TA-21

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OCT 2004
NMED Hazardous Waste Bureau

Date: October 29, 2004
Refer To: ER2004-0604

Mr. James Bearzi
NMED-Hazardous Waste Bureau
2905 Rodeo Park Drive East
Building 1
Santa Fe, NM 87505-6303

SUBJECT: RESPONSE TO THE NOTICE OF DISAPPROVAL FOR THE INVESTIGATION WORK PLAN FOR MATERIAL DISPOSAL AREA T, LOS ALAMOS NATIONAL LABORATORY, NM8900010515

Dear Mr. Bearzi:

Enclosed please find two copies of the response of the Los Alamos National Laboratory (LANL) and the Department of Energy (DOE) to the New Mexico Environment Department's Notice of Disapproval of the "Investigation Work Plan for Material Disposal Area T, at Technical Area 21, Solid Waste Management Unit 21-016(a)-99". This Notice of Disapproval was received by the Risk Reduction and Environmental Stewardship–Remediation Services (RRES-RS) project office on September 30, 2004.

If you have any questions, please contact Ron Rager at 505-665-4065 or Woody Woodworth at 505-665-5820.

Sincerely,

David McInroy, Deputy Project Director
Remediation Services
Los Alamos National Laboratory

Sincerely,

David Gregory, Federal Project Director
Department of Energy
Los Alamos Site Operations

DM/DG/BCR/jr

Enclosures: 1. LANL's and DOE's responses to NMED's comments for the notice of disapproval for MDA T (ER2004-0603)

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Response to the Notice of Disapproval for the Investigation Work Plan for Solid Waste Management Unit 21-016(a)-99, Dated September 30, 2004, Material Disposal Area T, at Technical Area 21

INTRODUCTION

This submittal is the response by Los Alamos National Laboratory (LANL or the Laboratory) to the "Notice of Disapproval for the Investigation Work Plan for Solid Waste Management Unit (SWMU) 21-016(a)-99, Material Disposal Area T, at Technical Area 21," issued by the New Mexico Environment Department (NMED) Hazardous Waste Bureau on September 30, 2004. The *Investigation Work Plan for Solid Waste Management Unit (SWMU) 21-016(a)-99, Material Disposal Area T, at Technical Area 21* (LA-UR-04-0559) (LANL 2004, 85641) was submitted by LANL to NMED in February 2004.

To facilitate review of these responses, NMED's comments are included verbatim. The comments are divided into general and specific categories as presented by NMED. LANL's responses follow each NMED comment.

GENERAL COMMENTS

NMED Comment

1. *Any disclaimers regarding testing, monitoring, or reporting of radionuclide data should include a statement that the Permittees will collect, sample, and analyze for radioactive constituents in accordance with the August 26, 2004, letter from Everet Beckner (NNSA Deputy Director) to NMED Secretary Ron Curry, and that these data will be regularly reported to NMED.*

LANL Response

1. LANL agrees to modify the disclaimer by replacing the last sentence with the following one: "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 in accordance with U.S. Department of Energy policy."

NMED Comment

2. *The Permittees must resubmit the work plan for MDA T. The resubmittal must include required text changes, additions, and revisions of all tables and figures that incorporate the comments in this notice of disapproval (NOD). The resubmittal must follow the format and function described in Section XI of the proposed Consent Order (Consent Order).*

LANL Response

2. LANL will resubmit the investigation work plan after its responses to NMED's notice of disapproval have been resolved.

NMED Comment

3. *The Permittees must include a table of regulatory criteria, with summaries, and the most applicable cleanup levels for each contaminant for which analyses are conducted.*

LANL Response

3. Item 1 of Section XI.B.11 of the September 1, 2004, proposed Consent Order states that regulatory criteria, background values, and cleanup levels may be included in analytical data tables, instead of as separate tables. LANL has chosen to satisfy this requirement by presenting screening levels as well as background values in the analysis data tables. Therefore, a separate summary table is not required as specified in NMED's comment. These tables are presented in the historical investigation report (HIR) rather than in the main body of the investigation work plan (see Tables B-23 through B-25 of the HIR). Data for subsurface tuff are compared to soil screening levels and screening action levels in these tables per Section VIII of the September 1, 2004, proposed Consent Order.

NMED Comment

4. *The Permittees must submit updated figures that include locations of underground utilities that may impact subsurface investigations and potential contaminant migration.*

LANL Response

4. In the resubmitted work plan, LANL will include a figure showing the location of buried utilities in the area of Material Disposal Area (MDA) T. Additional surveys at Technical Area (TA-) 21 are currently being conducted and will provide further information regarding buried utilities and former process piping at TA-21. This information will be reviewed upon completion of the surveys. Based on this review, boreholes may be relocated to avoid newly identified utilities. Any changes in borehole locations will be provided to NMED for review before field activities are initiated. A full summary of the geophysical investigation will be presented in the investigation report.

NMED Comment

5. *The Permittees propose the use of angled boreholes. In this case, NMED discourages the use of angled boreholes to ascertain the extent of contamination. While the Permittees may use angled boreholes, additional vertical boreholes are required since the current proposed boreholes do not provide adequate coverage to characterize the extent of contamination.*

LANL Response

5. LANL has eliminated the use of angled boreholes in the proposed characterization. Three deep (~385 ft below ground surface [bgs]) vertical boreholes are proposed (boreholes 1, 2, and 3) as shown in the revised Figure 12, which is included with this response. Borehole 1 is located to the south of beds 1 and 2. Boreholes 2 and 3 are located along the northern fence line of MDA T. These boreholes will assess the nature and extent of contamination from MDA T (absorption beds, shafts, and retrievable waste storage area [RWSA]), both in the rock matrix and in fractures which trend in a roughly north-south direction across DP Mesa. Boreholes 4 and 5 will be drilled to total depths of 280 ft bgs and increase the coverage along the northern boundary of MDA T. Two contingent boreholes (8 and 9) are planned as stepout boreholes north and south of MDA T. The decision to drill either borehole, and the final locations of these two boreholes, will be based on field observations

during the logging of the recovered cores (such as unusual staining) or if elevated field-screening results indicate that the lateral extent has not been defined. The location of borehole 9 is restricted by the steep topography northeast of beds 3 and 4, and the location of borehole 8 is restricted by industrial structures in the area of Building 21-005.

NMED Comment

6. *Numerically modeled behavior (e.g., Sections 3.2.2 and 3.2.2.1) of contaminants and moisture in the subsurface cannot be verified or reproduced by the NMED, the public, or other stakeholders. More importantly, field data indicating that contaminants have migrated in the subsurface are more reliable than numerical models in determining the nature and extent of contamination. NMED deems such models irrelevant in this case, and the Permittees should therefore remove such references in the resubmitted work plan.*

LANL Response

6. LANL will remove references to numerical modeling from the resubmitted section 3.2.2 of the investigation work plan.

NMED Comment

7. *Most of the discussion of historic processes, releases and contaminants associated with MDA T focuses on radiological constituents. The Permittees must identify and discuss nonradiologic constituents, such as inorganic and organic compounds, that were utilized or may have been used at the site and are known or suspected chemicals contained in the wastewater. In addition, the Permittees must discuss the non-radioactive composition of the sludge produced at buildings 21-35 and 21-257 treatment facilities. Some of the sludge wastes were mixed with cement and pumped into corrugated metal pipes (CMPs), placed in the retrievable waste storage area and removed at a later date. Other wastes were mixed with cement and injected into the shafts at MDA T. Still other wastes were apparently containerized in another manner and sent for disposal at a different (e.g., another technical area or offsite) location. If the disposal location is not MDA T, then identify the disposal location of the sludge. The Permittees must provide estimated volumes of sludge wastes disposed at the various locations.*

LANL Response

7. Because nonradiological constituents of disposed wastes at MDA T are unavailable, LANL has compiled the attached Table A, which shows all process constituents, including inorganic and organic chemicals, known or suspected to have been used at TA-21 during the MDA T operational period. Table A will be integrated into, and referenced in, the resubmitted Appendix B of the MDA T investigation work plan.

   LANL analyzed the sludge produced at the Buildings 21-035 and 21-257 treatment facilities only for radiological constituents during operations. Data indicating the nonradioactive composition of the sludge do not exist, and LANL will revise the investigation work plan to indicate this lack of data. Records of the off-site disposal of wastes other than the corrugated metal pipes (CMPs) have not been identified. The volumes of containerized wastes generated in Buildings 21-035 and 21-257, and the disposal locations do not have a bearing on planning the current investigation.

The CMPs placed in the retrievable waste storage area were moved to Area G at TA-54. LANL will revise the investigation work plan to indicate that the CMPs are currently located at TA-54. LANL is not providing disposal paperwork for MDA G since it does not bear directly on the planning of this investigation.

NMED Comment

8. *Investigations of several sites located at the Los Alamos National Laboratory facility (Facility) provide evidence that fractures and surge beds influence subsurface contaminant migration. At the 21-57 AST diesel spill, at least 50,000 gallons of diesel fuel migrated to depths of 150 to 165 feet below ground surface (bgs). According to the Permittees, this happened within a few months of the release, suggesting that saturated conditions may not be necessary for subsurface contaminant migration. Considering the volume of effluent released to the MDA T absorption beds, contaminant migration to depths greater than 165 feet is likely. In addition, historic investigations at MDA T identified subsurface migration of plutonium and americium to at least 100 feet bgs. In addition, perchlorate has migrated to depths of at least 280 feet bgs based on analyses of core samples collected from LADP-4. The concentrations of perchlorate observed in samples obtained from LADP-4 reportedly ranged between 200 and 1000 ppb. These data indicate movement of perchlorate in the subsurface to the north and east of MDA T. Therefore, NMED requires that the boreholes investigating the extent of contamination around the absorption beds extend to a minimum depth of 280 feet bgs. At a minimum, fractures, "moist" zones, fracture fill material, and surge beds/higher permeability intervals must be targeted for offsite fixed analytical laboratory analyses.*

LANL Response

8. LANL will assess the contamination migration along higher permeability intervals as part of the drilling and sampling of boreholes 2, 3, 4, and 5 (see also NMED Comment 5). In addition to the originally proposed samples shown in the submitted Tables 1 and 2 of the investigation work plan, LANL proposes collecting a minimum of four additional samples from fractures, fracture-fill materials, moist zones, and surge beds/higher permeability intervals in the 280 ft bgs and 385 ft bgs boreholes. These samples will also be sent to an off-site laboratory for analysis. The attached replacement Tables 1 and 2 and replacement Figures 11 and 12 reflect the updated number of proposed samples.

NMED Comment

9. *Data collected during historic Environmental Restoration Program investigations were often of substandard quality (e.g., mobile laboratory data, use of Permittees in-house laboratories, poor documentation, incorrect lamp usage in photo-ionization detectors). While the Permittees may include such information in work plans and reports, NMED considers much of these data suspect and will not base regulatory decisions on them.*

LANL Response

9. LANL has not based its MDA T site decisions on mobile laboratory data, in-house analysis, or suspect screening data generated during previous investigations. LANL plans to characterize the surface and subsurface by using analytical data generated during the implementation of this investigation work plan. Data from historic investigations are not categorically suspect or of substandard quality, as indicated in NMED's comment. Decisions on the usability of historic data are

based on the validation of these data and data-quality reviews. LANL will clarify this approach in the resubmitted investigation work plan.

NMED Comment

10. *The Permittees must provide the disposal location (pit, trench, and/or shaft numbers) and dates of disposal of the corrugated metal pipes (CMPs) that were removed from the retrievable waste storage area. In addition, the Permittees must also provide all waste characterization forms and other waste analyses documentation regarding the disposal of the CMPs.*

LANL Response

10. The former Health, Safety, and Environment (HSE-) 7 is the LANL group identified in the waste-management database as the generator associated with the disposal of the two CMP waste streams. LANL's Facility and Waste Operations (FWO) and Solid Waste Operations (SWO) personnel have identified 158 transuranic waste (TRU) CMPs that were disposed at TA-54 MDA G, Pit 29. The TRU CMP disposal at MDA G took place between August 7 and October 1, 1986. The waste type in the database is TRU cement paste.

    According to an FWO-SWO summary database, the 69 low-level radioactive waste (LLW) CMPs (193 m^3) are LLW in a cement matrix and were disposed of in MDA G Pit 26 at TA-54 between July 12 and July 18, 1984. The waste type in the database is LLW cement paste.

    Waste documentation for both TRU and LLW CMP waste streams from the RWSA at MDA T are being retrieved from the archives and will be provided to NMED as soon as it is available.

NMED Comment

11. *The Permittees are required to investigate the extent of saturation in DP Canyon in the Los Alamos and Pueblo Canyons investigation work.*

LANL Response

11. The extent of alluvial saturation in DP Canyon has been addressed in the Los Alamos and Pueblo Canyons Investigation Report (LANL 2004, 87390) delivered to NMED in April 2004. The intermediate and regional extent of saturation related to DP Canyon will be addressed in a followup report to the Los Alamos and Pueblo Canyons investigation report (unscheduled).

NMED Comment

12. *It is not clear that the proposed investigations will cover all SWMUs and AOCs listed in the Work Plan. The Permittees must provide a cross-reference listing the proposed investigation activities for each of the associated SWMUs and AOCs covered in the Work Plan.*

LANL Response

12. LANL has replaced all angled boreholes with vertical boreholes and has re-sited several of the planned boreholes. The attached Figure 12 has been revised to reflect these changes. The close proximity of the individual SWMUs relative to the known large extent of subsurface contamination, and the absence of waste records that might identify chemical constituents relative to disposal

operations at individual SWMUs (except for select constituents such as the dioxins and furans from the operation of the incinerators), do not allow specifically targeting individual SWMUs to determine nature and extent. The revised borehole layout will identify releases from individual and consolidated SWMUs. LANL will develop a table for inclusion in the resubmitted work plan that demonstrates the correlation between boreholes and individual SWMUs. LANL stresses that all significant releases from site SWMUs will be defined using the revised borehole numbers and locations.

SPECIFIC COMMENTS

NMED Comment

13. *Page 3: Section 2.2 Waste Inventory*

    The statement that the only wastes that remain at Material Disposal Area (MDA) T are found in the disposal shafts is not accurate. Untreated and treated industrial wastewater from TA-21 was discharged to the absorption beds located at MDA T. Contaminants that were suspended and dissolved in the effluent now reside in the subsurface. The Permittees shall correct the inaccuracy in the statement in the resubmitted work plan.

LANL Response

13. While untreated and treated waste water was discharged to the absorption beds, the migration of the contaminants in the waste water to the subsurface requires that they be viewed as contaminant releases and not as part of the waste inventory. Defining the nature and extent of these releases is the goal of the proposed investigation work plan. LANL has not modified the text of section 2.2, Waste Inventory, because it is important to distinguish between the defined and controlled waste materials in the shafts and the contaminants released to the subsurface from the absorption beds.

NMED Comment

14. *Page 3: Section 2.3, Relationship to Other SWMUs and AOCs.*

    The Permittees shall include a brief discussion of the nature of the contamination found at the adjacent SWMUs and areas of concern AOCs. For example, the chemicals of concern (COCs), the release mechanisms, estimated volumes released, and how they impacted or may have impacted the SWMUs and AOCs addressed in this work plan must be discussed. The Permittees must include in the resubmitted work plan periods of operation for each of the SWMUs and AOCs identified in this section.

LANL Response

14. In section 2.3 of the submitted investigation work plan, Relationship to Other SWMUs and AOCs, LANL presented a list of SWMUs possibly impacted by operations at MDA T or possibly impacting contaminant distributions within MDA T. The resubmitted investigation work plan will be revised to present readily available information on chemicals of potential concern (COPCs), volumes, release mechanisms of COPCs, and periods of operation associated with these SWMUs. Only qualitative assessments of the impacts of the surrounding SWMUs upon MDA T can be included in the work plan.

NMED Comment

15. Page 20: Section 3.2.2.1, Absorption

See comment #8.

LANL Response

15. See LANL's response to NMED comment 8 above.

NMED Comment

16. Page 21: Section 3.2.2.2, Perched Intermediate Waters

DP Spring discharges between the contact of stream gravels and Bandelier Tuff unit Qbt-1g indicating the presence of perched groundwater in DP Canyon. Contaminants, including tritium and strontium-90, have been identified in DP Spring discharge. The Permittees shall include, in the resubmitted work plan, text indicating the occurrence of perched groundwater in DP Canyon as exhibited by DP Spring and discuss contaminants, including non-radiologic constituents, that have been identified in the spring discharge.

LANL Response

16. LANL agrees to include the following text in the resubmitted work plan:

DP Spring discharges at the contact of older alluvium (estimated at approximately 37,000 years from C-14 dating) and Bandelier Tuff unit Qbt 1g. Surface water runoff generally associated with summer precipitation and snowmelt is temporarily stored in the older alluvium and then discharges as DP Spring. Discharge at DP Spring has been observed to be highly variable, generally ranging from zero flow to less than one gallon/minute, and has been observed to respond rapidly to surface water runoff from upper DP Canyon.

Several COPCs have been previously detected in samples from DP Spring, as noted in the Los Alamos and Pueblo Canyons investigation report (LANL 2004, 87390) submitted to NMED in April 2004. These COPCs primarily include strontium-90, iso-uranium, and tritium, although tritium concentrations have decreased significantly since the cessation of effluent releases from SWMU 21-011(k) in 1986.

NMED Comment

17. Page 22: Section 4.1, MDA T Field Investigations

The Permittees proposed two angled boreholes in the Work Plan; however, the borings may not be necessary to characterize fractures as several recent and historic investigations at adjacent sites may be cited. Instead, the Permittees must increase the number of proposed borings and use vertical rather than angled borings to determine nature and extent of contamination.

The five borings (three boreholes drilled to the Cerro Toledo interval) are proposed within the boundaries of MDA T are not likely to provide enough information to delineate the extent of contamination at MDA T. Additional borings should be advanced to adequately discern the extent of contamination. The additional borings should be located outside the boundaries of MDA T and be

focused in directions and depths that follow typical fracture orientation, the old alluvium, and the paleotopography controlling the Cerro Toledo interval. In addition to a subset of samples collected from competent tuff, core from each boring marked for off-site laboratory chemical analyses should be selected based on higher permeability intervals such as surge beds, old alluvium, and fractures, as well as fracture fill materials.

Evidence of subsurface contaminant migration gathered from prior investigations lead NMED to conclude that boreholes must extend a minimum of 100 feet bgs

LANL Response

17. LANL has increased the number and depth of borings as described in LANL's responses to NMED comments 5 and 8 and in the attached replacement Table 1 and replacement Figure 12. All boreholes, with the following exceptions, will be drilled to a minimum depth of 100 ft bgs. The three boreholes (numbers 20, 21, and 22) associated with septic system of Building 21-035 are planned for total depths of 40 ft bgs. The eight boreholes (numbers 24 through 31) planned to lithologically characterize and generate data on the paleochannel are planned for total depths of approximately 35 ft bgs.

    LANL will replace angled boreholes with vertical boreholes and has increased the number and depth of borings, as described in LANL's responses to NMED comments 5 and 8. The borehole locations have been revised, as illustrated on the attached replacement Figure 12. The new boreholes specifically target possible contaminant transport along the dominant north-south fracture orientation. To bound the extent of contamination, additional boreholes (numbers 8–10 and 16–18) will be drilled and sampled as necessary, based on field screening and field observations during the logging of the recovered cores from the prescribed boreholes. These additional boreholes are identified on replacement Figure 12.

    LANL will collect a minimum of four additional samples from fractures, fracture-fill materials, moist zones, and surge beds/higher permeability intervals from each borehole; these samples will be analyzed by an off-site laboratory. Boreholes will be advanced to the planned total depths identified in attached Table 1. To define vertical extent, the continuation of the boreholes to depths greater than planned will be based on the presence of elevated field screening and/ or field observations (such as unusual staining) to within 25 ft of the total depth.

NMED Comment

18. Page 23: Section 4.1.2.1, VOCs

Field screening for volatile organic compounds (VOCs) should not be dismissed based on previous investigation results. As previously mentioned, NMED finds the quality of the previous sample collection and analyses is often questionable. NMED therefore requires that the Permittees screen for VOCs, and do so in accordance with Section IX.B.2.d. of the proposed Consent Order. The Permittees must report the results in accordance with Section XI.C of the proposed Consent Order.

LANL Response

18. As prescribed in the submitted investigation work plan, LANL will collect volatile organic compounds (VOCs) screening data in accordance with Section IX.B.2.d. of the proposed Consent Order and will report the data in accordance with Section XI.C of the proposed Consent Order.

NMED Comment

19. Pages 23 and 24: Section 4.1.3, Sample Analysis

NMED requires the Permittees to collect samples for dioxins and furans, as required in Section IV.C.2.e.iv of the proposed Consent Order, from the subsurface in areas that are or were disturbed. In areas where fill material was imported during post-operational activities (i.e., the "Salamanders") at TA-21, the Permittees must also collect samples from the former surface rather than fill material.

LANL Response

19. The sampling proposed by LANL in the MDA T investigation work plan identified collection of dioxin and furan samples at all borehole locations where the former operational surface (now buried at some locations) could be identified in the recovered core samples during lithological logging (refer to section 4.1.3 of the work plan). Replacement Tables 1 and 2 (attached) present the proposed sampling.

    The RWSA is the only postoperational disturbance identified that requires sampling for dioxins and furans. As shown on replacement Figure 12, borehole 6 has been located to allow for sampling of the backfill material within the former RWSA. Dioxin and furan sampling is also identified in replacement Table 2 (attached).

NMED Comment

20. Page 25: Section 4.4, Sampling and Analysis at Building 257

The Permittees do not sufficiently justify the proposal to drill angled boreholes surrounding Building 21-257 rather than utilizing vertical boreholes. NMED believes that the angled boreholes are not necessary in this situation. Rather, additional vertical boreholes to the east and southeast are needed to investigate subsurface contaminant migration via interflow (between fill material and tuff) and fracture flow (typical fracture orientation) towards DP Canyon, and to investigate lateral and vertical migration via the paleochannel to the east of Building 21-257. Vertical boreholes should be drilled adjacent to the structures to characterize extent until the building is decontaminated and decommissioned (D&D).

The Permittees must remove approximately 15 feet of piping that remains associated with the outfall [21-011(k)] and eliminate all potential for accidental releases to the environment from ancillary piping from the tanks that may be inadvertently opened. Vertical boreholes should be drilled adjacent to the structures to characterize contaminant extent until D&D activities commence.

The Permittees also must include a schedule identifying the D&D schedule for structure 21-257. NMED may require additional sampling once Building 21-257 and other associated structures are D&D.

LANL Response

20. LANL has revised the borehole locations and depths, as shown in the revised Figure 12 (attached). Vertical boreholes 11 through 15 are 100 ft deep and are located on all sides of Building 21-257, with boreholes 14 and 15 oriented north and south of the building along the preferred orientation of fractures. Four boreholes (10 and 16 through 18) will be drilled, if necessary, based on field-screening results and on observations during core logging (such as unusual staining) that might indicate

contaminant transport. Additionally, the four paleochannel characterization boreholes (28 through 31) will be sampled and serve to further assess eastward lateral migration of contaminants.

See also LANL's responses to NMED comments 5 and 8.

The removal of the remaining SWMU 21-011(k) outfall pipe is currently not possible because of the requirement for a Documented Safety Analysis (DSA) for this activity. The outfall pipe is disconnected from any active system and blanked off within the concrete vault located just inside the MDA T perimeter fence. The current status of the remaining pipe was confirmed in the field during the SWMU 21-011(k) remediation effort. The removal of the remaining pipe will be completed as part of the decontamination and decommissioning (D&D) of Building 21-257 and of above-ground tanks 21-112 and -113. The D&D of these structures is scheduled for June 7, 2007, through June 8, 2008.

NMED Comment

21. *Page 25: Section 4.4, Sampling and Analysis at Building 257*

    Rather than drilling one angled borehole to investigate releases from tanks 21-012 and 21-013, the Permittees must drill additional vertical borings surrounding the tanks to investigate potential releases from these structures. Some of the boreholes must follow the preferred orientation of the fractures characteristic of TA-21.

    The Permittees must include a schedule identifying the D&D schedule for structures 21-012 and 21-013. NMED may require additional sampling once these and other associated structures are D&D.

LANL Response

21. LANL has revised the proposed borehole locations as presented in replacement Figure 12. Boreholes 5 and 19 are located north and south of tanks 21-112 and 21-113 and will be sufficient to assess any migration along the preferred fracture orientation across DP Mesa. The D&D of these structures is scheduled for June 7, 2007, through June 8, 2008.

    Also refer to LANL's responses to NMED comments 5 and 8.

NMED Comment

22. *Page 25: Section 4.5, Sampling and Analysis at Building 035*

    The Permittees must drill additional borings (minimum depth 40 feet) to determine the nature and extent of contamination in the area of the former leach field associated with Building 21-035. A 1957 H-7 Division Annual Report indicates that discharges from the treatment plant that did not meet current [1957] standards were either "recirculated or discharged to the tile field." Because these discharges were likely to the leach field associated with Building 21-035, the investigation of the septic tank and leach field require additional borings.

    The Permittees must provide the current status (e.g., in-place or removed) and the dimensions of the septic tank and leach field associated with Building 21-035. The Permittees must advance additional borings to depths greater than the base of the septic tank around the former septic tank (inlet and outlet piping).

    See also comments #8 and #31.

LANL Response

22. In addition to borehole 21 (renumbered from the submitted work plan), LANL will drill two additional boreholes (20 and 22) to a depth of 40 ft bgs to determine the nature and extent of contamination in the area of the former septic tank and leach field associated with Building 21-035.

    As referenced in Appendix B, section B 2.2, of the investigation work plan, the status of the current septic tank is "abandoned in place." The septic tank is a 390-gal.-capacity tank, and the leach field measures 50 ft long by 2.0 ft wide. The depth to the base of the septic tank is not known.

    Since the septic tank is small (390 gal.) and located close to Building 21-035, only a single borehole (20) is required to identify a release from the inlet, outlet and the septic tank. Borehole 21 will be sufficient to determine whether contaminants were released from the septic system drain field. Borehole 22 will determine if contamination extends beyond the east end of the drain field. Figures 11 and 12 and Tables 1 and 2 of the investigation work plan (attached) have been revised to reflect these updates.

NMED Comment

23. *Page 25: Section 4.6, Sampling and Analysis for Absorption Bed Area/Shaft Area/RWSA Area*

    The Work Plan states that air rotary drilling methodologies will be utilized for deeper boreholes; however, the Permittees must utilize hollow stem auger to the point of refusal in an attempt to minimize impacts to the subsurface conditions so that representative field screening and soil/sediment/rock samples may be collected. Boreholes with depths greater than 300 feet in similar geologic conditions have been drilled around the Facility (e.g., MDA H and 260 Outfall investigations) utilizing hollow stem auger drilling methods.

LANL Response

23. LANL will attempt to advance all boreholes to the prescribed total depth using hollow stem auger drilling methods. In the event that boreholes cannot be completed with this methodology, LANL will switch to air-rotary drilling methods to complete the borehole(s). The resubmitted investigation work plan text will reflect this change in approach, including reducing the pore-gas sampling events from two to one for boreholes drilled using hollow-stem auger (sampling will be consistent with the approach described for MDA G).

NMED Comment

24. *Page 25: Section 4.6, Sampling and Analysis for Absorption Bed Area/Shaft Area/RWSA Area*

    The Work Plan identifies five boreholes designated to investigate the extent of contamination at the absorption beds that comprise part of MDA T. Two of the five proposed boreholes are to be angled at 45° to a depth of 385 feet bgs. NMED requires that the Permittees delineate the nature and extent of contamination utilizing vertical boreholes. The Permittees must propose additional vertical borings surrounding the absorption beds to a minimum depth of 280 feet or 25 feet below the last detected contamination in accordance with Section IX.B.2.b.i of the proposed Consent Order.

    Additional shallow borings (minimum depth targeting base of old alluvium) must be proposed to investigate the paleochannel (apparently trending to the southeast) as a contaminant transport pathway.

Although the Permittees must advance borings surrounding the absorption beds, the borings should focus on the dominant fracture orientation and the paleochannel. If contamination is not bound by the advancement of the required boreholes, then the Permittees shall move farther away from the source and last detected contamination above background, fallout values or detection limits until the vertical and lateral extent of contamination is established.

See also comments #8, #17 and #31.

LANL Response

24. As discussed in LANL's responses to NMED comments 5, 8, and 17, LANL has revised the borehole locations, as shown in replacement Figure 12 (attached). Boreholes 2, 3, 4, and 5, located along the north perimeter of MDA T, will be used to characterize the extent of contamination to the north of the absorption beds and shafts and are in line with the preferred fracture orientation in the area. Boreholes 1, 7, and 23 are located to the south of the absorption beds and shafts and will serve to define the extent to the south. These boreholes also are located so that any preferential flow along the dominant fracture trace will be intercepted. Boreholes 8 and 9 will be drilled if field observations or elevated field screening indicate that additional boreholes are required to define lateral extent.

    The investigation of the paleochannel as a transport pathway is addressed by drilling two rows of four boreholes at each end of the MDA T site. Each borehole will be sampled at the base of the paleochannel or the most permeable material identified during lithologic logging of the recovered cores.

    The determination of the nature and extent of contamination has been based on measuring decreasing trends in concentration of contaminants. The guidance and interpretation provided to LANL on the decreasing trends in concentration is relative to the background for inorganic chemicals, fallout values for radionuclides, and practical quantitation limits for organic chemicals. In other words, the trend is such that the concentrations are approaching background/fallout levels or quantitation limits but may not reach this limit or may be less than these limits (as in the case of organic chemicals detected below quantitation limits).

    The approach is consistent with the Environmental Protection Agency's (EPA's) current guidance for defining the extent of contamination under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the corrective action under Resource Conservation and Recovery Act (RCRA). EPA's "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA" (EPA 1988, 59107, p. 3-13) states that one of the primary objectives of site investigations is "to characterize the nature and extent of contamination such that informed decisions can be made as to the level of risk presented by the site and the appropriate type(s) of remedial response." In most cases, and specifically at MDA T, neither of these decisions requires defining the extent of contamination to background levels. EPA offers similar guidance with respect to RCRA corrective actions. In the EPA's May 1, 1996, Advance Notice of Proposed Rulemaking for RCRA Corrective Action (61 FR 19444), EPA states, "in delineating the extent of contamination it may not be necessary to delineate to background concentrations in all cases. In some cases, information adequate to support cleanup decisions can be obtained through delineation to risk-based concentrations or other investigation endpoints."

NMED Comment

25. *Page 26: Section 4.7, Sampling and Analysis for Perched Water and Vadose Zone Characteristics*

    If contamination is discovered at the targeted Cerro Toledo interval (roughly 350 feet bgs), the Permittees must either proceed with drilling through the Cerro Toledo interval or complete the boring in the Cerro Toledo and advance another boring beyond the Cerro Toledo adjacent to the other borings to determine the extent of contamination.

    See also comment #31.

LANL Response

25. LANL refers NMED to section 5.4 of the investigation work plan, Potential Pore-Gas or Perched Saturation Zone Monitor Well Installation. The comment above is addressed in this section as written.

NMED Comment

26. *Page 26: Section 4.7, Sampling and Analysis for Perched Water and Vadose Zone Characteristics*

    The Permittees must describe how "representative" subsurface carbon dioxide and oxygen "conditions" will be determined in regard to purging the well prior to vapor phase sampling.

LANL Response

26. The following additional information will be included in the resubmitted work plan:

    LANL standard operating procedure (SOP) 6.31, Sampling of Subatmospheric Air, defines the process for ensuring that subsurface gas conditions have stabilized and are representative of formation conditions prior to the collection of subatmospheric (formation vapor) samples. In brief, a purge pump is used to withdraw borehole and formation vapors through the borehole or constructed sampling port. Concentrations of purge indicator gases (CO_2 and O_2) are monitored continuously during this presampling cycle. Once indicator gas concentrations are stable, proper purge is achieved and formation vapor sampling can proceed. The resubmitted investigation work plan will be revised to include a reference to this SOP along with a brief discussion of this methodology.

NMED Comment

27. *Page 26 and 27: Section 5.0, Investigation Methods*

    The Permittees may not list standard operating procedures in lieu of a brief description of how samples will be collected, or how field instruments will be utilized and calibrated. As stated in section IX.A of the proposed Consent Order, the Permittees may not substitute a reference to their SOPs for a description of its procedures. At a minimum, a brief description of referenced procedures must be included in the resubmitted work plan.

LANL Response

27. LANL will add brief descriptions of all referenced procedures to the appropriate section of the resubmitted investigation work plan.

NMED Comment

28. *Page 27: Section 5.1, Drilling Methods*

    See comments #23.

LANL Response

28. As described in the response to NMED comment 23, LANL will attempt to advance all boreholes to the prescribed total depth by using hollow-stem auger drilling methods. In the event that boreholes cannot be completed using this method, LANL will switch to air-rotary drilling methods to complete the borehole(s). The resubmitted investigation work plan will be revised to reflect this change in approach.

NMED Comment

29. *Page 27: Section 5.1, Drilling Methods*

    See comments #8 and #32

LANL Response

29. See LANL's responses to NMED comments 8 and 32.

NMED Comment

30. *Page 28: Section 5.2 Methods of Collecting Soil and Rock Samples*

    In addition to those samples selected for offsite fixed laboratory analyses using field screening methods, NMED requires that material surrounding fractures, fracture fill material, and higher permeability units such as surge and pumice beds must also be targeted for off-site fixed laboratory analyses.

LANL Response

30. LANL will collect a minimum of four additional samples from fractures, fracture-fill materials, moist zones, and surge beds/higher permeability intervals from each borehole; these samples will be analyzed by an off-site laboratory. Tables 1 and 2 (attached) have been revised to reflect the increased number of analytical samples and the additional sampling targets.

NMED Comment

31. *Page 28: Section 5.2 Methods of Collecting Soil and Rock Samples*

    The Permittees must extend borings a minimum of 25 feet beyond the last contaminant detection based on appropriate field screening and/or laboratory analyses. Radiological field screening may not be indicative of the presence of all contamination at the site (e.g., where organic and inorganic chemicals were discharged). Therefore, before cessation of drilling and properly abandoning the boreholes, the Permittees should receive confirmation with analytical data that the borehole extends at least 25 feet past the last confirmed contaminant detection in accordance with Section IX.B.2.b.i of the proposed Consent Order.

LANL Response

31. Section IX.B.2.b.i of the September 1, 2004, Consent Order requires boreholes to be advanced "25 ft below the deepest detected contamination based on field screening, laboratory analyses, and/or previous investigations at the site." The Permittees intend to satisfy this requirement primarily on the basis of field screening, which includes field observations. As described in section 5.4 of the investigation work plan, boreholes will not be abandoned until a decision is made to complete boreholes as pore-gas monitoring wells.

NMED Comment

32. *Page 29 Section 5.3, Collection of Geotechnical Data*

    Unless the quality and/or validity of the hydraulic conductivity, matrix potential, porosity, Kd and bulk density data of previously collected from around the laboratory of each Bandelier Tuff unit is in question, NMED recommends that these data (from competent tuff samples) not be collected again. In addition, NMED is not requiring the collection of chloride data from these boreholes and recommends not collecting this information. Actual subsurface contaminant data will provide information regarding subsurface contaminant transport.

LANL Response

32. These data are site-specific and important for evaluating the nature and extent of contamination, as well as for supporting site corrective-action decisions to be evaluated during corrective measures evaluation (CME). LANL will collect data on the hydrogeologic characteristics and on chloride.

NMED Comment

33. *Page 30: Section 5.5, Borehole Abandonment*

    The backfilling of boreholes with cuttings produced from the drilling activities will not be permitted. All drill cuttings must be containerized and analyzed before disposal. Depending on the concentrations, NMED may consider a "contained in" determination of drill cuttings if the cuttings contain listed or characteristic waste. As a reminder, land disposal restrictions may still apply to this type of investigation-derived waste (IDW).

    See also comment #43.

LANL Response

33. LANL will abandon all boreholes by filling the borehole with bentonite grout and fill material. Using a tremie pipe, LANL will fill upward from the bottom of the borehole to within 20 ft of the surface. After emplacing the bentonite grout the remaining portion of the borehole will then be sealed with a Portland Type I or Type II cement that contains 2% to 5% bentonite. All cuttings will be managed as discussed in NMED comment 43 below. This information will be included in the resubmitted investigation work plan.

NMED Comment

34. Page 54: Table 2, Summary of Proposed Borehole Drilling and Sampling at MDA T

See comment #19.

LANL Response

34. Revised Table 2 reflects changes to the proposed drilling and sampling at MDA T and will be included in the revised work plan.

NMED Comment

35. Page B-3: Section B-2.2, Historic Facility Descriptions

The Permittees must provide descriptions of SWMUs 21-010(c and d).

LANL Response

35. LANL will revise text to provide descriptions of SWMUs 21-010(c, d). NMED may wish to consult Appendix B, Table B-1 (page B-48), of the HIR for SWMU descriptions.

NMED Comment

36. Page B-5: Section B-2.3, Operational History

The Permittees must provide, in the resubmitted work plan, a discussion of the chemical (non-radiologic) composition and description of the "solids," "semi solids, " and raffinate wastes described in the section. If there are no chemical analyses of these wastes, the Permittees must provide a listing of the chemicals (inorganic and organic) that may comprise the wastes based on process knowledge. If the solid, semi solid, and raffinate wastes were similar to sludge generated at TA-50, provide waste analysis forms for the waste sludge. For all wastes not disposed in the shafts at MDA T, provide a location of disposal and method of disposal for the wastes.

LANL Response

36. Chemical analysis of these wastes could not be located, and it is not clear whether the semi-solid, solid, and raffinate wastes generated at TA-21 were directly comparable to the wastes generated at TA-50. LANL has reviewed the available process information and has attached Table A to show the chemicals and radionuclides used in processing activities at TA-21. This table also will be included in the revised Appendix B of the investigation work plan. The final disposal location and the methods of wastes not disposed of at MDA T are not relevant to the MDA T investigation.

NMED Comment

37. Page B-5: Section B—2.3.1, Untreated and Treated Waste Water

Identify and provide a reference a map depicting the location of the drainage(s) into DP Canyon that received the overflow from the absorption beds. It is not clear if Figure 11 represents the drainage discussed in the text.

LANL Response

37. The relevant figures presented in the revised work plan (including Figure 11, attached) will include the trace of the drainage to be sampled.

NMED Comment

38. Page B-5: Section B-2.3.1, Untreated and Treated Waste Water

Detailed discussion of the radionuclides present in the wastewater released to the absorption beds and DP has been provided; however, the Permittees must document the non-radiologic composition of the treated and untreated effluent. Historic monitoring of the releases and impacted alluvial groundwater and surface non-radiologic water quality should be discussed in order to provide a more accurate portrayal of the potential impacts to the environment. If the information is not available, the Permittees must identify the chemicals (inorganic and organic) used historically at TA-21 that may have been discharged via the absorption beds, directly to the canyon or through the industrial wastewater treatment plants.

See also comment #7.

LANL Response

38. The chemical analyses of each specific waste stream produced during the historic processes at TA-21 are not available. LANL has attached Table A that lists all process chemicals (inorganic and organic chemicals and radiological) known to have been used at TA-21 during this period.

NMED Comment

39. Page B-7: Section B-2.3.4 Industrial Waste Treatment Processes at Building 035

The Permittees must provide a table identifying the applicable standards that applied to discharges when Building 035 was in operation.

LANL Response

39. The facility discharges to the absorption beds would have been governed by the standards of the Atomic Energy Act of 1954. No other documentation regarding operational discharges from Building 21-035 to the absorption beds has been identified.

NMED Comment

40. Page B-7: Section B-2.3.4 Industrial waste Treatment Processes at Building 257

The Permittees must provide a table identifying the applicable standards that applied to discharges when Building 257 was in operation.

LANL Response

40. The facility discharges to the absorption beds would have been governed by the standards of the Atomic Energy Act of 1954. No other documentation regarding operational discharges from Building 21-257 to the absorption beds has been identified.

NMED Comment

41. Page B-9: Section B-2.4.2, Cement-Treated Waste Treatment and Other Solid Waste Disposal

See comments #7 and #36.

LANL Response

41. See LANL's responses to NMED comments 7 and 36 above.

NMED Comment

42. Page B-79, Figure B-39 Data Interpretation Process

Certain chemicals of concern (COCs) may not be dropped from consideration simply because the Permittees believe a particular analyte is a common laboratory contaminant. The Permittees operate a facility with many analytical laboratories and a variety of "Common Lab Contaminant[s]" are expected as COCs. For example, methylene chloride and acetone are used throughout the facility and NMED considers it likely that the contaminants have been released to the environment.

LANL Response

42. Figure B-39 will be deleted from the revised MDA T investigation work plan. The figure incorrectly represented the plan for dealing with common laboratory contaminants. The fact that acetone, methylene chloride, 2-butanone, and phthalates are categorized as common laboratory contaminants does not eliminate them as chemicals of potential concern. It does, however, influence how the data for these compounds are assessed with respect to the data from laboratory blanks. If a compound is detected in a blank and in a sample associated with that blank, the sample concentration is compared to the blank concentration to evaluate whether the compound is present as a result of laboratory contamination or is actually present in the characterization sample. According to "EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review," if the concentration of the compound in the sample is less than or equal to 10 times the concentration in the blank for the common laboratory contaminants or less than 5 times the concentration in the blank for all other compounds detected, the data are qualified as undetected (U). Otherwise, the data are reported as presented.

NMED Comment

43. Page C-1: Appendix C-1.0, Management of Investigation-Derived Waste

NMED does not approve the Permittees' plan for handling Investigation Derived Waste (IDW). Specifically, the Permittees may not return cuttings or other environmental media to their point of origin. Rather, the Permittees must contain all IDW, and characterize it to ensure proper handling, including but not limited to, final disposal. The resubmitted work plan must include a description of IDW management (see Section IX.B.5 of the proposed Consent Order).

In their description of the methods and procedures used to characterize and manage all IDW, the Permittees may not substitute a reference to their SOPs for a description of its procedures (see Section IX.A of the proposed Consent Order).

Drill cuttings, purge and decontamination water, personal protective equipment (PPE), and all other environmental media must be containerized and characterized prior to disposal. Each container of waste generated must be properly labeled immediately following containerization. All IDW must be sampled and analyzed for hazardous contaminants that are suspected or detected prior to or during investigation activities. All suspected radioactively contaminated waste/material should be sampled or surveyed for radionuclides. All IDW must be disposed of properly at an appropriate disposal facility. The methods used to store, control, and transport each waste type and classification must be included in the investigation report.

The Permittees may not use previous sampling data for the purpose of characterizing newly generated waste streams. The Permittees must collect samples of all newly generated waste streams related to IDW and submit the samples for laboratory analysis.

The Permittees assume all the waste steams generated during the investigation of MDA T will be disposed of as low level waste (LLW) at TA-54 MDA G. Before disposal, the Permittees must characterize the waste. At that point, a determination can be made as to where the waste may be disposed.

See also comment #33.

LANL Response

43. Appendix C will be revised to include a more descriptive work plan for IDW management. This plan will further describe the methods proposed for containerizing, characterizing, storing, transporting, and disposing of IDW generated from the investigation activities. Specifically, reference to returning drill cuttings to their point of origin will be removed from the appendix.

    The methods and procedures used to characterize and manage all IDW will be described as explained above. However, reference to the applicable LANL operations requirements documents and SOPs will be retained, not as a substitute for this description but for clarity. IDW will be characterized in accordance with SOP-01.10, Waste Characterization, and in accordance with the regulatory requirements incorporated by reference in SOP-01.10. The Permittees expect most wastes to be characterized on the basis of acceptable knowledge (AK), rather than on direct waste analysis. AK will consist of the results of analysis of the environmental media associated with each waste stream. For example, spent personal protective equipment (PPE) and disposable sampling supplies that potentially come in contact with contaminated media will be characterized based on the results of analysis of that media. Similarly, borehole cuttings will be characterized on the basis of analytical results of the core samples from that borehole. If decontamination fluids are to be sent off-site for disposal, they will be sampled to demonstrate compliance with the waste acceptance criteria of the receiving facility. Otherwise, less than six gal. per day of decontamination fluid can be discharged to the ground in accordance with an existing Notice of Intent (NOI) for discharge to groundwater approved by the NMED Ground Water Quality Bureau.

    LANL is anticipating, for planning purposes, that waste streams from the investigation of MDA T will be categorized as LLW; however, ultimate disposal determinations will be based on the results of the waste characterization.

REFERENCES

EPA (U. S. Environmental Protection Agency), October 1988. "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, Interim Final," OSWER Directive 9355.3-01, Office of Remedial Response, Washington, D.C. (EPA 1988 59107)

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, 85641)

LANL (Los Alamos National Laboratory), April 2004. "Los Alamos and Pueblo Canyon Investigation Report," Los Alamos National Laboratory document LA-UR-04-2714, Los Alamos, New Mexico. LANL 2004, 87390)

Table A
Process Chemicals Used During 1943–1978 at MDA T

Chemical Name	ID	CAS Number
Actinium	Ac	7440-34-8
Acetone	C_3H_6O	67-64-1
Aluminum	Al	7429-90-5
Aluminum nitrate	Al_3H-N-O_3	13473-90-0
Aluminum oxide	Al_2O_3	1344-28-1
Amberlite LA-1	C_6-H-C_{l5}	100915-96-6
Americium	Am	7440-35-9
Americium raffinates	n/a	n/a[a]
Americium trifluoride	AmF_3	n/a
Ammonium ion	NH_4	n/a
Ammonium nitrate	NH_4NO_3	6484-52-2
Ammonia	NH_3-N	7664-41-7
Ammonium citrate	$(NH_4)_2C_6H_6O_7$	3012-65-5
Ammonium hydroxide	NH_4OH	1336-21-6
Amorphous silica	SiO3	1344-95-2
Armeen 2-12	C_{14}-H_{31}-N	112-18-5
Asbestos	n/a	1332-21-4
Barium	Ba	7440-39-3
Berkelium	Bk	7440-40-6
Beryllium	Be	7440-41-7
Bismuth	Bi	7440-69-9
Bispyridinium oxime	HI	96-64-0
Boron plastic	n/a	n/a
Bromine	Br_2	7726-95-6
Cadmium	Cd	7440-43-9
Calcium	Ca	7440-70-2
Californium	Cf	7440-71-3
Carbon	C	7440-44-0
Carbon dioxide	CO_2	124-38-9
Carbon tetrachloride	C-C_{14}	56-23-5
Cerium	Ce	7440-45-1
Chloride	Cl^- (ion)	n/a
Chromium	Cr	7440-47-3
Chromium nitrate / nitride	$Cr(NO_3)_3$ / CrN	$Cr(NO_3)_3$ - 13548-38-4 CrN - 24094-93-7
Cobalt	Co	7440-48-4
Copper	Cu	7440-50-8

Table A (continued)

Chemical Name	ID	CAS Number
Curium	Cm	7440-51-9
Deuterium	^{2}H	7782-39-0
Di-ammonium citrate	$C_6H_8O_7 \cdot 2(H_3N)$	7632-50-0
Di-butyly phospate	C_8-H_{19}-O_4-P	107-66-4
Dioxygen difluoride	O_2F_2	Not Found
Einsteinium	Es	7429-92-7
Ethyl (ether)	$(C_2H_5)_2O$	60-29-7
Ferric hydroxide	Fe $(OH)_3$	n/a
Fluoride	Fl^- (ion)	n/a
Fluorine	F_2	7782-41-4
Gallium	Ga	7440-55-3
Germanium	Ge	7440-56-4
Hafnium	Hf	7440-58-6
Helium	He	7440-59-7
Hydrochloric acid	HCL	7647-01-0
Hydrogen	H	1333-74-0
Hydrogen bromide	HBr	10035-10-6
Hydrogen fluoride	HF	7664-39-3
Hydrogen peroxide	H_2O_2	7722-84-1
Hydroxide	OH-	n/a
Indium	In	7440-74-6
Iodine	I	7553-56-2
Iridium	Ir	7439-88-5
Iron	Fe	7439-89-6
Kerosene	n/a	8008-20-6
Lanthanides		Ce - 7440-45-1, Pr- 7440-10-0 Nd - 7440-00-8, Pm - 7440-12-2 Sm - 7440-19-9, Eu - 7440-53-1 Gd - 7440-54-2, Tb - 7440-27-9 Dy -7429-91-6, Ho - 7440-60-0 Er - 7440-52-0, Tm - 7440-30-4 Yb - 7440-64-4, Lu -7439-94-3
Lanthanum	La	7439-91-0
Lead	Pb	7439-92-1
Lithium	Li	7439-93-2
Magnesium	Mg	7439-95-4
Magnesium oxide	MgO	1309-48-4
Manganese	Mn	7439-96-5
Mecuric nitrate	HgN_2O_6	10045-94-0

Table A (continued)

Chemical Name	ID	CAS Number
Mercury	Hg	7439-97-6
Methane	$C\text{-}H_4$	74-82-8
Molybdenum	Mo	7439-98-7
Mono-butyl phospate	$C_4H_{11}O_4P$	n/a
N-decyl alcohol	$C_{10}\text{-}H_{22}\text{-}O$	1322-98-1
Neptunium	Np	7439-99-8
Nickel	Ni	7440-02-0
Niobium carbide	NbC	12069-94-2
Nitrate nitrogen	$NH_3\text{-}N$	014797-55-8
Nitrates	NO_3 (anion)	n/a
Nitric acid	HNO_3	7697-37-2
Nitrogen	N_2	7727-37-9
Osmium	Os	7440-04-2
Oxalate	salt of oxalic acid	n/a
Oxalic acid	$H_2C_2O_4$	144-62-7
Palladium	Pd	7440-05-3
P-bromo-mandelic acid	Br-HOCH(C6H5)COOH	Not Found
Perchlorates	ClO_4^-	n/a
Phosphates	PO_4 (anion)	n/a
Phosphoric acid	H_3PO_4	7664-38-2
Platinum	Pt	740-0604
Plutonium	Pu	7440-07-5
Plutonium fluoride	PuF_3	13842-83-6
Plutonium hexafluoride	PuF_6	n/a
Plutonium hydroxide	$Pu(OH)_4$	n/a
Plutonium nitrate	$PuNO_3$	n/a
Plutonium oxalate	$Pu(C2O_4)$	n/a
Plutonium oxide	PuO_2	n/a
Plutonium peroxide	$Pu(O_2)^2$	n/a
Plutonium trioxalate	$Pu_2(C_2O_4)_3$	n/a
Plutonium-cerium-cobalt	Pu-Ce-Co alloy	Pu - 7440-07-5 Ce - 7440-45-1 Co - 7440-48-4
Plutonyl ion	PuO_2^{2+}	n/a
Polonium	Po	7440-08-6
Polyethlyene	$(C_2H_4)_n$	9002-88-4
Potassium iodate	KIO_3	7758-05-6
Potassium iodide	KI	7681-11-0

Table A (continued)

Chemical Name	ID	CAS Number
Potassium permanganate	$KMnO_4$	7722-64-7
Potassium plutonium fluoride	K_2PuF_6	n/a
Potassium pyrosulfate	$K_2S_2O_7$	7790-62-7
Primene JMT	$C_8H_{17}NH_2$	68955-54-4
Protactinium	Pa	7440-13-3
Rhodium	Rh	7440-16-6
Ruthenium	Ru	7440-18-8
Selenium	Se	7782-49-2
Silica	$CaSiO_3$	14464-46-1 14808-60-7
Silicon tetrafluoride	SiF_4	7783-61-1
Silver	Ag	7803--62-5
Sodium acetate	$NaC_2H_3O_2$	127-09-3
Sodium bromate	$NaBrO_3$	7789-38-0
Sodium bromotrioxide	$NaBr_2O_3$	n/a
Sodium chromate	Na_2CrO_4	7775-11-3
Sodium citrate	$C_6H_8O_7Na_32H_{20}$	68-04-2
Sodium fluoride	NaF	7681-49-4
Sodium hydroxide	NaOH	1310-73-2
Sodium nitrate	$NaNO_3$	7631-99-4
Sodium plutonyl acetate	$NaPuO_2(C_2H_3O_2)_3$	n/a
Sodium bromotrioxide	$NaBr_2O_3$	n/a
Sulfates	SO_4 (anion)	n/a
Sulfur	S	7704-34-9
Sulfur dioxide	SO_2	7446-09-5
Sulfuric acid	H_2SO_4	7664-93-9
Tantalum	Ta	7440-25-7
Tetrafluoride	xF_4[b]	n/a
Thenoyl-tri-fluoracetone	$C_8H_5O_2F_3S$	326-91-0
Tin	Sn	7440-31-5
Thorium	Th	7440-29-1
Thorium flouride	ThF_4	n/a
Titanium	Ti	7440-32-6
Tri-lauryl amine	$3\{CH_3(CH_2)_{11}\}NH_2$	n/a
Tri-n-butyl phosphate	$C_{12}H_{27}O_4$	126-73-8
Tri-n-octylamine	C_{24}-H_{51}-N	n/a
Tritium	H3	10028-17-8

Table A (continued)

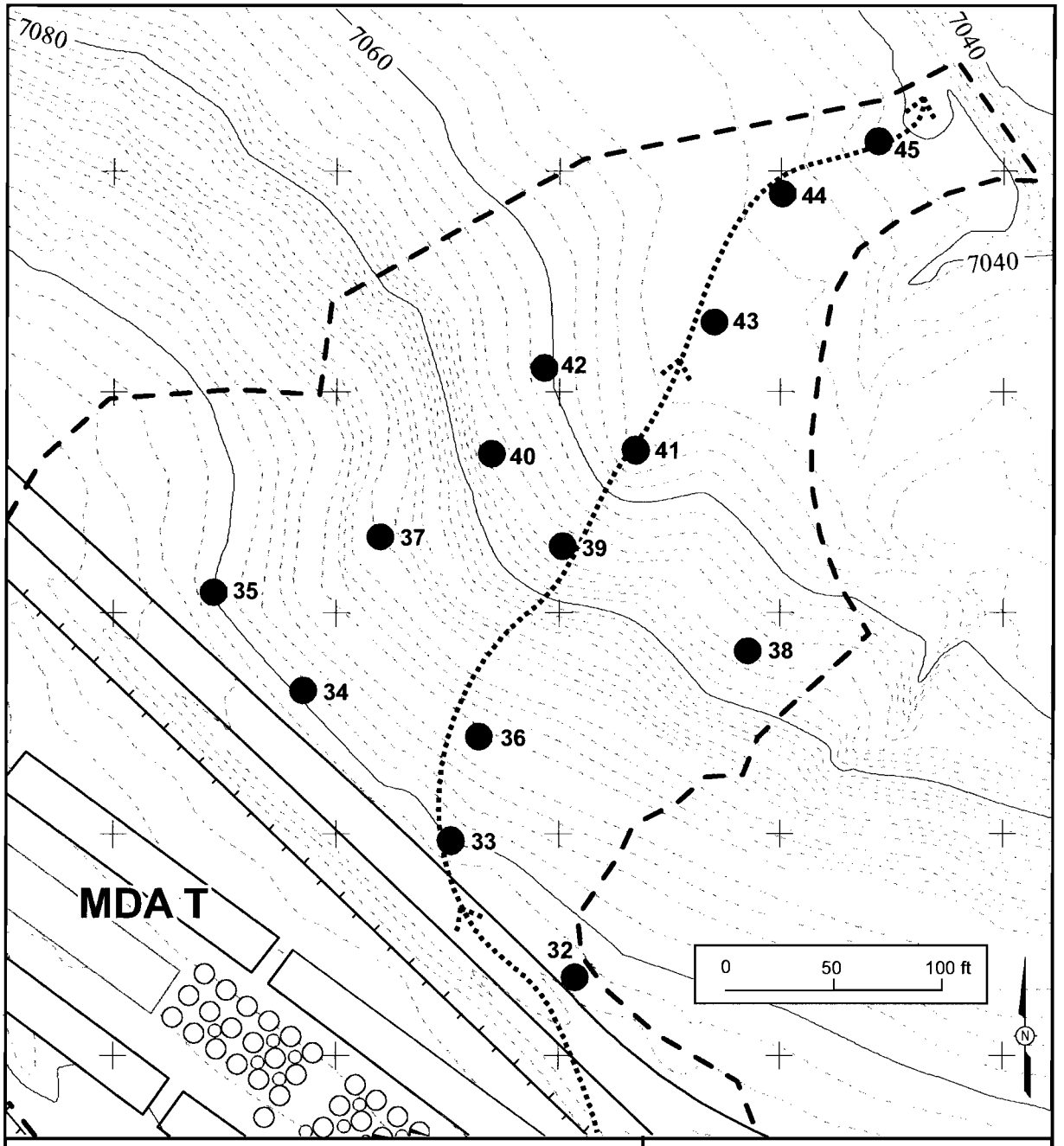
Chemical Name	ID	CAS Number
Uranium	U	7440-61-1
Zirconium	Zr	7440-67-7
Zinc	Zn	7440-66-6
Radionuclides:		
227 ac	Actinium	7440-34-8
137 cs	Cesium	7440-46-2
233 u	Uranium	13968-55-3
234 u	Uranium	13966-29-5
235 u	Uranium	15117-96-1
238 u	Uranium	7440-61-1
237 np	Neptunium	7439-99-8
238 pu	Plutonium	7440-07-5
239 pu	Plutonium	7440-07-5
240 pu	Plutonium	7440-07-5
241 pu	Plutonium	7440-07-5
242 pu	Plutonium	7440-07-5
241 am	Americium	7440-35-9
242 am	Americium	7440-35-9
243 am	Americium	7440-35-9
244 cm	Curium	7440-51-9
210 po	Polonium	7440-08-6
89 sr	Strontium	7440-24-6
232 th	Thorium	7440-29-1
140 ba	Barium	7440-39-3
140 la	Lanthanum	7439-91-0
90 sr	Strontium	7440-24-6
Organic chemicals identified during previous investigations:		
Anthracene	$C_{14}H_{10}$	120-12-7
Benz(a)anthracene	$C_{18}H_{12}$	56-55-3
Benzo(a)pyrene	$C_{20}H_{12}$	50-32-8
Benzo(b)fluoranthene	$C_{20}H_{12}$	205-99-2
Benzo(g,h,i)perylene	$C_{22}H_{12}$	191-24-2
Benzo(k)fluoranthene	$C_{20}H_{12}$	207-08-9
Miscellaneous:		
17o		
15n		
13c		

Table A (continued)

Chemical Name	ID	CAS Number
9d-178		
Cement paste = americium strip and alkaline fluoride		
Corrosive gases (gas cylinders)		
Mineral oils		
Cyanide plating waste		
Anion exchange resin		
Biological waste		

[a] n/a = Not applicable.

[b] Where x is the stabilizing element.



NOTES:

1. Locations will serve as surface as well as sub-surface sample-collection sites.
2. Locations will be spade and scoop sampled (0–0.5 ft), then hand-augered to a depth of nondetect field-screening results or to refusal.
3. All locates, features, and scale approximate.

Fence

Contour line

MDA T boundry

Surface and shallow subsurface sample location

Historic surface drainage from MDA T

Figure 11. Planned sample locations (renumbered) for the south side of DP Canyon

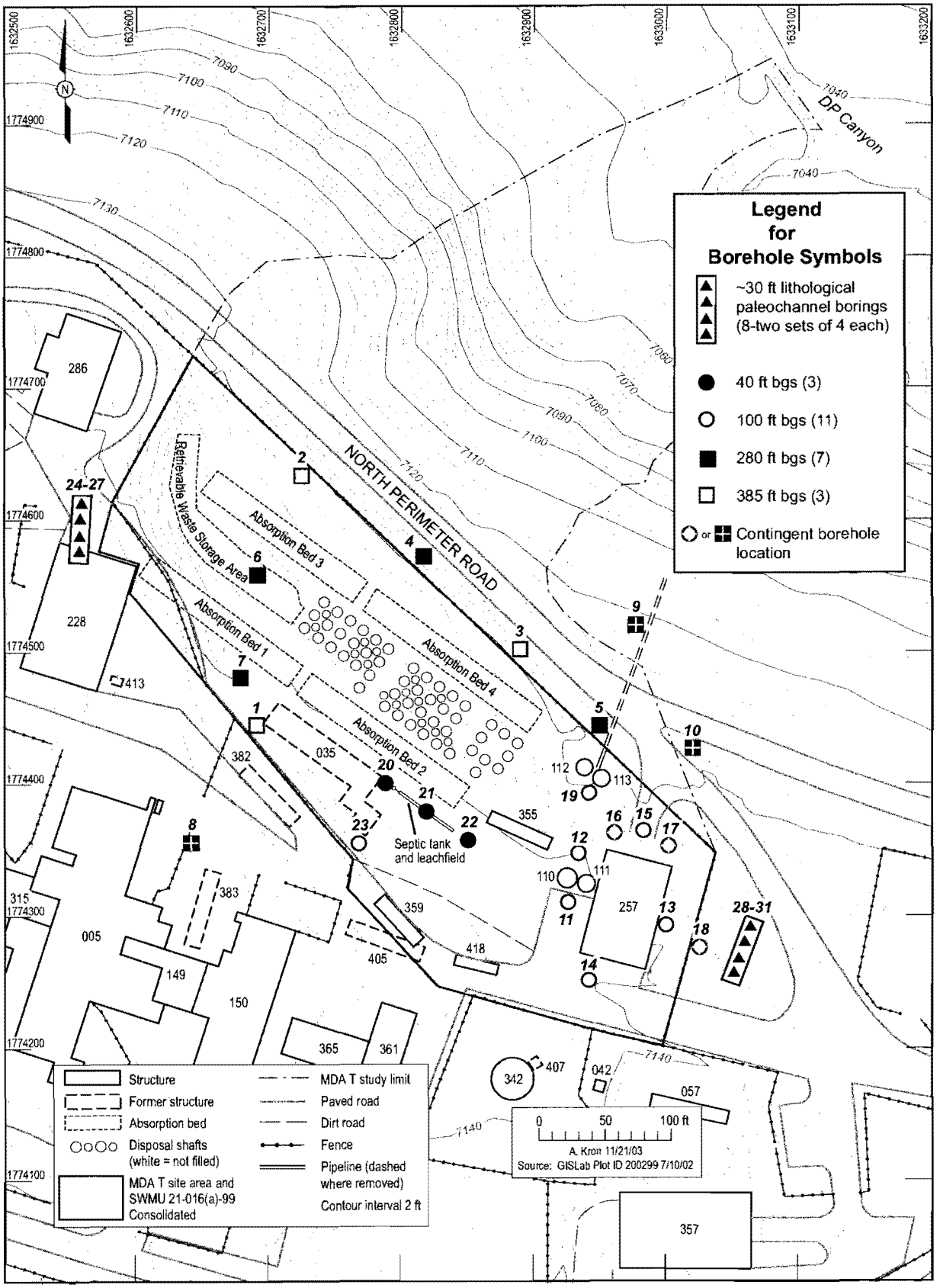


Figure 12. Proposed revisions to borehole locations at MDA T

Table 1
Summary of Proposed Borehole Sample Targets

Borehole ID	Site/Data Need Addressed	Planned Sample Target Depths and Borehole Total Depth	Estimated Minimum No. of Samples for Fixed-Lab Analysis	Field Screening Intervals[a]	Core Intervals
1, 2, and 3	Absorption beds, shafts and RWSA/vertical and lateral extent of contamination, preferential pathways, and perched water	Qbt3/2 contact: ~85 ft bgs. Top of Cerro Toledo Fm: ~350 ft bgs. Bottom of Cerro Toledo Fm: ~385 ft bgs. Screening and observation based intervals: TBD[b] TD: ~385 ft bgs.	**18 per location** (4 prescribed, 7screening based, and 7 observation based) **54 total**	5 ft	2.5 ft
4	Absorption beds, shafts and RWSA/vertical and lateral extent of contamination, preferential pathways, and perched water	Qbt3/2 contact: ~85 ft bgs. Screening and observation based intervals: TBD TD: 280 ft bgs.	**9 total** (2 prescribed, 3 screening based, 4 observation based)	5 ft	2.5 ft
5	Absorption beds, shafts, RWSA, and tanks 112 and 113 / Vertical and lateral extent of contamination, preferential pathways, and perched water	Qbt3/2 contact: ~85 ft bgs. Screening and observation based intervals: TBD TD: 280 ft bgs.	**9 total** (2 prescribed, 3 screening based, 4 observation based)	5 ft	2.5 ft
6	Absorption beds, shafts and RWSA/vertical and lateral extent of contamination, preferential pathways, and perched water, and paleochannel	Qbt3/2 contact: ~85 ft bgs. Screening and observation based intervals: TBD TD: 280 ft bgs.	**9 total** (2 prescribed, 3 screening based, 4 observation based)	5 ft	2.5 ft
7	Subsurface moisture associated with absorption beds/vertical and lateral extent of contamination, preferential pathways, and perched water	Qbt3/2 contact: ~85 ft bgs. Screening and observation based intervals: TBD TD: 280 ft bgs. Moisture sample interval: every 2.5 ft	**9 total** (2 prescribed, 3 screening based, 4 observation based) **112 total** (moisture analysis only)	5 ft	2.5 ft
8, 9, and 10	Contingent boreholes for lateral extent of contamination (located as needed in the field), preferential pathways, and perched water	Qbt3/2 contact: ~85 ft bgs. Screening and observation based intervals: TBD TD: 280 ft bgs.	**9 per location** (2 prescribed, 3 screening based, 4 observation based) **27 total**	5 ft	2.5 ft
11 and 12	Bldg. 21-257 including loading dock/western extent of contamination. Tanks 21-110 and 21-111/nature and extent of contamination	Screening based intervals: TBD TD: 100 ft bgs.	**4 per location** (1 prescribed, 3 screening based) **8 total**	5 ft	2.5 ft

Table 1 (continued)

Borehole ID	Site/Data Need Addressed	Planned Sample Target Depths and Borehole Total Depth	Estimated Minimum No. of Samples for Fixed-Lab Analysis	Field Screening Intervals[a]	Core Intervals
13, 14, and 15	Bldg. 21-257 including raw waste tanks/nature and extent of contamination to the north, south and east.	Screening based intervals: TBD TD: 100 ft bgs.	**4 per location** (1 prescribed, 3 screening based) **12 total**	5 ft	2.5 ft
16, 17, and 18	Bldg. 21-257/contingent boreholes for lateral extent of contamination (located as needed in the field)	Screening based intervals: TBD TD: 100 ft bgs.	**4 per location** (1 prescribed, 3 screening based) **12 total**	5 ft	2.5ft
19	Tank 113/nature and extent of contamination	Tank 21-113 base: TBD Screening based intervals: TBD TD: 100 ft bgs	**5 total** (2 prescribed, 3 screening based)	5 ft	2.5 ft
20	Bldg. 21-035, septic system, and citric acid tank/nature and extent of contamination	Screening based intervals: TBD TD: 40 ft bgs	**4 total** (1 prescribed, 3 screening based)	5 ft	2.5 ft
21 and 22	Septic system associated with Bldg. 21-035/nature and extent of contamination	Screening based intervals: TBD TD: 40 ft bgs	**4 per location** (1 prescribed, 3 screening based) **8 total**	5 ft	2.5 ft
23	Bldg. 21-035 southeast side/nature and extent of contamination	Screening based intervals: TBD TD: 40 ft bgs	**4 total** (1 prescribed, 3 screening based)	5 ft	2.5 ft
24-31	Paleochannel/subsurface mapping of paleochannel and nature and extent of contamination	Observation based (within paleochannel): TBD TD: 30 ft bgs	**1 per location** (observation based) **8 total**	5 ft	2.5 ft
Shallow Soil Sampling by Spade & Scoop or Hand Auger Methods					
32–33	Previous spills from Absorption bed 4 along top of DP Canyon slope/vertical and lateral extent of contamination (locations based on previous site data)	Surface soil: 0-0.5 ft Shallow subsurface: 1.5-2.0 ft	**4**	Sample screening	n/a[c]
34-45	DP Canyon slope and drainage down to channel/vertical and lateral extent of contamination (some locations based on previous site data)	Surface soil: 0-0.5 ft Shallow subsurface: 1.5-2.0 ft	**24**	Sample screening	n/a

Table 1 (continued)

Borehole ID	Site/Data Need Addressed	Planned Sample Target Depths and Borehole Total Depth	Estimated Minimum No. of Samples for Fixed-Lab Analysis	Field Screening Intervals[a]	Core Intervals
46–49	Locations distributed across the beds, shafts, and RWSA/dioxin and furan characterization of the buried operational surface	Shallow subsurface: TBD (based on observation of operational surface)	**4**	Sample screening	n/a
n/a (not shown on map)	MDA T-wide/contingent shallow soil samples to bound nature and extent of contamination identified in other shallow samples	Soil/shallow subsurface: TBD (dependent on field screening results)	**10**	Sample screening	n/a

[a] Field screening consists of alpha, beta/gamma, VOCs, and tritium.

[b] TBD = To be determined.

[c] n/a = Not applicable.

Table 2
Summary of Proposed Borehole Drilling and Sampling at MDA T

Site/ Data Need Addressed	Borehole or Location ID	Location	Borehole Depth (ft)	Geologic Units encountered	VOCs[a]	SVOCs	Dioxins/Furans[b]	pH	Total Uranium	Radionuclides	TAL Metals	Nitrates	Perchlorate	CO_3 and HCO_3	Gamma Spectroscopy	Americium-241	Isotopic Plutonium	Isotopic Uranium	Strontium-90	Tritium
Borehole Drilling					**Borehole Sampling: X = planned — = not planned**															
Absorption beds, shafts and RWSA / vertical extent, fractures, perched water	1, 2, and 3	North of absorption bed 3 and 4, south of absorption bed 1	385	Qbt 3, Qbt 2, and Qct	X	X	X	X	X	X	X	X	X	—	X	X	X	X	X	X
Absorption beds, shafts / nature and extent	4	North of MDA T	280	Qbt 3, Qbt 2	X	X	X	X	X	X	X	X	X	—	X	X	X	X	X	X
Absorption beds, shafts; Tank 112 / nature and extent	5	North of MDA T	280	Qbt 3, Qbt 2	X	X	X	X	X	X	X	X	X	—	X	X	X	X	X	X
RWSA, beds and shafts / nature and extent and paleochannel characterization.	6	RWSA	280	Qbt 3, Qbt 2	X	X	X	X	X	X	X	X	X	—	X	X	X	X	X	X
South side of bed #1 / for continuous moisture profiling; vertical extent and potential shaft release characterization	7	~10 ft south of bed #2, ~25 ft west of the eastern end of the bed	280	Qbt 3, Qbt 2	X	X	X	X	X	X	X	X	X	—	X	X	X	X	X	X
Contingent boreholes / for lateral extent (located as needed in the field)	8, 9, and 10	TBD	280	Qbt 3, Qbt 2	X	X	X	X	X	X	X	X	X	—	X	X	X	X	X	X

Table 2 (continued)

Site/issue Addressed	Borehole or Location ID	Location	Borehole Depth (ft)	Geologic Units Encountered	VOCs[a]	SVOCs	Dioxins/Furans[b]	pH	Total Uranium	Radionuclides	TAL Metals	Nitrates	Perchlorate	CO_3 and HCO_3	Gamma Spectroscopy	Americium-241	Isotopic Plutonium	Isotopic Uranium	Strontium-90	Tritium
Bldg. 21-257: Americium loading dock, and tanks 21-110 and 111/nature and extent, fractures	11 and 12	~20 ft west of Bldg. 257	100	Qbt 3, Qbt 2	X	X	X	X	X	X	X	X	X	—	X	X	X	X	X	X
Bldg. 21-257: foundation (w/raw waste tanks on north side)/nature and extent, fractures	13, 14, and 15	North, south, and east sides of Bldg. 257	100	Qbt 3/ Qbt 2,	X	X	X	X	X	X	X	X	X	—	X	X	X	X	X	X
Bldg. 21-257: contingent boreholes / for nature and extent (located as needed in the field)	16, 17, and 18	TBD	100	Qbt3, Qbt2	X	X	X	X	X	X	X	X	X	—	X	X	X	X	X	X
Tank 113 / nature and extent	19	South of tank 113	100	Qbt3, Qbt 2	X	X	X	X	X	X	X	X	X	—	X	X	X	X	X	X
Bldg. 21-035: septic system	20	20 ft south of absorption bed 2	40	Qbt 3	X	X	X	X	X	X	X	X	X	—	X	X	X	X	X	X
Bldg. 21-035: septic system/nature and extent within drain field	21 and 22	Southeast of absorption bed 2	40	Qbt 3	X	X	X	X	X	X	X	X	X	—	X	X	X	X	X	X
Bldg. 21-035: septic tank (removed) and leach field/lateral and vertical extent	23	Within leach field southeast of Bldg. 35	40	Qbt 3	X	X	X	X	X	X	X	X	X	—	X	X	X	X	X	X
Paleochannel borings	24–31	Two sets of four borings on east and west side of MDA T to characterize the paleochannel	30	Qbt 3	X	X	X	X	X	X	X	X	X	-	X	X	X	X	X	X

Table 2 (continued)

Site/Issue Addressed	Borehole or Location ID	Location	Borehole Depth (ft)	Geologic Units Encountered	VOCs[a]	SVOCs	Dioxins/Furans[b]	pH	Total Uranium	Radionuclides	TAL Metals	Nitrates	Perchlorate	CO_3 and HCO_3	Gamma Spectroscopy	Americium-241	Isotopic Plutonium	Isotopic Uranium	Strontium-90	Tritium
Diversion drainage; vertical and lateral extent	n/a[c]	Western end of MDA T study area	0 – 2 ft	Fill/soil/ Qbt3	—	X	—	X	X	X	X	—	X	X	X	X	X	X	X	X[d]
Canyon slope (north facing)/vertical and lateral extent	Drainages and deposition features (32 through 45)	North of DP Road down to the canyon bottom	0 –2 ft	Fill/soil/ Qbt3	—	X	—	X	X	X	X	—	X	X	X	X	X	X	X	X[d]
Dioxin/furan sampling of buried operation surface	46–49	Distributed throughout MDA T	TBD	Fill	—	—	X	—	—	—	—	—	—	—	—	—	—	—	—	—

Notes: 1. All boreholes will be continuously cored for collection of curation materials to a depth of 40 ft; material for curation will be collected every 10 ft thereafter.

2. From all boreholes, a minimum of four samples will be collected for fixed lab analysis including:
   a. shallowest field-screening detection;
   b. deepest field-screening detection;
   c. highest field-screening result;
   d. total depth (TD) of borehole.
3. From all boreholes greater than 100 ft in depth, a minimum of four additional samples from preferential flow pathways will be collected for lab analysis.
4. Tuff sample for permeability tests just above Qbt 2/Qct contact in borings that pass into the Cerro Toledo interval.
5. Geotechnical analysis suite will include saturated and unsaturated hydraulic conductivity, matrix potential, porosity, Kd, chloride analysis, and bulk density. Samples will be taken from soil, Qbt3, Qbt2, twice in the Cerro Toledo, and at least once each from an open and filled fracture for a minimum total of seven samples.
6. All borehole locations will also be sampled at the existing surface, if warranted by the results from walkover radiological surveys.
7. Shallow soil sampling will continue to depths greater than 2 ft if appropriate as indicated by field screening or previous sampling.

[a] VOCs for pore gas by method TO-14.

[b] Dioxin and furan sampling from the former operational surface only (where identified in recovered cores).

[c] n/a = Not applicable.

[d] Will be analyzed for tritium in soil only.