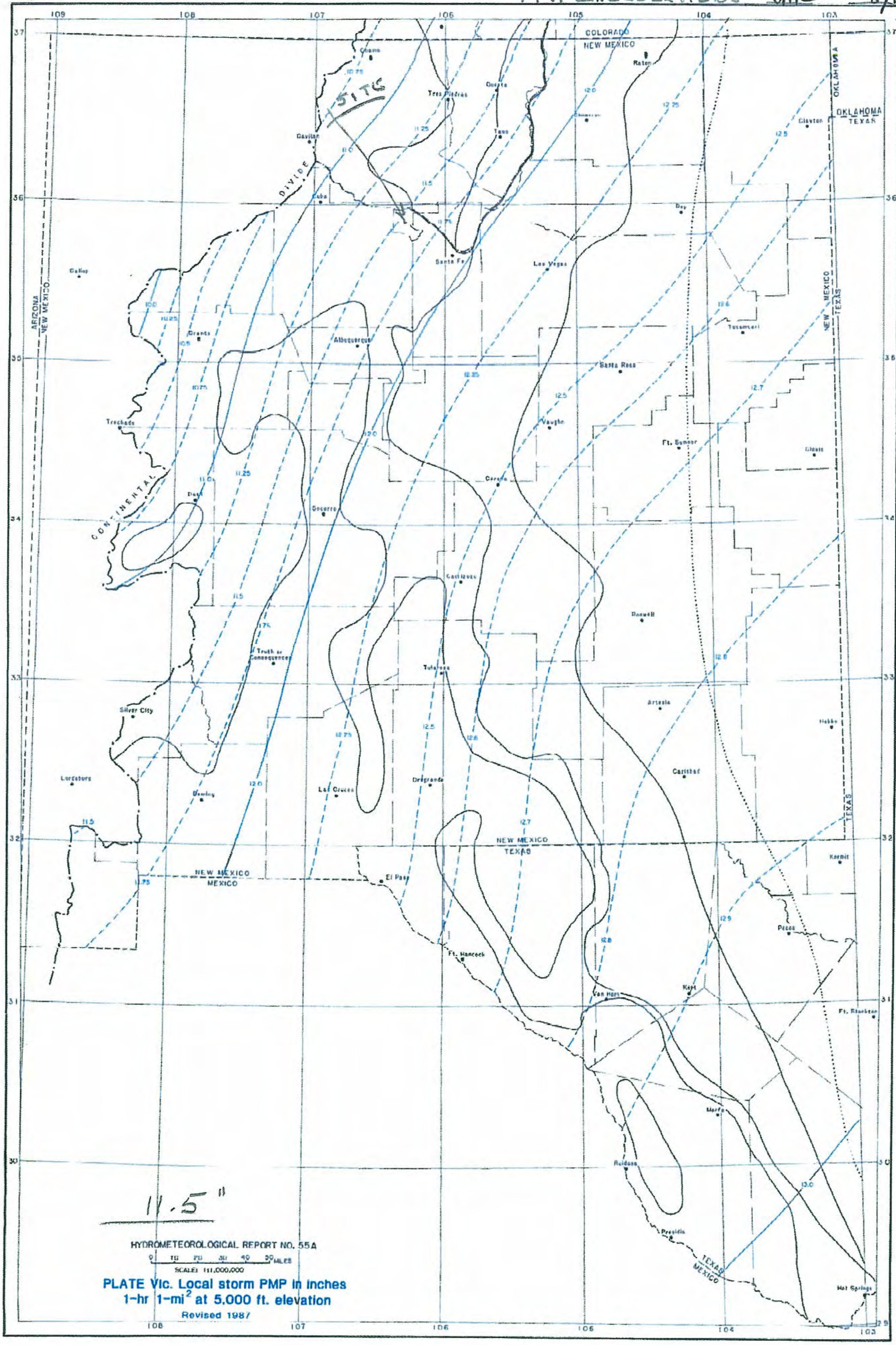


Figure 4.12.--Maximum persisting 12-hr 1000-mb dew points (°F) for August.

MPA A
CAP DESIGN
PMP CALCULATIONS

SHEET 9 OF 12
RER E-1.3 7/23/08
VAR 8/18/08

REF: HMR 55a



11.5"

HYDROMETEOROLOGICAL REPORT NO. 55A

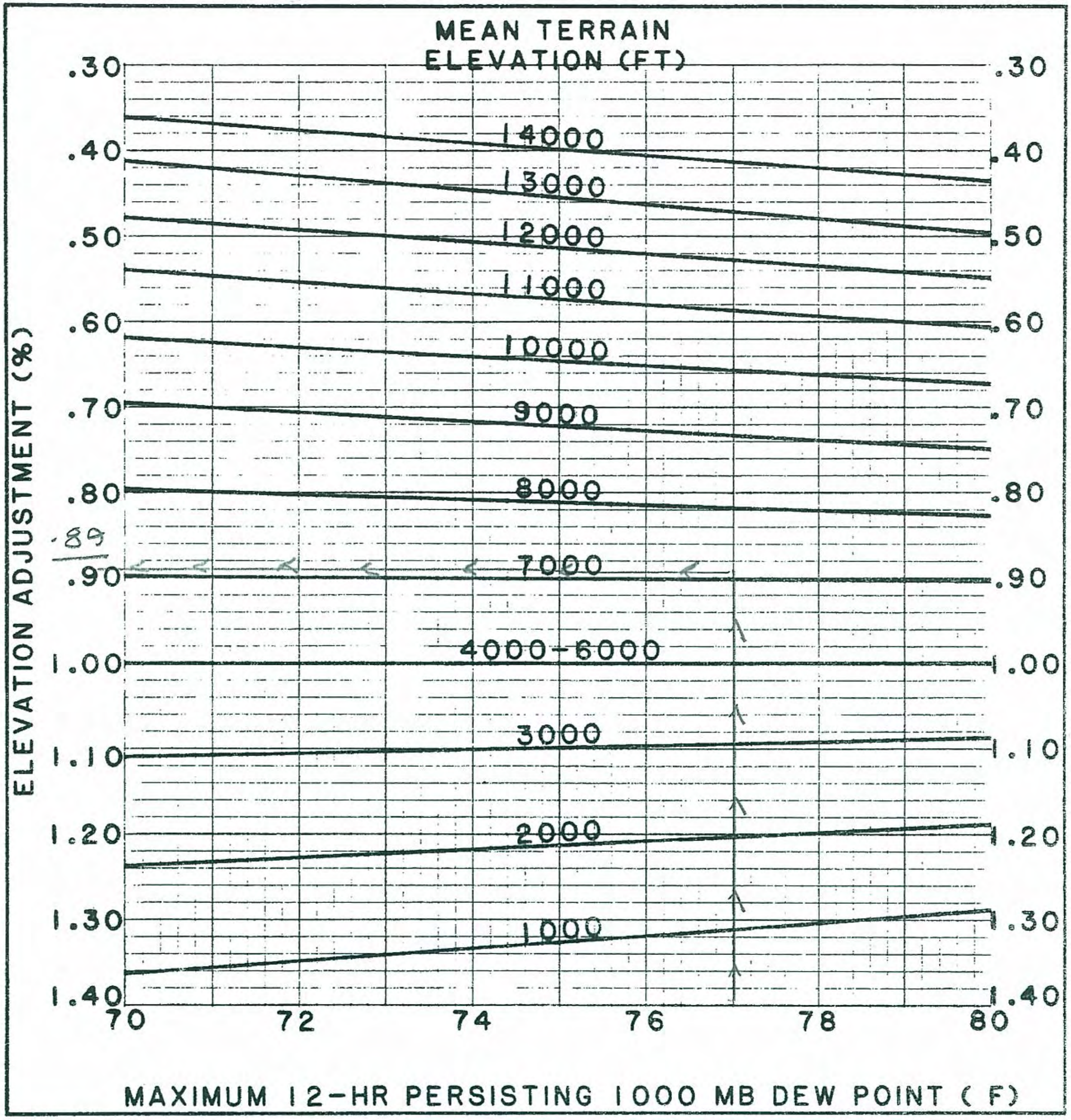
PLATE VIc. Local storm PMP in inches 1-hr 1-mi² at 5,000 ft. elevation

Revised 1987

MDA A
CAP DESIGN
PMP CALCULATIONS

SHEET 10 OF 12
E-13
REE 7/23/08
VAR 8/18/05

REF HMR 55a



REDUCE 1 HR, 1 MI^2 LOCAL STORM BY .89

.89 · 11.5 = 10.2"

Figure 14.3.--Adjustment for elevation for local-storm PMP based on procedures developed in the report and maximum persisting 12-hr 1000-mb dew point (F).

Washington

Sheet 11 OF 12

Project MDA - A

Contract No. —

File No. E-1.3

Feature EROSION PROTECTION

Designed REK

Date 7/24/08

Item SIDE SLOPE ROCK SIZING

Checked

Date

$$Y = \left[\frac{.0260 \times .0330}{1.486 \times .25^{0.5}}\right]^{3/5} = .0173' = .207''$$

$n = .0260$

$s = .2500$ (4:1)

SIZE ROCK USING STEPHENSON METHOD

$$k = \left[\frac{Q\,(\tan T)^{7/6}\, p^{1/6}}{C g^{1/2} \left[(1-p)(G_s-1)\cos T\,(\tan P - \tan T)\right]^{5/3}}\right]^{2/3}$$

k = d_{50} ROCK SIZE IN '

Q = FLOW CFS

T = ANGLE OF SLOPE 14.03°

C = CONSTANT (ASSUME .22)

G_s = SPECIFIC GRAVITY OF ROCK = 2.7

P = ANGLE OF REPOSE 35°

g = 32.2 FPS²

p = POROSITY .4 USE

$$= \left[\frac{.321\,(\tan 14.03°)^{7/6}\,.4^{1/6}}{.22\,(32.2)^{.5}\left[(1-.4)(2.7-1)\cos 14.03°(\tan 35° - \tan 14.03)\right]^{5/3}}\right]^{2/3}$$

$$= \left[\frac{0.0546}{1.2484\left[\underbrace{(1.02)\overset{.9702}{\cancel{\cos 14.3°}}\,(.4503)}_{.2600}\right]^{5/3}}\right]^{2/3}$$

$\frac{.0546}{.3246} = .1682^{2/3} = .3047' = 3.656$ USE 4.0" d_{50} IF ROUNDED ROCK

THICKNESS OF RIPRAP:

$d_{100} = 8$ (ASSUMED)

$t_{MIN\ REQ} = 4''$ USE $t = 1'$ OR 12"

t = LAYER THICKNESS

ROCK SIZE

USE $d_{100} = 8''$ $d_{50} = 4''$

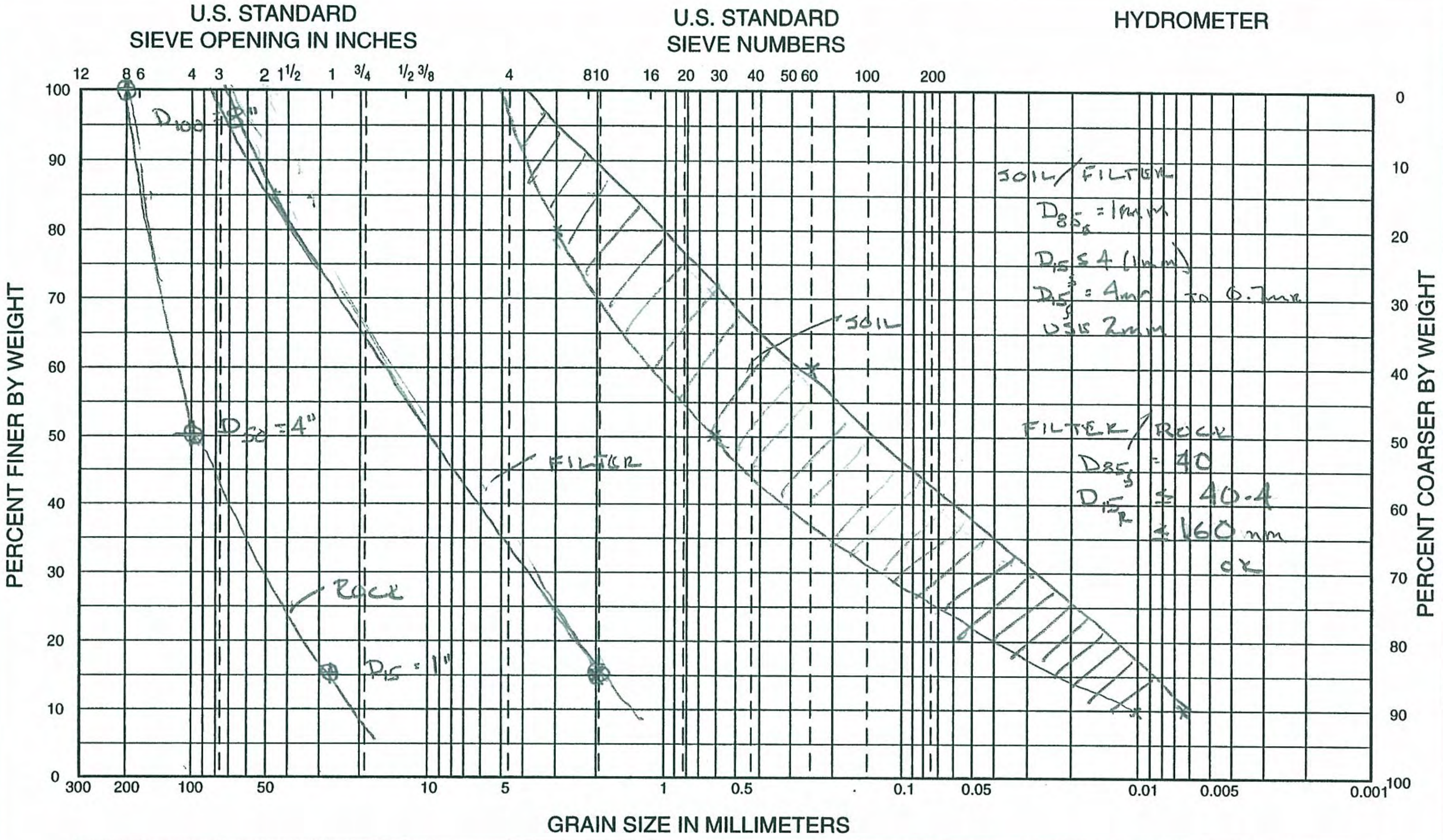
FILTER SIZE $D_{100} = 3\frac{1}{2}''$ $D_{50} = 3/8''$ $D_{15} = 2mm$ (SEE SHT 12)

MORRISON KNUDSEN CORPORATION

PROJECT MDA A E-1.3
FILE ROCK SIZING FILTER DESIGN
BY R BRAGER DATE 7/24/08
CHECKED BY ________ DATE ________

P 12 OF 12

GRAIN SIZE ANALYSIS



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE NO.	ELEV. OR DEPTH	UNIFIED SOIL CLASSIFICATION (USCS)	NAT. WC	LL	PI

PROJECT
TASK
HOLE NO.
LOCATION.
DATE

MORRISON KNUDSEN CORPORATION

Project MDA A Remediation
Contract No. —
Sheet 1 of 1
File No. E-1.4
Feature Cover Design
Designed RER
Date 7/22/08
Item Erosion of Topslope
Checked
Date

USE METHODOLOGY OF UMTRA TAD, R2 p98-107
ASSUME COVER SOIL GRADATION SAME AS TA 61 BORROW AREA SOILS

d_{75} = .5 TO 2mm ∴ AVERAGE $d_{75} \cong$ 1.27mm ... OK

$T_a = .4(1.3) = .52$ PSF

$n_s = d_{75}^{1/6} \div 39 = .0267$

$$D = \left[\frac{n \times Q}{1.468 \times S^{0.5}}\right]^{3/5}$$

TRY n = .15

C_R = .15 TABLE 4.7 TAD, R2 p103

∴ $F_{cl} = 3(.15) = .0657$

$Q = F_{cl} \cdot I \cdot L = .0657(67.3/43200)165 = .0169$

$$D = \left[\frac{.0267(.0169)}{1.488 \times .0268^{0.5}}\right]^{3/5} = .0231' \times 12''/' = .2774''$$

∴ $I = 67.3''$/HR
SEE CALC E-1.3
SHEET 2

L = 165 CALC E-1.3
SHEET 1

$T_o = \gamma_w D S_e$

$= 62.4(.0231).0268 = .0386$

$$T_a / T_o = \frac{0.52}{.0386} = 13.5 > 1.0 \ldots \text{OK}$$

GRADATION OF CRUSHED TUFF IS SUITABLE FOR BARE SOIL EROSION PROTECTION

MORRISON KNUDSEN CORPORATION

Sheet 1 OF 2
Project MDA A REMEDIATION Contract No. —— File No. E-1.5
Feature CAP DESIGN Designed RER Date 8/8/08
Item SLOPE STABILITY Checked VAR Date 8/19/08

THE CRITICAL CROSS SECTION FOR SLOPE STABILITY IS THE HIGHEST SLOPE LOCATED IN THE NORTH WEST CORNER OF THE COVER.

SINCE THE COVER MATERIAL IS GRANULAR IN NATURE AND THERE IS NO WATER IN THE SLOPE, A SIMPLE INFINITE SLOPE STABILITY ANALYSIS CAN BE PERFORMED.

METHODOLOGY IS PRESENTED IN LAMB & WHITMAN, 1969 A JOHN WILEY PUBLICATION, P193:

Safety Factor

The safety factor for an infinite slope usually is defined as

$$FS = \frac{\tan \phi}{\tan i}$$

The only unknown factor in the stability of an infinite slope is the appropriate value for the angle of internal friction. This quantity can be estimated with reasonable accuracy and, furthermore, the consequences of failure of such a slope are slight. Hence the safety factor does not need to be large. Usually an engineer will be conservative in his choice of $\phi = \phi_{cv}$, and will use $FS = 1$.

THE FRICTION ANGLE FOR GRANULAR SOILS RANGES FROM 32°-42° (BELL, FG, "ENGINEERING PROPERTIES OF SOILS AND ROCK" p 17):

Coarse Grained Soils 17

Table 2.2 SOME VALUES OF THE COMMON PROPERTIES OF SOILS

A. COHESIONLESS SOILS	*Gravels*	*Sands*
Relative density	2.5–2.8	2.6–2.7
Bulk density (Mg/m³)	1.45–2.3	1.4–2.15
Dry density (Mg/m³)	1.4–2.1	1.35–1.9
Porosity (%)	20–50	23–35
Shear strength (kPa)	200–600	100–400
Angle of friction	35–45°	32–42°

MORRISON KNUDSEN CORPORATION

Sheet 2 of 2
Project MDA A REMEDIATION
Contract No. —
File No. E-1.5
Feature CAP DESIGN
Designed RER
Date 8/8/08
Item SLOPE STABILITY
Checked VAR
Date 8/19/08

USE $\phi = 32^\circ$

$$FS = \frac{\tan 32^\circ}{\tan 14.03^\circ} = 2.5 > 1.5 \ldots\ldots \text{OK}$$

BY INSPECTION THE SLOPE WILL BE SAFE FROM STATIC LOADING

Attachment E-2

Excerpts from Unnumbered Log Book

Recovery of Pu from the General's Tanks

Work started by J.P. Nigon and L.J. Mullins on Jan. 24, 1947

Contents of General's Tanks:

The following is a summary of the best information available on the contents of the General's Tanks:

KOH Tank: N = ~~2 N~~ ~.17 N

VOLUME = 62,000 l

Pu = 165 g

Pu conc. = .001 g/l

pH ≈ 10

Comp.

- NaOH
- KOH
- $Ca(NO_3)_2$
- $Mg(NO_3)_2$
- Al
- I_2
- H_2O_2
- KNO_3
- Fe
- Cr
- Ni
- La
- Mg

NH_4OH TANK

VOLUME = 13,200 l

Pu = 86. g

Pu conc. = ~ .001g/l ?

Comp:

- ~5N in NO_3^-
- ~5N in NH_4^+
- Mg
- Ca

This tank is obviously highly buffered.

pH = ~ 8

CALCULATIONS:

On the basis of an IR 100 column (4.2" x 5/8") having adsorbed sufficent Na^+ (to reduce pH to acid side) from 100 cc. of .2N NaOH, let's calculate the volume of IR100 necessary to reduce 62,000 l sol'n to an acid pH. (assuming and volume IR100 is proportional to Na^+ adsorbed)

Vol. of IR 100 test column

$$(3.14)\left(\frac{5}{8} \times \frac{1}{2}\right)^2 (42'') = \frac{1.29}{\cancel{1.29}} \text{ cu in}$$

~~1.290~~

$$\frac{1.29 \text{ cu in}}{.1 l} = \frac{x \text{ cu in}}{62,000}$$

$$x \text{ cu in} = \frac{(62,000)(1.29)}{.1} = 800,000 \text{ cu in}$$

$$\text{in } \frac{8\cancel{00000} \text{ cu in}}{5.79 \times \cancel{1000}} = \boxed{13.8 \text{ cu ft}}$$

L. J. Mullins Jan 30, 1947

Jan 31, 1947 J. P. Nigon

An experiment to determine the exchange capacity of amberlite I R 100 was started. Two columns (No 1, No 2) were used No 1 had been regenerated several times, No 2 had been regenerated only once before the experiment was started. the each column was treated with 3N HCl, the excess acid washed off and a capacity ammount 100 ml of 1N NaOH passed thru. This procedure was repeated until it was no longer ~~possible~~ to put 100 ml ~~thru~~ of NaOH thru the column.

Data column 1
1st 100 ml ph 3.3
2nd 100 ml ph 2.9
3/4/47 J.P.N.
3rd " " ph 3.3
4th " " ph 3.1
5th " " ph 3.1
6th " " ph 2.9

column 2
1st 100 ph 2.9
2nd 100 ph 2.7
3rd " ph 3.3
4th " ph 2.5
5th " ph 3.2
6th " ph 3.1

FEB 3, 1947

ADSORPTION of Pu sol'ns ...

Two 50cc. samples were taken from the General's Tank ("Na") and run through the experimental column (as illustrated on pg. 2).

	pH (start)		pH (run 1)	pH (re-cycle 50cc)
Sample #1	12.5	"39"	"40" 1.2 (dark yellow sol'n)	"42" 10.0 (clear sol'n)
" #2	12.5	"39"	"41" 0.9 (lt. yellow)	"43" 9.5 (" ")

(slower flow rate than #1

Samples of the above sol'ns were sent to Radio Assay for analysis.

2BM 39 - sample of GEN. TNK sol'n
40 - sample #1 run 1
41 - " " 2 " 1
42 - " " 1 ~~rough~~ recycle
43 - " " 2 ~~rough~~ recycle

L. J. Mullins
J. P. Nigon

Feb. 4. J. P. Nigon

With the respect to the Pu solution in the General's tanks the following course of action was decided upon.

(a) The solution in the tanks will be passed thru a column until the adsorption capacity is reached, the column will then be washed with .5 N H_2SO_4 to regenerate it. After this procedure has been repeated several times the Pu adsorbed will be eluted with conc. Oxalic acid and the oxylate turned over to recovery for concentration.

A solution of .5 N H_2SO_4 was made up and standardized against standard NaOH. The solution is .503 N

WEDNESDAY, MARCH 26, 1947

PILOT COLUMNS

Packed columns 1 and 2 with Zeo Karb H (20-30 mesh) and AMBERLITE IR100 (20-30 mesh).
Unit - now ready for operation.

EXPERIMENT P1 --- To determine whether Pu will exchange for Na on Zeo Karb Na resin.

FRIDAY, MARCH 28, 1947

ZEO KARB-H ---- Exp. P1

Washed col 1 (Zeo-H) with water. Resin still in Na form.

439 - Commenced passing *KOH sol'n thru column.
(LJM 157) ph. 12.6
SOLIDS (Pg. 27) 77.34

1520 - Stopped at 4 liter -- withdrew sample
(LJM 158) ph ~~11.5~~ 11.3
LJM 159 BLANK -- dist. water

1525 - Resumed passage

1543 Stopped at 6 liter withdrew sample
(LJM 160) ph · 6.8

1545 resumed passage

1558 passing 8 l. mark

1611 Stopped at 9 Liters withdrew sample
(LJM 161) ph 6.6

---

*KOH sol'n was taken from Trailer Tank in back of Rm 213. Very cruddy mixture, large amts Fe(OH)$_3$ and gravel

~~Monday, March 31, 1947~~

see pg 27

Results of Exp. P1	Solids (g/l)	Rad. Assay	Rad. Rpt.
LJM 157 -- original Pu conc.	77.34	.0011 g/l	6×10^{-4}
LJM 158 -- conc. at 4 l.	.49	~~1.8x~~ 1.8×10^{-6} g/l	2.4×10^{-6}
LJM 159 -- H_2O blank		4.5×10^{-6} g/l	5.3×10^{-7}
LJM 160 -- conc. at 6 l	3.10	2.0×10^{-6} g/l	2.8×10^{-6}
LJM 161 -- conc. at 9 l.	19.99	7.5×10^{-6} g/l.	2.1×10^{-6}

Conclusions

Pu does exchange for Na^+.
Future experiments should be tried using:

1- Zeo Karb Na^+ cycle column followed by AMBERLITE Na^+ cycle column (provided that the pH of the sol'n has been sufficiently reduced (not above 8.5)

2- If pH is not sufficiently lowered, use 2 Zeo Karb Na^+ columns.

3- Radio-Assay Results in this (above) range are ~~[illegible]~~ undependable (see BLANK-- LJM 159).

Summary P1 Exp.

~~Start~~ Time	Vol.	pH	total solids	Pu conc.
1439	0	12.6	77.34 g/l	.0011 g/l
1520	4 l.	11.3	.49 g/l	1.8×10^{-6}
1543	6 l	6.8	3.10	2.0×10^{-6}
1611	9 l	6.6	19.99	7.5×10^{-6}

P3 .... (general plan) ---- (test for pw) 10% NaCl
NaCl regeneration
Wash
Influent thru ---- (pass at least 20 l.)
Wash
Elutant thru (~~soln~~ ~~excess acid~~.)

1300 Withdrew Trade Tank of sol'n from General Tank.

Future Work:
Clean & repack Zeo Karb Column (pack only half the column).

WEDNESDAY, APRIL 16, 1947
NaCl sol'n ... $\frac{1\#}{}$ = 453 g
∴ $\frac{\times 2}{906}$ g/gal. sol'n (~9% sol'n).

THURSDAY, APRIL 17, 1947
1300 - started NaCl regeneration (total of 4# NaCl in 20 l H_2O), of Zeo Karb - sampled effluent NaCl sol'n - LJM 173 (LJM 173) [4.5 × 10^{-9} g/l]

MONDAY, APRIL 21, 1947 --- ZEO Karb Na.
RUN P3

0830 Continued salt rinse
0900 Started H_2O rinse

2.3 l

	VOL. (l)	pH	*Remarks	Sample #
✓1025	0.0	12.1	Fairly clear green sol'n	LJM 174
1125	5.2	10.08	Clear sol'n - slight yellow	175
			Slowed flow rate	
			Clear - slight yellow	176
1356	7.6	10.1	" "	177
1556	9.4	10.1		
1615	STOPPED			

174	1.9 × 10^{-4}
175	3.7 × 10^{-7}
176	9.5 × 10^{-7}
177	2.3 × 10^{-6}

NOTE * -- all sol'ns were filtered, before solids were determined.

TUESDAY, APRIL 22 1947

P3 – cont'd   STARTED COLUMN at 0815

Time	Vol.	pH		Sample #	
*✓0820	10.4	10.28		178	7.1 × 10^{-7}
BLANK	~~1c NaCl~~ + H_2O (distilled)			179	9.4 × 10^{-7}
✓1125	✓13.7	± 9.85		180	8.1 × 10^{-7}
1137	Secured column flow at Vol. 13.8 l and sucked up to 0.1 l at 1145				
1145	✓0.1				
1453	3.9	10.1		181	6.9 × 10^{-7}
1620	Secured column				

WEDNESDAY APRIL 23, 1947 – P3 cont'd.

✓0813	6.2	Resumed column flow		
✓0923	7.8	10.25	.00000035	182
~1000	Slowed	flow		
✓1143	10.2	10.85	2 × 10^{-6}	183
1355	11.7	10.92	1 × 10^{-6}	184
1555	14.1	11.08	3 × 10^{-6}	185
~~Resumed~~	SECURED COLUMN			

THURSDAY, APRIL 24, 1947

P3 cont'd

~~but~~ Obtained additional bottle of G.T. sol'n. Allowed sol'n to settle.

✓1352	✓0.2	12.4 (G.T. starting sol'n)	3 × 10^{-4}	186
✓1618	2.8	11.0		187
✓2245	10.6	11.4	5 × 10^{-7}	188.
	Secured	COLUMN		

FRIDAY, APRIL 25, 1947

0818	10.8	STARTED COLUMN		
1115	14.2	11.52	1 × 10^{-6}	189
	Secured column			
	Sucked up to – ~.005 l. Vol			
1135	✓0.	Started COLUMN		~~190~~
	0.	12.8	G.T. Sol'n 2 × 10^{-5}	190

---

* This sample has been in contact with resin all night. @1615 April 21 – 0815 April 22.

P3 SOLID DETERMINATION

20 cc SOL'N TAKEN

173 + T1 = 28.0410 +1.0
T 2 = 28.0040 R = +.3
.037

+ T_2 = 31.5810 R = +1.3
T_2 = 29.6690 R +.2
174 1.9120

29.2670 R = +1.0 (some sol.d lost
T_3 = 28.3940 R = 0
175 .8730

29.2290 +.5
T_4 = 27.9240 ~~28.~~ R = +.2
176 1.3050

T_5 =
~~177~~

29.1020 R = +1.2
T_6 = 27.6160 R = +1.0
177 = 1.4860

→

33.1660 R = + .6
T_7 = 31.1690 R = +1.2
178 1.9970

31.5330 R = -1.2
T_8 = 29.6200 R = -1.0
179 1.9130

28.2480 +.8
T_9 = 26.5140 R = +1.1
.80 1.7340

32.6170 R = -1.0
T_{10} = 30.8020 R = -.9
181 : 1.8150

TOTAL SOLIDS
g/l [Fe SOX]

173	– 1.5 g/l
174	- 95.6 g/l
175	- ~~65.3~~ 43.6
176	65.3
177	73.3
178	99.8
179	95.7
180	86.7
181	90.8
182	99.00
183	99.95
184	100.80
185	100.65
186	104.60
187	100.35
188	94.75
189	103.30
190	97.70
191	105.30

192	108.70
193	110.20
194	36.65

Time	Vol	pH		Sample
P3 –	April	25, 1947	cont'd	
1635	5.3 l	12.15		191

MONDAY, APRIL 28, 1947

P3 cont'd

Time	Vol.	pH	Remarks	Sample #
0817	5.7		Restarted column.	
1548	14.2 56.7 TOTAL	12.2	Secured Run	192

SAMPLE # ~~192~~ LJM 193

This sample is from the General's Tanks ~~after the s~~. It was taken after the sol'n had been pumped thru the tanks for several days. Solution was filtered (Filtrate = #193). 5.2 x 10⁻⁶

^ Request Repeat

TUESDAY, APRIL 29, 1947

~~T 30.8010 R= +.8~~

32.9800 R=-1.0

T1 = 30.8020 R= 0

192 2.1780

WHITE - BROWN TINGE

30.2050 +.8

T2 = 28.0010 R= +1.3

193 = 2.2040

WHITE-GREEN TINGE

27.2470 +1.0

T3 = 26.5140 R = +.3

194 0.7330

BLANK (NaCl in H₂O)

T4 = 27.9240 R = -.3

*SOLIDS from G.T. sol'n

ASH = .00018g

* ~~Take~~ Get dried solids, into a known volume of sol'n and send samples to Rad. Assay and Spec Lab.

No ppt'n occurred. Added 20 more cc H_3PO_4, still no ppt'n. Diluted with ~100 cc H_2O. Ppt'n occurred

Centrifuged at ~1500 for 15 min

Note for Tuesday -- evaporate to convenient vol. for LaF_3 ppt'n. -- get rid of excess HNO_3

TUESDAY, AUG. 19, 1947

Evaporated sol'n --- added $NH_2OH \cdot HCl$ during evaporation --- lost some of sol'n (~1/10)..

Note for Wed. --- do LaF_3 step.

WEDNESDAY, AUG 20, 1947

TOTAL Volume (room temp.) = 22 cc. Large amts of solids present.

THURSDAY, AUG 21, 1947

Assigned to a new problem. I am now working with BILL MAGNESS on recovery of Pu from Vault Concentrate BOTTLES. (see L.A. NOTEBOOK).

FRIDAY, AUG 22, 1947

Working with BILL MAGNESS.
(see LA Note Book

MONDAY, AUG 25, 1947

Working with BILL MAGNESS

TUESDAY, AUG 26, 1947

10 ml Centrifuge Run: —

Took 2 10 ml samples from LOT #19 (Recovery Batch). Centrifuged at 2000 rpm for 20 min.

	COLOR	VOL.	
Ppt.	BROWN	(2.2)(1.7)	LJM 1004 ~~LJM 1003~~
SN.	GREEN		

SN. → LJM 1003 - R00 ASSAY
1004 - ~~Chem.~~ Plate analysis

Ppt. → washed 3 times H_2O (went into sol— small amts solids
LJM 1005 - SPEC.

SOLVENTS

10cc. ~~conc~~ HCl - heat evolved .... heated under lamps.

SN - red-brown
Ppt - dark brown - not as red-brown as before HCl treatment

Washed ppt with H_2O (10cc) + HCl (~0.5cc)
(Tube D)

HNO_3 - added 10cc.

Appendix F

Cost Summary Report for Alternative 1
(on CD included with this document)

Appendix G

Cost Summary Report for Alternative 2
(on CD included with this document)

Appendix H

Cost Summary Report for Alternative 3
(on CD included with this document)

Appendix I

Risk Assessment

EXECUTIVE SUMMARY

This report documents the hypothetical magnitude of impacts to human health and the health of ecological receptors remaining after the application of the corrective measures alternatives proposed for Material Disposal Area (MDA) A, Solid Waste Management Unit (SWMU) 21-014, located at Los Alamos National Laboratory's (the Laboratory's) Technical Area 21 (TA-21). Results of the assessment are presented in this report in terms of short-term (0–100 yr) and long-term (1–1000 yr) risks to human and ecological health in relation to the implementation of the following three proposed remedies from the corrective measures evaluation. Each of the three alternatives includes removal of the contents and remediation of the General's Tanks and of two 50,000-gal. cylindrical steel storage tanks constructed and buried at the western end of MDA A.

- Alternative 1—No Action with Monitoring and Maintenance. The no action with monitoring and maintenance alternative uses the existing conditions at the site and simply monitors the performance of the existing cover.
- Alternative 2—Evapotranspiration (ET) Cover. This alternative is similar to Alternative 1 except the existing cover system will be partially removed and replaced with a cover system having enhanced features needed to reduce maintenance and add robustness of performance.
- Alternative 3—Waste Removal. Complete or partial excavation and removal of waste from the eastern pits, the central pit, and the General's Tanks. The shell of the General's Tanks has also been removed.

The largest source of risk in MDA A is the General's Tanks, which contain plutonium-239, plutonium-240, plutonium-241, and americium-241. The tanks probably also contain metals, although quantitative estimates are limited. To a lesser extent, these contaminants are also found in the other disposal areas at the MDA.

Historically, MDA A has been used for industrial purposes. Current land use for the MDA A site is industrial; the area is fenced and access control is maintained by the Laboratory. It is expected that the land use will remain industrial in the reasonably foreseeable future.

The human health risk assessment for MDA A included the industrial, construction worker, and recreational scenarios. Human receptors may be exposed through direct contact with soil or suspended particulates by ingestion, inhalation, dermal contact, and external irradiation pathways.

The entire area provides potential habitat for ecological receptors. No aquatic habitat is present on or near the site. The Mexican spotted owl may be assumed to forage in the area with moderate to low frequency. Exposure pathways are complete to surface soil and tuff for ecological receptors. The potential pathways are root uptake by plants, inhalation of vapors (burrowing animals only), inhalation of dust, dermal contact, incidental ingestion of soil, external irradiation, and food web transport.

Alternative 1—No Action with Monitoring and Maintenance

Remediation of the General's Tanks will result in small risks to the workers engaged in the remediation operation. In the short-term (0–100 yr), after remediation of the General's Tanks, the existing cap is assumed to remain in place. Today's institutional controls will remain in place and periodic maintenance will occur, similar to maintenance activities currently occurring. Although potential increased risk from carcinogenic and noncarcinogenic chemicals and radionuclides are potentially present in the soil, the risks will not be realized (except in the case of an accident) because workers will be trained and protected. Thus, there is no potential for unacceptable dose or risk to human health for the decision scenarios.

During remediation of the General's Tanks, terrestrial resources will be minimally disturbed. Once the tanks waste removal is completed, the MDA will provide habitat similar to that existing before remedial actions were implemented. Although MDA A borders on foraging habitat for the Mexican spotted owl, direct impacts on this species are not expected from tank removal or subsequent maintenance activities. Because all of the chemicals of potential ecological concern (COPECs) for ecological risk were eliminated in the assessment, there was no potential risk to ecological receptors at the site.

Over the 1000 yr of the long-term scenarios, the cover on MDA A will likely remain intact. The area will likely remain under institutional control and the waste will remain isolated. Under these conditions, the long-term risks from the radioactive and hazardous chemicals in MDA A are not expected to exceed those currently found at the site.

Alternative 2—ET Cover

As in Alternative 1, remediation of the General's Tanks will result in small radiation risks to workers and the public. During the construction of the enhanced cap, there will be somewhat increased radiological doses received by site workers compared with Alternative 1. In the short-term (0–100 yr), after construction, the enhanced cap is assumed to function as designed. Appropriate institutional controls will be in place and periodic maintenance will occur, similar to maintenance activities occurring today. Because the enhanced cap reduces the ability of contaminants to migrate to the soil surface, risks from these sources will be reduced compared with Alternative 1. The risk in the absence of the enhanced cap provides a reasonable upper bound to the risk for this alternative. Based on these results, there is no potential for unacceptable dose or risk to human health for the decision scenarios.

Under Alternative 2, terrestrial resources will be minimally disturbed as the MDA is cleared of vegetation and then capped. Once the MDA is capped and revegetated, it will provide habitat similar to that existing before remedial actions were implemented. Although MDA A borders on foraging habitat for the Mexican spotted owl, direct impacts on this species are not expected from remediation activities. Because the enhanced cap reduces the ability of contaminants to migrate to the soil surface, the ecological risk in the absence of the enhanced cap provides a reasonable upper bound to the risk for this alternative. Because all of the COPECs for ecological risk were eliminated in the analysis, there was no potential risk to ecological receptors at the site.

Over the 1000 yr of the long-term scenarios, the new enhanced cover on MDA A will likely remain intact. The General's Tanks will be removed, ensuring the contents do not escape into the surrounding soil. The area will likely remain under institutional control and the waste will remain isolated, with reduced potential for migration to the surface. Thus, the human health and ecological risk in the absence of the enhanced cap provides a reasonable upper bound to the risk for this alternative, and there is no potential for unacceptable dose or risk to human health for the decision scenarios.

Alternative 3—Waste Removal

Alternative 3 will result in larger radiation doses to site workers than Alternative 2. In addition, Alternative 3 could result in increased risks to site workers from exposure to hazardous or toxic chemicals. These risks will be minimized through training, administrative controls, monitoring, and proper use of equipment.

Short-term impacts on ecological resources under Alternative 3 will be similar to those described for Alternative 2. Although little habitat exists within MDA A, siting and operation of temporary remediation support facilities could disrupt some nearby habitat over the short-term, and noise and human presence could disturb wildlife. This disruption will probably occur whether removals are complete or partial. Once remediation actions are complete, the site will be recontoured and revegetated. Because wastes will have been removed from the MDA, there will be few restrictions on the types of plants that could be reintroduced. This will permit the establishment of more natural conditions that will in turn provide additional habitat for area wildlife.

Alternative 3 will reduce long-term risks to members of the public from either contaminants released slowly over time or from inappropriate uses of the sites, assuming temporary future accidental breakdowns in institutional control. The bulk of the contamination within and near MDA A will be removed, and remaining contamination will be stabilized in place. Although remedial actions will create a disruptive environment for local wildlife in the short-term, long-term impacts will be beneficial. This option will result in long-term benefits because of reductions in contaminants.

The human health and ecological risk assessments in this document are order of magnitude kinds of assessments that build from, and rely heavily on, the risks determined in the MDA A investigation report. Therefore, these assessments are subject to the same uncertainties as those found in that assessment. In addition to the uncertainties identified in the investigation report, this analysis is subject to uncertainties associated with interpretation of the effectiveness of the alternatives.

In general, apart from short-term increases in human health and ecological risks due to the removal of the General's Tanks, these analyses show little potential for significant increases in long-term human health or ecological risk after application of the alternatives. Every alternative has risks that are no greater and probably less than current-day risks.

CONTENTS

Figures

Tables

I-1.0 INTRODUCTION

This report documents the hypothetical magnitude of impacts to human health and the health of ecological receptors remaining after the application of the corrective measures alternatives proposed for Material Disposal Area (MDA) A, Solid Waste Management Unit (SWMU) 21-014, located at Technical Area 21 (TA-21). Los Alamos National Laboratory (LANL or the Laboratory), The results of the MDA A investigation report (IR) (LANL 2006, 095046) were the basis for identifying the corrective measure alternatives that could effectively reduce potential future impacts to human health and the environment. The MDA A site IR defines the nature and extent of contaminant releases at MDA A, provides general site characterization data, and demonstrates that contaminant releases from MDA A pose no present-day potentially unacceptable risks to human and ecological receptors. This risk assessment report was prepared in conjunction with the corrective measures evaluation (CME) being performed for MDA A to ensure that risks from future releases from the site are acceptable. Results of the assessment are presented in terms of short-term (0–100 yr) and long-term (1–1000 yr) risks to human and ecological health in relation to the implementation of the three proposed remedies from the CME.

It should be noted that the General's Tanks, although already buried approximately 8 ft below existing grade, are not in a suitable state for a no action alternative. Therefore, each of the following alternatives include the remediation or removal of the tanks in order to render an acceptable remedy for MDA A. Remediation of the General's Tanks, applied in Alternatives 1 and 2, will consist of excavation and stockpiling the clean cover soils; demolition, removal, and disposal of the concrete slab; and further excavation of soil below the slab depth to expose the upper half of both tanks. Sections of the upper portion of each tank will be removed to allow removal of the tank heel (waste). Once the tank heel is removed and the tank is cleaned, the sections will be replaced, the tanks will be filled with concrete, and the area will be backfilled and regraded. Removal of the tanks, applied in Alternative 3, will begin as in remediation. However, once the tank heel is removed, the interior surface of the tank will be sprayed with a fixative and the tank will be cut up and packaged for disposal using guidance from the waste acceptance criteria of the appropriate disposal facility. After removal of the tanks and confirmation that the excavation meets cleanup criteria, the area will be backfilled and regraded as necessary.

The proposed alternatives are listed below:

- Alternative 1—No Action with Monitoring and Maintenance. The no action with monitoring and maintenance alternative uses the existing conditions at the site and simply monitors the performance of the existing cover.
- Alternative 2—Evapotranspiration (ET) Cover. This alternative is similar to Alternative 1 except the existing cover system will be partially removed and replaced with a cover system having enhanced features needed to reduce maintenance and add robustness of performance.
- Alternative 3—Waste Removal. Removal of waste would involve the excavation of the eastern pits and the central pit, in addition to the General's Tanks. Removal of waste would begin with the eastern pits. Because of the relatively small size of the pits, all excavation and waste sorting, handling, and packaging would occur within the main enclosure. Once the waste is properly packaged, it would be loaded into trucks and transported to the appropriate on-site or off-site disposal facility. Upon completion of the excavation, the site will be graded to allow drainage and covered with a 1–2-ft-layer of soil from the clean soil stockpile. This will allow the soil cut and fill to balance.

Upon completion of the eastern pit removal operation, the removal process would be repeated at the central pit. Some size reduction of waste placed in the central pit is anticipated. In addition, a larger segregation effort is anticipated because waste placement practices used in the central pit included placing waste in layers with a soil layer over the waste layer and compaction to minimize voids in the waste. The potential chemical hazard from stored liquids present in the eastern pit is not expected for the central pit.

Upon completion of the central pit removal operation, removal activities would begin at the General's Tanks area with removal proceeding as described above.

I-1.1 Background

This section summarizes the historical and current characteristics of MDA A as excerpted from the "Final Sitewide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico"(DOE 2008, 102731),"Historical Investigation Report for Material Disposal Area A at Technical Area 21, Solid Waste Management Unit 21-014"(LANL 2005, 088052.5), and "Investigation Report for Material Disposal Area A, Solid Waste Management Unit 21-014, at Technical Area 21 (LANL 2006, 095046).

I-1.2 Site Description

I-1.2.1 General Site Information

MDA A, SWMU 21-014, is situated on the eastern end of the Delta Prime (DP) Mesa within TA-21. TA-21 (DP Site) is located on the DP Mesa east-southeast of the Los Alamos townsite. The DP Mesa trends southeast-northwest and is bounded on the south by Los Alamos Canyon and on the north by DP Canyon. From 1945 to 1978, TA-21 was used for chemical research and for plutonium (Pu) and uranium (U) metal production. TA-21 comprises two operational areas: DP West and DP East, both of which produced liquid and solid radioactive wastes. The operations at DP West included Pu processing, while the operations at DP East included the production of weapons initiators. There are five MDAs located within TA-21: MDAs A, B, T, U, and V (removed). The location of TA-21 and MDA A in relation to surrounding TAs, MDAs, and SWMUs is illustrated in Figure I-1.2-1.

MDA A comprises of a 1.25-acre, fenced, and radiologically controlled area bounded by DP Canyon to the north and Los Alamos Canyon to the south. MDA A was used for disposal of liquid and solid waste from 1945 to 1949 and from 1969 to 1977 and is classified as a Hazard Category 2 nuclear facility (DOE 2003, 087047, p. 1). MDA A has been designated by the Laboratory as a nuclear environmental site (NES) because of the potential inventory of nuclear materials (DOE 2005, 093722).

MDA A consists of four disposal units: the General's Tanks, eastern disposal pits, central disposal pit, and the former drum disposal area. The General's Tanks received waste material from 1945 to 1947. The two eastern disposal pits received waste from 1945 to 1946. The central pit received waste from 1969 to 1978, and the former surface drum storage area was used from the late 1940s to 1960. These disposal units are discussed in further detail in section I-2.2. In addition to the four disposal units, two vertical shafts were constructed in 1975 but were never used. The vertical shafts are also discussed in more detail in section I-2.2.

I-1.2.2 History of MDA A

In 1945, two disposal pits were dug at the east end of the MDA, and two underground tanks (General's Tanks) for liquid waste storage were emplaced at the west end. In the late 1940s or early 1950s, several hundred 55-gal. drums that contained sodium hydroxide solution and stable iodine waste, possibly containing Pu and U were stored in the former drum storage area. During 1969, a large pit in the center of the MDA was dug for placement of demolition debris. Two vertical shafts (~65 ft deep) were installed in 1975 adjacent to the General's Tanks to clarify rinse water generated by cleaning cement paste from the transfer hose between the pug mill and the General's Tanks. The operational history of the site is summarized in Table I-1.2-1. Figure I-1.2-2 shows the MDA A site.

I-1.2.3 General's Tanks

In 1945, two 50,000-gal. cylindrical steel storage tanks were constructed and buried at the western end of MDA A (labeled A-3 on Figure I-1.2-2). Named after General Leslie Groves, the tanks were designed and installed to receive waste solutions containing Pu-239/240 and Am-241 (DOE 2008, 102731). Each tank is 12 ft (3.7 m) in diameter × 62.8 ft (19.1 m) long and rests approximately 17 ft (5.2 m) below grade. The primary burial configuration of the General's Tanks consists of two steel tanks covered by 18 in. of soil, an 8-in. reinforced concrete cap, and about 36 in. of overburden soil. In 2009, caissons will be extended through the overburden soil down to the concrete cap at the locations (two on each tank) of vent/fill port piping to provide periodic access (LANL 2007, 098554).

Beginning in 1945, personnel at TA-21 discharged radiological liquid waste to the two tanks (LANL 2007, 098554). The last recorded discharge to the tanks was in 1947. Liquid waste was to be stored until improved chemical recovery methods could be developed for extracting and recovering the Pu-239/240, but in 1975 the liquid waste was removed from the tanks, solidified in cement, and buried in MDA A, leaving an unknown volume of sludge in the bottom of the tanks. The solidified waste was subsequently moved to Pit 29 in MDA G, where it is still stored. Evidence of rainwater entry into the tanks led to the sealing of openings in the top of the tanks in 1985 (DOE 2008, 102731).

I-1.2.4 Eastern Disposal Pits

Contemporary engineering drawings depict four pits, yet only two pits were built, based on later engineering drawings showing pits roughly 15 ft (6 m) wide at the top × 12 ft (3.7 m) deep. The "Material Disposal Area Cores Document" (LANL 1999, 063984) states that the pits were 13 ft (4 m) deep and received 36,000 ft^3 (1020 m^3) of "solid wastes with alpha contamination accompanied by small amounts of beta and gamma" (Rogers 1977, 005707). The work plan for TA-21 states that the pits received "…laboratory equipment, building construction material, paper, rubber gloves, filters from air cleaning systems, and contaminated or toxic chemicals." The possibility exists that "…plutonium, polonium, uranium, americium, curium, Radium-Lanthanum [sic], actinium, and waste products from the Water Boiler were present in the waste. Polonium and plutonium-239/240 were also thought to be the major contaminants in the waste" (LANL 1991, 007529; DOE 2008, 102731). In 1946, crushed Bandelier Tuff was used to backfill and cover the pits (LANL 2005, 088052.5). The location of the eastern disposal pits is shown in Figure I-1.2-2.

I-1.2.5 Central Disposal Pit

In 1969, a large pit was excavated in the center of MDA A to receive and store debris from demolition work conducted at TA-21 (Figure I-1.2-2). The depth of the pit was 22 ft (6.7 m), which led to a waste capacity of 4885 yd^3 (3735 cm^3). In 1972, the pit was enlarged but not deepened to a total capacity of 18,736 yd^3 (14,325 cm^3) (DOE 2008, 102731).

In July 1972, exhaust ductwork from building 21-005 was placed in the western end of the pit, covered with about 1 ft of dirt and then the ductwork was crushed. Between February and July 1973, the pit received Pu-contaminated building debris from the demolition of building 21-012. Waste from building

21-012 disposed of at MDA A included items such as doors, lumber, pipes, building materials, roofing materials, electrical boxes, wire, metals, concrete, brick, contaminated soil, and large metal items such as steel columns.

Building debris from other TA-21 buildings and structures was placed into the central disposal pit until late 1974 when the demolition work was completed; however, waste of an unspecified nature was placed in the unfilled parts of the pit until 1977 when the waste disposal operations at MDA A ended. Asphalt was also disposed of in this pit.

The waste in the central disposal pit was contaminated with Pu-239/240, Pu-238, U-235, depleted uranium, and other unspecified radionuclides. The pit was decommissioned in May 1978, and a soil cover (crushed tuff) was placed over the pit (LANL 2005, 088052.5).

I-1.2.6 Former Drum Storage Area

During the 1950s, several hundred 55-gal. drums were stored at the east end of MDA A. These drums contained a solution of sodium hydroxide and stable iodine used to scrub ventilation air containing Pu and possibly U. The liquid volume and its chemical content are unknown. Drum corrosion released some of the solution to surface soil. The drums were removed in 1960 and the storage area was paved (DOE 2008, 102731).

I-1.2.7 Vertical Shafts

In 1975, two 4-ft diameter vertical shafts were excavated to a depth of approximately 65 ft below ground surface (bgs), south of the General’s Tanks. The shafts were installed to clarify rinse water generated by cleaning cement paste from a transfer hose between the pug mill and the General’s Tanks. Since the General’s Tanks were never filled with cement paste, the shafts were never used and subsequently were filled with soil in 1977 (LANL 2005, 088052.5).

I-1.2.8 Historical Investigations

Historical site investigations include surface and subsurface sampling in 1980 and 1984 and a geophysical investigation in 1989. Four test holes were drilled next to the General’s Tanks in 1974 and six holes in 1983. Surface soil samples found U, and Pu-238, Pu-239, and Pu-240, above background levels in most of the area over and near the General’s Tanks. Limited data suggested elevated U levels in vegetation. This contamination was covered after site remediation in 1985 and 1987. Uranium, Pu-238, Pu-239, and Pu-240 above background levels in most sampling intervals were collected in subsurface samples in 1974 and 1983 near the General’s Tanks to 30-ft (9.1-m) depths (LANL 1991, 007529). The 1989 geophysical investigation used several remote sensing techniques (magnetics, electromagnetics, resistivity, radar, and self-potential) to improve knowledge of pit and trench geometries and to locate other buried material (Gerety et al. 1989, 006893).

The MDA A investigation work plan required by the Compliance Order on Consent (the Consent Order) was submitted to the New Mexico Environment Department (NMED) on January 31, 2005 (LANL 2005, 088052.113). The MDA A IR was submitted to NMED on November 9, 2006 (LANL 2006, 095046).

I-2.0 CONCEPTUAL SITE MODEL

Conceptual site models (CSMs) are based on the existing knowledge about a site and describe potential contaminants, exposure pathways, transport mechanisms to potential receptors, current and reasonably foreseeable land uses, and any currently uncontaminated media that may become contaminated in the future as a result of contaminant migration (EPA 1989, 008021). The current CSM for MDA A is discussed in the MDA A IR (LANL 2006, 095046). The potential sources, pathways, and receptors are illustrated schematically in Figures I-2.0-1 and Figure I-2.0-2. They are also summarized below.

I-2.1 Contaminant Sources

Contamination associated with MDA A originated from four of the five waste disposal areas (the shafts were never used for waste disposal): the General's Tanks, the two eastern pits, the central pit, and the former drum storage area. Potential contaminants include radionuclides, inorganic chemicals, and organic chemicals. A complete waste inventory for MDA A does not exist. Details of the disposal areas are discussed in section I-2.2.

I-2.2 Waste Inventory

Documentation about waste inventory at MDA A is limited. The following sections describe what is known about the waste inventory at MDA A.

I-2.2.1 General's Tanks

The 1991 work plan for TA-21 estimated the total tank inventory to be 12 to 25 Ci, mostly Pu-239 and Pu-24 but also including Pu-241 and Am-241 (LANL 1999, 063984). It was estimated that one-third of the activity was Am-241 (Rogers 1977, 005707). The 2007 documented safety analysis (DSA) (LANL 2007, 098554) reported the inventory of the General's Tanks described in Table I-2.2-1. The tanks also contain a variety of metals and inorganic compounds, including Ca^{++}, NO_3^-, N, Al^{+3}, NH_4-N, Na^+, Cl^-, K^+, SO_4^{--}, I, NaOH, KOH, Mg, H_2O_2, Fe, Cr, Ni, and La, although quantitative estimates are limited. In the area surrounding the tanks, the MDA A investigation found above-background concentrations of the inorganic chemicals Al, As, Hg, Se, iodide, nitrate, and perchlorate; the organic chemicals acetone, anthracene, Aroclor-1260, benzo[a]pyrene, benzo[b]fluoranthene, benzo[k]fluoranthene, chrysene, fluoranthene, isopropyltoluene[4-], nitroaniline[2-], phenanthrene, pyrene and toluene; the dioxin and furan congeners heptachlorodibenzodioxin [1,2,3,4,6,7,8-], hexachlorodibenzodioxin [1,2,3,4,7,8-], hexachlorodibenzodioxin [1,2,3,6,7,8-], hexachlorodibenzodioxin [1,2,3,7,8,9-], octachlorodibenzodioxin [1,2,3,4,6,7,8,9-], pentachlorodibenzodioxin [1,2,3,7,8-], heptachlorodibenzofuran [1,2,3,4,6,7,8-], heptachlorodibenzofuran [1,2,3,4,7,8,9-], hexachlorodibenzofuran [1,2,3,4,7,8-], hexachlorodibenzofuran [1,2,3,6,7,8-], hexachlorodibenzofuran [1,2,3,7,8,9-], hexachlorodibenzofuran [2,3,4,6,7,8-], octachlorodibenzofuran [1,2,3,4,6,7,8,9-], pentachlorodibenzofuran [1,2,3,7,8-], pentachlorodibenzofuran [2,3,4,7,8-], and tetrachlorodibenzofuran [2,3,7,8-]; and the radionuclides Am-241, Cs-137, Pu-238, and Pu-239 (LANL 2006 095046).

I-2.2.2 Eastern Pits

The MDA A investigation found above-background concentrations of the inorganic chemicals Al, Ba, Co, Cu, Pb, Se, V, Zn, perchlorate, nitrate, and iodide; the organic chemicals acenaphthene, acetone, anthracene, Aroclor-1254, Aroclor-1260, benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[g,h,i]perylene, bis[2-ethylhexyl]phthalate, chrysene, dichlorobenzene[1,4], fluoranthene, fluorene, indeno[1,2,3-cd]pyrene, isopropyltoluene[4-], methylene chloride, phenanthrene, pyrene, and toluene; the dioxin and furan congeners heptachlorodibenzodioxin [1,2,3,4,6,7,8-], hexachlorodibenzodioxin [1,2,3,4,7,8-], hexachlorodibenzodioxin [1,2,3,6,7,8-], hexachlorodibenzodioxin [1,2,3,7,8,9-], octachlorodibenzodioxin [1,2,3,4,6,7,8,9-], pentachlorodibenzodioxin [1,2,3,7,8-], tetrachlorodibenzodioxin

[2,3,7,8-], heptachlorodibenzofuran [1,2,3,4,6,7,8-], heptachlorodibenzofuran [1,2,3,4,7,8,9-], hexachlorodibenzofuran [1,2,3,4,7,8-], hexachlorodibenzofuran [1,2,3,6,7,8-], hexachlorodibenzofuran [1,2,3,7,8,9-], hexachlorodibenzofuran [2,3,4,6,7,8-], pentachlorodibenzofuran [1,2,3,7,8-], pentachlorodibenzofuran [2,3,4,7,8-], octachlorodibenzofuran [1,2,3,4,6,7,8,9-], tetrachlorodibenzofuran [2,3,7,8-]; and the radionuclides Am-241, Cs-137, Pu-238, Pu-239, Sr-90, and U-235 (LANL 2006, 095046).

I-2.2.3 Central Pit

The MDA A investigation found above-background concentrations of the inorganic chemicals Al, As, Ba, Be, Cr, Cu, Fe, Mn, Ni, Se V, perchlorate, nitrate, and iodide; the organic chemicals acetone, anthracene, Aroclor-1254, Aroclor-1260, benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[g,h,i]perylene, bis[2-ethylhexyl]phthalate, chrysene, fluoranthene, indeno[1,2,3-cd]pyrene, methyl-2-pentanone[4-], phenanthrene, pyrene and toluene; the dioxin and furan congeners heptachlorodibenzodioxin [1,2,3,4,6,7,8-], hexachlorodibenzodioxin [1,2,3,4,7,8-], hexachlorodibenzodioxin [1,2,3,6,7,8-], hexachlorodibenzodioxin [1,2,3,7,8,9-], octachlorodibenzodioxin [1,2,3,4,6,7,8,9-], pentachlorodibenzodioxin [1,2,3,7,8-], heptachlorodibenzofuran [1,2,3,4,6,7,8-], heptachlorodibenzofuran [1,2,3,4,7,8,9-], hexachlorodibenzofuran [1,2,3,4,7,8-], hexachlorodibenzofuran [1,2,3,6,7,8-], hexachlorodibenzofuran [1,2,3,7,8,9-], hexachlorodibenzofuran [2,3,4,6,7,8-], octachlorodibenzofuran [1,2,3,4,6,7,8,9-], pentachlorodibenzofuran [1,2,3,7,8-], pentachlorodibenzofuran [2,3,4,7,8-], and tetrachlorodibenzofuran [2,3,7,8-]; and the radionuclides Am-241 Cs-137, Pu-238, Pu-239, Sr-90, and Sr-235 (LANL 2006, 095046).

I-2.2.4 Former Drum Storage Area

Drums containing sodium hydroxide and stable iodine solution were removed in 1960 and the storage area was paved (LANL 1999, 063984). Drum corrosion released some of the solution to surface soil at the former drum storage area and low concentrations of iodide can be detected there (LANL 2006, 095046).

I-2.3 Current and Reasonably Foreseeable Future Land Use

The current and reasonably foreseeable future land use(s) for a site determines the receptors and exposure scenarios used to select screening levels (SLs) for evaluating potential risk. The selected SLs are used as the decision criteria for whether the site is left in its current condition or a cleanup action is initiated. If an action is taken, the cleanup levels determine when the action is complete.

Historically, MDA A has been used for industrial purposes. Current land use for the MDA A site is industrial; the area is fenced and access control is maintained by the Laboratory. It is expected that the land use will remain industrial in the reasonably foreseeable future.

MDA A is located on DP Mesa, near the commercial district of Los Alamos and separated from the DP Canyon slope by the paved North Perimeter Road. The DP Canyon slope north of MDA A is currently undeveloped and is covered with natural vegetation. It is expected that the canyon slope will remain undeveloped. Potential future land use could include recreational activities, such as hiking, bird watching, or children playing (extended backyard scenario).

I-2.4 Human Health Receptors and Exposure Pathways

The human health risk assessment for MDA A included the industrial, construction worker, and recreational scenarios. The residential or other intruder scenarios are considered unlikely on any time scale because of the institutional controls expected to be in place; however, humans engaging in nearby recreation (e.g., on the slope of the DP Canyon) could be exposed to contaminants brought to the surface and redistributed. A 0- to 1-ft-depth interval was used to assess human health risk under the industrial and recreational scenarios, and a 0- to 10-ft depth interval was used under the construction worker scenario.

The primary exposure pathway for human receptors is surface soil and subsurface soil/tuff that may be brought to the surface through on-site activities. Migration of contamination to groundwater through the vadose zone is unlikely given the depth to groundwater (1265 ft bgs) at the site. Human receptors may be exposed through direct contact with soil or suspended particulates by ingestion, inhalation, dermal contact, and external irradiation pathways. Exposure pathways for pore gas are incomplete. Direct contact exposure pathways from subsurface contamination to human receptors are complete for the construction worker. The exposure pathways are the same as those for surface soil. Sources, exposure pathways, and receptors are shown in the CSM (Figure I-2.0-1).

I-2.5 Ecological Receptors and Exposure Pathways

The vegetative cover at MDA A ranges from high to medium and provides habitat for ecological receptors. The site is covered with grass and chamisa. Ponderosa pines grow near the fenceline within the boundary. The DP Canyon slope is covered with mature ponderosa pines. The understory consists of scrub oak/piñon-juniper/chamisa and grass.

The entire area provides potential habitat for ecological receptors. The DP Canyon slope has evidence of burrowing animals (gophers and mice) and deer. Several birds were observed in trees. The canyon presents quality habitat for a variety of receptors and is probably frequented by foxes, bears, and coyotes. No aquatic habitat is present on or near the site.

The site borders the foraging habitat for the Mexican spotted owl. The Mexican spotted owl may be assumed to forage in the area with moderate to low frequency. This site is within an area where the potential for foraging for the peregrine falcon is low. Red-tailed hawks have been seen in the area and may use the site for foraging.

Exposure pathways are complete to surface soil and tuff for ecological receptors. Exposure is assessed across the site to a depth of 0–5 ft (0–2 ft on the DP Canyon slope, maximum depth of samples collected). Weathering of tuff is the only viable natural process that may result in the exposure of receptors to chemicals of potential concern (COPCs) in tuff. However, because of the slow rate of weathering expected for tuff, exposure to COPCs in tuff is negligible, although it is included in the assessments. Exposure pathways to subsurface contamination below 5 ft are not complete unless contaminated soil or tuff were excavated and brought to the surface. The potential pathways are root uptake by plants, inhalation of vapors (burrowing animals only), inhalation of dust, dermal contact, incidental ingestion of soil, external irradiation, and food web transport. Pathways from subsurface releases may be complete for plants. Surface water was not evaluated in the screening ecological risk assessment because of the lack of surface-water features. Sources, exposure pathways, and receptors are presented in the CSM (Figure I-2.0-2).

I-3.0 SAMPLING RESULTS AND RISK-SCREENING LEVELS

Table I-3.0-1 presents the sampling results and risk-screening levels used in the MDA A IR (LANL 2006 095406) for industrial, construction worker, and recreational scenarios. Table I-3.0-2 provides sampling results and risk-screening levels for the residential scenario.

I-4.0 RISK ASSESSMENT RESULTS

Current human health and ecological risks were evaluated in the MDA A IR (LANL 2006, 095046), which concluded there is no potential for unacceptable dose or risk to human health for the decision scenarios analyzed (industrial, construction worker, and recreational). It was also concluded there is no potential risk to ecological receptors at the site.

This section discusses the hypothetical magnitude of the human health and ecological risk remaining after the application of each of the corrective measures alternatives. Both short-term (0–100 yr) and long-term (0–1000 yr) risks are addressed.

I-4.1 Alternative 1—No Action with Monitoring and Maintenance

I-4.1.1 Human Health Risk from Tank Remediation

Remediation of the General’s Tanks will result in small risks to the workers engaged in the removal operation. The sitewide environmental impact statement (SWEIS) (DOE 2008, 102731) estimated the worker and public dose rate from removal of the General’s Tanks. Because most of the potential dose comes from the tank heel, this represents a reasonable estimate, or an upper bound, to the doses that will be experienced during tank remediation.

The estimated worker dose rate from remediation of the General’s Tanks will be approximately 1.7×10^{-5} rem/h (DOE 2008, 102731, Table I-79). Assuming 70,000 h for removal of the tanks (DOE 2008, 102731, Table I-78), this would result in a maximum worker dose of approximately 1.05 person-rem, or a lifetime latent cancer fatality (LCF) risk of 6.3×10^{-4}.

Members of the public would also experience a dose from the remediation of the tanks. For MDA A, this was estimated in the SWEIS to be approximately 0.00066 person-rem per year over a removal period of 1.8 yr (DOE 2008, 102731). This value represents a lifetime LCF risk of approximately 7.1×10^{-7}. While this was an estimate for removal of the entire MDA (Alternative 3), the inventory used was dominated by the inventory in the General’s Tanks and again forms a reasonable upper bound. These estimates reflect the assumption of complete removal of waste from MDA A. Partial removal of waste would result in smaller doses and risks to workers. Doses and risks would be reduced in practice using standard radiation protection techniques, and in no case would the work be conducted in such a way as to cause violations of the applicable legal and administrative dose limits.

Risks will also be incurred by the crew and the public during transportation of the contaminated concrete, soil, and tank heel. The concrete and soil arise from removal of the concrete slab and soil overburden necessary to uncover the tanks. This volume was estimated, based on the methods used in the SWEIS (2008, 102731, section I.3.3.2.4.2), to be 445 yd^3 of low specific-activity low-level waste and suitable for shipment to an off-site, DOE facility. Using the assumptions in the SWEIS, this will be accomplished in 34 one-way shipments. The tank heel will be 68 yd^3 of contact-handled transuranic waste transported to the Waste Isolation Pilot Plant (WIPP) in eight one-way shipments (DOE 2008, 102731, section I.3.3.2.2.5). Using assumptions found in Table I-4.1-1, this results in the following transportation risks:

- Crew (LCF)—1.40×10^{-04}
- Population (LCF)—4.06×10^{-05}
- Radiological Accident (LCF)—4.42×10^{-07}
- Nonradiological accident (fatalities)—9.62×10^{-04}

I-4.1.2 Short-Term Human Health Risk

In the short-term (0–100 yr) after removal of the General's Tanks, the existing cap is assumed to remain in place. Today's institutional controls will remain in place and periodic maintenance will occur, similar to maintenance activities currently occurring. Industrial workers will perform site surveillance, maintenance, and monitoring activities designed to prevent deep-rooting plants and burrowing animals from transporting buried waste to the surface, to maintain erosion controls, and to repair erosion damage. The site workers will be in personal protection levels that will prevent direct dermal absorption and incidental ingestion exposures to contaminated soil particles, external irradiation from radionuclides in soil, and inhalation exposure to vapor-phase contaminants or contaminants in suspended soil. Although potential human health impacts include increased risk from carcinogenic and noncarcinogenic chemicals and potential radiation dose from radionuclides potentially present in the soil, the risks would not be realized (except in the case of an accident) because of workers will be trained and protected. Thus, the risk determined by the MDA A IR (LANL 2006, 095046) is applicable to this period. Table I-4.1-2 summarizes of the human health risk findings.

Based on these results, the MDA A IR concluded, "there is no potential for unacceptable dose or risk to human health for the decision scenarios." These conclusions are equally applicable to the short-term human health under Alternative 1.

I-4.1.3 Short-Term Ecological Risk

During removal of the General's Tanks, terrestrial resources will be disturbed. This activity will have minimal direct impact because most of the MDA is a grassy area enclosed by fencing. However, siting and operation of temporary support facilities could disrupt some nearby habitat over the short-term, and noise and human presence during removal could also disturb wildlife in nearby areas. Proper maintenance of equipment and restrictions preventing workers from entering adjacent undisturbed areas will be implemented, as appropriate, to lessen impacts on ecological resources. Once the tank removal is completed, the MDA will provide habitat similar to that existing before remedial actions were implemented (fenced, grassy areas).

Removal of the tanks and subsequent maintenance activities will have minimal impact, if any, on wetlands or aquatic resources. MDA A does not contain such resources. Best management practices (BMPs) will be implemented to prevent erosion and any subsequent sedimentation of downstream wetlands or ephemeral streams.

Although MDA A borders on foraging habitat for the Mexican spotted owl, direct impacts on this species are not expected from tank removal or subsequent maintenance activities. This sensitive species will not likely be present because of the disturbed nature of the MDA. Additionally, tank removal will not result in habitat loss. Indirect impacts on the Mexican spotted owl from noise are possible. Tank removal could in some cases generate noise levels greater than 6 decibels (dBA) above background levels (DOE 2008, 102731). A Laboratory biological assessment determined that provided reasonable and prudent alternatives are implemented, work at MDA A may affect, but is not likely to adversely affect, the Mexican spotted owl.

The IR also concluded there was no potential risk to ecological receptors at the site because all of the chemicals for potential ecological concern (COPECs) for ecological risk were eliminated by an analysis of background concentrations, potential effects, area of contamination, relative toxicity of related compounds, infrequency of detection, and other factors. These conclusions are equally applicable to the short-term ecological risks under Alternative 1.

I-4.1.4 Long-Term Human Health and Ecological Risks

Over the 1000 yr of the long-term scenarios, the cover on MDA A will be managed such that it will remain intact. The area will remain under institutional control and the waste will remain isolated. The dominant source of radiation risk from MDA A, the General's Tanks, will have been removed from the site. None of the organic or inorganic chemicals expected in MDA A have degradation products that exhibit greater risk than currently exist at MDA A. No processes will be active that will tend to make the chemicals more available; therefore, the risk from hazardous chemicals can be expected to decrease over time. Under these conditions, the long-term risks from the radioactive and hazardous chemicals in MDA A are not expected to exceed those currently found at the site.

I-4.2 Alternative 2—ET Cover

I-4.2.1 Human Health Risk from Tank Remediation and Cap Construction

As in Alternative 1, remediation of the General's Tanks will result in small radiation risks to workers and the public. The risks resulting directly from tank waste removal are reported in section I-5.1.1 and can be directly applied in this alternative as well.

During the construction of the enhanced cap, there will be somewhat increased radiological doses received by site workers compared with Alternative 1. The SWEIS (DOE 2008, 102731, Table I-78) assumed total labor hours to cap a small MDA at either 3700 or 7500, depending on whether a thin or thick cap was used. Assuming an hourly exposure rate of 1.14×10^{-5} rem/h (DOE 2008, 102731, p. I-198), the total worker dose will range between approximately 0.042 person-rem and 0.086 person-rem. This worker dose corresponds to a lifetime LCF risk ranging from 2.5×10^{-5} to 5.2×10^{-5}. Risks to workers from possible exposure to hazardous or toxic chemicals will continue to be minimized through training, administrative controls, monitoring, and proper use of equipment.

I-4.2.2 Short-Term Human Health Risk

In the short-term (0–100 yr), after construction the enhanced cap is assumed to function as designed. Appropriate institutional controls will be in place and periodic maintenance will occur, similar to maintenance activities occurring today. Industrial workers will perform site surveillance, maintenance, and monitoring activities designed to prevent deep-rooting plants and burrowing animals from transporting buried waste to the surface, to maintain erosion controls, and to repair erosion damage. Because the enhanced cap reduces the ability of contaminants to migrate to the soil surface, risks from these sources will be reduced compared with Alternative 1. The site workers will be in personal protection levels that will prevent direct dermal absorption and incidental ingestion exposures to contaminated soil particles, external irradiation from radionuclides in soil, and inhalation exposure to vapor-phase contaminants or contaminants in suspended soil. Although potential human health impacts include increased risk from carcinogenic and noncarcinogenic chemicals, potential radiation dose from radionuclides potentially present in the soil, the risks will not be realized (except in the case of an accident) because of training and protection of workers.

Because the enhanced cap reduces the ability of contaminants to migrate to the soil surface, the risk determined by the MDA A IR (LANL 2006, 095046) in the absence of the enhanced cap provides a reasonable upper bound to the risk for this alternative. Table I-4.1-2 provides a brief summary of the human health risk findings. Based on these results, the MDA A IR concluded, “there is no potential for unacceptable dose or risk to human health for the decision scenarios.” These conclusions are equally applicable to the short-term human health risks under Alternative 2.

I-4.2.3 Short-Term Ecological Risk

Under Alternative 2, terrestrial resources will be disturbed as the MDA is cleared of vegetation and then capped. This activity will have minimal direct impact because most of the MDA is a grassy area enclosed by fencing. However, siting and operation of temporary support facilities could disrupt some nearby habitat over the short-term, and noise and human presence during remediation could also disturb wildlife in nearby areas. Proper maintenance of equipment and restrictions preventing workers from entering adjacent undisturbed areas will be implemented, as appropriate, to lessen impacts on ecological resources. Once the MDA is capped and revegetated, it will provide habitat similar to that existing before remedial actions were implemented (fenced, grassy areas).

Alternative 2 will have minimal impact, if any, on wetlands or aquatic resources. MDA A does not contain such resources. BMPs will be implemented to prevent erosion and any subsequent sedimentation of downstream wetlands or ephemeral streams.

Although MDA A borders on foraging habitat for the Mexican spotted owl, direct impacts on this species are not expected from remediation activities. This sensitive species will not likely be present because of the disturbed nature of the sites. Additionally, remediation activities will not result in habitat loss. Indirect impacts on the Mexican spotted owl from noise are possible. Remedial action could in some cases generate noise levels greater than 6 dBA above background levels (DOE 2008, 102731). A Laboratory biological assessment determined that provided reasonable and prudent alternatives are implemented, work at MDA A may affect, but is not likely to adversely affect, the Mexican spotted owl.

Ecological risks will be reduced from contaminants being reintroduced into the environment by ecological processes. The cap over MDA A will be designed to prevent or reduce intrusion by roots or burrowing animals. The capped site will be maintained in a grassy state; shrubs and trees will be prevented from becoming established. Penetration of the waste by burrowing animals will be prevented by the design of barriers within the final MDA cover.

Because the enhanced cap reduces the ability of contaminants to migrate to the soil surface, the ecological risk determined by the MDA A IR (LANL 2006, 095046) in the absence of the enhanced cap provides a reasonable upper bound to the risk for this alternative. The IR also concluded there was no potential risk to ecological receptors at the site because all of the COPECs for ecological risk were eliminated by an analysis of background concentrations, potential effects, area of contamination, relative toxicity of related compounds, infrequency of detection, and other factors. These conclusions are equally applicable to the short-term ecological risks under Alternative 2.

I-4.2.4 Long-Term Human Health and Ecological Risk

Over the 1000 yr of the long-term scenarios, the new enhanced cover on MDA A will likely remain intact. The General's Tanks will be removed, ensuring the contents do not escape into the surrounding soil. The area will likely remain under institutional control and the waste will remain isolated. The cap over MDA A will be designed to prevent or reduce intrusion by roots or burrowing animals. The capped site will be maintained in a grassy state; shrubs and trees will be prevented from becoming established. Penetration of the waste by burrowing animals will be prevented by the design of barriers within final MDA cover. Thus, the human health and ecological risk determined by the MDA A IR (LANL 2006, 095046) in the absence of the enhanced cap provides a reasonable upper bound to the risk for this alternative. Table I-4.1-2 provides a brief summary of the human health risk findings. Based on these results, the MDA A IR concluded, "there is no potential for unacceptable dose or risk to human health for the decision scenarios." The IR also concluded there was no potential risk to ecological receptors at the site because all of the COPECs for ecological risk were eliminated by an analysis of background concentrations, potential effects, the area of contamination, the relative toxicity of related compounds, the infrequency of detection, and other factors. These conclusions are equally applicable to the short-term human health risks under Alternative 2.

I-4.3 Alternative 3—Waste Removal

I-4.3.1 Short-Term Human Health Risk

Alternative 3 would result in larger radiation doses to site workers than Alternative 2. Assuming 70,000 h to remove each of the three sections of MDA A (DOE 2008, 102731, Table I-78) and estimated worker dose rates of 1.3×10^{-5} rem/h (eastern pits), 1.2×10^{-6} rem/h (central pit), and 1.7×10^{-5} rem/h (General's Tanks) (DOE 2008, 102731), the total worker dose for complete removal of contamination from MDA A is estimated to be 2.2 person-rem. This is equivalent to a lifetime LCF risk of 1.33×10^{-3}. These estimates reflect the assumption of complete removal of waste from MDA A. Partial removal of waste would result in smaller doses and risks to workers. Doses and risks could be reduced in practice using standard radiation protection techniques.

Compared with Alternative 2, Alternative 3 could result in increased risks to site workers from exposure to hazardous or toxic chemicals. These risks would be minimized through training, administrative controls, monitoring, and proper use of equipment.

Risks will also be incurred by the crew and the public during transportation of the contaminated material from the removal action. The SWEIS (DOE 2008, 102731, Table I-54) estimated 130 shipments of low specific activity waste, 1350 shipments of low-level and mixed low-level waste (MLLW), and 120 shipments of contact-handled transuranic waste (CH-TRU). For this analysis, the CH-TRU waste was assumed to be shipped to WIPP, and the other waste was shipped to an off-site DOE facility. Using assumptions found in Table I-4.1-1, this results in the following transportation risks:

- Crew (LCF)—0.0119116
- Population (LCF)—0.0037888
- Radiological accident (LCF)—3.00×10^{-08}
- Nonradiological accident (fatalities)—0.000064

I-4.3.2 Short-Term Human Health and Ecological Risk

Alternative 3 would reduce short-term residual risks (0–100 yr) to members of the public. The bulk of the contamination within and near MDA A would be removed, and remaining contamination would be stabilized in place.

Short-term impacts on ecological resources under Alternative 3 would be similar to those described for Alternative 2. Although little habitat exists within MDA A, siting and operation of temporary remediation support facilities could disrupt some nearby habitat over the short-term, and noise and human presence could disturb wildlife. This would probably occur whether removals are complete or partial. Once remediation actions are complete, the sites would be recontoured and revegetated. Because wastes would have been removed from the MDA, there would be few restrictions on the types of plants that could be reintroduced. This would permit the establishment of more natural conditions that would in turn provide additional habitat for area wildlife.

I-4.3.3 Long-Term Human Health and Ecological Risk

Alternative 3 would reduce long-term risks to members of the public from either contaminants released slowly over time or inappropriate uses of the sites assuming temporary future accidental breakdowns in institutional control. The bulk of the contamination within and near the MDA A would be removed, and remaining contamination would be stabilized in place.

Although remedial actions would create a disruptive environment for local wildlife in the short term, long-term impacts would be beneficial. With the removal of wastes and contamination from the MDA, deep-root penetration and burrowing animals would not reintroduce contamination to the environment. Thus, this option would result in long-term benefits because of reductions in contaminants.

I-4.4 Uncertainty Analysis

The human health and ecological risk assessments in this document are order of magnitude kinds of assessments that build from and rely heavily on the risks determined in the MDA A IR (LANL 2006, 095046); therefore, these assessments are subject to the same uncertainties found in that assessment.

The analysis in the human health screening assessment is subject to the uncertainties associated with the data evaluation, exposure assessment, and toxicity assessment. All these uncertainties, considered individually or in combination, may affect the assessment results. The IR identified uncertainties in the following broad categories:

- data evaluation and COPC identification process
- exposure assessment
    - the applicability of the standard industrial and recreational scenarios
    - the assumptions underlying the exposure pathways
    - the depth over which SLs based on the exposure scenario were applied
    - the derivation of exposure point concentrations (EPCs)
- toxicity assessment
    - extrapolation from animals to humans
    - extrapolation from one route of exposure to another route of exposure

- individual variability in the human population
- derivation of reference doses and slope factors
- chemical form of the COPC
- use of surrogate chemicals
- use of saturation limit screening levels
- use of additive approach

The qualitative uncertainty analysis of the issues relevant to evaluating the potential ecological risk at MDA A can result in either adding or removing chemicals from the list of COPECs for MDA A. The analysis from the MDA A IR (LANL 2006, 095046) identified uncertainties in the following broad categories:

- chemical form of the COPECs
- exposure pathways
- use of no observed adverse effect levels to establish ecological screening levels (ESLs)
- use of background concentrations to eliminate COPECs
- determining area use factors
- application of population area use factors (PAUF)
- interpreting the use of COPECs contributing to PAUF-adjusted hazard indices greater than 1
- treatment of COPECs without ESLs
- treatment of pore gas COPECs
- use of DOE Tier I bioconcentration guides compared with Laboratory ESLs

In addition to the uncertainties identified in the IR, this analysis is subject to uncertainties associated with interpretation of the effectiveness of the alternatives.

I-5.0 CONCLUSIONS AND RECOMMENDATIONS

In general, apart from short-term increases in human health and ecological risks due to the remediation or removal of the General's Tanks, these analyses show the little potential for significant increases in long-term human health or ecological risk after application of the alternatives. Every alternative has risks that are no greater, and probably less than, current-day risks.

I-6.0 REFERENCES

The following list includes all documents cited in this appendix. Parenthetical information following each reference provides the author(s), publication date, and ER ID number. This information is also included in text citations. ER ID numbers are assigned by the Environmental Programs Directorate's Records Processing Facility (RPF) and are used to locate the document at the RPF and, where applicable, in the master reference set.

Copies of the master reference set are maintained at the NMED Hazardous Waste Bureau; the U.S. Department of Energy–Los Alamos Site Office; the U.S. Environmental Protection Agency (EPA), *Region 6; and the Directorate. The set was developed to ensure that the administrative authority has all material needed to review this document, and it is updated with every document submitted to the administrative authority. Documents previously submitted to the administrative authority are not included.*

DOE (U.S. Department of Energy), June 13, 2000. "Procedure for the Release of Residual Radioactive Material from Real Property," U.S. Department of Energy memorandum to D. Glenn, I.R. Triay, M. Zamorski, E. Sellers, D. Gurule, and D. Bergman-Tabbert from C.L. Soden, Albuquerque, New Mexico. (DOE 2000, 067489)

DOE (U.S. Department of Energy), November 26, 2003. "New Categorization of Existing Nuclear Facilities at LANL," U.S. Department of Energy memorandum to J. Holt (Associate Laboratory Director of Operations/Los Alamos National Laboratory) from C.M. Steele (Senior Authorization Basis Manager/DOE-LASO), Los Alamos, New Mexico. (DOE 2003, 087047)

DOE (U.S. Department of Energy), January 24, 2005. "Safety Evaluation Report (SER), Documented Safety Analysis and Technical Safety Requirements (TSRs) for Surveillance and Maintenance of Nuclear Environmental Sites at Los Alamos National Laboratory, LA-UR-04-7505, ER2004-0606, LA-UR-04-7504, ER2004-0607," DOE Los Alamos Site Operations document, Los Alamos, New Mexico. (DOE 2005, 093722)

DOE (U.S. Department of Energy), May 2008. "Final Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico," DOE/EIS-0380, Los Alamos, New Mexico. (DOE 2008, 102731)

EPA (U.S. Environmental Protection Agency), December 1989. "Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part A), Interim Final," EPA/540/1-89/002, Office of Emergency and Remedial Response, Washington, D.C. (EPA 1989, 008021)

EPA (U.S. Environmental Protection Agency), December 2007. "EPA Region 6 Human Health Medium-Specific Screening Levels," U.S. EPA Region 6, Dallas, Texas. (EPA 2007, 099314)

Gerety, M., J.W. Nyhan, and R. Oliver, October 1989. "History and Geophysical Description of Hazardous Waste Disposal Area A, Technical Area 21," Los Alamos National Laboratory report LA-11591-MS, Los Alamos, New Mexico. (Gerety et al. 1989, 006893)

LANL (Los Alamos National Laboratory), May 1991. "TA-21 Operable Unit RFI Work Plan for Environmental Restoration," Vol. II (Chapters 14 to 16), Los Alamos National Laboratory document LA-UR-91-962, Los Alamos, New Mexico. (LANL 1991, 007529)

LANL (Los Alamos National Laboratory), August 1999. "Material Disposal Areas Core Document," Los Alamos National Laboratory document LA-UR-99-4423, Los Alamos, New Mexico. (LANL 1999, 063984)

LANL (Los Alamos National Laboratory), January 2005. "Historical Investigation Report for Material Disposal Area A at Technical Area 21, Solid Waste Management Unit 21-014," Los Alamos National Laboratory document LA-UR-05-0095, Los Alamos, New Mexico. (LANL 2005, 088052.5)

LANL (Los Alamos National Laboratory), January 2005. “Investigation Work Plan for Material Disposal Area A at Technical Area 21, Solid Waste Management Unit 21-014,” Los Alamos National Laboratory document LA-UR-05-0094, Los Alamos, New Mexico. (LANL 2005, 088052.113)

LANL (Los Alamos National Laboratory), May 2005. “Derivation and Use of Radionuclide Screening Action Levels, Revision 1,” Los Alamos National Laboratory document LA-UR-05-1849, Los Alamos, New Mexico. (LANL 2005, 088493)

LANL (Los Alamos National Laboratory), November 2006. “Investigation Report for Material Disposal Area A, Solid Waste Management Unit 21-014, at Technical Area 21,” Los Alamos National Laboratory document LA-UR-06-7902, Los Alamos, New Mexico. (LANL 2006, 095046)

LANL (Los Alamos National Laboratory), June 2007. “Documented Safety Analysis for Surveillance and Maintenance of Nuclear Environmental Sites at Los Alamos National Laboratory, Revision 1,” Los Alamos National Laboratory document NES-ABD-0101, Los Alamos, New Mexico. (LANL 2007, 098554)

NMED (New Mexico Environment Department), June 2006. “Technical Background Document for Development of Soil Screening Levels, Revision 4.0, Volume 1, Tier 1: Soil Screening Guidance Technical Background Document,” New Mexico Environment Department, Hazardous Waste Bureau and Ground Water Quality Bureau Voluntary Remediation Program, Santa Fe, New Mexico. (NMED 2006, 092513)

Rogers, M.A., June 1977. “History and Environmental Setting of LASL Near-Surface Land Disposal Facilities for Radioactive Wastes (Areas A, B, C, D, E, F, G, and T),” Vol. I, Los Alamos Scientific Laboratory report LA-6848-MS, Los Alamos, New Mexico. (Rogers 1977, 005707)

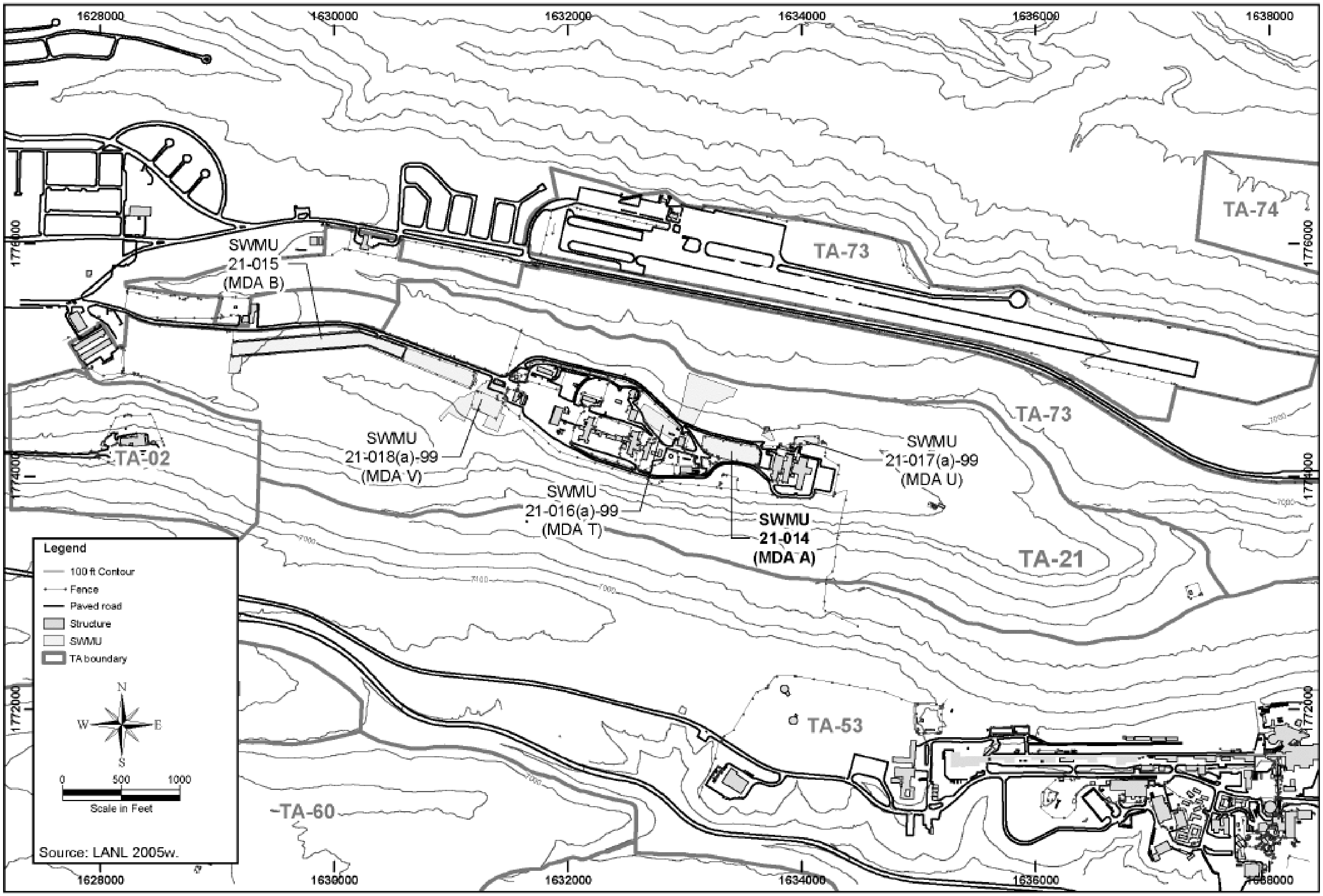


Figure I-1.2-1   MDA A in relation to TA-21 and surrounding TAs, MDAs, and SWMUs

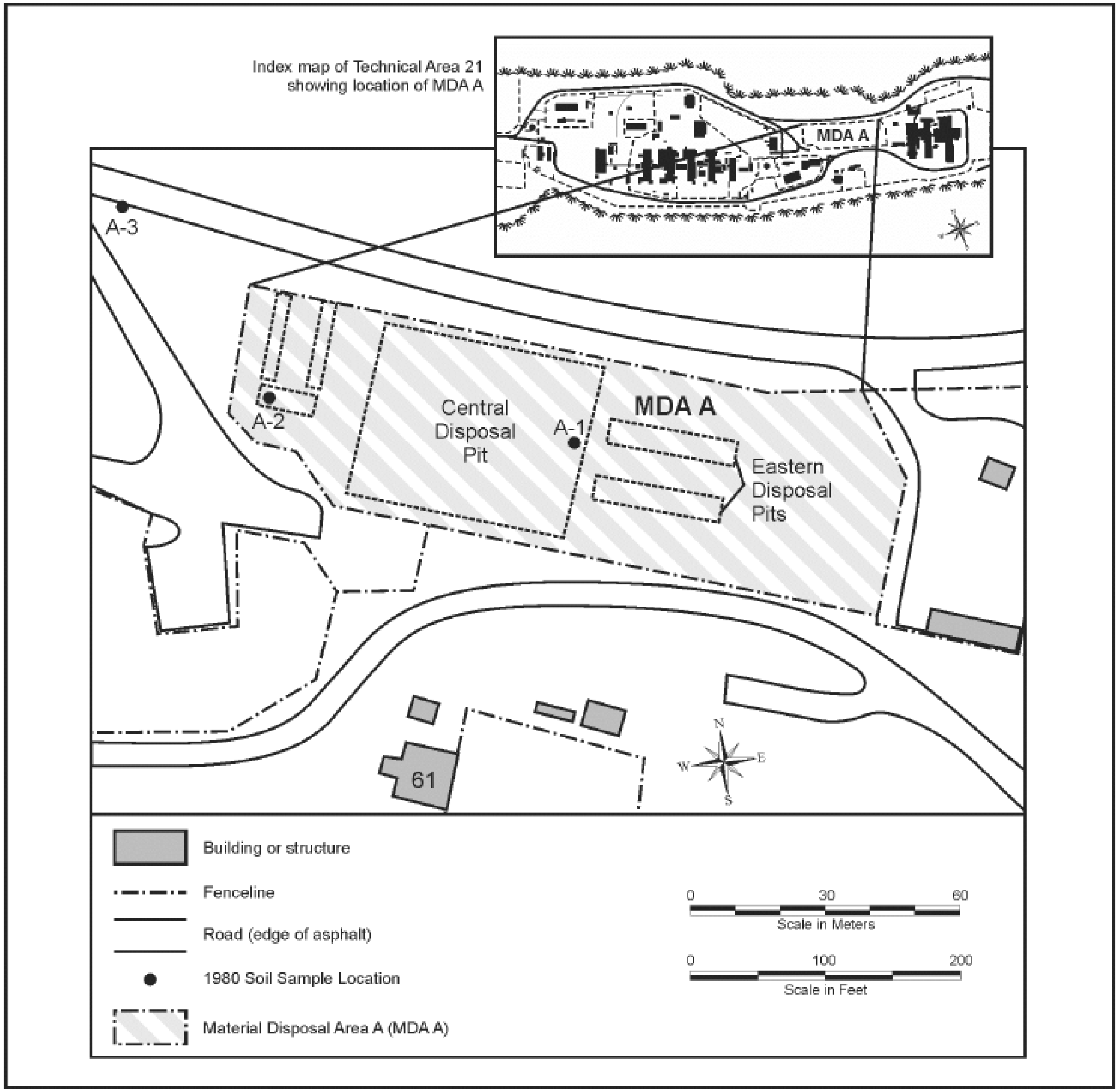


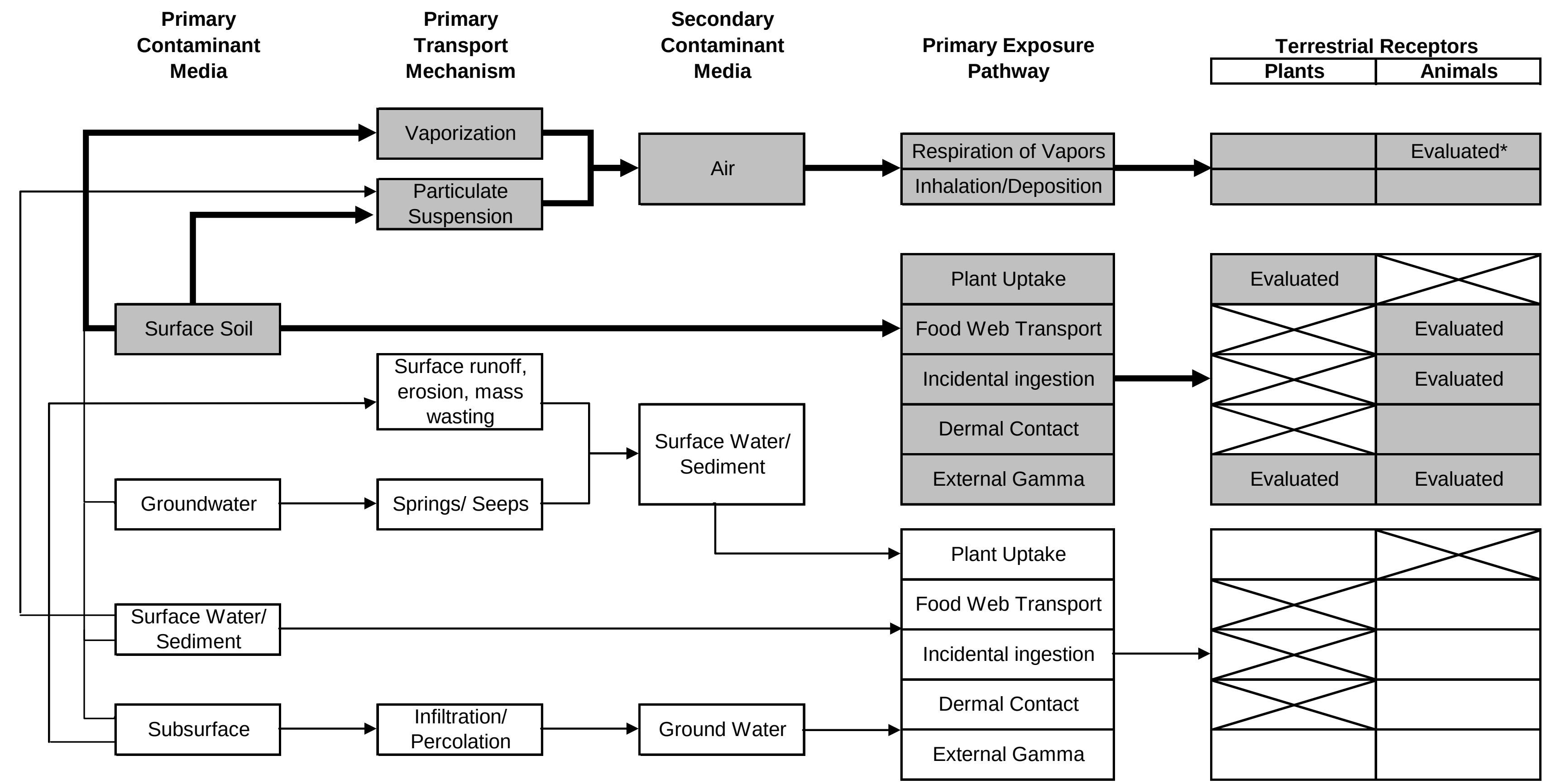
Figure I-1.2-2 MDA A

Primary Source	Primary Release Mechanism	Affected Media	Secondary Release Mechanism	Impacted Media	Exposure Pathways	Industrial	Construction Worker	Recreational
Laboratory operations, waste disposal, and releases to surface soil, subsurface soil, and sediment	Stormwater Runoff	Surface Water	Direct Contact	Water	Ingestion	M	M	M
					Dermal	M	M	M
	Infiltration	Groundwater	Domestic Use	Water	None	O	O	O
	Percolation		Seeps	Water	None	O	O	O
	Volatilization	Soil and Tuff	Volatilization	Air	Inhalation	X	X	X
	Resuspension	Airborne Particulates		Air	Inhalation	X	X	X
	Direct Release	Surface Soil (0 to 1 ft)		Soil	Ingestion	X	X	X
					Dermal	X	X	X
					External Irradiation	X	X	X
			Erosion	Sediment	Ingestion	X	X	X
					Dermal	X	X	X
					External Irradiation	X	X	X
		Subsurface Soil (1 to 10 ft)		Soil and Tuff	Ingestion	O	X	O
					Dermal	O	X	O
					External Irradiation	O	X	O
		Subsurface Soil (below 10 ft)		Soil and Tuff	None	O	O	O

X = Evaluated in risk screen; major pathway.
M = Not evaluated in risk screen; minor pathway.
O = Not evaluated in risk screen; no pathway.

Source: Adapted from the MDA A IR (LANL 2006, 095046).

Figure I-2.0-1 Human health CSM



Note: Boxes with Xs indicate incomplete pathways. Open boxes indicate complete pathways. Complete pathways for soil exposure are gray, evaluated pathways are included in the soil ESL calculations.

*For burrowing animals only.

Source: Adapted from the MDA A IR (LANL 2006, 095046).

Figure I-2.0-2 CSM for terrestrial receptor

Table I-1.2-1
Summary of Historical Activities at MDA A

Date	General's Tanks	Vertical Shafts	Eastern Pits	Central Pit	Former Drum Storage Area
1945	Two 50,000-gal storage tanks (12-ft diameter, 62-ft-10-in. long) were buried on the western end of MDA A to receive waste solutions containing Pu-239, Pu-240, and Am-241.	—*	Two pits were constructed on eastern end of MDA A (125 ft × 18 ft × 12.5 ft). Solid waste possibly containing mainly alpha contamination and some beta and gamma contamination, was placed into pits.	—	—
1946	No record exists of waste management activities.	—	Solid waste possibly containing mainly alpha contamination and some beta and gamma contamination was placed into pits Pits were closed and crushed tuff was used to backfill and cover the trenches.	—	—
1947–1952	—	—	—	—	Late 1940s or early 1950s: Several hundred 55-gal drums of sodium hydroxide solution and stable iodine waste, possibly containing Pu and U were stored in area.
1953–1959	—	—	—	—	There is no record of drum activity.

Table I-1.2-1 (continued)

Date	General's Tanks	Vertical Shafts	Eastern Pits	Central Pit	Former Drum Storage Area
1960	—	—	—	—	Drums were removed and area was paved to immobilize contaminants.
1961–1968	—	—	—	—	—
1969	—	—	—	Large pit was constructed (150 ft × 40 ft × 22 ft) in the center of MDA A to receive debris from demolition work at TA-21. May 9, 1969: A geologic reconnaissance was made of the central disposal pit by observing geology and taking measurements with a compass.	—
1970–1971	—	—	—	Building debris from demolition work at TA-21 was placed into pit.	—
1972	—	—	—	Pit was enlarged to 172 ft × 134 ft × 22 ft to receive building debris from demolition of building 21-012.	—
1973	—	—	—	Pit received Pu-contaminated building debris from demolition of building 21-012.	—
1974	May 1974: Four holes were augered adjacent to the General's Tanks to a depth of 35 ft bgs, and composite samples were collected at 5-ft intervals.	—	—	Debris from TA-21 buildings and structures placed into pit.	—

Table I-1.2-1 (continued)

Date	General's Tanks	Vertical Shafts	Eastern Pits	Central Pit	Former Drum Storage Area
1975	June 19, 1975: Liquid waste (approximately 10,570 gal.) was transferred from the western tank to building 21-257 for processing.	December 3, 1975: Two 4-ft diameter vertical shafts (~65 ft deep) adjacent to the General's Tanks were excavated for disposal of nonretrievable cement paste.	—	Waste of an unspecified nature was placed into pit.	—
1976	—	—	—	—	—
1977	—	Shafts were "grouted up" for closure.	—	—	—
1978	—	—	—	May 1978: Pit was decommissioned and soil cover (crushed tuff) was placed over the pit.	—
1979	—	—	—	—	—
1980	Sample A-2 at three depth intervals	—	—	Sample A-1 at three depth intervals.	—
1981–1982	—	—	—	—	—
1983	Liquid waste was transferred from the tanks to building 21-257 for processing. Six holes were drilled around the perimeter of the General's Tanks to a depth of 30 ft bgs, and subsurface soil profile samples were collected from 3-ft intervals.	—	—	—	—
1984	A radiation field survey was conducted at approximately 100 locations with a phoswich detector analyzer and high-pressure ion chamber instrument. May–August 1984: Soil and vegetation samples were collected from 39 locations from the western third of MDA A.				

Table I-1.2-1 (continued)

Date	General's Tanks	Vertical Shafts	Eastern Pits	Central Pit	Former Drum Storage Area
1985	Tops of the tanks were sealed because of evidence of rain water seepage.	—	—	—	—
	First quarter 1985: Seven locations were sampled for soils within and outside of MDA A at 0.03 ft and 0.33 ft and 0.33 ft to 0.98 ft.				
1986	A surface reconnaissance survey was performed, which addressed the general conditions of cover.				
1987–1988	—	—	—	—	—
1989	Geophysical techniques were used, including magnetics, electromagnetics, resistivity, radar, and self-potential to determine pit geometry, accurately locate material, and determine the physical properties of sites and buried material.				
1990	October 1990: Surface soil was sampled within the boundaries of MDA A at approximately 20 locations.				
1991	—	—	—	—	—
1992	March–May and June–July: Phase I Resource Conservation and Recovery Act facility investigation (RFI was performed across TA-21. Surface soil was sampled during two sampling events (grid 1 and grid 2).				
1993	—	—	—	—	—
1994	August–September: A Phase I RFI was performed on the surface outside the MDA A fence and surface and near-surface within the associated drainage area. Activities included a radiation field survey (59 survey locations); collection of surface and near-surface samples (51 locations; sediment samples were collected from 0 to 0.25 ft, 0.25 to 0.5 ft, and 0.5 to 1 ft; all other surface samples were collected from 0 to 0.25 ft); field screening of samples with field instruments and a mobile laboratory; and analysis of samples at a fixed analytical laboratory.				
1995	—	—	—	—	—
1996	June: An electromagnetic survey was conducted using a GEM-2.				
1997–1998	—	—	—	—	—
1999	June: Geophysical surveys were conducted using ground-penetrating radar (GPR), magnetics, and electrical resistivity (students, faculty, and visitors of the Summer of Applied Geophysical Experience).				
2000–2002	—	—	—	—	—
2003	September: An integrated geophysical survey was conducted using capacitively coupled electrical resistivity and digital GPR (Advanced Geological Services, Inc.).				
2004	—	—	—	—	—

Table I-1.2-1 (continued)

Date	General's Tanks	Vertical Shafts	Eastern Pits	Central Pit	Former Drum Storage Area
2005	January: Investigation work plan submitted to NMED. June: Plan approved by NMED.				
2006	April–October: Site characterization activities conducted in conjunction with the MDA A site investigation.				

Source: This table was adapted from LANL 2006, 095046.

*— = Not applicable.

Table I-2.2-1
MDA A Inventory Based on the Documented Safety Analysis

NES	Brief Description of Site	Radionuclide	DSA Inventory (Ci)
TA-21 MDA A	MDA A West General's Tank	^{235}U	1.1E-03
		^{238}Pu	2.5E-01
		^{239}Pu	4.3E+01
		^{241}Pu	6.3E+01
		^{241}Am	4.8E+00
TA-21 MDA A	MDA A East General's Tank	^{235}U	3.1E-04
		^{238}Pu	1.6E-02
		^{239}Pu	1.1E+01
		^{241}Pu	1.6E+01
		^{241}Am	1.2E+00
TA-21 MDA A	MDA A Total (includes both General's Tanks)	^{235}U	1.4E-03
		^{238}Pu	2.66E-01
		^{239}Pu	5.43E+01
		^{241}Pu	7.89E+01
		^{241}Am	6.07E+00
TA-21 MDA A	MDA A Pit Disposal Areas	Insufficient data	Insufficient data

Note: This table was adapted from LANL 2006, 095046.

Table I-3.0-1

Sampling Results and Risk-Screening Levels for the Industrial, Construction Worker, and Recreational Scenarios at MDA A

COPC	Industrial Maximum Concentration	Industrial 95% Upper Concentration Limit (UCL)	Distribution Type[a]	Construction Worker Maximum Concentration	Construction Worker 95% UCL	Distribution Type	Recreational Maximum Concentration[b]	Recreational 95% UCL	NMED Industrial SSLs	NMED Construction Worker SSLs	LANL Recreational SSLs
Inorganic Chemicals (mg/kg)											
Antimony	–[c]	–	–	0.443	0.0961	NP	–	–	–	1.24E+02	–
Barium	–	–	–	238	139	N	–	–	–	6.02E+04	–
Cobalt	–	–	–	13.6	5.23	G	–	–	–	6.10E+01	–
Iodide[d]	16.25	5.18	L	156	9.69	L	3.13	1.88	0.01	0.01	7.30E+02
Lead	40.9	15.6	G	40.9	13.4	G	45.7	24.5	8.00E+02	8.00E+02	5.60E+02
Manganese	–	–	–	1,010	410	NP	–	–	–	1.50E+02	–
Mercury	0.146	0.0544	NP	0.146	0.0276	G	–	–	1.00E+05	9.27E+02	–
Nitrate	2.34	1.84	NP	2.34	1.8	G	–	–	1.00E+05	1.00E+05	–
Perchlorate[e]	0.0401	0.0115	NP	0.0461	0.0103	NP	0.00125	0.0011	1.40E+03	7.90E+02	1.40E+03
Selenium	1.87	0.977	NP	1.87	0.89	NP	0.895	0.805	5.68E+03	1.55E+03	3.96E+03
Silver	–	–	–	0.114	0.0772	NP	–	–	–	1.55E+03	–
Thallium	–	–	–	2.77	0.183	N	–	–	–	2.04E+01	–
Zinc	95.9	45.9	NP	95.9	38.5	NP	–	–	1.00E+05	9.29E+04	–
Semivolatile Organic Compounds (mg/kg)											
Acenapthene	0.175	0.0992	NP	0.175	0.0641	NP	0.07	0.0297	3.35E+03	1.41E+04	4.40E+04
Anthracene	0.175	0.0995	NP	0.175	0.0638	NP	0.07	0.0302	1.00E+05	8.60E+04	1.00E+05
Aroclor-1254[f]	0.0307	0.0164	N	2.15	0.0853	NP	–	–	8.26E+00	4.28E+00	–
Aroclor-1260[f]	0.22	0.18	NP	0.22	0.11	NP	–	–	8.26E+00	4.28E+00	–
Benzo(a)anthracene[f]	0.175	0.105	NP	0.175	0.0668	NP	0.07	0.05	2.34E+01	2.12E+02	3.01E+01
Benzo(a)pyrene[f]	0.175	0.0743	G	0.178	0.0715	NP	0.07	0.0336	2.34E+00	2.12E+01	3.01E+00
Benzo(b)fluoranthene[f]	0.308	0.156	L	0.308	0.16	NP	0.21	0.15	2.34E+01	2.12E+02	3.01E+01

Table I-3.0-1 (continued)

COPC	Industrial Maximum Concentration	Industrial 95% Upper Concentration Limit (UCL)	Distribution Type[a]	Construction Worker Maximum Concentration	Construction Worker 95% UCL	Distribution Type	Recreational Maximum Concentration[b]	Recreational 95% UCL	NMED Industrial SSLs	NMED Construction Worker SSLs	LANL Recreational SSLs
Benzo(g,h,i)perylene[g]	0.175	0.15	NP	0.175	0.0542	NP	0.0944	0.0727	3.09E+04	2.29E+03	2.38E+04
Benzo(k)fluoranthene[f]	0.175	0.145	NP	0.175	0.0521	NP	0.07	0.0299	2.34E+02	2.12E+03	3.01E+02
Benzoic Acid	–	–	–	3.45	1.05	NP	–	–	1.00E+05	1.00E+05	–
Bis(2-ethylhexyl) phthalate[f]	0.85	0.49	NP	0.85	0.306	NP	0.34	0.148	1.37E+03	4.66E+03	1.83E+03
Chrysene[f]	0.175	0.116	NP	0.175	0.0741	NP	0.07	0.05	2.31E+03	2.12E+04	3.01E+03
Fluoranthene	0.259	0.116	G	0.259	0.0958	NP	0.129	0.0638	2.44E+04	8.73E+03	1.39E+04
Fluorene	0.175	0.099	NP	0.175	0.0618	NP	0.07	0.0296	2.65E+04	1.02E+04	3.03E+04
Indeno(1,2,3-cd)pyrene[f]	0.175	0.167	NP	0.175	0.0588	NP	0.104	0.0786	6.21E+00	2.12E+02	3.01E+01
Phenanthrene	0.194	0.125	NP	0.194	0.0784	NP	0.111	0.0684	1.83E+03	6.99E+03	1.20E+04
Pyrene	0.251	0.123	G	0.251	0.101	NP	0.14	0.0836	2.29E+03	9.01E+03	2.38E+04
Volatile Organic Compounds (mg/kg)											
Acetone	–	–	–	0.00458	0.00294	NP	–	–	1.06E+02	3.45E+02	–
Dichlorobenzene[1,4-][f]	1.75	0.989	NP	1.75	0.617	NP	–	–	3.95E+01	1.96E+03	–
Isopropyltoluene[4-][h]	0.00664	0.00257	NP	0.00664	0.00162	NP	–	–	2.71E+02	3.89E+02	–
Methylene chloride[f]	–	–	–	0.00577	0.00288	NP	–	–	1.82E+02	2.63E+03	–
Toluene	0.00173	0.00089	NP	0.00239	0.000919	NP	–	–	2.52E+02	2.52E+02	–
Radionuclides (pCi/g) Excluding the General's Tanks									**LANL SALs**		
Americium-241[i]	0.791	0.325	G	0.791	0.257	G	0.856	0.477	180	34	280
Cesium-137[i]	–	–	–	0.442	0.124	NP	–	–	23	18	210
Plutonium-238[i]	1.81	0.999	NP	1.81	0.533	NP	2.01	1.87	240	40	330
Plutonium-239[i]	8.67	2.99	G	9.22	2.52	G	0.105	0.0632	210	36	300
Strontium-90[i]	0.128	0.0795	N	0.262	0.0771	G	16.6	12.4	1,900	800	5,600
Dioxins											

Table I-3.0-1 (continued)

COPC	Industrial Maximum Concentration	Industrial 95% Upper Concentration Limit (UCL)	Distribution Type[a]	Construction Worker Maximum Concentration	Construction Worker 95% UCL	Distribution Type	Recreational Maximum Concentration[b]	Recreational 95% UCL	NMED Industrial SSLs	NMED Construction Worker SSLs	LANL Recreational SSLs
Tetrachlorodibenzo dioxin [2,3,7,8-][f]	1.24E-06	8.62E-07	NP	1.24E-06	2.53E-07	NP	–	–	–	–	–
Pentachlorodibenzo dioxin [1,2,3,7,8-]	1.12E-05	7.72E-06	NP	1.12E-05	4.16E-06	NP	–	–	–	–	–
Hexachlorodibenzo dioxin [1,2,3,4,7,8-]	1.42E-05	9.83E-06	NP	1.42E-05	5.32E-06	NP	–	–	–	–	–
Hexachlorodibenzo dioxin [1,2,3,6,7,8-]	2.51E-05	7.33E-06	L	2.51E-05	9.49E-06	NP	–	–	–	–	–
Hexachlorodibenzo dioxin [1,2,3,7,8,9-]	2.73E-05	3.15E-06	L	2.73E-05	1.02E-05	L	–	–	–	–	–
Heptachlorodibenzo dioxin[1,2,3,4,6,7,8-]	4.23E-04	7.31E-05	L	4.23E-04	9.46E-05	L	–	–	–	–	–
Octachlorodibenzo dioxin [1,2,3,4,6,7,8,9-]	3.56E-03	7.22E-04	L	3.56E-03	7.94E-04	L	–	–	–	–	–
Furans											
Tetrachlorodibenzofuran [2,3,7,8-]	1.25E-06	5.51E-07	G	1.25E-06	7.50E-07	NP	–	–	–	–	–
Pentachlorodibenzofuran [1,2,3,7,8-]	8.40E-07	3.62E-07	L	8.40E-07	2.57E-07	NP	–	–	–	–	–
Pentachlorodibenzofuran [2,3,4,7,8-]	2.11E-06	1.06E-06	L	2.11E-06	1.14E-06	NP	–	–	–	–	–
Hexachlorodibenzofuran [1,2,3,4,7,8-]	5.95E-06	2.08E-06	L	5.95E-06	2.69E-06	NP	–	–	–	–	–
Hexachlorodibenzofuran [1,2,3,6,7,8-]	6.48E-06	1.19E-06	L	6.48E-06	5.39E-06	L	–	–	–	–	–
Hexachlorodibenzofuran [1,2,3,7,8,9-]	1.15E-06	9.55E-07	NP	1.15E-06	2.99E-07	NP	–	–	–	–	–
Hexachlorodibenzofuran [2,3,4,6,7,8-]	6.22E-06	1.27E-06	L	6.22E-06	5.96E-07	L	–	–	–	–	–
Heptachlorodibenzo furan [1,2,3,4,6,7,8-]	9.64E-05	1.82E-05	L	9.64E-05	3.09E-05	L	–	–	–	–	–
Heptachlorodibenzo furan [1,2,3,4,7,8,9-]	8.31E-06	1.58E-06	L	8.31E-06	3.20E-06	NP	–	–	–	–	–

Table I-3.0-1 (continued)

COPC	Industrial Maximum Concentration	Industrial 95% Upper Concentration Limit (UCL)	Distribution Type[a]	Construction Worker Maximum Concentration	Construction Worker 95% UCL	Distribution Type	Recreational Maximum Concentration[b]	Recreational 95% UCL	NMED Industrial SSLs	NMED Construction Worker SSLs	LANL Recreational SSLs
Octachlorodibenzofuran [1,2,3,4,6,7,8,9-]	1.85E-04	1.30E-04	NP	1.85E-04	2.66E-05	L	–	–	–	–	–

Source: This table was adapted from LANL 2006, 095046.

[a] NP = Nonparametric, N = normal, G = gamma, L = lognormal.

[b] DP Canyon Slope (LANL 2005, 088493).

[c] – = Not applicable.

[d] SSL from the Agency for Toxic Substances and Disease Registry (ATSDR).

[e] SSLs from EPA Region 6 (2007, 099314).

[f] Carcinogen.

[g] Isopropylbenzene values used because it is a surrogate for 4-Isopropyltoluene.

[h] Pyrene is used as a surrogate based on structural similarity.

[i] Screening action levels from (LANL 2005, 088493).

Table I-3.0-2
MDA A Residential Scenario (for Comparison Purposes Only)

COPC	Residential Maximum Concentration	95% UCL	Distribution Type	NMED Residential SSLs
Inorganic Chemicals (mg/kg)				
Antimony	0.443	0.0961	NP	3.13E+01
Barium	238	139	N	1.56E+04
Cobalt	13.6	5.23	G	1.52E+03
Iodide[b]	156	9.69	L	0.01
Lead	40.9	13.4	G	4.00E+02
Manganese	1,010	410	NP	3.59E+03
Mercury	0.146	0.0276	G	1.00E+05
Nitrate	2.34	1.8	G	1.00E+05
Perchlorate[c]	0.0461	0.0103	NP	5.50E+01
Selenium	1.87	0.89	NP	3.91E+02
Silver	0.114	0.0772	NP	3.91E+02
Thallium	2.77	0.183	N	5.16E+00
Zinc	95.9	38.5	NP	2.35E+04
Semivolatile Organic Compounds (mg/kg)				
Acenapthene	0.175	0.0641	NP	3.73E+03
Anthracene	0.175	0.0638	NP	2.20E+04
Aroclor-1254[d]	2.15	0.0853	NP	1.12E+00
Aroclor-1260[d]	0.22	0.11	NP	1.12E+00
Benzo(a)anthracene[d]	0.175	0.0668	NP	6.21E+00
Benzo(a)pyrene[d]	0.178	0.0715	NP	6.21E+01
Benzo(b)fluoranthene[d]	0.308	0.16	NP	6.21E+00
Benzo(g,h,i)perylene[e]	0.175	0.0542	NP	2.29E+03
Benzo(k)fluoranthene[d]	0.175	0.0521	NP	6.21E+01
Benzoic Acid	3.45	1.05	NP	1.00E+05
Bis(2-ethylhexyl)phthalate[d]	0.85	0.306	NP	3.47E+02
Chrysene[d]	0.175	0.0741	NP	6.15E+02
Fluoranthene	0.259	0.0958	NP	2.29E+03
Fluorene	0.175	0.0618	NP	2.66E+03
Indeno(1,2,3-cd)pyrene[d]	–	–	–	–
Phenanthrene	0.194	0.0588	NP	1.83E+03
Pyrene	0.251	0.0784	NP	2.29E+03
Volatile Organic Compounds (mg/kg)				
Acetone	0.00458	–	–	1.06E+02
Dichlorobenzene[1,4-][d]	1.75	0.00294	NP	3.95E+01

Table I-3.0-2 (continued)

COPC	Residential Maximum Concentration	95% UCL	Distribution Type	NMED Residential SSLs
Isopropyltoluene[4-][f]	0.00664	0.617	NP	2.71E+02
Methylene chloride[d]	0.00577	0.00162	NP	1.82E+02
Toluene	0.00239	0.00288	NP	2.52E+02
Radionuclides (pCi/g)—Excluding the General's Tanks				**LANL SALs**
Americium-241[g]	0.791	0.257	G	30
Cesium-137[g]	0.442	0.124	NP	5.6
Plutonium-238[g]	1.81	0.533	NP	37
Plutonium-239[g]	9.22	2.52	G	33
Strontium-90[g]	0.262	0.0771	G	5.7
Dioxins				
Tetrachlorodibenzodioxin [2,3,7,8-][d]	1.24E-06	2.53E-07	NP	–
Pentachlorodibenzodioxin [1,2,3,7,8-]	1.12E-05	4.16E-06	NP	–
Hexachlorodibenzodioxin [1,2,3,4,7,8-]	1.42E-05	5.32E-06	NP	–
Hexachlorodibenzodioxin [1,2,3,6,7,8-]	2.51E-05	9.49E-06	NP	–
Hexachlorodibenzodioxin [1,2,3,7,8,9-]	2.73E-05	1.02E-05	NP	–
Heptachlorodibenzodioxin[1,2,3,4,6,7,8-]	4.23E-04	9.46E-05	L	–
Octachlorodibenzodioxin [1,2,3,4,6,7,8,9-]	3.56E-03	7.94E-04	L	–
Furans				
Tetrachlorodibenzofuran [2,3,7,8-]	1.25E-06	7.50E-07	NP	–
Pentachlorodibenzofuran [1,2,3,7,8-]	8.40E-07	2.57E-07	NP	–
Pentachlorodibenzofuran [2,3,4,7,8-]	2.11E-06	1.14E-06	NP	–
Hexachlorodibenzofuran [1,2,3,4,7,8-]	5.95E-06	2.69E-06	NP	–
Hexachlorodibenzofuran [1,2,3,6,7,8-]	6.48E-06	5.39E-06	L	–
Hexachlorodibenzofuran [1,2,3,7,8,9-]	1.15E-06	2.99E-07	NP	–
Hexachlorodibenzofuran [2,3,4,6,7,8-]	6.22E-06	5.96E-07	L	–
Heptachlorodibenzofuran [1,2,3,4,6,7,8-]	9.64E-05	3.09E-05	L	–
Heptachlorodibenzofuran [1,2,3,4,7,8,9-]	8.31E-06	3.20E-06	NP	–
Octachlorodibenzofuran [1,2,3,4,6,7,8,9-]	1.85E-04	2.66E-05	L	–

[a] NP = Nonparametric, N = normal, G = gamma, L = lognormal.

[b] SSL from ATSDR.

[c] SSLs from EPA Region 6 (2007, 099314).

[d] Carcinogen.

[e] Isopropylbenzene values used because it is a surrogate for 4-isopropyltoluene.

[f] Pyrene is used as a surrogate based on structural similarity

[g] SALs from Laboratory guidance (LANL 2005, 088493).

Table I-4.1-1
Summary of Transportation Risks per Shipment for Remediation or Removal of the General's Tanks

		Crew Dose and Risk		Population Dose and Risk		Accidents	
Destination	Waste	Person-Rem	LCF	Person-Rem	LCF	Radiological (LCF Fatality)	Nonradiological (Fatalities)
DOE Site	Low-specific activity	0.0014	$8.2{\times}10^{-7}$	0.00027	$1.6{\times}10^{-7}$	$1.3{\times}10^{-8}$	0.000025
DOE Site	LLW and MLLW	0.012	$7.5{\times}10^{-6}$	0.0039	$2.4{\times}10^{-6}$	$1.7{\times}10^{-8}$	0.000025
WIPP	CH-TRU	0.023	0.000014	0.0073	$4.4{\times}10^{-6}$	$3.3{\times}10^{-11}$	0.000014

Note: This table was adapted from DOE 2008, 102731, Table I-54.

Table I-4.1-2
Summary of Human Health Residual Risk at MDA A

	Scenarios				
Risk Parameter	Industrial	Construction Worker	Recreational	Residential[a]	Screening Level[b]
Excess Cancer Risk	8×10^{-6}	5×10^{-6}	2.0×10^{-7}	3×10^{-5}	10^{-5}
Hazard Index	0.02	3.0 (0.2)[c]	0.04	0.4	1.0
Radiation Dose (mrem/y)	0.3	1.5	0.7	2	15
Radiation Cancer Risk	3×10^{-7}	10^{-6}	2×10^{-7}	—[d]	10^{-5}

[a] Included for comparison purposes only. This scenario is considered unlikely at MDA A.

[b] Screening levels were derived from DOE (2000, 067489) and NMED (2006, 092513).

[c] The EPC for manganese is above the construction worker SSL but the EPC for manganese is similar to background. The construction worker hazard index without manganese is approximately 0.2.

[d] Not evaluated.